ABSTRACTS OF PAPERS

Presented at Meetings of the American Phytopathological Society

The American Phytopathological Society

72nd ANNUAL MEETING

In Conjunction with the Canadian Phytopathological Society

August 24-28, 1980

ABSTRACTS

HOST EFFICIENCY AND EFFECT OF INITIAL DENSITIES OF *HETERODERA GLYCINES* ON GROWTH OF SOYBEAN AND DRY BEAN UNDER GREENHOUSE CONDITIONS. G. S. Abawi and B. J. Jacobson, Departments of Plant Pathology, N.Y.S. Agric. Exp. Sta., Cornell University, Geneva, NY 14456; and University of Illinois, Urbana, IL 61801.

California light red kidney bean (LRK) and the soybean cv. Amsoy 71 were equally efficient as hosts for the soybean cyst nematode (SCN). There was no difference ($P = 0.05$) in the number of second stage larvae that penetrated roots of LRK and Amsoy 71. Larval development and production of brown cysts were similar in both crops. In 6-wk tests, the final population of SCN in soils planted to both crops did not differ significantly. There was a close correlation between initial population (P_i) density of SCN and growth of Amsoy 71 but not of LRK in nontreated and steam-treated soils. In Fusarium-root-rot soil, the growth and root-rot severity of LRK were not significantly affected when the soil was infested with SCN at P_i densities from 1 to 100 eggs-and-larvae/cm^3 soil.

INFLUENCE OF HOT WATER TREATMENT OF PEANUT SEED ON GERMINATION AND DAMPING OFF. M. Abdel-Rehim, P.A. Backman, and R. Rodriguez-Kabana, Department of Botany, Plant Pathology and Microbiology, Auburn University, Auburn, ALA 36830.

Healthy Florunner peanut seed (germination 80-90%) were immersed in hot (40-55°C) water for 5-25 min to determine the effect of the treatment on germination of the seed and the vigor and total length of seedlings. A treatment of the seed in 50°C water for 15-20 min resulted in increased germination after 24 hr and longer and more vigorous seedlings than were obtained with untreated seed. Treated (50°C) seed planted in sterilized soil infested with Rhizoctonia solani resulted in significantly higher emergence than untreated seed in the soil. The hot water extract from peanut seed was inhibitory to germination of the treated seed but stimulated germination of sclerotia of R. solani and of Sclerotium rolfsii.

INTERACTION OF SOUTHERN BEAN MOSAIC VIRUS WITH LIPOSOMES. Aly M. AbdelSalam and O.P. Sehgal, Dept. of Plant Pathology, University of Missouri, Columbia, Missouri 65211.

Interaction of southern bean mosaic virus (SBMV) in vitro with liposomes prepared with phosphatidyl inositol was examined with sucrose density gradient sedimentation and electron microscopy. Optimal binding of either the native or divalent cation-free virions was observed at pH 5.5 and at 25 C. The addition of poly-L-ornithine to liposome:virion mixtures caused the migration of micelles closer to the virus peak in sucrose gradients. Electron microscopic examination revealed an intimate surface association of virions with the liposomes and in some cases particle engulfment. Under alkaline conditions, only the divalent cation-free virions were dissociated with liposomes releasing RNA. Variability of virion-liposome binding at different pH levels, temperatures, and the use of 2-chloroethanol (as hydrophobic interaction breaker), suggests the involvement of both electrostatic and hydrophobic interactions in the SBMV:liposome binding process.

POLAR ASSEMBLY OF CLOVER YELLOW MOSAIC VIRUS. Mounir AbouHaidar, Botany Dept., Univ. of Toronto, Toronto, Ont. M5S 1A1 Canada.

In earlier investigations of the initiation process of the assembly of some helical plant viruses, we have shown that, unlike tobacco mosaic virus (TMV), the assembly of tobacco rattle virus (TRV) and papaya mosaic virus (PMV) begins at or near the 5' end of the RNA (Virol. 76:173, 90:54). We have extended our observations to clover yellow mosaic virus (CYMV), which is a member of potato virus X (PVX) family. CYMV-RNA has the structure $M^7G^{5'}ppp^{5'}Gp$ at the 5'-end and a polyadenylate sequence of about 30-40 nucleotides located at the 3'-end as determined by enzymatic treatments and electrophoresis and by binding on Poly U-sepharose column respectively. These particular structures were used to locate the "initiation site" for the assembly of the virus. After partial encapsidation of the RNA by the protein and ribonucleases treatment, protected initiation fragments contained the 5'-end indicating that the initiation site of CYMV is located at this end and consequently the maturation process is polar (5' to 3' direction). This suggests that polar maturation is the general model of the assembly of helical viruses.

HOST RANGE AND MORPHOLOGY OF A NEW VIRAL PATHOGEN OF SPINACH IN TEXAS. E.B. Adams and R.S. Halliwell, Department of Plant Pathology, Washington State University Pullman, Wa. 99164 and Department of Plant Sciences, Texas A&M University, College Station, Tx. 77843.

In 1978 a previously undescribed virus was isolated from diseased spinach plants in the Winter Garden area of Texas and designated virus isolate SP-I. In greenhouse studies SP-I caused spinach plants to become stunted and chlorotic with distorted leaves. The virus was mechanically transmitted to 3 species of the Chenopodiaceae, Beta vulgaris, Chenopodium amaranticolor, and C. quinoa, and 6 species of the Cucurbitaceae, Cucumis melo, C. sativus, Cucurbita foetidisma, C. maxima, C. pepo and Micrampelis lobata. No hosts were found in the Amaranthaceae, Cruciferae, Gramineae, Leguminosae, or Solanaceae. SP-I was found to be a complex of two polyhedral particles, one 13 nm in diameter and the other 19 nm in diameter. These two particles separate into 3 light scattering fractions in a sucrose density gradient. None of the fractions was infective by itself; however, a combination of equal parts of each of the 3 fractions was infective on C. amaranticolor.

INFLUENCE OF HUMIDITY AND SOIL MOISTURE ON HYMENIUM FORMATION BY THANATEPHORUS CUCUMERIS (FRANK) DONK. G. C. Adams Jr. and E. E. Butler. Department of Plant Pathology, University of California, Davis, CA 95616.

Optimizing the relative humidity (RH) and flow rate of air through three-liter boxes containing agar cultures of Thanatephorus cucumeris improved sporulation. Flow rates of air at 100% RH in the range 0.3-3 liter/min induced hymenial formation of isolates of anastomosis group1(AG-1); AG-4 isolates required a flow rate greater than 0.75 L/min for hymenial induction. A continuous inflow of air adjusted to various RH values between 66 and 100% at 1 L/min consistently induced hymenial formation in both AG. Successful stimulation of hymenial formation on a casing soil was dependent upon soil structure and soil water content more than on soil matric potential. Compaction of sieved soil caused by saturation and drainage in sintered glass Buchner funnels prevented fruiting.

PATHOGENICITY AND OCCURRENCE OF STRANDS OF PHYMATOTRICHUM OMNIVORUM. S.C. Alderman and R.B. Hine, Dept. of Plant Pathology, University of Arizona, Tucson, Arizona 85721.

Soil cores (5x90cm) were taken in infested cotton soils in Marana, Az. at approximately 1 month intervals from June, 1978 to April, 1980 to determine the vertical distribution and viability of strands of Phymatotrichum omnivorum. Total viable strand length (VSL) per 50g soil ranged from 0.0 to 1.0cm. VSL was low in June and increased during July. During August and September highest VSL of 0.2cm, 0.4cm, 1.0cm and 0.6 cm were recorded at soil depths of 0-15cm, 15-30cm, 30-60cm, and 60-90cm, respectively. Field, greenhouse, and laboratory studies demonstrated that strands were not pathogenic to tap roots of cotton plants unless they were attached to sclerotia. Sclerotia were shown to germinate only from the broken ends of attached strand fragments.

STRAND ONTOGENY IN PHYMATOTRICHUM OMNIVORUM. S.C. Alderman, L.J. Stowell, and R.B. Hine, Department of Plant Pathology, University of Arizona, Tucson, Arizona 85721.

When sclerotia of Phymatotrichum omnivorum are placed on soil, water-agar, or near the tap root of cotton plants, germination and subsequent strand formation occur only from the ends of broken strand fragments attached to sclerotia. Scanning electron microscopy techniques demonstrated that within 1 to 2 days after germination a large celled central hypha extends away from the germination point. Smaller hyphae wrap around the central hypha forming tightly woven layers. Cruciform branching develops from the smaller hyphae. After 7 to 10 days the central hypha enlarges to 20 to 30 µm. After 10 to 15 days the strand turns buff to brown and is considered mature. Repeated germination studies indicated a multiple germination capacity for sclerotia whereas mature strands germinate to produce strands only once.

VARIATION IN PATHOGENICITY AND VIRULENCE OF SEPTORIA NODORUM IN FLORIDA. E. A. Allingham and L. F. Jackson, Department of Plant Pathology, University of Florida, Gainesville, FL 32611.

Pathogenicity and virulence of a sample of the Florida population of Septoria nodorum, causal agent of glume blotch of wheat, were determined. Two hundred eighty-two single-spore isolates were inoculated singly onto eight wheat cultivars that varied in their resistance to glume blotch. Cultivar reactions, measured as percent necrosis of seedling leaves, were classified into 253 different patterns of resistance. An isolate was considered pathogenic if it caused necrosis on a cultivar. Of the isolates tested, 95 were pathogenic to all eight cultivars; 85, to seven; 53, to six; 32, to five; 11, to four; four, to three; and one, to two cultivars. Virulence of the isolates to each of the eight cultivars varied, with maximum induced necrosis ranging from 13 to 80%. Virulence was influenced by the host cultivar and geographic area from which an isolate was obtained.

ULTRASTRUCTURE OF REACTION BETWEEN A COMPATIBLE COTTON LINE AND XANTHOMONAS MALVACEARUM. Almousawi, A., Richardson P. and Essenberg, M. OSU, Stillwater, OK 74078. Johnson, W. Langston Univ., Langston, OK 73050 and OSU, Stillwater, OK 74078.

Xanthomonas malvacearum race 3 at an inoculum level of 10^6 cells per ml was inoculated into cotyledons of a susceptible cotton line (Ac44). Samples for EM were taken every 12 hr for 6 days. During this period the bacterial population increased 10^9 bact/cm^2. Plasmolysis and plasmalemma disruption were seen after the first day of inoculation. Chloroplast disruptions were followed by disruption of mitochondria and other cell organelles. Intercellular spaces increased in size. Cell wall breaks were found in some mesophyll cells at day 6. Bacteria surrounded by capsular material were found inside some mesophyll cells. Dense crystalline structures were found inside the cytoplasm in control cells. In cells of inoculated leaves this material was found in intercellular spaces as well as inside the cells. This intercellular material increased in density with time.

EFFECT OF TRIFLURALIN ON RHIZOCTONIA DEVELOPMENT IN PINTO BEANS. Jack Altman, Botany & Plant Pathology, Colorado State University, Fort Collins, CO 80523 USA

Pinto bean varieties Olathe, San Juan Select and UI 114 were inoculated with a bean, sugar beet and a soybean isolate of Rhizoctonia solani. Lesions from Rhizoctonia infection were produced by all isolates on all bean varieties tested. Beans grown in inoculated soil pretreated with 1.25 ppm Trifluralin (a,a,a-Trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine) developed Rhizoctonia lesions 2 x and 3 x diam. compared to inoculated non-herbicide treated controls. In addition, seedling damping-off was evaluated with the bean and the sugar beet R. solani isolates. Percent Rhizoctonia damping-off in soil without herbicide but inoculated with the bean isolate was Olathe 45%, San Juan Select 80% and UI 114 100%. Damping-off from the sugar beet isolate was Olathe 54%, San Juan Select 33% and UI 114 43%.

INCREASE IN CYST NEMATODE POPULATIONS IN SOIL TREATED WITH CYCLOATE AND DIALLATE. Jack Altman, Botany & Plant Pathology, Colorado State University, Fort Collins, CO 80523 USA

Cyst nematode (Heterodera Schachtii) populations were increased in soil pretreated with 5 ppm Cycloate (S-ethylcyclohexylethylthio carbamate) or 5 ppm Diallate (SC2, 3-Dichloroallyl)-diisopropylthiocarbamate), planted to sugar beets var. MonoHi A1 and MonoHi D2 in field soil naturally infested with the nematode. Populations of mature cysts containing viable eggs were doubled in the Cycloate treated soil while populations in the Diallate treated soil increased 10 fold. These increases were evident 6 weeks after seedling emergence and again at after 12 weeks. The data suggest that these carbamate herbicides may predispose sugar beets early to soils that develop high density cyst populations.

MAINTENANCE OF PURE CULTURES OF HEMILEIA VASTATRIX ON COFFEE LEAF EXPLANTS, M. M. Alves de Lima and P. O. Larsen. Dept. of Plant Pathology, The Ohio State University, Columbus, OH 43210 and OARDC, Wooster, OH 44691.

To obtain aseptic uredospores of Hemileia vastatrix Berk. & Br., coffee leaves exhibiting rust lesions were surface sterilized with 1% calcium hypochlorite for 20 min and rinsed three times in sterile double distilled water. Lesions at the yellow fleck and mature stages were excised, placed into 30 ml French square bottles with 10 ml 1% water agar medium, and incubated at 24 C with 12 hr illumination at 6000 lux. Aseptic, viable uredospores were produced only on leaf explants that originally had mature uredosori. No sporulation was observed on leaf explants originally having lesions at the yellow fleck stage. The cultures can be maintained indefinitely under aseptic conditions by repeated inoculum transfers to 7 to 10 mm^2 healthy leaf explants placed on 1% water agar medium at 1-month intervals.

HETEROTHALLISM AND HOMOTHALLISM IN LABORATORY MATINGS OF ENDOTHIA PARASITICA. Sandra L. Anagnostakis. The Connecticut Agricultural Experiment Station, Box 1106, New Haven, CT 06504.

Ascospores are considered the prime means for dispersing the chestnut blight fungus, Endothia parasitica. Perithecia can be produced in the laboratory in petri dishes containing autoclaved chestnut stem pieces supported by water agar with 100 mg/l methionine and 1 mg/l biotin. I chose 63 strains derived from cankers in the field in North America, France, Italy, Greece, and China. These were mated with two test strains which were sexually compatible with each other. The results suggest that the genetic control of sexual development is usually simple heterothallism, with compatible strains possessing different alleles at a single locus. Among the 63 strains, 24 mated only with one tester, and are designated mating type A, and 36 mated only with the other tester, and are designated mating type a. Two Italian strains and one North American strain produced perithecia in pairings with both testers and when selfed. The mating system of the North American strain that appears to be homothallic has been examined in detail.

FACTORS AFFECTING PREMATURE DECLINE OF PLANTS IN INTERIOR LANDSCAPES. J. S. Anderson and C. C. Powell, Jr. Dept. of Plant Pathology, The Ohio State University, Columbus, OH 43210 and OARDC, Wooster, OH 44691.

A survey was undertaken to determine the cause of premature plant decline. Samples were taken from 117 plants representing 15 species in 10 commonly used genera. A soil pH of less than 5.0 was found in 48% of the samples. Soluble salt levels greater than 3.0 mmhos/cm (1920 ppm) occurred 18% of the time. Only 1.7% of the samples contained media with less than 10% air-filled pore space. Plant pathogenic fungi were present but may not be a major factor in such decline. Plant pathogenic nematodes were found in only 5% of the samples. The relationship between the length of time the plant was in the interior landscape and the various soil factors was investigated.

MEASUREMENT OF LATENT PERIOD OF BARLEY INFECTED WITH PUCCINIA HORDEI. M.W. Andres, R.D. Wilcoxson, A.P. Roelfs. Department of Plant Pathology, University of Minnesota, St. Paul, MN 55108.

Latent period is closely correlated with slow rusting. Unfortunately, it is difficult to measure, and, present methods lack desired precision. Seedlings of four barley cultivars, infected with a culture of Puccinia hordei were kept in a growth chamber at 15 and 25° C and light intensity of 100 lux for 14 hr daily. Latent period (LP), time for 50% of the uredia to appear, was obtained by counting uredia several times daily from inoculation until no more developed. Uredia (y) were plotted versus time (x), resulting in a S-shaped curve therefore y was transformed to log 10. Linear regression of log 10 on x estimated the log phase of the curve and was used to estimate LP. R^2 values ranged from 0.64 to 0.98. At 25 C LP was

142, 146, 148 and 155 hr and at 15°C, it was 207, 217, 239 and 262 hr for Larker, Gus, MN 7572, and MN 9062, respectively. Differences due to temperature were significant as were differences in LP for the extreme cultivars ($P = 0.05$).

FUSARIUM SPOROTRICHIOIDES AS A PATHOGEN OF EURASIAN WATERMILFOIL (MYRIOPHYLLUM SPICATUM L.). J. H. Andrews and E. Hecht, Department of Plant Pathology, University of Wisconsin, Madison, WI 53706.

Fusarium sporotrichioides Sherb. was isolated in July, 1978 from a necrotic stem lesion on the aquatic weed Eurasian watermilfoil growing submerged in Lake Mendota, Wisconsin. Similar lesions developed when milfoil cuttings 5-7cm long, suspended in lake water under laboratory conditions, were wounded with a needle and exposed to Fusarium spore suspensions of $1x10^6$ macro- and microconidia per ml. Apical chlorosis also developed on these infected plants within 7 days, intensified to a yellow-orange color, and spread downward to involve 30-50% of the tissue within 14 days. Plants growing rooted in aquaria developed elongate lesions at the inoculation point when injected with 0.03-0.06 ml of a suspension containing $3.5x10^7$ spores/ml. The pathogen was reisolated consistently from surface-sterilized inoculated plants, but never from wounded uninoculated controls. It appears to penetrate mainly, if not only, through wounds, and grows extensively in cortical lacunae of infected plants. This is the first strong evidence of pathogenicity of F. sporotrichioides to milfoil.

MICROBIAL POPULATIONS FROM BUDS AND DEVELOPING LEAVES OF APPLE. J. H. Andrews and C. M. Kenerley, Department of Plant Pathology, University of Wisconsin, Madison, WI 53706.

Apple buds and developing leaves and floral parts were assessed for microbial populations by a washing procedure and scanning electron microscopy (SEM) at six stages ranging from dormancy through early tight cluster. Densities of yeasts, filamentous fungi, and bacteria associated with dormant buds approximated $5x10^5$ propagules per gram fresh weight of tissue. Populations tended to peak as buds swelled and to diminish during subsequent developmental stages. External surfaces, particularly those of the peripheral scales, also supported abundant microflora. SEM showed few microbes associated with floral and leaf primordia. Surface-sterilization was not adequate to differentiate external from internal bud microflora. Microbes included fluorescent pseudomonads, Aureobasidium pullulans and species of Cryptococcus, Sporobolomyces, Rhodotorula, Coniothyrium, Alternaria, Phomopsis, Phoma, Epicoccum, Cladosporium, Acremonium, Fusarium, Stachybotrys, and Sclerotium. The data are relevant to microbial ecology of the gemmisphere and biological control of foliar pathogens.

POSITIONAL VARIATION IN EPIPHYTIC MICROBIAL POPULATIONS WITHIN AN APPLE TREE CANOPY. J. H. Andrews, C. M. Kenerley, and E. V. Nordheim. Departments of Plant Pathology, and Forestry and Statistics, University of Wisconsin, Madison, Wisconsin 53706.

Variation in density of epiphytic yeasts, filamentous fungi, and bacteria on apple leaves collected from eight trees at nine dates for two seasons was determined with respect to three positional factors: height, compass direction from the center of the tree, and lateral proximity to the canopy periphery. Univariate analyses of variance were performed on each of the microbial classes for each date according to a model that excluded tree effect but accounted for the positional factors with interactions. For filamentous fungi and yeasts, height and lateral position were most significant factors. Trends were less clear for bacteria, but all three positional factors and some two-way interactions seemed notable. For filamentous fungi and bacteria, frequently no factors were significant at $p < 0.10$, but usually certain positional factors and interactions were significant at $p < 0.25$. These results have implications for experimental design, and to the microbial ecology of the phylloplane community.

EFFECT OF PUCCINIA RECONDITA ON GRAIN YIELD OF WINTER WHEAT IN LOUISIANA. Louis Anzalone, Jr., Dept. of Plant Pathology and Crop Physiology, Louisiana State Univ., Agric. Exp. Sta., Baton Rouge, 70803.

The relationship of Puccinia recondita to loss in grain yield was studied on Arthur 71 wheat by spraying Indar and Dithane M-45 alone and in combination to prevent leaf rust. Indar was applied at the tillering and flowering stages and Dithane M-45 was applied every 7 days from tillering to maturity. Grain yields for 1978 were 3219, 3165, 3030, and 2977 kg/ha for plots sprayed with Indar + Dithane M-45, Indar, Dithane M-45, and nonsprayed plots, respectively. Grain yields for 1979 were 2372, 2339, 2211 and 2117 kg/ha for the Indar + Dithane M-45, Indar, Dithane M-45, and nonsprayed wheat plots, respectively. Leaf rust caused no significant losses in grain yield at the 5% level of probability during 1978 or 1979.

USE OF POLYETHYLENE TARPS FOR CONTROL OF VERTICILLIUM WILT IN A PISTACHIO NUT GROVE. Lee J. Ashworth, Jr., Department of Plant Pathology, University of California, Berkeley 94720.

A pistachio nut grove in which 85 percent of trees were replaced due to Verticillium wilt during its five years was used. Mean inoculum densities of Verticillium dahliae Kleb. were 3.1, 0.9, 0.6, and 0.4 microsclerotia/g soil at, respectively, depths of 0-20, 30-60, 60-90, and 90-120 cm. The efficacy of complete tarping was compared with tarps separated in the planting row by 48 cm and by 120 cm. The tarps were installed on unirrigated (except by drippers) soil and on soil pre-irrigated with sprinklers on July 7, 1979; tarps were removed after two months. The unirrigated soil, except near drippers, was at or near 15 bars to a depth of 100-120 cm. Five replicates of 86 trees per treatment were used. The fungus was essentially eliminated to a depth of 120 cm in the completely tarped unirrigated and pre-irrigated treatments, both in the partially shaded tree row and in the unshaded area between rows. The other treatments were ineffective except where soil was covered with tarps.

INTERACTION OF PSEUDOMONAS TABACI, P. PISI AND P. GLYCINEA WITH TOBACCO CALLUS SUSPENSION CULTURES. Merelee M. Atkinson and Jeng-sheng Huang, Department of Plant Pathology, North Carolina State University, Raleigh, NC 27650.

Pseudomonas tabaci, a tobacco pathogen, multiplied rapidly in tobacco callus suspension cultures whereas the incompatible bacteria P. pisi and P. glycinea multiplied slowly. Marked necrosis of callus tissue was observed within 12 h of inoculation with 10^6 cells/ml of P. pisi or P. glycinea. Callus cultures inoculated with P. tabaci developed mild necrosis. Filtrates of callus cultures prepared 48 h after inoculation with either P. pisi or P. glycinea gave similar absorption spectra in the UV region. Filtrates of P. tabaci inoculated cultures gave a distinctly different spectrum. Tobacco callus suspension culture thus provides an appropriate system for studying the interactions of tobacco with these bacterial plant pathogens.

INVOLVEMENT OF CELL WALL PROTEINS IN ADSORPTION OF PSEUDOMONAS FLUORESCENS CELLS TO TOBACCO CELL WALLS. Merelee M. Atkinson and Jeng-sheng Huang, Department of Plant Pathology, North Carolina State University, Raleigh, NC 27650.

Nearly 100% of Pseudomonas fluorescens, a saprophyte, cells were adsorbed to isolated tobacco callus cell walls within 2 h of application. Adsorption of P. pisi, a pea pathogen, cells to tobacco cell walls was 50-60% less efficient. Heat treatment or preincubation of tobacco cell walls for 1 h with 50 µg/ml pronase or 0.5M NaCl did not reduce adsorption of P. fluorescens cells. Heat treatment of bacterial cells or preincubation with pronase reduced adsorption by 15-25%. These results suggest that bacterial cell envelope proteins, but not tobacco cell wall proteins, are involved in the adsorption of P. fluorescens cells to tobacco cell walls.

YIELD LOSSES FROM SOYBEAN ANTHRACNOSE CAUSED BY COLLETOTRICHUM DEMATIUM f. TRUNCATA. P.A. Backman and J.C. Williams, Dept. Botany, Plant Pathol. & Microbiol., Auburn Univ., Agr. Exp. Sta., Auburn, AL 36830.

Soybean cultivars Forrest, Davis, Bragg, and Hutton were treated with various fungicides at early pod-set and 14-18 days later. After senescence, severity of anthracnose was assessed in each plot and yields were determined. The relationship between anthracnose severity and yield was plotted and analyzed by quadratic regression. Losses of 14, 34, 16 and 17% respectively, occurred on each of the four cultivars. Three of the four regression curves were highly significant (P=0.01). Infections limited to the stems caused little yield reduction, but losses increased rapidly as the percentage of infected pods increased.

STERILE GROWTH OF WHEAT SEEDLINGS. J. E. Bailey, Department of Botany and Plant Pathology, Michigan State University, East Lansing, MI 48824.

Surface disinfested seeds (70% ethanol, and 5.25% sodium hypochlorite, 5 min each) were rinsed four times in sterile distilled water and placed in petri plates (60 mm diam. X 15 mm) containing 3 ml nutrient broth (0.1 strength) for 3 days. Uncontaminated seedlings were placed in 30 ml plastic disposable syringes containing 3 ml sterile Hoagland's solution. Sterile

serum bottle caps covered the small orifice and sterile cotton plugged the large orifice. Seedlings were grown until the first true leaf touched the cotton plug. The cotton was removed, and seedlings elevated so that the seed and root were within and the shoot outside the syringe. The cotton was then aseptically replaced and syringes were racked in "Conetainer" trays (Ray Leach's "Conetainer" Nursery, Canby, OR 97013). Any liquid (root exudates, nutrients, etc.) may be injected or removed by a sterile hypodermic syringe via the serum bottle cap without jeopardizing the sterility.

STIMULATION OF CEPHALOSPORIUM GRAMINEUM BY EXUDATES FROM FROZEN ROOTS OF WHEAT. J. E. Bailey and J. L. Lockwood, Department of Botany and Plant Pathology, Michigan State University, East Lansing, MI 48824.

To impose fungistatic conditions, conidia were pipetted onto water agar disks (8 mm diam. X 1 mm thick) previously placed on a Millipore filter (0.45 µm, 47 mm diam.) covering non-sterilized field soil. Sterile four-day-old wheat seedlings were freeze-stressed by reducing the temperature of water covering their roots in a beaker from 20°C to -5°C in 12 min. Frozen and non-frozen seedlings then were positioned so that their roots lay on the surface of the agar disks. Conidia on control disks without roots did not germinate. Conidia incubated near non-frozen roots had sparse germination with slow growing germ tubes even after six days, whereas conidia incubated near frozen roots had abundant germination and rapid growth. Electron micrographs of the frozen roots showed that hyphae readily grew through the epidermal and cortical cells both inter- and intracellularly. Previously, passive entry via wounds was thought to be the only means of penetration.

INFECTION OF BEAN MESOPHYLL PROTOPLASTS BY BEAN GOLDEN MOSAIC VIRUS DNA. Narceo B. Bajet and R.M. Goodman, Department of Plant Pathology, University of Illinois, Urbana, IL 61801.

Protoplasts were isolated from expanding primary leaves of French bean (Phaseolus vulgaris L. 'Top Crop'). The abaxial side was abraded with a brush and floated, abraded side down, on 0.6M mannitol, pH 6.5. After 1.5-2.0 hr, the mannitol was replaced with a solution of 10.9%(w/v) mannitol, 0.7% cellulase, and 0.1% Macerozyme, pH 6.5. After overnight digestion in the dark at 30 C, protoplasts were harvested and washed. Freshly sedimented protoplasts (1 X 10^6) were resuspended in 10 ml cold inoculum solution (0.02M potassium citrate, pH 9.0; 0.6M mannitol) containing 10.0 µg BGMV-DNA and 10.0 µg poly-L-ornithine. After 3 min at 0 C, the protoplasts were transfered to 30 C for 5 min, then washed twice with a 0.6M mannitol-1.0 mM $CaCl_2$ solution. Protoplasts were resuspended in culture medium and incubated at 30 C under continuous light. Using an indirect fluorescent antibody method to score infected cells, percentage infection ranged from 48 to 73% after 24 hr.

FURTHER CHARACTERIZATION OF LIPOPOLYSACCHARIDE (LPS) PRODUCED BY PSEUDOMONAS SOLANACEARUM. C. J. Baker and L. Sequeira, Dept. of Plant Pathology, University of Wisconsin, Madison, WI 53706.

Differences in LPS structure previously have been correlated with differences in ability to induce a hypersensitive reaction (HR) in tobacco. To further characterize these structural features, LPS was extracted with aqueous phenol from HR-inducing (B1) and non-inducing (K60) strains of P. solanacearum. LPS was then purified by dialysis, ultracentrifugation, and Sepharose 4B gel filtration. Modification of culture age or C-source did not affect the carbohydrate composition of LPS. Electrophoresis showed that BI produces rough-form LPS and K60 produces rough-and smooth-form LPS. Gel filtration of polysaccharide chains released from LPS by mild acid hydrolysis showed that K60 contained both a low mol wt and a high mol wt fraction; B-1 contained only the low mol wt fraction. The low mol wt fraction is assumed to represent the R-core and contains rhamnose, glucose and heptose. The high mol wt fraction contains the R-core constituents plus xylose, glucosamine and additional rhamnose. These latter sugars appear to be components of the O-polysaccharide repeating unit.

A MODEL OF MORTALITY IN DWARF MISTLETOE INFESTED BLACK SPRUCE STANDS. F.A. Baker and D.W. French, Department of Plant Pathology, and D.W. Rose, College of Forestry, University of Minnesota, St. Paul, MN 55108.

A model for estimating mortality of black spruce in dwarf mistletoe-infested stands was developed, based on the rate of spread of dwarf mistletoe and the mortality rate of dwarf mistletoe-infected black spruce trees. Although the model has not been empirically validated, model assumptions were tested using sensitivity analysis. In the model, a coordinate system is used to input stand boundaries and infection center locations. Other inputs are: stand age, rotation age, stocking, basal area, site index, radii of infection centers, stumpage value, discount rate, and control cost. The model predicts areas of mortality and control for 10-year intervals to rotation age, and uses these figures to compute standing volume present, volume lost to dwarf mistletoe, control costs, and volume saved by eradicating dwarf mistletoe for each period. Simulation results indicate that investments in dwarf mistletoe control may provide substantial financial returns.

SPREAD OF ARCEUTHOBIUM PUSILLUM, AND RATES OF INFECTION AND MORTALITY IN DWARF MISTLETOE INFESTED BLACK SPRUCE STANDS. F.A. Baker and D.W. French. Department of Plant Pathology, University of Minnesota, St. Paul, MN 55108.

Based on 25 permanent plots located in infection centers of Arceuthobium pusillum in stands of black spruce (Picea mariana) examined in 1979, an average of 8% of the infected trees had died each year since the previous examination, and each year 11.11 trees (adjusted to reflect an original population of 100 infected trees) became infected. White spruce (P. glauca) present only on one plot, had an annual mortality rate of 2.68, and newly infected trees appeared at the rate of 0.94 trees/year/100 infected trees. The lateral rate of spread was 0.74 m/yr.

PHOTOBIOLOGY OF OOSPORES OF PHYTOPHTHORA CACTORUM. Zia Banihashemi and J. E. Mitchell, Dept. of Plant Protection, University of Shiraz, Iran, and Dept. of Plant Pathology, University of Wisconsin, Madison, WI 53706, respectively.

Oospores of P. cactorum were produced in cleared V-8 broth in cultures grown in the dark for 2-4 months. Media for oospore germination were distilled water, dilute soil extract, or 2% water agar. Light was required for activation of oospore germination. Duration of short, intermittent light exposures was more important than exposure time for activating germination. Activation in light was prevented or reduced at 4-6 C, at 28-32 C, by a lack of O_2, or in the presence of Na azide, or flavin inhibitors such as KI (20-40 mM), phenylacetic acid (0.1 mM), or salicylhydroxamic acid (0.1-1 mM). Oospores germinated in the dark at 8 C or 32 C or under red light, if first activated at 20 C under blue light. This appears to be of ecological significance in nature because more infection of safflower seedlings occurred in naturally infested soil or in sterilized soil infested with oospores when soil surface was exposed to the light during 4 weeks at 20-22 C than when light was excluded.

SINGLE OR COMBINED ANTISERA FOR DETECTION OF POTATO VIRUSES S AND X IN PLANTS OR TUBERS USING ENZYME-LINKED IMMUNOSORBENT ASSAY. Ernest E. Banttari and G.D. Franc. Department of Plant Pathology, University of Minnesota, St. Paul, MN 55108.

Enzyme-linked immunosorbent assay (EIA) using the double antibody sandwich method with potato virus S (PVS), potato virus X (PVX) or combined PVS and PVX antisera was effective for detecting PVS, PVX or PVS + PVX in Norland, Kennebec and Russet Burbank potato plants. Potato virus S in some infected Norland tubers was not detected and spurious positive reactions occurred in one assay of some Kennebec and Russet plants grown from PVS- and PVX-free tubers. The additives, 2.0% polyvinyl pyrrolidone 40,000 MW (PVP), 5% bovine serum albumin (BSA), 0.2% ovalbumin (O), 0.01 M sodium diethyldithiocarbamate (NaDIECA) or a combination of these were included with phosphate buffered saline + Tween 20 (polyoxyethylene sorbitan monolaurate) in plant sap extracts. NaDIECA increased virus specific absorbancies (A_{405}) and diminished the non-specific background absorbancies (A_{405}). Re-used enzyme conjugates were effective in EIA for both viruses.

CYLINDROCLADIUM SCOPARIUM ON EUCALYPTUS SPP. IN A SOUTH FLORIDA TREE NURSERY: DAMAGE AND FUNGICIDAL CONTROL. E. L. Barnard, Divisions of Forestry and Plant Industry, FDACS, P. O. Box 1269, Gainesville, FL 32602

During the past two years, Cylindrocladium scoparium has caused the loss of nearly 220,000 container-grown eucalyptus seedlings, including 50% of one crop in a south Florida nursery. Initially, infections appear as leaf spots and small, brown stem lesions. Under nursery conditions including overhead irrigation, close seedling spacing ($25/ft^2$), and high relative humidity, infections develop into a blight

of foliage and severe (black and/or constricted) cankers on the lower portion of seedling stems. Although C. scoparium is considered largely a nursery problem, evidence suggests that seedling mortality can occur after outplanting as a result of pathogen carry-over. A preliminary screening of seven fungicides indicates that control may be achieved in the nursery with benomyl and/or chlorothalonil.

THE GENERAL GAS LAW AND POST-HARVEST DISEASES OF TOMATOES. J. A. Bartz, Dept. of Plant Pathology, U. of Florida, Gainesville, 32611.

Tomatoes immersed in aqueous suspensions of post-harvest pathogens can be infiltrated through the stem attachment region with both water and microorganisms because of two phenomena predicted by the general gas law. In both, external pressures on immersed fruit exceed gas pressures inside the fruit. One is associated with cooling of immersed fruit and the other with a water-head resulting from immersion. Both can act simultaneously in an additive fashion, whereas, warming of an immersed fruit may cancel water-head forces. Infiltration is manifested by an increase in fruit weight (0.01 to > 4g/fruit) and decay in storage. Weight increases vary ($p=0.05$) among different lots of the same cultivar and different cultivars. Furthermore, greater than 100-fold differences in weight increases may exist within a given lot of fruit treated identically. This variation complicates the development of recomendations for commercial tomato handling. Water-contact periods, immersion depths, water-fruit temperature differentials, tissue porosities, and suspension surface tensions all interact to determine the amount of infiltration.

CHARACTERIZATION OF A SPIROPLASMA FROM FLORAL SURFACES OF CALLIANDRA HAEMATOCEPHALUS. H.G. Basham, R.E. McCoy, & R.E. Davis. University of Florida A.R.C., 3205 S.W. 70 Ave., Ft. Lauderdale, FL 33314, & Plant Virology Laboratory, U.S.D.A., A.R.S., Beltsville, MD 20705.

A helical mycoplasma was isolated in Florida from healthy flowers of Calliandra haematocephalus. This spiroplasma (PPS1) requires cholesterol, ferments sugars, does not hydrolyze urea or arginine, and grows at 20-37C. Excepting the inability to hydrolyze arginine, PPS1 is typical of the family Spiroplasmataceae. Comparisons were made with other described members of the Spiroplasmataceae by serological properties (growth inhibition assay, immunoflourescence assay and ELISA), nucleic acid composition, and electrophoretic pattern of cell proteins. Comparisons suggest the PPS1 is related to other isolates collected from floral surfaces in Maryland and France, and distinct from the Spiroplasma citri serogroup. The ready isolation of these organisms from healthy plants reemphasizes the fact that simple isolation of Mollicutes from diseased plants is not sufficient basis for assumption of pathogenicity of the isolates.

EXISTENCE OF CHLAMYDOSPORES OF PHYTOPHTHORA MEGASPERMA AS SOIL SURVIVAL AND PRIMARY INFECTIVE PROPAGULES. P.K. Basu, Ottawa Res. Sta., Agriculture Canada, Ottawa, Ontario K1A 0C6.

Direct microscopic examination of soil particles infested with mycelial suspensions of Phytophthora megasperma Drechs. and of infected alfalfa (Medicago sativa L.) seedlings revealed the existence of hitherto unreported chlamydospores. These originated from hyphal swellings and other parts of mycelium and were usually globular ranging in size from 6 to 16 µm in diameter, hyaline and thin-walled. They occurred singly, in chains or as clusters in both soil and host tissues. Individual chlamydospores germinated by one or more germ tubes which penetrated host cells and ramified inside the tissues, producing oospores, more chlamydospores and sporogenous hyphae. The latter emerged from tissues to bear sporangia which germinated directly or produced zoospores only in the presence of free water. Chlamydospores, hyphal swellings and some portions of mycelium survived in soil for at least seven months at a temperature range from 5°C to 30°C. The pathogen was recovered from infested soil containing as low as 30 µg of mycelium per gram of soil.

PHYSIOLOGY OF RESISTANCE IN LEMONS TO GEOTRICHUM CANDIDUM. A.B.A.M. Baudoin and J.W. Eckert, Department of Plant Pathology, University of California, Riverside CA 92521.

Injection of 5 µl spore suspension of G. candidum, 2.5 mm deep into the peel of lemon fruits, produced either an expanding soft rot or an arrested, dry lesion (resistant). Detached peel discs were extremely susceptible to infection. In whole fruits, sterile wounds at high relative humidity or covered with water developed resistance to infection within 20 h. This was retarded at 1-2% O_2 and was inhibited by cycloheximide (1 µg/ml). Infection was greatly stimulated when inoculation sites were kept under water or osmotic solutions for 2-3 days after inoculation. Fungal growth and polygalacturonase production began to differ in resistant and susceptible lemons between 10 and 20 h after inoculation. Macerating enzyme extracts produced less maceration in light-green or subturgid lemons than in more susceptible fruits. No antifungal compounds were detected in arrested infections. Lignin and other barriers were formed but appeared to develop too late to explain resistance completely.

SEROLOGY OF THE CYLINDRICAL INCLUSIONS OF SEVERAL WATERMELON MOSAIC VIRUS (WMV) ISOLATES. R. H. Baum and D. E. Purcifull, Dept. of Plant Pathology, Univ. of Florida, Gainesville 32611.

Antisera specific for cylindrical inclusions of a Jordanian isolate of WMV-1, a Florida isolate of WMV-2 and a Moroccan isolate (WMV-M) did not react with their respective purified viruses or with healthy antigens in SDS double immunodiffusion tests. In reciprocal tests with antisera collected 2 to 4 months after initial immunization, only the WMV-M inclusion antiserum reacted with crude sap or purified inclusions of other WMV isolates. Intragel absorption of WMV-M inclusion antiserum with purified inclusions of WMV-1, WMV-2 or WMV-M confirmed that WMV-M inclusions are immunochemically distinct from, but related to, WMV-1 and WMV-2.

EVALUATION OF HORIZONTAL AND VERTICAL RESISTANCE IN THE COTTON-XANTHOMONAS MALVACEARUM HOST-PATHOGEN SYSTEM. Melanie B. Bayles, William M. Johnson, and L. M. Verhalen, Oklahoma State University, Stillwater, OK 74078 and Langston University, Langston, OK 73050

This study demonstrates that horizontal and vertical resistance are operative in the cotton-Xanthomonas malvacearum host-pathogen system. Data indicate a fairly constant ranking among differentials over races of the pathogen and of races over differentials, but some interactions were observed. In vivo studies show that homologous populations reach higher population levels than heterologous populations in fully blight susceptible and moderately blight resistant differentials. In the blight immune differential Im 216 the heterologous populations were as high or higher than the homologous populations suggesting that Im 216 possesses a nonspecific resistance mechanism which inhibits the growth of all phytopathogenic bacteria tested. Some differences were observed between blight severity in the field and pathogen population levels in plants.

PENETRATION, INFECTION AND DEVELOPMENT OF CERCOSPORA ZEA MAYDIS, IN CORN LEAVES. P. M. Beckman and G. A. Payne, Plant Pathology Department, N. C. State University, Raleigh 27650.

Penetration, infection and development of Cercospora zea maydis were studied on corn leaves maintained at 100% relative humidity and 18 C. Spores germinated within 24 hr after inoculation, hyphal aggregates were observed after 96 hr, and lesions and conidiophores were evident after 16-18 days. Hyphal aggregates were observed on naturally and artificially inoculated corn leaves over stomata, guard cells and at the junction of epidermal cells. In this study, infection pegs were only associated with hyphal aggregates over stomata. Intercellular hyphae observed in advancing lesions and 1-2 days prior to lesion development were limited usually to a single strand within the leaf parenchyma. Hyphal growth perpendicular to the vascular system was delimited by sclerenchyma tissue surrounding major veins resulting in typical long, narrow lesions. Degradation and disorganization of lesion tissue and proliferation of fungal hyphae increased with lesion age. Fungal stroma developed in substomatal cavities coincident with lesion development. Conidia were borne in sympodula arrangement on conidiophores erupting through stomata.

COLONIZATION OF THE PRIMARY TISSUES OF PINUS DIVARICATA BY CRONARTIUM COMANDRAE. D. R. Bergdahl, Dept. of Forestry, University of Vermont, Burlington, VT 05405 and D. W. French, Dept. of Plant Pathology, University of Minnesota, St. Paul, MN 55108

One-month-old seedlings of Pinus divaricata were inoculated with Cronartium comandrae. Then cotyledons, primary needles and stems were processed for light and/or scanning electron microscopy 10, 26, 36, 67 and 97 days after infection. Germ tubes of basidiospores penetrated via stomata and formed fusiform substomatal vesicles that became extended to form intercellular hyphae. These hyphae were primarily restricted to the mesophyll tissues of cotyledons or primary needles. Intercellular hyphae grew along the leaf trace into the stem. Infected needle tissues were chlorotic and then necrotic by 37

and 97 days after infection, respectively. In the stem intercellular hyphae were restricted to the specialized mesophyll tissues and these hyphae produced abundant haustoria within 10 days after infection. Longitudinal and radial growth rates of these intercellular hyphae averaged 53.0 µm and 9.5 µm per day, respectively during the initial 10 days after infection.

HAUSTORIAL DEVELOPMENT OF CRONARTIUM COMANDRAE IN THE PRIMARY TISSUES OF PINUS DIVARICATA. D. R. Bergdahl, Dept. of Forestry University of Vermont, Burlington, VT 05405.

Infection hyphae of Cronartium comandrae penetrated cell walls of Pinus divaricata and formed single-lobed (simple), bilobed or multilobed haustoria. These haustoria appear to be covered with a sheath-like material and to have a smooth to rugose surface. In all types of host cells single-lobed haustoria were the most common followed by bilobed and multilobed forms, respectively. All forms of haustoria are commonly in direct contact with host cell nuclei especially in mesophyll cells of leaves and in parenchyma cells of stems. In cortical parenchyma, single-lobed, bilobed and multilobed haustoria occurred 47, 48 and 5% of the time, respectively and of these, 84% were in direct contact with host cell nuclei. In ray cells, 97% of the haustoria were single-lobed and 83% of these were in contact with host cell nuclei. These haustoria do not appear to penetrate nuclei, but may distort them.

EXTENDED APHID RETENTION OF MDMV; IMPLICATIONS FOR LONG DISTANCE VIRUS DISPERSAL. P.H. Berger and R.J. Zeyen. Department of Plant Pathology, University of Minnesota, St. Paul, MN.

The longest published maize dwarf mosaic virus (MDMV) retention time was 6 hr; now retention times up to 70 hr have been recorded. Aphid populations were given 10 min acquisition access times with post-acquisition conditions that either allowed or denied solid surface test probing opportunities. Denial of test probing behavior by gas (N_2 at 25 C) or cold (7 C) anesthesia mimicked the common behavioral state shared by aphids aloft in low-level jet winds and resulted in lower rates of population infectivity loss than occurred with mobile insects held in petri plates. Five aphid species and MDMV-'A' and 'B' were tested and showed extended (18 - 70 hr) retention times. Aphid species used were: Schizaphis graminum, Rhopalosiphum maidis, Myzus persicae, Dactynotus ambrosiae, and Macrosiphum euphorbiae. Maximum measured retention times now exceed those necessary to explain aphid-MDMV dispersal on low-level jet winds from the southern Great Plains to the Northern Corn Belt of the USA.

USE OF NITROGEN AND ARGON FOR ANESTHESIA OF APHID VECTORS. P.H. Berger and R.J. Zeyen. Department of Plant Pathology, University of Minnesota, St. Paul, MN 55108.

The most used gas anesthesia for aphid vectors is CO_2; however, when used for periods in excess of 1 hr, CO_2 causes excessive mortality and severe locomotor problems in surviving insects. The use of N_2 or argon, 20 sec cycles at 2000 standard cubic centimeters per minute (SCCM) when interspersed with 20 sec cycles of bottled air (800 SCCM) creates an hypoxic state in which mortality is greatly reduced and surviving insects are free of post-anesthesia locomotor problems. The procedure is very useful for manipulation of aphid vectors and for denial of probing behavior during retention time studies, and may be used for periods up to 24 hr in duration.

THE GOMPERTZ TRANSFORMATION - MORE APPROPRIATE THAN THE LOGISTIC TO DESCRIBE DISEASE PROGRESS. R. D. BERGER, Dept. of Plant Pathology, Univ. of Florida, Gainesville 32611.

The logistic transformation [$\ln(x/(1-x))$; where x=proportion of disease] is frequently used to straighten progress curves of compound interest diseases. Although a credible statistical fit often occurs in the range $0.05<x<0.6$, very poor fit is obtained when x is outside this range because of the asymmetrical shape of most disease progress curves. Because of the poor fit, researchers may make aberrant assumptions with this transformation in estimating initial (x_o) or final disease, in determining infection rates, and in predicting disease progress after epidemic interruption. When the gompertz transformation was employed, close statistical fits (high coefficients of determination and low residual sums of squares) were obtained for over 100 disease progress curves with wide ranges of x. For the gompertz transformation [$-\ln(-\ln(x))$], values are easy to obtain and use, the rate parameter allows treatment comparisons, and the position parameter permits a reasonable estimate of x_o. The gompertz transformation seems more appropriate than the logistic to describe disease progress when broad ranges of x are encountered.

INDUCTION OF SYSTEMIC RESISTANCE IN CUCUMBER TO BACTERIAL WILT AND GUMMY STEM BLIGHT. G. C. Bergstrom and J. Kuc'. Department of Plant Pathology, University of Kentucky, Lexington, KY.40546

Systemic resistance was induced in cucumber against bacterial wilt and gummy stem blight by prior inoculation of plants with various infectious agents. Inoculation of leaf 1 with tobacco necrosis virus, Colletotrichum lagenarium, or Mycosphaerella melonis induced resistance in upper leaves to gummy stem blight incited by M. melonis. Protection was evident as a reduction in the number and size of lesions and as a reduction in the amount of tissue maceration associated with lesions. Inoculation of leaf 1 with TNV, Pseudomonas lachrymans, or C. lagenarium induced systemic resistance to bacterial wilt incited by Erwinia tracheiphila. E. tracheiphila was introduced into the stem by puncturing through the first node. TNV also effectively induced resistance against E. tracheiphila introduced into leaf veins. Protection against bacterial wilt was evident as a delay in the onset of symptoms but appeared to have no effect on the subsequent rate of wilt development.

DECAY IN OAK TREES INOCULATED WITH FOUR DECAY FUNGI. Frederick H. Berry, USDA, Forest Service, Northeastern Forest Experiment Station, Forestry Sciences Laboratory, P.O. Box 365, Delaware, OH 43015.

In 1969, 80 trees each of scarlet oak (Quercus coccinea Muenchh.), black oak (Q. velutina Lam.), and white oak (Q. alba L.) were inoculated with cultures of Polyporus compactus Overh., Laetiporus sulphureus (Bull. ex Fr.) Bond. et Sing., Phlebia chrysocrea (Berk. et Curt. in Berk.) Burds., and Inonotus andersonii (Ell. et Ev.) Cerny. Forty trees of each species were felled in 1974 and decay development after 5 years reported. In 1979, the remaining trees were felled, sectioned, and examined for decay. After the 10-year development period no significant difference was found between the upward and downward spread of decay from the point of inoculation. Also, there was no significant difference in size of the decay columns among the 3 oak species. Comparison of vertical decay progress after 10 years with progress after 5 years showed that decay progressed faster the first 5 years of the study.

A FUSARIUM ROOT ROT OF LENTILS. M.K. Bhalla and E.F. Schneider, Department of Biology, University of Ottawa and Chemistry and Biology Research Institute, Agriculture Canada, Ottawa, Ontario.

Soil samples from a field of diseased lentils (Lens culinaris) at Ottawa were processed by the soil plate dilution method and eleven isolates of Fusarium and one of Helminthosporium were among the fungi isolated. Fusarium oxysporum and a Helminthosporium isolate were also isolated from surface sterilized seed which was germinated aseptically. The most virulent isolate, identified as F. oxysporum, produced cortical rot symptoms in the roots of 8-day-old lentil seedlings within 6 days after inoculation with a conidial suspension. Isolates of F. equiseti, F. solani and F. melanochlorum were pathogenic but much less virulent.

A BACTERIAL LEAF SPOT OF YAM BEAN (PACHYRRHIZUS EROSUS) CAUSED BY PSEUDOMONAS PHASEOLICOLA. R.G. Birch, A.M. Alvarez and S.S. Patil, Department of Plant Pathology, University of Hawaii, Honolulu, HI 96822.

The bacterium causing leaf spot of yam bean, Pachyrrhizus erosus (L.) Urb. in Hawaii was identified as Pseudomonas phaseolicola (Burkh.) Dowson. The organism conformed with this nomenspecies on the basis of in vitro biochemical properties, symptoms induced in yam bean, Red Kidney bean and detached bean pods, remission of toxin-induced systemic chlorosis at elevated temperatures, inhibition of ornithine carbamoyltransferase in an enzymatic assay, and behaviour in a microbial assay for antimetabolic toxins. The organism was distinct from Pseudomonas syringae and P. tabaci in each of these aspects. Although the inhibition zones caused by P. phaseolicola in the microbial assay were different in appearance to those caused by P. syringae and P. tabaci, other toxigenic pseudomonads not pathogenic to bean caused similar zones, thus limiting the use of the assay as a determinative test. Yam bean may be a significant alternative host for the bean halo-blight pathogen in tropical regions, where this perennial vine is widely cultivated as a food crop.

RELATIONSHIP OF THE PINEWOOD NEMATODE TO SLASH PINE IN LOUISIANA. W. Birchfield, Choi-Pheng Yik, Richard Carlton, and

Jimmy Dunkley, USDA, SEA, Dept. Plant Path. and Crop Physiol., La. State Univ. Agric. Expt. Sta. and La. Dept. of Agric., Baton Rouge LA 70803

The pinewood nematode, Bursaphelenchus lignicolus Mamiya and Kiyohara, was recently discovered in Louisiana. It was recovered from 40% of 89 dead or dying slash pines, Pinus elliotti, examined from widely scattered places in the state, and also from loblolly pine, Pinus taeda. Wood sections stained with lactophenol-acid fuchsin, cleared in lactophenol, and viewed with the compound and scanning microscopes, showed coiled, congregated nemas in the axial and radial resin canals. We isolated the nematode from pine chips surface sterilized with 4.75% mercury bichloride, and placed on potato-dextrose agar. Third stage larvae emerged from the pine chips onto the agar in a few hours, and fed on associated fungi. Egg laying and hatching were observed and a large population of all stages in agar culture resulted within a few days. The life cycle from egg to egg required only 3 days at room temperature; cleaving and hatching occurred within the first few hours.

A NEW VIRAL RNA SPECIES IN TOBACCO RATTLE VIRUS INFECTED TISSUE. D. Bisaro and A. Siegel. Department of Biological Sciences, Wayne State University, Detroit, MI 48202.

Cells infected with the CAM strain of tobacco rattle virus contain at least one unique species of RNA (RNA-3, MW 0.5×10^6) in addition to the two virion RNAs (RNA-1, MW 2.4×10^6 and RNA-2, MW 0.7×10^6). The new species was detected by electrophoresing RNA from leaf tissue that had been incubated in the presence of actinomycin D and ^{3}H-uridine. It was determined that RNA-3 is derived from RNA-2 as follows: An infected leaf extract was electrophoresed on methyl mercury containing agarose gel and transfered to diazotized filter paper. RNA-3 hybridized with ^{32}P-labeled cDNA prepared against RNA-2 but not with RNA-1 cDNA. Further, a sucrose gradient fraction which contains both RNAs 2 and 3 stimulates the synthesis of two discrete polypeptides in a cell-free protein synthesizing system. One of these co-migrates with coat protein (MW 22,000) on PAGE. Since RNA-2 has been shown to direct the synthesis only of coat protein, it seems likely that the larger protein is translated from RNA-3.

PITCH CANKER CAUSES LATE-SEASON MORTALITY OF SEEDLINGS IN FOREST TREE NURSERIES. G.M. Blakeslee[1], T. Miller[2], S.W. Oak[1] and E.L. Barnard[3]. [1]Univ. of Florida, [2]US Forest Service and [3]Florida Dept. Agriculture and Consum. Serv., Gainesville, Florida.

In the late summer and fall of 1979, dead and dying slash pine seedlings were observed in 7 forest nurseries in Florida. Symptomatic seedlings had resin-soaked lesions at the cotyledonary node, root-collar, or the upper taproot. Fusarium moniliforme var. subglutinans (FMS) was isolated from these lesions and from associated sporodochia. Diseased seedlings occurred singly or in small clusters of up to 25 trees. The disease was detected in seedlings from 49 of the 51 seed sources used in the 7 nurseries. While the overall disease incidence was relatively low, it varied considerably between infected seed sources within nurseries (e.g. 1-9 seedlings/thousand). The disease was also detected infrequently in loblolly pine seedlings. In addition to inciting cankers on older trees and infecting pine seeds, FMS is now recognized as a cause of seedling mortality in forest nurseries where it may pose a potential threat to both nursery production and regeneration efforts.

THE ROLE OF ACTINOMYCETES IN THE DISCOLORATION AND DECAY PROCESS OF LIVING SILVER MAPLE TREES. R. A. Blanchette, Pl. Path. Dept. Wash. State Univ., Pullman, WA 99164. J.B. Sutherland & D.L. Crawford, Dept. Bact. & Biochem., Univ. of Idaho, Moscow, ID 83843.

Three actinomycetes, Streptomyces parvullus, S. sparsogenes, & an unidentified Streptomyces sp., were isolated from greenish-brown margins of discolored wood of living silver maple, Acer saccharinum. These isolates were able to grow in the presence of several phenols incorporated into liquid media. All three actinomycetes inhibited growth of selected wood-destroying fungi when paired on malt agar. Scanning electron microscopy was used to elucidate the role of actinomycetes within discolored tissue. Actinomycete hyphae and fibrous vessel plugs were observed within the discolored zone. In pure culture, the actinomycetes colonized sterile blocks of sapwood and discolored wood. After 60 days, hyphae had grown through vessels and colonized occlusions; no degradation of cell walls was observed. The role of actinomycetes in the discoloration process suggests possible uses as a biological wound treatment for living trees.

INDIRECT QUANTITATION OF SOILBORNE WHEAT RESIDUE INFESTED WITH CEPHALOSPORIUM GRAMINEUM. W. W. Bockus, Department of Plant Pathology, Kansas State University, Manhattan, KS 66506.

Cephalosporium gramineum survives between wheat crops in the residue of parasitically colonized plants. The fungus sporulates profusely from the residue to produce inoculum. The amount of soilborne wheat refuse infested with C. gramineum was indirectly estimated by placing 100 g subsamples of air-dry soil in 20 x 100 mm petri dishes and moistening to about field capacity with distilled water. The plates were incubated four weeks at 15.5 C. Soil dilutions were then plated on a medium selective for C. gramineum, incubated 14 days at 15.5 C, and the number of colonies counted. One l of the medium consisted of the infusion from 12 g cornmeal, 15 g agar, 0.08 g $CuSO_4$, 0.015 g PCNB adjusted to pH 3.8 with 25% lactic acid. When added to soil containing no detectable C. gramineum, increasing amounts of wheat residue infested with the fungus produced increasing numbers of colony forming units. This procedure was also used to detect differences in amounts of infested refuse in field plots under five different tillage regimes.

APPARENT PATHOGENICITY TO ALFALFA EXHIBITED BY SEVERAL STRAINS OF HUMAN-PATHOGENIC BACTERIA. M. G. Bookbinder, F. L. Lukezic, and J. R. Bloom. Department of Plant Pathology, The Pennsylvania State University, University Park, PA 16802.

Isolates of selected human-pathogenic species in the family Enterobacteriaceae caused root injury to, and reduced weights of inoculated seedlings of Saranac AR alfalfa grown in sand or soil, when applied at concentrations of 0.1-2.0 x 10^8 cells per gram of growing medium. Strains of Salmonella choleraesuis, S. typhi-suis, S. typhimurium, Shigella flexneri, Sh. boydi, Sh. sonnei, Sh. dysenteriae, Klebsiella pneumoniae and Escherichia coli were pathogenic when applied alone, and produced greater growth reductions when applied simultaneously with the root knot nematode Meloidogyne hapla. Pathogenic Enterobacteriaceae did not induce a hypersensitive response on leaves of 'Havana 425' tobacco, and failed to rot onion and potato slices in vitro. Effects on alfalfa seedlings of HR+, phytopathogenic Pseudomonas isolates ranged from no response to complete destruction of root tissue; HR- Ps. aeruginosa and Ps. fluorescens isolates had no effect on host seedlings.

BACTERIAL LEAF STREAK OF WILD RICE. R.L. Bowden and J.A. Percich. Department of Plant Pathology, University of Minnesota, St. Paul, MN 55108.

Bacterial leaf streak (BLS) of wild rice (Zizania aquatica L.) is characterized by narrow, dark green, water-soaked, linear lesions which eventually become necrotic. Isolations from diseased plants collected in northern Minnesota in 1979 consistently yielded white, Gram-negative, oxidase-negative colonies which were fluorescent on King's Medium B. These isolates reproduced the water-soaked streak symptom when infiltrated into wild rice leaves at approximately 10^8 colony forming units (CFU)/ml and were readily reisolated. Physiological, biochemical, and morphological characters of the causal agent of BLS are consistent with Pseudomonas syringae van Hall.

EVALUATION OF RESISTANCE IN POTATO TO PSEUDOMONAS SOLANACEARUM. J. Bowman and L. Sequeira, Dept. of Plant Pathology, University of Wisconsin-Madison, Madison, WI 53706.

Infectivity titrations were used to assess resistance in seven potato cultivars to a highly virulent Race 3 strain of P. solanacearum (No. 276). The ED_{50}'s (dosage required to wilt 50% of the population) ranged from 3 and 100 CFU for susceptible Katahdin and Russet Burbank, respectively, to 2.1×10^6 CFU for resistant clones of Solanum phureja. The distribution of P. solanacearum was determined after stem inoculation of resistant and susceptible clones. In incompatible combinations (virulent strain in a resistant clone or avirulent strain in a normally susceptible clone), multiplication and spread were greatly reduced in contrast to compatible interactions (virulent strain in a susceptible clone). High populations of bacteria (10^6 CFU/mg tissue) were detected at inoculation sites in all clones. The bacteria induced plugging of xylem vessels in all interactions; however, spread into adjacent tissues was reduced in the incompatible ones.

IMMUNE ELECTRON MICROSCOPY OF TYMOVIRUSES: THE TRAPPING OF PARTICLES BY ADSORPTION AND SEROLOGICAL BINDING. R. F. Bozarth, D. E. Lesemann, and R. Koenig. Indiana State Univ., Terre Haute, IN 47809, and Biologische Bundesanstalt fur Land und Forstwirtschaft, D3300 Braunschweig, West Germany.

When electron microscopic grids coated with homologous antisera (AS) of several TYMO viruses or 0.1 M potassium phosphate buffer pH 7.0 were floated on drops containing purified virus top or bottom components, the number of particles trapped on the grids was proportional to their concentration over the range of 0.1 to 10 µg per ml. Normal sera (NS)-coated grids trapped fewer particles at all concentrations. When grids coated with homologous AS, NS, or buffer were floated on extracts of infected plants or healthy plants to which virus had been added, the AS-coated grids trapped significantly more particles than NS- or buffer-coated grids. Thus, adsorption of viruses to EM grids was inhibited by serum or plant sap. Antisera overcame this inhibition by specific serological binding.

REOLIKE VIRUS ASSOCIATED WITH MAIZE RIO CUARTO DISEASE IN ARGENTINA. O. E. Bradfute, E. Teyssandier*, E. Marino*, & J. L. Dodd**. Ohio Agricultural Research & Development Center, Wooster, OH 44691. *Cargill S.A.C.I., C. Correo 103, 2700 - Pergamino, Argentina; **Cargill Incorporated, Box 470, Aurora, IL 60507.

Maize Rio Cuarto disease (MRCuD) has been endemic near the city of Rio Cuarto in the western corn belt of Argentina since the 1950's. Diseased plants are severely stunted, malformed, and dark green with stiff or brittle stalks and leaves. Electron microscopy (EM) of negatively stained leaf dip preparations revealed reolike virus particles (RVP) in 3/3 maize plants with MRCuD collected from each of three sites near Rio Cuarto and one site in the eastern corn belt near Pergamino. RVP were found in 3/3 severely affected plants with many small vein-enations (VE), 3/3 nonstunted plants with few large VE, but 0/3 healthy plants without VE. Antisera to maize rough dwarf virus (MRDV) or rice black-streaked dwarf virus adhered to reolike subviral particles in immune EM. EM of thin sections of MRCuD plants revealed RVP and inclusions similar to those associated with MRDV. There was no evidence of other viruses or mycoplasmalike organisms. Genetic resistance appears to be available and dominant.

EXTRACELLULAR POLYSACCHARIDE AND VIRULENCE OF ERWINIA STEWARTII IN RELATION TO AGGLUTINATION BY A CORN AGGLUTININ. J. Bradshaw-Rouse, L. Sequeira and A. Kelman, University of Wisconsin, Madison, WI 53706 and D. Coplin, Ohio Agr. Dev. Center, Wooster, OH 44691.

A corn agglutinin was prepared by extracting ground corn seed (WI hybrid 64AXW117) with phosphate buffered saline (pH 6.0) followed by ammonium sulfate precipitation. Relative amounts of extracellular polysaccharide (EPS) were compared with agglutination indices (agglutination titre÷mgm protein/ml) of 30 strains of E. stewartii representing a range in colony types and virulence (11 avirulent and 19 weakly to highly virulent). Most virulent strains formed copious amounts of EPS but did not agglutinate readily. Strains lacking EPS generally were avirulent and were agglutinated rapidly. Loss of EPS generally was accompanied by loss of virulence and exposure of cell wall binding sites for the agglutinin. The relative viscosity of culture filtrates of avirulent strains was lower than that of virulent ones and correlated directly with lack of EPS and butyrous colony appearance.

ANATOMICAL OBSERVATIONS OF RESISTANT AND SUSCEPTIBLE CORN INBREDS INFECTED WITH Erwinia stewartii. E. J. Braun. Department of Plant Pathology, Seed and Weed Sciences, Iowa State University, Ames, IA 50011.

Anatomical changes associated with the development of Stewart's wilt were studied in resistant (C123) and susceptible (B14A) corn inbred lines using light and transmission electron microscopy. When corn leaves were inoculated with Erwinia stewartii at the tasseling stage, lesions expanded 3-4 times more rapidly in B14A than in C123. Samples from lesions such as these were prepared for microscopy. In both lines pit membranes became plugged with bacterial exopolysaccharide (EPS) while pathogen populations in the vessels were still very low. As populations built up, vessels often became totally occluded with EPS. Four other types of material, assumed to be of host origin, were found in the vessels of infected plants. These materials, which could be differentiated on the basis of histochemical staining reactions, were found more frequently in C123 than B14A, and they might possibly function in the localization of the pathogen.

SCANNING ELECTRON MICROSCOPY OF THE XYLEM OF PLANTS AFFECTED BY PIERCE'S DISEASE OF GRAPES, ALMOND LEAF SCORCH, PERIWINKLE WILT, AND CITRUS BLIGHT. R. H. Brlansky, AREC, University of Florida, Lake Alfred, FL 33850 and B. C. Raju, Department of Plant Pathology, University of California, Davis, CA 95616.

Scanning electron microscopy was used to study the xylem vessels of plants affected by two diseases caused by a rickettsia-like bacteria (RLB), and two vascular wilts in which RLB's have been associated. Samples of roots, stems, and twigs were fixed in a 3% buffered glutaraldehyde, post-fixed in 2% osmium, dehydrated, and critical point dried. Specimens were mounted, sputtered with gold:paladium, and the xylem vessels scanned. RLB and plugging material were found in all samples of almond leaf scorch-affected almonds and Pierce's disease-affected grapes. Only RLB were found in periwinkle affected with periwinkle wilt. In blight-affected citrus plugging material as described by VanderMolen (Physiol. Plt. Path. 13:271-274) was consistently found. Bacteria resembling RLB were found in only a few specimens.

THE INFLUENCE OF UNNECESSARY VIRULENCE GENES ON THE REPRODUCTIVE FITNESS OF ERYSIPHE GRAMINIS F. SP. TRITICI. Charlotte R. Bronson and A. H. Ellingboe, Dept. of Botany & Plant Pathology, Michigan State University, East Lansing, MI 48824.

Vanderplank has suggested that unnecessary genes for virulence reduce the reproductive fitness of a pathogen. To test this "hypothesis of stabilizing selection", two isolates of Erysiphe graminis f. sp. tritici that differ by three genes for virulence were allowed to compete on a susceptible wheat line for several generations in a controlled environment chamber. The isolate with the greater number of virulence genes declined in frequency in the population, indicating that it was less fit. A cross of the two isolates was made and isolates of the eight possible genotypes of offspring were collected. Competitions of the offspring and subsequent calculations of their fitness showed no clear relation between the number of genes for virulence and reproductive fitness. This suggests that the difference in the fitness of the parental isolates may be attributable to genes other than those controlling virulence.

THE INCORPORATION OF WEATHER UNCERTAINTY WITH PREDICTIONS OF FUTURE PESTICIDE LOSS. J. A. Bruhn and W. E. Fry, Department of Plant Pathology, Cornell University, Ithaca, NY 14853.

A mathematical model was used to quantify the effects of rainfall uncertainty on the prediction of future pesticide residue levels. The model assumed that: pesticide residues decayed exponentially over time; the proportion of pesticide remaining after rainfall was a decreasing exponential function of rainfall; the daily rainfall amount, given rainfall occurrence, was an independent, identically distributed gamma random variable. The expected value, variance, moment generating function and confidence interval estimates of future residue levels were derived as functions of rainfall variability and pesticide tenacity. Rainfall variability is a property of geographic location, and tenacity is a characteristic of the pesticide and plant. We used these results to determine how the frequency of pesticide applications could be adjusted to account for changes in rainfall variability and pesticide tenacity.

WEATHERING OF CHLOROTHALONIL RESIDUES IN A POTATO CANOPY. J. A. Bruhn and W. E. Fry, Department of Plant Pathology, Cornell University, Ithaca, NY 14853

The initial deposition and subsequent redistribution of chlorothalonil were monitored (via gas-liquid chromatography) in field plots of potatoes. The initial deposits increased exponentially with foliage height. The change in chlorothalonil residues over time was examined at three canopy levels (Upper (U): ≥46 cm; Middle (M): 30 to 46 cm; Lower (L): <30 cm). Exponential decay modified by rain described residue change over time with varying degrees of success for the three canopy levels (U: $R^2 = 0.933$; M: $R^2 = 0.677$; L: $R^2 = 0.743$). Average daily fungicide loss without rainfall was 12, 16 and 17% for U, M, and L, respectively. The rate of fungicide loss was independent of the magnitude of the initial deposit. Cumulative rainfall was a significant variable ($P = 0.05$) only in the L canopy level. These relationships have been incorporated into a preliminary mathematical model describing the initial deposition and redistribution of chlorothalonil residues in a potato canopy.

CONTROL OF ALFALFA DAMPING-OFF WITH SEED TREATMENT. G.W.Buchenau F. R. Vigil, C. J. Mankin and C. W. Wirth. Plant Science Dept. South Dakota State University - Brookings, SD 57007

Seedling mortality of alfalfa in interseeded rangeland was extreme in South Dakota in 1977 and 1978 and resulted in numerous poor stands and some complete failures. Pythium ultimum was

consistently isolated from dying plants grown in samples of problem soils. Two percent corn meal sand inoculum of P.ultimum in steamed UC Mix 'C' resulted in nearly complete mortality. Metalaxyl (Ridomyl) seed treatment at 0.31 g ai/kg resulted in 67% stands of Travois alfalfa, compared with 19% stand from untreated seed in inoculated greenhouse tests using two isolates. Similar results occurred in naturally infested field soil. Captan, arasan and ethazole performed erratically in these tests. Acetone infusion of 5% ai Captan for 30 minutes improved its effectiveness compared with slurry treatment at 700 mg/kg. There was no apparent effect of seed treatment on nodulation by Rhizobia applied to treated seed, although quantitative evaluations were not attempted.

PHYTOALEXINS IN TOBACCO CALLUS TISSUES CHALLENGED BY ZOOSPORES OF PHYTOPHTHORA PARASITICA VAR. NICOTIANAE. Allen D. Budde and J. P. Helgeson, USDA, SEA, AR, Plant Disease Resistance Res. Unit, Dept. of Plant Pathology, Univ. of Wisconsin, Madison 53706

Tobacco callus tissues accumulate at least 4 different sesquiterpenoid phytoalexins after challenge with either compatible or incompatible races of Phytophthora parasitica var. nicotianae. Two materials from tobacco callus are identical to authentic rishitin and capsidiol with respect to GLC and TLC mobilities, mass and NMR spectra, and biological activity. A third compound (MW=222) appears to be an isomer of rishitin. The fourth compound (MW=238) appears to have the same ring structure as the other compounds but probably has two vicinal hydroxyls on the exocyclic, 3-carbon side chain. We have developed a GLC technique for separating all of the compounds as chloromethyl-dimethylsilyl-ethers on 3% DC-11 on Chromosorb W. Samples as little as 20 mg (frest wt) of tobacco callus can be analyzed for phytoalexin content by this method.

THE EFFECT OF SEED INFECTED WITH PHOMA BETAE ON ROT AND SUCROSE YIELD OF STORED SUGARBEET. W. M. Bugbee and D. F. Cole. USDA, SEA-AR, Walster Hall, North Dakota State University, Fargo, ND 58105

Sugarbeet seed moderately (25%) infected with Phoma betae, had a slightly better stand than heavily (95%) infected seed. Seed treatment with several fungicides did not improve the stand counts under Red River Valley conditions but did reduce the prevalence of seedlings infected with the fungus. The reduced seedling infection produced only a partial and unacceptable reduction in storage rot of the mature root. This reduced rot did not significantly reduce sucrose loss during storage. A 1% increase in infected seedlings caused a 0.04% increase in storage rot. A 1% increase in storage rot caused a loss of 3 kg of sucrose per ton of sugarbeets during 150 days of storage at 5 C.

THE EFFECT OF VARIABILITY IN A RESEARCH PLOT ON SUGARBEET JUICE QUALITY AND STORAGE ROT. W. M. Bugbee and D. F. Cole, USDA, SEA-AR, Walster Hall, North Dakota State University, Fargo, ND 58105.

A research plot 61.5 x 73.1 m was planted with sugarbeets. Sucrose contents and clear juice purities (CJP) of juice expressed from roots were taken at harvest and after root storage of 150 days at 5 C. A gradient along the east-west axis of the plot showed a decrease in sucrose content and CJP and an increase in storage rot and loss of recoverable white sugar per ton of roots. The cause of the gradient is not known but the replicates that contributed most toward the gradient were located on land cropped to corn the previous year. The remaining land had been cropped to wheat. These results emphasized the necessity of a uniform soil environment within research plots intended for sugarbeet storage research. The appearance of the growing crop or the harvested roots gave no indication that poor storability could be anticipated. The data did provide the first evidence that CJP at harvest correlated positively with subsequent storage rot development.

PECTIC ENZYME INHIBITION BY THE PHYTOALEXIN, KIEVITONE. C. A. Bull and D. A. Smith, Plant Biology Department, The University, Hull HU6 7RX, U. K.; Plant Pathology Department, University of Kentucky, Lexington, Ky., 40546.

Viscometric and reducing sugar assays indicated that polygalacturonate and polymethylgalacturonate-degrading enzymes were inhibited by kievitone. High pectolytic activity was obtained from Rhizoctonia solani liquid cultures containing citrus pectin as sole carbon source. Enzyme preparations were incubated with the phytoalexin (0.05 - 1 mg/ml in 2% ethanol) for 1 hr, or overnight, prior to assay. Inhibition of enzyme activities was about 50% after 1 hr exposures to kievitone (0.5 mg/ml). Tween 80, bovine serum albumin or Tris-HCl buffer (pH 8.0) added to enzyme preparations before kievitone prevented inhibition. Dialysis of enzyme-kievitone mixtures did not restore enzyme activities. Crude lesion extracts from R. solani-infected Phaseolus vulgaris hypocotyls, containing pectolytic enzymes, were not inhibited by kievitone; partial purification of these enzymes rendered them sensitive. Limitation of R. solani in bean hypocotyls may reflect kievitone-mediated inactivation of cell wall degrading enzymes, as well as overt antifungal activity.

FIELD RESULTS WITH BEAM (TRICYCLAZOLE) FOR RICE BLAST (PIRICULARIA ORYZAE CAV.) CONTROL IN THE UNITED STATES. K. R. Burnside, J. L. Pafford and J. D. Froyd, Lilly Research Laboratories, Greenfield, Indiana 46140

Rice blast (Piricularia oryzae Cav.) is an economically important disease on rice in the southern rice growing areas of the United States. It can cause severe rice yield losses, particularly along the Gulf Coast. BEAM 75W (tricyclazole) was evaluated as foliar treatments for the control of rice blast in several small plot research experiments during the period from 1972 to 1979 and in large scale field plots in 1979 under an experiment use permit (EUP) program. All EUP trials were treated with commercial aerial equipment using a total spray volume of 93.5 l/ha. Nine EUP trials were conducted in Arkansas, Mississippi, Louisiana and Texas. Blast infection levels were sufficient in five of these to obtain valid efficacy data. Results from both small plot research and large scale EUP trials showed that BEAM at 0.28 to 0.56 kg/ha a.i. applied at booting and heading provided blast control equal to or better than the currently registered fungicide. Also, these treatments provided higher yields and improved milling quality when compared to the reference fungicide and untreated control.

RHIZOCTONIA CEREALIS CAUSES YELLOW PATCH OF TURFGRASSES. L.L. Burpee, Bermuda Dept. of Agriculture and Fisheries, P.O. Box 834, Hamilton 5, Bermuda.

Isolates of a binucleate Rhizoctonia sp. which causeschlorosis and blight of turfgrasses fit the species concept of Rhizoctonia cerealis. Nine of these binucleate Rhizoctonia isolates, which had previously been assigned to anastomosis group CAG 1, were compared on the basis of mycelial and sclerotial characteristics and hyphal anastomoses with 3 isolates of R. cerealis from small grains. The 9 unidentified isolates and the isolates of R. cerealis exhibited similar cultural morphology and were assigned to the common anastomosis group CAG 1. Based on morphological and anastomosis evidence, isolates of R. cerealis are assumed to be the cause of chlorosis and blight of turfgrasses, and the descriptive name "yellow patch" is proposed for the disease caused by R. cerealis on turfgrass species.

OCCURRENCE OF *AGROBACTERIUM RADIOBACTER* PV. *TUMEFACIENS* (SMITH & TOWNSEND) CONN BIOTYPE 3 ON GRAPEVINES IN NEW YORK STATE. T. J. Burr and B. Hurwitz, Dept. of Plant Pathology, New York State Agricultural Experiment Station, Cornell University, Geneva, NY 14456.

Agrobacterium radiobacter pv. *tumefaciens* was isolated from typical crown galls on *Vitis vinifera*, French hybrid, and Labruscana grapevines collected from the major grape growing regions of New York State. Vinifera and certain French hybrid cultivars were consistently the most seriously infected. Eleven of 13 isolates were characterized as biotype 3 according to the following test results: utilization of malonate and tartrate and failure to utilize erythritol or produce 3-ketolactose. Two isolates were atypical of biotypes 1, 2, or 3. Pathogenicity tests were conducted in the greenhouse on grapevines, tomato, sunflower, *Datura*, and *Kalanchoe*, and in the laboratory on carrot slices. Sunflower could be easily propagated and was the most consistent indicator host. All isolates from grapevine were insensitive to the bacteriocin agrocin 84 in vitro and in vivo.

QUANTITATIVE ELISA TECHNIQUE: UNIFORMITY ANALYSIS AND EXPERIMENTAL DESIGN. P. M. Burrows[1], R. M. McLaughlin[2], O. W. Barnett[2], and R. H. Baum[2], Experimental Statistics Unit[1], and Dept. of Plant Pathology and Physiology[2], Clemson Univ., SC 29631.

Variations in quantitative ELISA results were investigated by uniformity trials employing all wells of several microtiter plates at each plant virus concentration. Absorbance at 405 nm was used to measure virus concentration. Average differences

among plates and systematic variations associated with row and column positions of wells within plates were detected, the latter varying from plate to plate in an unpredictable manner. Variation associated with columns and rows ranged ±0.15 OD from a plate average of ~1.0 OD (0.04 OD background). The necessity to accomodate such variation in precise and unbiased comparisons led to the adoption of experimental designs with 2-way controls, such as Latin squares, Youden squares and lattice squares. Where the assay involved factorial combinations of treatments it was possible to achieve designs more economically than with lattice squares.

PATULIN IN APPLES INFECTED IWTH BENOMYL-TOLERANT ISOLATES OF PENICILLIUM EXPANSUM. C.L. Burton and A.B Filonow, Department of Botany and Plant Pathology, Michigan State University, and USDA, SEA-AR, East Lansing, MI 48824.

Penicillium expansum (Pe, blue mold rot) was isolated from decaying apples (Malus sylvestris) which had previously been treated with benomyl at harvest. Pe was also isolated from the water in flotation dump tanks. Several isolates grew well and sporulated both on agar medium containing 100 µg/ml benomyl, and on apples inoculated with Pe and dipped in a 300 µg/ml benomyl solution. Eight benomyl-tolerant (BT) and two benomyl-sensitive (BS) isolates were tested for production of the mycotoxin patulin in apples; all isolates produced patulin in Red Delicious apples. Generally, patulin production increased over time. After 12-14 days of incubation, apples inoculated with BT isolates were severely rotted, and patulin levels ranged from 0.06 µg/g to 5.36 µg/g apple. BS isolates produced 0.66 µg/g to 1.20 µg/g apple in a similar period.

ISOLATION OF CERATOCYSTIS ULMI IN CALIFORNIA FROM ELMS WITH BURIED INFECTIONS FROM PREVIOUS YEARS. R.J. Campana, A French and R. Locatelli. California Department FA, Sacramento, California 95814.

Isolation of C. ulmi in 1977 from buried annual rings which predated disease development and confirmation, suggested earlier infections at other sites. To determine earliest dates of infection at different sites, more than 100 large elms of various species were dissected in 1978. Wood samples with staining in buried annual rings were obtained for isolation trials. Samples included stems 2-82 cm diam. and/or discs of wood 2-4 cm thick from the lower trunk. Discolored and/or clear xylem tissues were dissected from specific wood rings and incubated in petri plates at room temperature. Pure cultures were made on agar plates from coremial heads. The fungus was commonly isolated from wood rings formed before 1978 and as far back as 1958, but was rarely isolated from non-discolored wood. The data indicate that C. ulmi was present at several sites in California many years before earliest confirmation.

ROOT ROT OF LADINO CLOVER INDUCED BY CODINAEA FERTILIS. C. Lee Campbell, Department of Plant Pathology, North Carolina State University, Raleigh 27650.

Codinaea fertilis was isolated from roots of Ladino clover (Trifolium repens) in clover/fescue (Festuca arundinacea) plantings in Wake County, NC. In 10 samples from 4 locations, isolates of C. fertilis comprised from 6.1 to 29.1% of isolates obtained from clover roots. Other fungi frequently isolated were: Fusarium oxysporum, F. solani, F. roseum, Rhizoctonia solani, binucleate Rhizoctonia-like fungi, and Gliocladium sp. Isolates of C. fertilis were grown on 5% cornmeal-sand medium and incorporated into pasteurized or field soil in greenhouse studies. A brown surface discoloration and necrosis developed on clover roots within 10 weeks. C. fertilis was consistently reisolated from diseased roots. Optimum temperature for growth of C. fertilis was between 24 and 28 C on potato dextrose agar. Symptoms of root rot induced on white clover with NC isolates of C. fertilis are similar to those reported by S.A. Menzies in New Zealand. This fungus has not been previously reported in the United States.

SOIL FUMIGATION FOR CONTROL OF TOMATO CORKY ROOT. R. N. Campbell, Department of Plant Pathology, Univ. of Calif., Davis, CA 95616, and V. H. Schweers, Univ. of Calif., Coop. Ext. Service, Visalia, CA 93277.

Chemical treatments were applied to soil under plastic tarps in a fresh-market tomato field heavily infested with Pyrenochaeta lycopersici in the fall of 1978. Tomatoes were transplanted into this field in March, 1979. In one plot (4 replications) treatment with chloropicrin (168 kg/ha) or chloropicrin + methylbromide (119 kg/ha + 262 kg/A) gave the greatest reduction in root infection and the greatest increase in yield of large fruit. Chloropicrin + ethylene dibromide (94 kg/ha + 108 kg/ha) and methylbromide (269 kg/ha) were not significantly different from the nontreated check in disease control and yield response. In the second plot (3 replications), Vapam (935 l/ha) applied under a tarp significantly reduced disease severity on roots but it was ineffective without the tarp.

PECTOLYTIC CLOSTRIDIA AND ERWINIA SPP. IN RELATION TO DECAY OF POTATOES IN STORAGE. E. Campos, E. A. Maher, and A. Kelman, Dept. of Plant Pathology, University of Wisconsin, Madison, WI 53706.

Prevalence of pectolytic clostridia and Erwinia spp. was evaluated in 100 tuber samples of decayed potatoes collected from each of 7 commercial storage bins maintained at 5°C. Clostridia were a significant component of the bacterial populations in decayed potatoes. Pectolytic clostridia were present in 22%, Erwinia carotovora subsp. carotovora (Ecc) in 13% and Erwinia carotovora subsp. atroseptica (Eca) in 45% of the samples. In 58% of the samples from which clostridia were isolated, Ecc and/or Eca were also present. The proportion of clostridia to Erwinia increased when healthy tubers from storage bins were injured and incubated at 20°C. In vitro, clostridia and Ecc but not Eca were favored at temperatures above 18°C. Pectolytic clostridia from potato were similar to the "butyric acid" group of Clostridium species, but differed in several major characteristics from species described previously.

ACTIONS AND INTERACTIONS OF ENDOMYCORRHIZAL FUNGI, ROOT-KNOT NEMATODE, PHOSPHORUS AND PEANUT. D.E. Carling, R. W. Roncadori, and R. S. Hussey. Department of Plant Pathology and Plant Genetics, University of Georgia, Athens, GA 30602.

Interactions between Meloidogyne arenaria and Gigaspora margarita or Glomus etunicatus at 4 levels of phosphorus (0, 25, 75 and 125 ppm P) (initial P content 5 ppm) on Arachis hypogaea cv 'Starr' were investigated. Both fungi produced significant increases in top weight and yield at 0, 25, and 75 but not at 125 ppm P. M. arenaria decreased top weight and yield at 75 and 125 but not at 0 and 25 ppm P. Root weights were increased in dually infected plants due to extensive (mycorrhizal influenced) gall development. Sporulation by both fungi decreased as phosphorus was increased. When the nematode was present, sporulation by G. etunicatus, but not G. margarita, was significantly increased at 0 ppm P. Nematode reproduction was increased in the presence of either fungus at 25 but not at 0, 75, or 125 ppm P. Delaying nematode inoculation resulted in significant increases in egg production at all phosphorus levels when either fungus was present. These latter increases appear to be due to a factor(s) other than improved phosphorus nutrition.

BACTERIAL MOSAIC OF WHEAT: DISTRIBUTION AND HOSTS. R.R. Carlson and A.K. Vidaver, Department of Plant Pathology, Univ. of Nebraska, Lincoln, NE 68583.

Bacterial mosaic is a disease of wheat caused by Corynebacterium michiganense subsp. tesellarium. It is a foliar disease characterized by yellow lesions with indefinite margins, giving the appearance of a mosaic. The disease has been found in 17 counties in Nebraska and Iowa, and the pathogen has been isolated from 16 varieties of winter wheat. Spring durum, and winter wheat were all susceptible when inoculated, in the greenhouse. The pathogen is apparently specific for wheat, as no symptoms were seen in nine other graminaceous plants inoculated by vacuum infiltration. High populations of the pathogen (greater than 1×10^6 CFU/gm fresh weight) were present asymptomatically in six of these grasses ten days after inoculation. These plants are thus considered possible alternate hosts for the pathogen. The other three grasses did not support appreciable populations and are considered non-hosts.

FACTORS AFFECTING DETECTION OF ERWINIA CAROTOVORA VAR. ATROSEPTICA BY ELISA. Michel Caron and R.J. Copeman. Plant Science Dept., University of B.C., Vancouver, B.C. V6T 2A2.

Optimum reaction conditions for detecting E. carotovora var. atroseptica (Eca) in suspensions of known cell numbers were found to be 2 µg/ml coating γ-globulin and a 1:400 dilution of enzyme-conjugate. Color developed more rapidly at lower enzyme-conjugate dilutions but no increase in sensitivity resulted. The rate of color development in samples and controls was constant over 90 min. The standardized test, employing antiserum prepared against glutaraldehyde-fixed, whole, bacterial cells,

routinely detected 10^5 to 10^6 cells/ml of the homologous strain (serogroup I). Heating samples at 75 C increased sensitivity to 10^4 to 10^5 cells/ml. Strains of three other Eca serogroups (XVIII, XX, XXII) and strains of one E. carotovora var. carotovora serogroup (III) also reacted but only at 10^8 cells/ml. Culture age, growth medium and washing of cells had no effect on sensitivity. Because rigorous washing of the microtiter plates between steps delayed color development by 15 to 30 min, washing conditions had to be standardized.

A SURVEY OF THE INCIDENCE OF SPECIFIC APPLE REPLANT DISEASE IN MAINE. F.L. Caruso, R.L. Homola, and C. Allen. Department of Botany and Plant Pathology, University of Maine, Orono 04469.

Apple growers in Maine have experienced difficulty in acquiring satisfactory growth of apple trees when apple orchards are replanted. An intensive survey was conducted state-wide to determine the prevalence of replant problems and probable causes. Orchard soils were sampled three times during the growing season from replant sites and from adjacent sites with no incidence of the problem. Soils were examined for the presence of pathogenic fungi, bacteria, or nematodes, and pathogenicity was monitored on apple plants in greenhouse trials. Soil pH, soil type, site drainage, rootstock source, and mineral content were noted in replant and non-replant sites. Particular attention was devoted to the determination of the populations of endomycorrhizal fungi in the sites. Apple roots were stained with 0.5% trypan blue in lactophenol for the detection of vesicular-arbuscular mycorrhizae. Soil samples were also wet-sieved to detect spores and sporocarps of the endophytes, and populations were correlated with disease incidence.

HISTOPATHOLOGY OF FUSARIUM MONILIFORME INFECTION OF SORGHUM KERNELS. L. L. Castor and R. A. Frederiksen, Dept. of Plant Sciences, Texas A & M University, College Station 77843.

Grain molds are some of the more important sorghum diseases worldwide and Fusarium moniliforme (FM) is one of the principal grain mold fungi. Sorghum lines were inoculated at anthesis with FM to determine when and how infection occurs. Observations of diseased and healthy kernels indicated that infection occurred in glumes, lemma, palea, and lodicules 5 days after anthesis. Subsequent colonization occurred in pedicel and basal ovary tissues. Mats of fungal hyphae, progressing acropetally, were produced between the ovary wall and the aleurone layer between 5 and 10 days after anthesis. FM hyphae entered the endosperm, germ, and ovary wall tissues directly from the hyphal mats. A false black layer formed in some kernels, without extensive FM colonization, 10 to 16 days earlier than normal black layer formation in healthy kernels. This resulted in smaller kernels than normal. This study provides histological evidence that FM parasitizes sorghum kernels prior to maturity.

RETAIL AND CONSUMER LEVEL LOSSES IN WESTERN SWEET CHERRIES MARKETED IN GREATER NEW YORK. M.J. Ceponis and J.E. Butterfield, USDA-New Jersey AES Postharvest Research Center, P.O. Box 231, New Brunswick, New Jersey 08903.

The nature and extent of losses in the marketing of western 'Bing' and 'Lambert' sweet cherries in Greater New York were studied over three years. Supermarkets in low, middle, and high income areas were visited twice weekly during the June-August marketing periods of 1977-79. Yearly retail losses ranged from 8.4% to 12.6%, averaging 10.3%. Losses averaged 4.5% from diseases and 5.8% from non-parasitic causes. Blue mold rot (1.8%), and Alternaria rot (1.0%) were the leading causes of parasitic loss in retail. Overripeness (2.0%), mechanical injury (1.4%), and a brown flesh discoloration (1.0%) caused most of the non-parasitic loss at this level. In consumer-grade samples, held for three days at 4 C, parasitic disease losses averaged 5.0% yearly and non-parasitic losses, 6.3% yearly. Alternaria rot (2.2%), mechanical injury (2.0%), brown flesh discoloration (1.6%), and overripeness (1.5%), were the leading causes of loss in consumer samples.

CYANIDE-INSENSITIVE GROWTH AND RESPIRATION IN AN ALFALFA SNOW MOLD PATHOGEN. D.B.Chalkley and R.L.Millar, Dept. of Plant Pathology, Cornell University, Ithaca, New York 14853.

Cyanide tolerance in pathogenic fungi has been associated with production of the enzyme formamide hydro-lyase. However, this cyanide-degrading enzyme was not detected in a cyanide-producing low-temperature basidiomycete pathogenic to alfalfa. Instead, cyanide tolerance in this fungus appears to be due to activity of the cyanide-insensitive mitochondrial alternate terminal oxidase (ATO). Antimycin, which like cyanide blocks the normal respiratory pathway in mitochondria, failed to prevent growth and respiration when the ATO pathway was functional. In the presence of antimycin, the growth rate was 30-45% of the control. Antimycin-resistant growth was prevented by both salicylhydroxamic acid and rotenone, inhibitors, respectively, of ATO activity and coupling of ATO activity to ATP synthesis. Support of cyanide-tolerant growth is a possible biological function for the ATO in this organism.

THE MECHANISM OF APHID NONTRANSMISSIBILITY IN SOYBEAN MOSAIC VIRUS. Eui Kyoo Cho and Robert M. Goodman. Department of Plant Pathology, University of Illinois, Urbana, IL 61801.

The reactions of soybean differentials to seven biologically distinct strains of soybean mosaic virus (SMV) transmitted by Myzus persicae Sulz. were similar to those obtained when sap inoculation was used. An isolate of SMV-G5, originally aphid transmissible, was no longer transmissible after about 30 successive sap inoculations in 20 months. The nontransmissible G5 isolate was not transmitted when aphids were given prior access to plants infected with aphid transmissible potato virus Y or other SMV isolates. For example, aphids given acquisition access successively to plants infected with transmissible SMV-G3 and nontransmissible G5 did not transmit G5 to test plants susceptible only to G5 and they transmitted only G3 to plants susceptible to both G5 and G3. Aphid transmission of nontransmissible G5 was occasionally observed when acquisition access was to plants infected with both G5 and G3. The transmission frequency of G3 from the mixed infection was reduced to 3% compared to the 50% frequency from plants infected with G3 alone.

IDENTIFICATION OF VIRULENCE GENES GOVERNING PYCNIAL AND UREDIAL INFECTION OF BEANS BY RUST. B.J. Christ and J.V. Groth. Department of Plant Pathology, University of Minnesota, St. Paul, MN 55108.

Genes for virulence in the uredial and pycnial stages of six isolates of bean rust (Uromyces phaseoli var. typica) were identified using Phaseolus vulgaris 'US#3' and 'Early Gallatin' (EG). The isolates were parental isolates S1-5 and P10-1 and progeny isolates 151, 108 and 20 from a cross of the parental isolates. Isolates were mass-selfed to show homo- or heterozygosity of uredial virulence genes. Normal pycnia developed on the cultivar to which isolates were homozygous virulent in the uredial stage. Normal pycnia and flecks occurred 1:1 on the cultivar to which isolates were heterozygous avirulent for one gene in the uredial stage. Only pycnial flecks occurred on the cultivar to which the isolates were homozygous avirulent in the uredial stage. We conclude that inheritance of virulence in the uredial and pycnial stages of these isolates may be due to the same genes.

SEED TRANSMISSION OF VERTICILLIUM WILT IN ALFALFA. A. A. Christen, Irrigated Agriculture Research and Extension Center, Prosser, Washington 99350.

Greenhouse grown plants of susceptible alfalfa (Medicago sativa L.) cultivar 'Apalachee' and resistant cultivar 'Vertus' were inoculated with the alfalfa strain of Verticillium albo-atrum. A conidial suspension was injected into the stem at intervals of 0-1, 1-2, 2-3, and 3-4 wk after pollination. Mature seed was hand harvested and sorted into size classes with the aid of a seed blower to average weights of .8, 1.2, 1.6, 2.0, 2.2, and 2.4 mg per seed. Plating of surface sterilized seed on a selective media, modified from Komadas' Fusarium medium revealed that V. albo-atrum had entered small and large seed of susceptible and resistant cultivars and occurred in a higher proportion of small seed. By use of scanning electron microscopy, the fungus was found within the vascular tissue and between layers of differentiated cells within the seed coat. On some severely affected seed, mycelia were also present on the seed surface.

ACCUMULATION OF FURANOTERPENOIDS IN SWEET POTATOES IN RESPONSE TO VARIOUS PATHOGENS. C. A. Clark, A. Lawrence, and F. A. Martin. Dept. of Plant Path. & Crop Physiol., La. State Univ. Agric. Expt. Sta., Baton Rouge, LA 70803.

Accumulation of 4-ipomeanol and 1,4-ipomeadiol following inoculation with different pathogens was positively correlated with ipomeamarone accumulation and occurred only when ipomeamarone accumulated. Concentrations of 4-ipomeanol and 1,4-ipomeadiol were <2% of ipomeamarone concentration. Macrophomina phaseoli and Sclerotium rolfsii induced high levels of ipomeamarone and 4-ipomeanol but did not induce detectable levels of 1,4-ipomeadiol. Pathogens which did not induce furanoterpenoid pro-

duction included: Streptomyces ipomoea, Monilochaetes infuscans, and Internal Cork Virus. Rhizopus stolonifer and Erwinia carotovora induced low levels (100-1,000 ug/g ipomeamarone). Plendomus destruens, Diaporthe batatatis, Diplodia tubericola, Fusarium solani, Ceratocystis fimbriata, M. phaseoli, and S. rolfsii induced high levels (1,000-25,000 ug/g ipomeamarone). Highest levels of 4-ipomeanol (200-300 ug/g) and 1,4-ipomeadiol (300-500 ug/g) occurred in tissue infected by F. solani and D. tubericola.

ACCUMULATION AND DISTRIBUTION OF CADMIUM IN THE TOBACCO PLANT AND ITS SIGNIFICANCE. Bruce Clarke and Eileen Brennan. Dept. of Plant Pathology,PO 231, Cook College, N.B., NJ. 08903

A preliminary experiment revealed that tobacco foliage has an unusually high Cd absorptive capacity. A greenhouse study was conducted to compare Cd uptake and distribution in tobacco and tomato plants treated with 0 or 2 ppm $CdCl_2$ for 30 days in sand culture. Total plant uptake of Cd was similar in the two species, but its distribution within the plant varied significantly. Tobacco foliage accumulated seven times more Cd than tomato foliage, and the roots contained one-half as much Cd. Having previously isolated a Cd-binding protein from tomato roots we speculate that tobacco may lack a protein of equal effectiveness for fixing Cd in the roots. The accumulation of Cd in tobacco leaves has practical significance in that this fraction is used in cigarettes, cigars, and pipe tobacco. We analyzed 13 different brands of tobacco products and found a range of Cd from 1.8 to 8.9 ppm (dry wt.). Cigarette wrapping papers contained 0.6 to 5.7 ppm. Seedlings of 16 commercially-grown tobacco varieties are being tested in a greenhouse study to determine their efficiency in accumulating Cd from the substrate.

PYTHIUM WOUND-HEALING RELATIONSHIP IN GERANIUM CUTTINGS. Molly Niedbalski Cline and Dan Neely, Dept. of Plant Pathology, University of Illinois, Urbana, IL 61801.

Geraniums are still propagated by cuttings even though new seed strains are now used. They are available as unrooted, callused, redi-rooters (root initials present) or rooted cuttings. Blackleg, caused by Pythium spp., is a problem in geranium propagation. Cuttings of Pelargonium hortorum 'Yours Truly' were inoculated with an isolate of Pythium ultimum. Extensive basal stem rot occurred on all freshly broken cuttings. A restricted basal stem rot occurred on cuttings that had healed 1 day in soil prior to inoculation. Basal stem rot did not occur on cuttings that had healed 2 days or longer. The cuttings were studied using histological and histochemical techniques. After 2 days a distinct morphological change occurred in the cell walls of all tissues nearest the wounded surface. The cell walls were thickened and suberin and lignin-like deposits were observed in the intercellular spaces. A wound callus developed after 7-10 days. A wound periderm developed after 14-21 days.

THE EXTENT AND PERSISTENCE OF BENOMYL ON LEAVES AND NUT HULLS OF BLACK WALNUT. Steven Cline and Dan Neely, Dept. of Plant Pathology, University of Illinois, Urbana, IL 61801.

Benomyl is an effective protectant fungicide used to control walnut anthracnose. An evaluation of persistence of benomyl residue on nut hulls and leaves of black walnut was performed. In field studies, cellophane bioassays were conducted on leaves at weekly intervals following treatment with sprays of 1X, 2X, or 4X the recommended rate. In greenhouse studies, simulated rainfall was applied weekly to 1X foliar-treated, incubator-grown trees. Benomyl was very resistant to degradation on leaves following 10 inches of simulated rainfall. Persistence in the field appeared precipitation-dependent, but all rates persisted for similar lengths of time (3 to 9 weeks). Other factors besides rainfall are implicated as contributory to degradation of benomyl in the field. In nut hull tests at higher rates of 2X and 4X, residue was detected for longer periods. The effects of precipitation with respect to degradation were variable.

EFFECT OF WINTER AND SPRING TEMPERATURES ON DEVELOPMENT OF STRIPE RUST EPIDEMICS ON WINTER WHEAT. S. M. Coakley and R. F. Line. NCAR, P.O. Box 3000, Boulder CO 80307, and USDA Cereal Research Lab., Washington State University, Pullman, WA 99164

Stripe rust intensities (%) at the dough stage of plant growth were determined for Gaines and Nugaines winter wheat (cultivars that become more resistant at high temperatures at later stages of growth) and Omar wheat (susceptible at all temperatures and stages) at Pullman, WA in 1963-79. The rust intensities were grouped and designated by a 0-9 index. Correlations between disease indices and meteorological data were calculated. Disease index was most highly correlated with accumulated negative degree days (NDD) below 7C in December and January and positive degree days (PDD) above 7C in April to June. The relationship between disease index and NDD or PDD was quantified using regression analysis. Rust on all three cultivars responded similarly to temperature changes, but more NDD (a lower winter temp.) and PDD (higher spring temp.) were required to reduce rust intensity on Omar. NDD for December to January may be used to predict subsequent stripe rust severity.

SURVIVAL OF MYCELIUM, ZOOSPORES, AND OOSPORES OF PHYTOPHTHORA MEGASPERMA VAR. SOJAE RACE 1 IN SOIL. S. D. Cohen and J. L. Lockwood, Department of Botany and Plant Pathology, Michigan State University, East Lansing, MI 48824.

Propagules of Phytophthora megasperma var. sojae race 1 on membrane filters were buried between nylon nets in a loam soil at different matric potentials and temperatures. Lysis of 1-day-old mycelium began after 2 days at -0.1 or -0.3 bar and in 4 days at -3.0 bars. When incubated at -0.1 bar, lysis after two days was greater at 24 C and 28 C than at 16 C or 20 C; after 8 days at 24-28 C, lysis was complete. Zoospores on membranes were buried in soil at 0, -0.1, -0.3, and -5.0 bars and in air-dried soil. After two days, the number of zoospores germinating, on transfer to water agar, was lowest from air-dried soil. At the other moisture treatments, the number of germinable zoospores decreased over time, and was zero by the 16th day. Temperature from 16-28 C had no effect. Oospores were incubated at 0, -0.3, and -5.0 bars, and in air-dried soil at 16, 20, 24, or 28 C. Oospore viability, as determined by the viability stain MTT, was at least 90% in all treatments for 12 weeks.

THE EFFECT OF INDUCED SYSTEMIC RESISTANCE WITH PERONOSPORA TABACINA ON THE ACCUMULATION OF PHENOLICS AND TERPENOIDS IN TOBACCO FOLIAGE. Y. Cohen, and J. Kuc, Department of Plant Pathology, University of Kentucky, Lexington, Ky. 40546

Leaves of tobacco plants infected by P. tabacina, the incitant of blue mold, accumulated phytuberin, phytuberol, solavetivone and scopoletin. Accumulation was associated with lesion development, reached a maximum in chlorotic lesions 7 days after infection, and declined thereafter. Accumulation of phenolics and terpenoids was not detected in stems or green tissue surrounding lesions. Plants systemically protected against blue mold by either stem injection or soil drench with conidia of P. tabacina accumulated capsidiol, diterpenes, scopoletin, and a number of unidentified compounds in the stems. Scopoletin, but none of the other compounds, increased in leaves of protected plants prior to challenge with P. tabacina. Protection was not due to the accumulation of fungitoxic terpenoids in foliage prior to challenge.

INDUCED SYSTEMIC RESISTANCE OF TOBACCO FOLIAGE TO BLUE MOLD BY CONIDIA OF PERONOSPORA TABACINA APPLIED TO THE SOIL. Y. Cohen, and J. Kuć, Department of Plant Pathology, University of Kentucky, Lexington, Ky. 40546

Conidia of P. tabacina applied to the soil of potted tobacco plants induced systemic resistance in foliage against blue mold. At 1, 2, 3, and 4 weeks after the inducing inoculation, browning in the phloem and cambium of stems reached a height of 0, 4, 7 and 13 cm, respectively. Protection based on percentage infected leaf area upon challenge was 0, 50, 90 and 98%, respectively. Plants challenged 2 or 3 weeks after induction produced small mostly non-sporulating lesions as compared to large sporulating lesions on control plants. Four weeks after induction, plants of cvs. Judy's Pride, K14 and K16 were stunted. Stunting was milder in Burley 21, and barely evident in B21 X L8. Etherel caused stunting but did not induce resistance. Suckers from induced unchallenged plants were symptom-free, showed no browning in the stem, and were susceptible. Browning in cambium and phloem stem tissue is required for systemic resistance to develop in leaves.

REGULATION OF ENDOPECTATE LYASE SYNTHESIS IN ERWINIA CHRYSANTHEMI: EVIDENCE FOR ROLE OF OLIGOGALACTURONIDE LYASE. A. Collmer and D. F. Bateman, Department of Plant Pathology, Cornell University, Ithaca, NY 14853.

The major end-products of the endopectate lyase (PL) and exo-poly-α-galacturonosidase secreted by Erwinia chrysanthemi are unsaturated and saturated digalacturonic acids (UDG and DG). Both products effectively induce PL; galacturonic acid does not. This suggests that regulation of the catabolism of monomeric and polymeric galacturonic acids is independent and that PL is induced by dimers and/or their metabolites. Oligogalacturonide

lyase (OGL), partially purified from cell-free extracts, converts UDG into 4-deoxy-5-keturonic acid (DK) which was found to be a highly effective inducer of PL. Since OGL also generates DK from DG, and since DK is quite different structurally from either of the parent dimers, we postulate that DK is the actual inducer (or its precursor) and that PL induction therefore requires OGL activity. Mutants deficient in OGL are being sought to test this hypothesis. They may also provide useful tools for exploring the role of pectic enzymes in pathogenesis.

FURTHER STUDIES ON A HOST PROTEIN ASSOCIATED WITH TMV VIRIONS. Candace W. Collmer and Milton Zaitlin, Dept. of Plant Pathology, Cornell University, Ithaca, NY 14853.

The presence of a protein of host origin (H protein) contained in virions of TMV has been confirmed by SDS polyacrylamide gel analysis of disrupted virions. This direct analysis confirms previous indirect estimates of an average of one molecule of H protein per virion. Following acetic acid disruption of virus, all of the H protein precipitates with the viral RNA along with 3% of the viral coat protein. Separation of H protein from contaminating coat protein can be accomplished by stringent dissociation followed by isoelectric focusing in the presence of urea. H protein is acidic with a pI about 0.5 units more basic than coat protein. Acetic acid-soluble coat protein (97% of total coat protein) has been shown to be free of H protein using this technique. As this H protein-free coat protein can be used with TMV RNA to reconstitute infectious virions, H protein apparently has no role in *in vitro* virus assembly. This work was supported by NSF Grant No. PCM 78-03255 and USDA/SEA Grant No. 7800119.

SPONTANEOUS MUTAGENESIS OF THE INDOLEACETIC ACID GENES IN PSEUDOMONAS SAVASTANOI. Luca Comai and T. Kosuge, Dept. Plant Path., Univ. Calif., Davis, CA 95616.

Indoleacetic acid (IAA) produced by Pseudomonas savastanoi causes gall formation in infected olive and oleander hosts. The bacterium synthesizes IAA from tryptophan in reactions catalyzed by tryptophan monooxygenase and indoleacetamide hydrolase which are coded by genes located on a 34×10^6 molecular weight plasmid (pIAA 1). Two IAA mutants, isolated by α-methyl tryptophan resistance, lack both enzyme activities but harbor a modified form of pIAA 1 with lower mobility in agarose gel electrophoresis. EcoRI restriction digestion of the modified plasmid in both mutants yielded a fragment of 3.8×10^3 base pairs (bp) in place of a fragment 2.3×10^3 bp found in wild-type pIAA 1. Data are consistent with the insertion of a 1.5×10^3 bp DNA sequence in the 2.3×10^3 fragment which was shown by molecular cloning experiments to carry the gene for tryptophan monooxygenase. We suggest the insertion had a polar effect and suppressed expression of genes for tryptophan monooxygenase and indoleacetamide hydrolase. If so both genes are part of the same transcriptional unit.

TOLERANCE TO BARLEY YELLOW DWARF IN AVENA STERILIS
André Comeau, Station de Recherches, Agriculture Canada, 2560, boul. Hochelaga, Ste-Foy, Qué, Canada G1V 2J6

The level of tolerance to barley yellow dwarf virus (BYDV) of 1420 lines of Avena sterilis from the Plant Gene Resources of Canada collection has been assessed under artificial inoculation conditions. Most of these lines came from countries around the Mediterranean Sea. Local distribution of centers of resistance appears to relate to the ecological factors that influence survival of the virus and its aphid vector. Hot, dry areas contain few lines with tolerance, but in relatively wet and/or cool areas the percentage of moderately tolerant lines often exceeds 50%. A high percentage of lines had moderate to good BYDV tolerance in specific areas of Northern Africa, Turkey and Iran. Higher levels of tolerance similar to C.I. 500 (Avena sativa cv. Norrland sel.) were found only in four lines from Turkey: CAV 1490, CAV 1514, CAV 1516, CAV 1517.

CONTROL OF PINEAPPLE DISEASE OF SUGARCANE BY FUNGICIDE, CGA-64251. J. C. Comstock and S. A. Ferreira, Dept. of Genetics and Pathology, Hawaiian Sugar Planters' Association, P. O. Box 1057, Aiea, Hawaii 96701.

CIBA-GEIGY'S fungicide CGA-64251, 1-[[2-(2,4-Dichlorophenyl)-4-ethyl-1,3-dioxolan-2-yl] methyl]-1H-1,2,4-triazole), provided control of a seedpiece rot of sugarcane caused by Ceratocystis paradoxa. Single-bud vegetative cuttings of cv. H62-4671 were hot-water treated for 20 min at 52C to stimulate germination, and given a 1 min fungicide dip at ambient temperature at concentrations of 3.125 to 50 ppm in water. Seedpieces were held in polyethylene bags overnight, inoculated with a spore suspension of C. paradoxa, and planted. In comparison with checks, CGA-64251 treatment increased germination at inoculum concentrations of 1.5×10^7, 1.5×10^5, 1.5×10^3 and zero spores/ml, by 27-50, 6-10, 1.8-2.2, and 1.1-1.3 times, respectively. At 12.5 ppm CGA-64251, control was equal to the 75 ppm benomyl standard used by the sugar industry. For all inoculum concentrations, germination increased as CGA-64251 rates increased. Efficacy tests are being conducted using industry seed handling procedures.

THE RESISTANCE OF RUST RESISTANCE IN INBRED LINES OF VICIA FABA. R.L. Conner and C.C. Bernier, Plant Science Dept., University of Manitoba, Winnipeg, Manitoba, Canada R3T 2N2.

Fababean (Vicia faba) cultivars have been found to be very heterogeneous for their reaction to two isolates of fababean rust (Uromyces viciae-fabae). Seventeen lines were selfed and tested against the two rust isolates for two or three generations. From this, six inbred lines, consisting of selections from three cultivars and three plant introductions, were found to react uniformly to the isolates. These lines included three lines with resistance to the less virulent isolate, one line with resistance to both isolates and two susceptible lines. Reciprocal crosses were made in all combinations and appropriate F_1 plants were backcrossed. Results from F_2 populations indicate that there are three dominant genes for resistance: Fr_1 and Fr_2, which are effective against isolate 1, and Fr_3, which controls resistance to isolate 2.

INFECTION OF CULTIVATED STRAWBERRIES BY TOMATO RINGSPOT VIRUS IN THE FIELD. R. H. Converse, USDA, SEA-AR, Dept. of Bot. & Pl. Path., Oregon State Univ., Corvallis, OR 97331.

Transmission of tomato ringspot virus (TomRSV) was observed in field plots of cultivated strawberries at Corvallis, OR that were naturally infected with dagger nematodes having a known history of TomRSV transmission to red raspberry. Enzyme-linked immunosorbent assay (ELISA) successfully detected TomRSV in test plants 6, 13, and 19 months after planting, from strawberry leaves which were unsatisfactory for sap transmission to herbaceous hosts. Of 23 Pacific Coast strawberry cvs. studied, Lassen, Olympus, Puget Beauty, and Sequoia became infected (range 9-67%) by 19 months. Infection was detected in Puget Beauty by 6 months. Because of the unevenness of infection, no evaluation of the resistance to TomRSV of the other 19 cvs. can be made. Plants indexing positive for TomRSV were usually dwarfed and produced fewer runners than uninfected plants. Generally, plants indexing positive only for TomRSV resembled those infected by common aphid-borne viruses. This is the first report of natural field infection of strawberry cvs. by TomRSV.

FIELD EVALUATION OF ALTERNARIA ALTERNANTHERAE AS A BIOLOGICAL CONTROL FOR ALLIGATORWEED. Kenneth E. Conway, and R. Charudattan. Department of Plant Pathology, Oklahoma State University, Stillwater, OK 74078 and University of Florida, Gainesville, FL 32611, respectively.

The efficacy of Alternaria alternantherae, a pathogen of alligatorweed (Alternanthera philoxeroides), was tested in the field as a biological control agent. Plots were established in alligatorweed mats along the shoreline of a small lake and were inoculated and monitored during two growing seasons. Greatest damage to the alligatorweed plants occurred at the highest inoculum rate of 60gm of comminuted wet weight mycelium applied to one square surface meter of plants. Symptom expression included the development of lesions on leaves and defoliation, both of which were significantly greater compared to non-treated plants. Inoculated plants were smaller and the mats became more recumbent. However, during the three-week time interval of the experiment, leaf production on inoculated plants was not affected and after the initial period of stress, the plants seemed to recover.

RECOVERY OF POSTHARVEST PATHOGENS FROM APPLE DUMP TANK WATER. William S. Conway, USDA, SEA-AR, Horticultural Science Institute, Agricultural Research Center-West, Beltsville, Maryland 20705

Serial dilutions were made of water samples taken from grading lines of a large apple storage and packing facility. Each dilution was then added to PDA. The resulting mixed cultures were subcultured to obtain pure fungal isolates. Seven genera were obtained, including 5 species of Penicillium. Recently harvested Stayman apples were wound inoculated with each isolate and observed for decay. As expected, Penicillium expansum caused a decay of these apples, as did another fungus, Trichoderma harzianum, not commonly associated with apple decay.

This decay, at least initially, was of a much firmer consistency than that caused by P. expansum. Since dump tank water is a constant source of inoculum, improved sanitation in this area would reduce storage losses due to decay.

EVIDENCE THAT TAKE-ALL DECLINE DOES NOT RESULT FROM LOSS OF VIRULENCE IN THE POPULATION OF GAEUMANNOMYCES GRAMINIS VAR. TRITICI. R.J. Cook, USDA, SEA, AR, Pullman, WA 99164.

Seven wheat fields (each cropped at least 7 consecutive yr to wheat), in which take-all caused by Gaeumannomyces graminis var. tritici (Ggt) was mild or not apparent, were sampled for Ggt from random plants by baiting the fungus from the roots. Ggt was recovered from roots of 478 of 920 plants (70-95% of fall- and 10-20% of spring-sown plants), and 80-90% of the original (field) isolates were virulent in greenhouse tests. Virulent isolates became avirulent or weakly virulent at increasing frequency upon successive mass transfers on PDA. Virulent types were maintained by starting the cultures from single ascospores; of 334 random single ascospore cultures representing 67 virulent (parent) field isolates, 81% were fully virulent and the remainder weakly-so or avriulent. The loss of virulence with mass transfer and the segregation of virulent from avirulent cultures by single sporing can be explained by genetic variation in the pathogen. Apparently a significant population of the virulent wild type is maintained in the field after take-all declines.

PLASMID-DETERMINED AGROCIN 84 SENSITIVITY IN RHIZOBIUM LEGUMINOSARUM. D. A. Cooksey and L. W. Moore, Department of Botany and Plant Pathology, Oregon State University, Corvallis, 97331.

Rhizobium leguminosarum strain 128C56 was inhibited in vitro by agrocin 84 produced by Agrobacterium radiobacter strain K84. Resistant colonies of strain 128C56 developed at a high frequency when it was grown in the presence of agrocin 84. Of 18 resistant colonies examined, all but one had lost a 93 megadalton plasmid. RP4-mediated transfer of this plasmid to avirulent A. tumefaciens strain NT1 produced a transconjugant that was sensitive to agrocin 84. We conclude that genes controlling agrocin 84 sensitivity in R. leguminosarum strain 128C56 are located on the 93 megadalton plasmid. In addition to providing a marker for Rhizobium genetic studies, plasmid-borne agrocin 84 sensitivity in R. leguminosarum suggests similarities between plasmids of Rhizobium and the Ti plasmids of A. tumefaciens where genes for agrocin 84 sensitivity also are located.

VIRULENCE TO WHEAT WITHIN PYRENOPHORA TRICHOSTOMA IN THE CENTRAL PLAINS OF NORTH AMERICA. Wilmar Cofio Da Luz and R. M. Hosford, Jr. Centro Nacional de Pesquisa de Trigo, Caixa Postal 569, Passo Fundo 99100 RS Brazil, and Department of Plant Pathology, North Dakota State University, Fargo, ND 58105.

Forty isolates of Pyrenophora trichostoma from the Central Plains of North America differentiated into 12 groups for leaf spotting virulence by their reaction on six wheat cultivars. A new source of resistance, the spring wheat BH 1146, was resistant to the largest number of groups. The most susceptible known cultivar, the spring wheat ND 495, was resistant to the smallest number. These isolates and cultivars begin the foundations for determining the genes for virulence and resistance. The fungus also caused 'black point' of wheat seed and brown spots on glumes and awns. Increased knowledge of its world wide destructiveness indicates that P. trichostoma is one of the major disease causing organisms of wheat.

PARTIAL PURIFICATION OF THE SPIROPLASMA GROWTH FACTOR OF HORSE SERUM. P. J. Cotty and T. A. Chen, Department of Plant Pathology, Cook College, Rutgers University, New Brunswick, NJ 08903.

Three methods were used to simplify horse serum components. All produced a colorless clear fraction with reduced osmotic pressure and protein concentration. Presence of the spiroplasma growth factor was determined by growth of Spiroplasma citri through 10 passages of 0.5% transfer in C-3G medium made with the given fraction substituted for whole serum. Media made with fractions yielded fewer cells with lengthened generation time. Fraction X was prepared by mixing hydrated $CaPO_4$ gel with horse serum and centrifuging at 10,000 G for 15 min. The supernatant retained the growth factor. Fraction Y was prepared by extracting one volume of horse serum with 40 volumes of chloroform 5 times. Between extractions the emulsion was broken by centrifugation and the aqueous phase containing the growth factor recovered. Fraction Z was prepared by slow freeze-thaw sedimentation. The upper colorless portion of the serum supported spiroplasma growth to various degrees depending on the number of serial freeze/thaws performed. The intensely colored, highly viscous lower portion promoted growth better than whole serum.

DISTINCTION BETWEEN THE 'CALIFORNIAN' AND 'EASTERN' FORMS OF STEMPHYLIUM LEAFSPOT OF ALFALFA IN NORTH AMERICA. W. A. Cowling, D. G. Gilchrist, Dept. Plant Pathology, Univ. Calif., Davis, CA 95616, & J. H. Graham, Waterman-Loomis Co., Highland, MD 20777.

Field symptoms of Stemphylium leafspot of alfalfa appear different in California and eastern areas of North America. The basis of this difference was investigated using representative isolates of Stemphylium botryosum (=Pleospora herbarum) from the two regions on susceptible alfalfa clones in a controlled environment chamber. The eastern isolates formed concentrically ringed dark brown lesions while the California isolates produced restricted light tan lesions with dark borders, consistent with the typical field symptoms in the respective regions. The two groups of isolates shared similar taxonomic characteristics, but responded differently to the effects of temperature on disease severity and growth characteristics on agar. It is concluded that the 'Californian' and 'eastern' forms of the disease are caused by biotypes of the same species unique to the respective regions. Adaptation of the pathogen to environmental conditions typical of the two regions will be discussed.

CHLOROTIC RINGSPOT DISEASE OF SHAMROCK (Oxalis regnellii Miq.) D.L. Coyier. USDA-SEA, Orn. Plants Lab., Corvallis, OR 97330.

A previously undescribed disease of O. regnellii appeared in a Washington nursery. The causal agent was transmitted when infected and healthy plants were grown in the same pot. Chlorotic ringspot symptoms appeared in leaves 100 da after planting infected and healthy propagules in mutual pots. Heavily infected plants were stunted, the rhizomes became darkened and the plants gradually declined. Transmission of the causal agent probably occurs through natural root grafts and not via some soilborne vector because the growing medium was pasteurized with aerated steam (30 min/75C) before planting. Healthy plants remained healthy when grown in soil which had previously supported growth of infected plants; no nematodes were found in these soils. In three separate tests, 90-100% transmission occurred. Attempts to mechanically transmit the causal agent to 6 virus indicator plants were unsuccessful. Low level (10-20%) symptom development occurred when healthy and infected plants were grown in close proximity, suggesting an aerial vector, probably aphids. The disease was controlled by spraying for insect control and by judicious roguing of infected plants.

EFFECTS OF CEPHALSOPORIUM GRAMINEUM AND A TOXIC METABOLITE ON STOMATAL ACTIVITY AND WATER RELATIONS OF WHEAT. P. Creatura, G. R. Safir, R. P. Scheffer, and T. Sharkey, Dept. of Botany and Plant Pathology, Michigan State Univ., E. Lansing, MI 48824.

The stomates of wheat plants infected by Cephalosporium gramineum were open wider and responded more slowly than those of healthy plants, prior to the appearance of chlorotic stripes. This phenomenon was especially evident under conditions of water stress. Roots of inoculated and uninoculated hydroponically-grown seedlings were placed in polyethylene glycol solutions of varying water potentials to induce water stress quickly and uniformly and to manipulate leaf water potential. Differences in stomatal activity were not caused by differences in leaf water status, implying the involvement of a diffusible toxin and indicating that blockage of the vascular system by the fungus or its metabolites probably does not play a significant early role in pathogenesis. Graminin A, a toxin produced by C. gramineum, caused abnormal opening of stomates when seedlings were subjected to water stress, and in the dark, implying that Graminin A has a role in disease development.

EFFECT OF HOST GENOTYPE ON ZEARALENONE CONTAMINATION OF CORN. D.Cullen, R. W. Caldwell, and E. B. Smalley, Dept. of Plant Pathology, University of Wisconsin, Madison 53706

Two single cross hybrids (A634 X Mo17, A632 X A619) and four inbreds (Mo17, A632, A634, A619) were evaluated for resistance to Gibberella zeae ear rot and zearalenone contamination. Plants were grown in a randomized complete block design in field plots at Arlington and Hancock, Wisconsin. Ears were inoculated ten days after silking by the toothpick method. After two months, ears were visually rated for the degree of rot and analyzed for zearalenone content. Statistically significant differences (P> .01) in susceptibility to

invasion were observed between the hybrids and inbreds tested. Ranked in order of increasing susceptibility they were: A632 X A619, A634 X Mo17, A619, A632, A634, Mo17. Zearalenone production was positively correlated with the extent of invasion and ranged from .5PPM (A632 X A619) to 15PPM (Mo17).

NEW PROCESS FOR T-2 TOXIN PRODUCTION. D. Cullen, and E. B.Smalley, Dept. of Plant Pathology, University of Wisconsin, Madison, 53706

Production of the toxic sesquiterpene, T-2 toxin, by Fusarium tricinctum on corn and rice requires long incubation periods (4-6 weeks) and purification is complicated by interfering substances. Liquid media (e.g., Gregory's, modified Czapeks-Dox) yield low toxin levels. We have developed a rapid and efficient method for the production, extraction and purification of T-2 toxin from nutrient broth-moistened vermiculite. The broth as described by Hidy (U.S.Patent 3,580,929) was thoroughly mixed with vermiculite (3 ml/1), heat sterilized in petri plates, inoculated with .5 ml of spore suspension (10^6/ml), and incubated at 19 C. Toxin was extracted and purified by a modification of Ikedobi's procedure (Anal. Biochem. 43:327-340) (>83% efficient). Maximum production was obtained within 12 days. Isolate NRRL 3299 yielded 339 mg/1. The same strain produced 2.7 mg/g, 1.7 mg/g, 155 mg/1, and 76 mg/1 on corn, rice, Gregory's, and peptone supplemented Czapeks-Dox, respectively.

INCREASED DETECTION OF SEPTORIA NODORUM IN STORED WHEAT SEED. Barry M. Cunfer, Department of Plant Pathology, Georgia Station, University of Georgia, Experiment, Georgia 30212.

Researchers have reported that survival of Septoria nodorum in wheat seed declined to nearly zero within 1 yr. Others have noted stable levels of S. nodorum after 1 yr in storage. Wheat seed from moderately infected plants were assayed for seed-borne S. nodorum at harvest and after 6, 12 and 18 months' storage at 5 and 25 C during 2 seasons. Seeds were assayed by the oxgall agar - NUV flourescence method. Seed infection ranged from 30-55% at harvest to 60-75% after 1 yr's storage. Detection of S. nodorum increased up to 12 months after harvest then remained the same after 18 months' storage. Increase in detection was accompanied by a decline in seed-borne Alternaria sp., Epicoccum sp. and other fungi. Increased detection of S. nodorum and decline of other fungi were more rapid at 25 C than at 5 C. S. nodorum survives in seed until the next season at levels sufficient to initiate fall infection of seedlings. Disagreement of these data with some previous results may be due to the more sensitive assay method now available.

IN VITRO TRANSLATION OF PHAGE Ø6 RNAS. D.A. Cuppels, J. Van Etten, D. Burbank, L. Lane, and A. Vidaver. Plant Pathology Dept., Univ. of Nebraska, Lincoln, NE 68583.

A lipid-containing phage of Pseudomonas phaseolicola, Ø6, has a segmented double-stranded RNA genome and at least 9 polypeptides. Treatment with Triton X-100 removes the lipid envelope of the phage leaving a stable nucleocapsid. Associated with this nucleocapsid is an RNA polymerase which synthesizes in vitro large amounts of small and medium Ø6 ssRNA and a small amount of large Ø6 ssRNA. These RNA products have been isolated and translated in an Escherichia coli cell-free protein synthesizing system. All 3 ssRNAs were effective as templates for the incorporation of [^{3}H] leucine into hot trichloroacetic acid-insoluble products. The large ssRNA coded for phage proteins P1, P2, P4, and P7; medium ssRNA for P3, P6, and P10; and small ssRNA for P5, P8, and P9. These results are in agreement with genetic studies of Ø6 and demonstrate that the products of the Ø6 RNA polymerase are messenger RNAs.

SEQUENCE HOMOLOGY AMONG PLASMIDS OF PATHOGENIC STRAINS OF PSEUDOMONAS GLYCINEA AND P. PHASEOLICOLA. M. S. Curiale, R. L. Quant and D. Mills, Oregon State University, Corvallis, OR 97331

The plasmids of 6 isolates of Pseudomonas glycinea and 7 isolates of P. phaseolicola were characterized in respect to the number of plasmid species, size and relatedness. The plasmids of P. glycinea varied from ca. 3 Mdal to 120 Mdal in size. The fingerprint patterns generated by EcoRI restriction endonuclease digestion of total plasmid DNA from each isolate were complex. No restriction fragment was common to all of the plasmid DNA preparations. Evidence of sequence homology among the plasmids was obtained by DNA:DNA hybridization of radioactive plasmid DNA to restriction fragments bound to nitrocellulose membranes. Two fragments of pMC11, representing 11.9 Mdal of the 43 Mdal plasmid contain sequences which are highly conserved among plasmids from all isolates. The EcoRI and BamI restriction patterns of plasmids of P. phaseolicola suggest a high degree of relatedness with 5 to 8 bands in common among the plasmids.

BIOLOGICAL MANAGEMENT OF FUSARIUM CROWN ROT OF ASPARAGUS SEEDLINGS WITH SAPROPHYTIC FUNGI. John P. Damicone and William J. Manning, Dept. of Plant Pathology, University of Massachusetts, Amherst, MA 01003

Conidia of Trichoderma harzianum, Fusarium oxysporum (saprophytic) and an Aspergillus sp. (at 4-6 X 10^6/ml) were suspended in 4% methyl cellulose and applied to seed (pelleted) and transplants of asparagus (Asparagus officinalis L.) cultivars Mary Washington (MW) and Rutgers Beacon (RB). Treated, non-treated, and fungicide-treated seedlings from a field naturally infested with both fusaria and from soil from that field in flats in a greenhouse were compared. T. harzianum and Aspergillus sp. seed treatments significantly decreased crown infections in the greenhouse, but gave variable results in the field. RB seedlings were more vigorous and gave better results. A 0.12% captan soak, prior to inoculation with T. harzianum, gave better results than with captan alone. Dipping root systems of MW and RB transplants in conidial suspensions of F. oxysporum (saprophytic), prior to planting, resulted in larger and more vigorous plants.

CONTROL OF CLADOSPORIUM ROT OF STORED CUCUMBER BY BENLATE. Ihsan Sahfik Damirdagh. Dept. of Biology College of Science, University of Sulaimaniya, Iraq.

Cladosporium cladosporoides (Fres.) de Vries was found to infect cucumber fruits var. Beta Alpha in the field and in storage. Healthy fruits were surface sterilized then dipped for one minute in water, 0.025% or 0.5% Benlate (active ingredient) then sprayed with spores (250,000/ml) of C. cladosporoides and stored at 5 or 10 C for 15 or 20 days. The severity of infection was estimated by the percentage of the fruit surface covered by the fungus. It was found that Benlate at either concentration reduced significantly the infection at either temperature. Storage at 10 C seemed better than at 5 C.

LABORATORY TESTS FOR THE CONTROL OF STIGMINA CARPOPHILA. Ihsan Sahfik Damirdagh and Salman Rasheed Hamad. Dept. of Biology. University of Sulaumaniyah, Sulaimaniyah, Iraq.

Stigmina carpophila (Lev) Ellis was found to cause shot hole disease in almonds, apricots and peaches in Iraq. The epidemiology of the disease and morphology of the fungus were studied. The colony growth of the fungus was completely inhibited on potato dextrose agar containing 10 ppm of Benlate. In laboratory tests using detached shoots of apricot, Benlate at 15 ppm, 30 ppm, prepared Bordeaux mixture at 4 g/1 or 6 g/1 reduced significantly the number of holes per leaf is sprayed before spores (25,000/ml) by one hour or 24 hours or one week. The significant reduction in the number of holes per leaf also occurred when leaves were sprayed with these fungicides 1, 24 or 72 hr after spraying with spores. The effect of these fungicides was reduced with time after inoculation.

INOCULUM POTENTIAL OF SPORES OF SIX VESICULAR-ARBUSCULAR MYCORRHIZAL FUNGI. B. A. Daniels and P. M. McCool, Department of Plant Pathology, University of California, Riverside, California 92521.

Spores were extracted from pot cultures of the vesicular-arbuscular mycorrhizal species Glomus fasciculatus (isolates 0-1, 92, and 185), G. constrictus, G. epigaeus and G. mosseae. Four three-fold dilutions were made from the standard inoculum density of 2000 spores/20 g sandy loam. Ten replications of the five dilutions per species were utilized. Each vial was seeded with 5 seeds of sudangrass and grown in a growth chamber for 6 weeks. Based on number of replicates at each dilution level which were scored as infected, G. mosseae has the highest inoculum potential. G. fasiculatus isolate 92 and G. constrictus were only 50% as effective as G. mosseae while G. fasiculatus (0-1), G. epigaeus, and G. fasciculatus (185) were only 10.7, 7.2, and 4.1% as effective, respectively, as G. mosseae according to probable number table. Differences in spore size did not appear to be related to inoculum potential.

THE INFLUENCE OF HYPERPARASITES OF VESICULAR-ARBUSCULAR MYCORRHIZAL FUNGI ON GROWTH OF CITRUS. B. A. Daniels. Department of Plant Pathology, University of California, Riverside, California 92521.

Three hyperparasites of vesicular-arbuscular mycorrhizal fungi (VAMF) (Anguillospora pseudolongissima, Humicola fuscoatra, and Phlyctochytrium sp.) were added separately to citrus plants inoculated with either Glomus fasciculatus isolate 0-1, G.

fasciculatus isolate 92, and G. epigaeus. The possibility that these hyperparasites could be chemically controlled was tested by applying Ethazole and Mancozeb. After 7 months VAMF inoculated plants were significantly larger than noninoculated controls and contained high levels of root infection (70-90%). G. fasciculatus isolate 92 and G. epigaeus appeared resistant to the 3 hyperparasites. Alternatively, all hyperparasites appeared to inhibit infection and growth response provided by G. fasciculatus 0-1. Application of Mancozeb and Ethazole did not result in increased infection by G. fasciculatus 0-1 in pots infested with any hyperparasite.

THE EFFECT OF ETHANOL ON THE LEVEL OF XYLEM FUNGITOXICANTS AND RESISTANCE OF TOMATO TO FUSARIUM OXYSPORUM F. SP. LYCOPERSICI. S.J. Danko and M.E. Corden, Department of Botany and Plant Pathology, Oregon State Univ., Corvallis, OR 97331.

Monogenic resistance of tomato to Fusarium was negated by the application of one percent ethanol through the roots of Jefferson tomato plants inoculated with race 1 of the wilt disease pathogen. In plants treated with ethanol, the pathogen population increased to a much higher level than in the controls and disease symptoms were more severe. Acetone extracts of the xylem of controls were much more fungitoxic than extracts from inoculated, ethanol-treated plants, but contained no α-tomatine or rishitin. The Fusarium population increased significantly more in inoculated, excised stem sections treated with ethanol than in controls and thus provided results similar to those obtained with intact plants. The fact that ethanol negates the resistance of tomato to Fusarium and also inhibits the normal increase in xylem fungitoxicants substantiates the implication of phytoalexin-like substances in wilt disease resistance.

PURIFICATION OF A VECTOR NONSPECIFIC ISOLATE OF BARLEY YELLOW DWARF VIRUS. Cleora J. D'Arcy, P. A. Burnett, A. D. Hewings, and H. Jedlinski. Department of Plant Pathology, University of Illinois and USDA-SEA-AR, Urbana, IL 61801.

A vector nonspecific isolate of barley yellow dwarf virus (BYDV) from Illinois was isolated from fresh roots of Coast Black oats. Three weeks after seeding in vermiculite and soil (1:2) the plants were infested with viruliferous aphids for 2 days. Plants were harvested 8 days later. Virus was extracted by grinding the roots in liquid nitrogen. Either triton and chloroform or polyethylene glycol (PEG) and NaCl were used for clarification. Virus was further purified by high speed and sucrose density gradient centrifugation. Virus yields in excess of 1 mg/kg of fresh roots were consistently obtained. The purified BYDV was fed to Rhopalosiphum padi through a Parafilm membrane and transmitted to seedlings of Coast Black oats.

CERCOSPORIN, A PHOTOSENSITIZING TOXIN FROM CERCOSPORA SPECIES Margaret E. Daub. Dept. of Crop and Soil Sciences, Michigan State University, E. Lansing, MI 48824.

Cercosporin was isolated from the mycelium of Cercospora beticola and C. nicotianae. Toxicity of cercosporin to suspension cultured cells of Nicotiana tabacum was assayed by counting the percent of dead cells as determined by staining with brom phenol blue. When cultures were incubated in the light (continuous exposure at 1.2×10^4 Ergs·cm^{-2}·sec^{-1}), all cells in a 50 ml suspension culture (5×10^6 cells) were killed within 24 hrs at a cercosporin concentration of 0.4 μM. By contrast, when cultures were incubated in the dark, no cell death occurred, even after incubation for one week at a cercosporin concentration of 40 μM. Preliminary results indicate that the killing response is greatest around 470 nm, which corresponds to the absorption maximum of cercosporin. Cercosporin is structurally related to known photosensitizing agents such as hypericin. The evidence thus suggests that cercosporin is acting as a photosensitizing agent in plants. Photosensitization may be an important mechanism of pathogenesis for Cercospora species.

EFFECTIVENESS OF IMAZALIL ON *PENICILLIUM DIGITATUM* SACC. STRAINS TOLERANT TO 2-AB, SOPP, TBZ AND BENOMYL. B. A. Dave and J. F. Petrie, Pennwalt Corporation, Monrovia, California 91016

Sporeload exposure plates and isolates from decayed fruits from citrus packinghouses are routinely used in our laboratory to isolate cultures of green molds and to determine their sensitivity to commercial fungicides. A large body of data has been accumulated that clearly demonstrates the ability of the new fungicide imazalil to control *Penicillium* strains that are individually tolerant to either 2-AB (2-amino butane), SOPP (orthophenylphenate), TBZ (thiabendazole), or benomyl. However, strains of *Penicillium digitatum* have been isolated with tolerance to all three groups of fungicides. These multiple tolerant strains have been found to be sensitive to imazalil in our *in vitro* tests. In *in vivo* tests using an imazalil (as Deccozil Emulsifiable Concentrate 68.25% a.i.) dip for 15 seconds gave excellent sporulation control of tolerant strains. A 1000 ppm imazalil spray over a brush bed on a pack line for 10 seconds or a 500 ppm dip for 15 seconds gives excellent decay control of green mold where other commercial fungicides have failed.

RATOON STUNTING DISEASE OF SUGARCANE: ISOLATION OF THE CAUSAL BACTERIUM. M. J. Davis, A. G. Gillaspie, Jr., and R. W. Harris. Department of Plant Pathology, Rutgers University, New Brunswick, NJ 08903; and USDA, SEA-AR, Beltsville, MD 20705.

Axenic cultures of a coryneform bacterium were consistently obtained from sugarcane with ratoon stunting disease (RSD) from the USA, Brazil, South Africa, and Japan; and from bermudagrass from Taiwan. The strains were aerobic, non-motile, Gram-positive, and non-acid-fast; and were serologically and morphologically similar. Bermudagrass (BG) strains, unlike sugarcane (SC) strains, grew faster in culture and produced a yellow, non-diffusable pigment. Both SC and BG strains multiplied in sugarcane (CP 44-101), bermudagrass, and sudangrass (NB 280S) upon inoculation, but only SC strains consistently incited RSD symptoms in sugarcane, and wilting of sudangrass uprights. A significant reduction of growth (fresh weight) was observed in bermudagrass inoculated with BG strains. SC strains were reisolated from sugarcane more frequently than were BG strains; conversely, BG strains were reisolated more frequently from bermudagrass. The RSD bacterium is apparently a new species in the plant pathogenic group of coryneform bacteria.

RNA RECOMBINANTS AS PROBES OF CUCUMBER MOSAIC VIRUS SEED TRANSMISSION IN PHASEOLUS. Robert F. Davis and R. O. Hampton, USDA SEA-AR. Dept of Botany and Plant Pathology, Oregon State Univ, Corvallis, OR 97331.

Genomic determination of cucumber mosaic virus (CMV) seed transmissibility in beans (Phaseolus vulgaris) was investigated by producing RNA recombinants between an isolate reported to be seedborne in beans (CMV-F) and a non-seedborne isolate (CMV-Le). The major RNA species separated by two cycles of polyacrylamide-agarose slab gel electrophoresis and elution were infectious when recombined. In the course of this work the molecular weights of the RNA from these and other CMV isolates were compared and found to be similar. Low molecular weight satellite RNA, capable of altering biological properties in some isolates, was not detected by RNA electrophoretic analysis of the isolates investigated. These studies are to be concluded by determinations of seed transmission potentials of recombinants in bean seeds from plants inoculated with each recombinant.

PHYTOALEXIN TOLERANCE WITHOUT PHYTOALEXIN DEGRADATION IN FUSARIUM. T. Denny and H. D. VanEtten, Department of Plant Pathology, Cornell University, Ithaca, NY 14853.

Fusarium solani f. sp. pisi isolate T-30 displayed a rapid adaptive tolerance to medicarpin, a phytoalexin from chickpea, in two sensitive bioassays. In one, spores were pretreated with repeated additions of medicarpin. Periodic microscopic examination showed that such spores then germinated at a phytoalexin concentration above that lethal to non-pretreated spores. In the second assay, microscopic observation of hyphae in a miniature flow cell revealed that hyphal growth was almost immediately arrested on exposure to medicarpin, but resumed within several hours. Adaptive tolerance of pathogens to phytoalexins has often been attributed to metabolic degradation of the phytoalexins to non-inhibitory compounds. Medicarpin is slowly degraded by isolate T-30. However, both spore germination and resumption of hyphal growth occurred without significant reduction in medicarpin concentration. Thus, isolate T-30 must have a mechanism of tolerance which is not dependent on phytoalexin detoxification.

INFECTION OF TOBACCO CALLUS BY ZOOSPORES OF PHYTOPHTHORA PARASITICA VAR. NICOTIANAE. G. A. de Zoeten, G. R. Gaard, G. T. Haberlach, and J. P. Helgeson. Dept. of Plant Pathology and USDA, SEA,AR Plant Disease Resistance Res. Unit. Univ. of Wisconsin. Madison, WI 53706

In conjunction with physiological studies on the response of tobacco callus tissues to Phytophthora parasitica var. nicotianae (Ppn) we have conducted a scanning electron microscope study of the infection process. We inoculated tissues from resistant and susceptible plants with zoospores of races 0 and 1. Within 3 h

of inoculation, zoospores from compatible and incompatible combinations had encysted and germinated; then both types penetrated callus cells. Penetration often occurred in cells other than those on which the spores germinated. By 24 h, when a hypersensitive reaction was clearly evident in the incompatible combination, almost all of the cells in the HR area had collapsed whereas most cells in areas on callus showing the compatible reaction were still turgid. By 48 h, more than 50 cell layers had been penetrated by the compatible fungus whereas the incompatible fungus was limited to 5-8 cell layers.

CHARACTERIZATION OF CELL MEMBRANES OF XANTHOMONAS CAMPESTRIS. J. C. Dianese and N. W. Schaad, Dept. of Plant Pathology, Univ. of Georgia, Ga. Experiment Station, Experiment, GA 30212.

Membranes of Xanthomonas campestris were obtained by a lysozyme-EDTA method (J. Biol. Chem. 247:3962-3972). To separate inner and outer membranes a 25/30/40/50/60% sucrose linear gradient was used. Two major bands, 5.2 cm and 9.3 cm from the meniscus, were detected at 280 nm. The upper and lower bands contained 16.7% and 53.3% of the total protein and 0.05 mg and 0.14 mg of 2-keto-3-deoxyoctonate/mg of protein, respectively. This indicated that the lower band was rich in outer membrane. Succinate dehydrogenase activity was not detected in either band. Electronmicroscopy showed relatively homogeneous membrane structures in both bands. Slab SDS-polyacrylamide gel electrophoresis of the total membrane fraction showed three major and 27 minor proteins. The molecular weights of the three major proteins were approximately 50,000, 41,000, and 16,000. These three major proteins were observed in the lower band which also contained 15 minor proteins. No major and 6 minor proteins were found in the upper band.

EPIPHYTIC POPULATION OF FUSARIUM MONILIFORME VAR. SUBGLUTINANS PATHOGENIC ON PINEAPPLE IN BRAZIL. J. C. Dianese, H. A. Bolkan, F. A. A. Couto*. Universidade de Brasilia, Brasilia DF, Brazil, 70910 and *EPAMIG, Uberlandia, Minas Gerais, Brazil.

Fruit rot, caused by Fusarium moniliforme var. subglutinans, is a limiting factor in pineapple production in Brazil. Symptoms of this disease are fruit and shoot rot with gummy exudate, leaf basal rot and leaf spots. To determine if leaves could serve as a source of inoculum, washings were collected from apparently healthy leaves in a field with 20% fruit infection. Isolations were made on Komada's medium (Proc. Am. Phytopath. Soc. 3:221) with 2% sucrose. Washings from 158 leaves yielded 319 isolates of Fusarium spp. Forty-nine (15.4%) of those isolates were F. moniliforme var. subglutinans. Leaves, inflorescences and lateral shoots of susceptible pineapple plants were inoculated with 21 of these isolates of F. moniliforme var. subglutinans. Nineteen of the 21 isolates were pathogenic. The presence of propagules of F. moniliforme var. subglutinans on the leaf surface of slips used for field planting may be contributing to its rapid and extensive spread in Brazil.

A DIFFERENTIAL RESPONSE TO CORYNEBACTERIUM MICHIGANENSE IN TOMATO SEEDLINGS. Dick,J., and B. H. MacNeill,Environmental Biology,University of Guelph,Guelph,Ontario. N1G 2W1.

Tomato cultivars C28 and H1350,which are considered to be field-resistant,could be differentiated from susceptible cultivars if they were spray-inoculated at a very early stage of cotyledonary development. The pattern of response was detectable even when the cotyledons were wound-inoculated. Such differences in susceptibility could not be demonstrated in plants inoculated at any time after the cotyledons were fully expanded. This technique of evaluating resistance appears to have relevance in determining the potential of certain genetic lines of tomato to carry C. michiganense in the seed.

VIRULENCE OF CRONARTIUM RIBICOLA DEVELOPED FROM BASIDIOSPORES IN AXENIC CULTURE. A. M. Diner, R. L. Mott, and L. F. Grand, Departments of Botany and Plant Pathology and Forestry, North Carolina State University, Raleigh, N. C. 27650

Routine procedures were developed for the direct generation of fungal colonies from basidiospores of Cronartium ribicola on a cell-free, defined agar medium. Colony establishment required preliminary inversion of the inoculated medium, since germinal hyphae grew antigeotropically. After 48 hours, growth and colony development were independent of orientation. Colonies retained virulence through subculture, infecting callus generated from embryos, cotyledons, or stem sections of Pinus monticola. Haustoria were abundant in callus overgrown by the fungal hyphae. Hyphae of the axenic cultures were generally "corkscrew" in appearance; hyphae examined from pine callus did not exhibit this characteristic.

EFFICACY OF A PEANUT LEAFSPOT FORECASTING SYSTEM IN VIRGINIA. R. L. Dow, N. L. Powell, and D. M. Porter. Dept. of Plant Pathol. and Physiol., and Dept. of Agron., VPI & SU, Blacksburg, VA 24061 and AR, SEA, USDA, Suffolk, VA 23437.

Peanut leafspot (Cercospora arachidicola and C. personata) disease development was studied during two seasons in field plots which were treated for leafspot on a 14-day interval as currently recommended (14DA), treated according to a forecasting system based on weather conditions (FS), or untreated (CK). Treatment consisted of chlorothalonil for 1978 and benomyl-sulfur for 1979 at recommended rates. Disease development (number of leaflets spotted plus number of leaflets shed divided by the number of leaflets formed per branch) was determined weekly. In 1978, the 14DA, FS, and CK plots had an average disease development at the end of the season of .64, .69, and .94 respectively, and in 1979 a disease development of .50, .54, and .68. Two less treatments, in both years, were required on the FS than on the 14DA plots. The forecasting system has potential in Virginia for giving disease control similar to that obtained with the current recommendations but with fewer treatments.

DORMANCY IN SCLEROTIA OF SCLEROTINIA SCLEROTIORUM J. Dueck, Agriculture Canada, 107 Science Cres., Saskatoon, Sask. S7N 0X2

Numerous reports on apothecial germination of sclerotia of Sclerotinia sclerotiorum (Lib.) de Bary provide conflicting information on physical requirements for germination. In this study germination of sclerotia of isolates from naturally infected rapeseed (Brassica napus L.) in Saskatchewan, Canada and soybean (Glycine max L.) in N.S.W., Australia was compared. The Sask. collection required 2-6 wk incubation at 10C followed by 4-6 wk at 20C in diffuse light for stipe initiation and cap expansion. Germination of the population was not synchronized. Sclerotia from natural infection or single ascospore cultures failed to produce apothecia when incubated continuously at 20C. Presence of a dormancy mechanism is suggested. The field collection from N.S.W. germinated within 5 wk at 20C. Sclerotia produced in culture from single ascospore isolates germinated uniformly, with more than 80% showing apothecia within 2 wk at 20C.

POTATO LATE BLIGHT CONTROL BY THE SYSTEMIC FUNGICIDE RIDOMIL. G. D. Easton and M. E. Nagle, Department of Plant Pathology, Washington State University, Irrigated Agriculture Research and Extension Center. Prosser, WA 99350.

In 1977, chemical trials in Pacific NW WA, the systemic fungicide Ridomil® [N-(2,6-Dimethylpheny1)-N-(methoxyacety1)-alanine methyl ester] but not Bravo® (chlorothalonil) in furrow and foliage sprays prevented late blight tuber storage rot of potato cv. White Rose. In 1978 Ridomil was dusted on cut seed, sprayed in an open furrow on seed pieces at planting, and sprayed at 2- and 4-week intervals on foliage, starting the last of July. Ridomil controlled foliage symptoms of late blight as well as standard non-systemic recommended foliar fungicides. Ridomil as seed piece and sidedress treatments at planting but not as foliage sprays controlled foliage late blight during a drought in 1979. The failure of foliar sprays in the absence of summer rain suggests that the active ingredients in Ridomil are not absorbed by leaves but may be washed from leaves by rains or sprinkler irrigations and absorbed by roots. Potato yield and tuber grade were not affected by the treatments.

A MODEL FOR DETECTING INFECTION PERIODS BY COCCOMYCES HIEMALIS ON SOUR CHERRY. S. P. Eisensmith and A. L. Jones. Dept. of Botany & Plant Pathology, Michigan State Univ., East Lansing, MI 48824

A regression model relating leaf wetness and temperature to infection of cherry (*Prunus cerasus*) by *C. hiemalis* was developed, and the minimum conditions for infection defined. For validation, lesions on tagged shoots observed every 4 to 7 days (A), and on potted cherry trees exposed in orchards (B) were counted. The model is $EFI = [-11.0 + 0.2858L + 1.4639T - 0.0019L^2 - 0.0389T^2 - 0.003LT]^2$, where L is hours of leaf wetness, T is mean air temperature (C) during wet period, and EFI is an environmental favorability index from 0 to 100. Minimum conditions

for infection corresponded to an EFI of 14. In 95% of 65 cases where infection was detected by A, the EFI was >14, and in 83% of 18 cases where no infection occurred, the EFI was <14. In 97% of 35 cases where infection was detected by B, the EFI was >14, and in 51% of 39 cases where no infection occurred, the EFI was <14. The model is useful between 8 and 28 C and for leaf wetness periods up to 68 hr and is being tested in timing fungicide applications for control of cherry leaf spot disease.

CULTIVAR EFFECTS ON PARASITIC FITNESS. V. J. Elliott, R. R. Nelson, and D. R. MacKenzie. Department of Plant Pathology, The Pennsylvania State University, University Park, PA 16802.

Two isolates of Erysiphe graminis f. sp. tritici were maintained separately on each of four wheat cultivars for five serial transfers. Each of the eight sub-isolates was then transferred to each of the four cultivars establishing a factorial combination of source cultivar by test cultivar. The fitness of the sub-isolates on the different cultivars, measured in terms of sporulation capacity, was measured over time. Analysis of the variation in sporulation over time demonstrated that the influence of the source cultivar diminished while the influence of the test cultivar increased with time. These results could represent evidence that pathogens may be able to adjust rapidly to the host cultivar on which they reside.

REDUCED PHOTOSYNTHESIS AND TRANSPIRATION IN APPLE LEAVES INFECTED BY PODOSPHAERA LEUCOTRICHA. M. A. Ellis, D. C. Ferree, and D. E. Spring, Depts. of Plant Pathology and Horticulture, the Ohio Agricultural Research and Development Center, Wooster 44691.

Powdery mildew infection significantly reduced photosynthesis (Pn) and transpiration (Tr) of apple leaves. Inhibition was more severe in leaves infected during early stages of development than in mature leaves. Nine days after inoculation, leaf area covered by mycelia was 20% for mature leaves, with no reduction in Pn or Tr. At 30 days after inoculation, 90% of the leaf was covered and percentage reduction of Pn and Tr was 54 and 46%, respectively. Young leaves (infected as they emerged from the bud) were 90% covered by mycelia when they were 11 days old and their mean rate of Pn and Tr was reduced 85 and 55%, respectively. Infected young leaves were severely distorted; mature leaves appeared normal, except for the presence of mycelia. Infected leaves did not recover from inhibition of Pn and Tr after eradication of the pathogen with fungicide and removal of surface mycelia.

A METHOD FOR REMOVING FUSARIUM MONILIFORME FROM INFESTED CORN KERNELS. El-Meleigi, M.A., J.K. Uyemoto, and L.E. Claflin, Dept. of Plant Pathology, Kansas St. Univ., Manhattan, KS 66506.

Utilizing conventional disinfesting procedures such as 1% NaOCl, hot water (65-75C) soaks or captan seed treatment, it was not possible to disinfest corn kernels (Zea mays L.) of Fusarium moniliforme Sheld. However, kernels soaked in a 1:1 mixture of 1% NaOCl and 95% ethanol at 65 or 75C for 45 or 30 sec (SET), respectively, were devoid of all externally-born inocula. When 10 corn hybrids were SET treated and tested, none of 100 kernels and seedlings of each hybrid contained F. moniliforme and germination was comparable to untreated seed lots. The level of F. moniliforme infestation of untreated seed lots ranged from 0 to 47%. Our results suggest that F. moniliforme is primarily a surface contaminant occurring in cracks and natural openings in the seed coat.

DEVELOPMENT OF FUSARIUM MONILIFORME STALK ROT IN RELATION TO WATER STRESS, INTERNODE LOCATION AND SUGAR CONTENT. El-Meleigi, M.A., and L.E. Claflin, Dept. of Plant Pathology, Kansas State University, Manhattan, KS 66506.

Hyphal growth rate of Fusarium moniliforme Sheld., on Potato Dextrose Agar (PDA) and Water Agar (WA), increased with a corresponding decrease in osmotic potential from -3 to -10 bars. The growth rate decreased at osmotic potentials greater than -10 bars. Optimum temps for growth were 25 and 30°C on unadjusted media. Internodes of Pioneer 3541 (tolerant) and B73 X Mo17 (Susceptible) corn (Zea mays L.) hybrids were inoculated with a F. moniliforme spore suspension containing 5 X 10^5 cell/ml and subjected to various water stress regimes (-0.8 to -20 bars). Lesion development was significantly greater with corresponding decreases in osmotic potential and significantly greater in the susceptible hybrid under the various moisture stress conditions. Upper internodes (adjacent to the ear) were more susceptible than lower internodes. Irrespective of the corn hybrids tested, lower internodes contained less sugars and higher moisture than upper internodes.

SIGNIFICANT LOSSES OF LONGLEAF PINE IN A FLORIDA TREE NURSERY CAUSED BY RHIZOCTONIA SOLANI. J. T. English and E. L. Barnard, Divisions of Forestry and Plant Industry, FDACS, P. O. Box 1269, Gainesville, FL 32602

Rhizoctonia solani was isolated consistently from blighted longleaf pine seedlings in three forest tree nurseries in Florida during 1979. Pathogenicity was verified in greenhouse trials using nursery-grown seedlings. In one nursery, severely blighted seedlings were rogued early in the growing season in an attempt to minimize disease spread within seedbeds. A systematic inventory of seedling canopy gaps resulting from this sanitation effort and additional disease-related mortality revealed an overall loss of 8% (120,000 seedlings). Disease incidence by seed lot showed a significant positive correlation with duration of seed storage before planting. To date, attempts to isolate R. solani from two different seed lots (stored 10 and 0.5 years) using a variety of techniques have been unsuccessful.

AN EXPERIMENTAL FUNGICIDE (CGA-64250) FOR EFFECTIVE CONTROL OF BROWN STEM ROT OF SOYBEANS. A.H. Epstein, C.C. Kusek, and H. Tachibana. Dept. of Plant Pathology, Seed and Weed Sciences, and USDA-SEA-AR, Iowa State Univ., Ames, IA 50011.

The experimental fungicide CGA-64250 (1-[[2-(2,4-dichlorophenyl)-4-propyl-1,3-dioxolan-2-yl]methyl]1-H-1,2,4-triazole) was tested for efficacy in the control of brown stem rot of soybeans in land naturally infested with Phialophora gregata in northern and central Iowa. Foliar sprays of 494 gms a.i./ha were applied one week before and one week after flowering. Eight soybean lines were tested, including susceptible Weber, Coles, Oakland, and Williams; and resistant A3, A77-116013, BSR 301, and BSR 302. Weber, Coles, A3 and A77-116013 are of maturity Group I, and Oakland, Williams, BSR 301, and BSR 302 are of maturity Group III. CGA-64250 significantly reduced extent of stem browning in Weber, Oakland, and Williams but not in Coles or in Group III resistant lines. Increase in yield as the result of BSR reduction was not detected in the results. However, a significant 10% yield increase was obtained in 7 of 8 tested lines, and only Coles had no significant yield increase with the spray treatment.

A BIOASSAY FOR DETECTING COMPOUNDS INVOLVED IN THE ANNULMENT OF FUNGISTASIS OF NUTRIENT-INDEPENDENT SPORES. L. Epstein and J. L. Lockwood, Department of Botany and Plant Pathology, Michigan State University, East Lansing, MI 48824.

A bioassay was developed to study the role of several compounds in the annulment of soil fungistasis of nutrient-independent spores. When condidia of Cochliobolus victoriae or C. sativum were placed on a 0.4 μm Nuclepore filter and the filter was floated on a dilute salt solution, the rate of germination was inversely proportional to the volume of the solution. Five to 15% of C. victoriae conidia germinated when floated on 40 ml of 10% White's solution or 0.05 M MES buffer for 3.5 hr, whereas 90% of the spores germinated when floated on 0.4 ml of 10% White's solution. When C. victoriae spores were floated on 40 ml of either buffer or dilute salts solution, compounds which stimulated germination included 10^{-3} M glucose, 10^{-3} M galactose, 10^{-4} M xylose, 100 ppm casein hydrolysate, 10^{-4} M EGTA, Hoagland's solution, White's solution, 1 ppm yeast extract and a water extract of C. victoriae conidia.

WASTEWATER IRRIGATION AND PLANT DISEASE. L. Epstein, K. Ditz, and G.R. Safir. Department of Botany and Plant Pathology, Michigan State University, East Lansing, MI 48824

During 1978 and 1979, the threat of plant disease in a wastewater irrigated field dominated by goldenrod and quackgrass was assessed. Pathogens that were abundant in the wastewater irrigated areas, Coleosporium solidaginis, Erysiphe cichoracearum, Phyllachora graminis and Helminthosporium sp., alternate on economically important hosts. The increased disease in the irrigated areas seemed mainly due to moisture and disease severity was reduced by a midseason harvest. Levels of plant pathogens in the wastewater were apparently low since wounded seedlings of 12 varieties of 7 field crops soaked in wastewater remained healthy. There was no difference in the survival of Alternaria tenuis or Stemphylium sarcinaeforme after 24 days in filter sterilized wastewater or tapwater, but both Erwinia herbicola and E. atroseptica survived better after 24 hrs in wastewater than in tapwater.

IDENTITY OF PHYTOPHTHORA ISOLATES FROM MILKWEED VINE (MORRENIA ODORATA). E. Feichtenberger, G. A. Zentmyer and J. A. Menge.

Department of Plant Pathology, University of California, Riverside, California 92521.

Previously, Phytophthora isolates from dying milkweed vine (MWV) (Morrenia odorata) in Florida have been identified as P. citrophthora. However, comparative morphological, physiological, and pathological tests indicate that the MWV isolates are P. palmivora. Six MWV isolates produced caducous, elongated, ellipsoid to ovoid sporangia, averaging 46 X 29 μm with length/breadth ratio of 1.7. Sporangial stalks averaged 2.7 μm in length. Sexual structures were observed in pairings with A1 isolates of P. palmivora and P. parasitica. MWV isolates were not pathogenic to sweet orange seedlings, in contrast to citrus isolates of P. citrophthora. Disc gel electrophoresis of hyphal proteins revealed high percentages of similarity between MWV isolates and P. palmivora (Morphological Form 1), but not between MWV isolates and P. citrophthora.

PHYTOPHTHORA ROOT ROT OF CITRUS AND THE DISTRIBUTION OF ROOTS AND PHYTOPHTHORA PARASITICA AS INFLUENCED BY DRIP AND FURROW IRRIGATION. **S. J. Feld and J. A. Menge, Department of Plant Pathology, University of California, Riverside, CA 92521.**

Drip and furrow irrigation systems were established on 32 mature Navel orange trees on sweet orange rootstock. Fifteen separate sites each under furrow and drip irrigation were sampled. The population of P. parasitica and the feeder root distribution were examined around the irrigation source. The frequency of feeder roots under furrow irrigation was greatest 15 cm below the soil surface and it increased with horizontal distance from the furrow center. Under drip irrigation root frequency was also lower at the surface, but in general the roots were found with equal frequency in the drip wetted area. The frequency of P. parasitica in the soil wetted by either irrigation was greatest where the frequency of roots was high. In the greenhouse and lathhouse, seedlings grown under drip irrigation had 32-49% fewer healthy roots than those grown under furrow irrigation.

METHODS TO INCREASE ENDOMYCORRHIZAL SPORE PRODUCTION. James J. Ferguson Department of Plant Pathology, University of California, Riverside, CA 92521.

Roots of sudan grass were infected at a more rapid rate and subsequent production of spores was greater when soil inoculum of Glomus fasciculatus (spores, mycorrhizal roots, and soil) was used than when only surface disinfested spores were used, even when inoculum spore concentrations were equivalent. At low spore concentrations surface disinfested G. constrictus spores stimulated a greater growth response in Brazilian sour orange than did two other isolates of G. fasciculatus. Within a 15-30 C soil temperature range, maximum spore production on sudan grass occurred at 30 C. Spore production also increased when sudan grass was exposed to 15 C for 48 hours within 4 to 8 weeks after inoculation. When inoculated sudan grass seedlings were grown in pots of varying volume (150-15,000 cc), plants grown in larger pots had a greater dry weight, greater spore production/g soil and much greater spore production per plant than plants grown in smaller pots.

CHARACTERIZATION OF ERWINIA CHRYSANTHEMI MUTANTS DEFICIENT IN SYNTHESIS OF POLYGALACTURONIC ACID TRANS-ELIMINASE. Ferguson, M.W. and A.K. Chatterjee, Dept. of Plant Pathology, Kansas State University, Manhattan, KS 66506.

Erwinia chrysanthemi (EC16) produces polygalacturonic acid trans-eliminase (PATE) which is involved in tissue maceration. Parent EC16 and 31 EC16 auxotrophic mutants, 19 of which were also deficient in PATE production (pat-), were examined for PATE production. Cultures, grown 18 hr on 0.1% polygalacturonic acid (PGA), were assayed for PATE activity in both cell extracts and culture supernatant (CS). EC16 excreted ca. 98% of the PATE activity into the CS while 2% remained in cells. Two classes of Pat- mutants were found: class I had low PATE activity in both cells and CS; class II had high activity in cells but low activity in the CS. Both classes of mutations map near the (his-) locus. Concentrated CS of EC16 and selected Pat- mutants when electrophoresed and overlayed with agar containing PGA, showed no qualitative isozyme differences. Loss of PATE activity may be a regulatory rather than structural gene mutation. EC16 and Pat+ autotrophs macerated both carrots and potatoes; Pat- did not.

REGULATION OF EXTRACELLULAR POLYGALACTURONIC ACID TRANS-ELIMINASE IN ERWINIA CHRYSANTHEMI. Ferguson, M.W. and A.K. Chatterjee, Dept. of Plant Path., Kansas State Univ., Manhattan, KS 66506.

The primary produce of degradation of polygalacturonic acid (PGA) by polygalacturonic acid trans-eliminase (PATE) from E. chrysanthemi (EC16) is unsaturated digalacturonic acid (UDG). Comparison of EC16 cells grown on UDG, PGA and glycerol (all 1 mg/ml) indicated that UDG induced equivalent levels of PATE activity 75 min sooner than PGA. PATE activity in glycerol cultures remained at basal level. The rate of enzyme synthesis in UDG or PGA was the same. The generation time of EC16 grown in media containing 1 or 5 mg UDG/ml did not differ from cells grown on PGA, but PATE activity was induced at least 75 min sooner. However, in 10 mg UDG/ml, growth was considerably reduced and PATE synthesis was totally inhibited. Log phase cells (EC16) were added to media containing 1 mg UDG/ml plus 5mM cAMP and PATE activity determined. In 30 min PATE activity was ca. 20 fold higher and evident 90 min sooner than with 1 mg UDG/ml alone. These results indicate that UDG induces PATE synthesis and that cAMP further potentiates the inducer activity of UDG.

RELATIONSHIP OF INFECTION AND DAMPING-OFF OF SOYBEAN TO INOCULUM DENSITY OF PHYTHIUM ULTIMUM. Richard S. Ferriss, Department of Plant Pathology, University of Kentucky, Lexington, KY. 40546

High quality seeds were planted in pasteurized soil infested with from 0.1 to 600 P. ultimum sporangia per gram (spg). At inoculum densities (ID's) of 10 to 600 spg, 14 day stand averaged 30.1$\pm$3.6% and was not significantly different for the various ID's. Regression of log (ln(1/1-X)) against log ID yielded slope values (95% confidence intervals) as follows: 0.70$\pm$0.26 for x = disease incidence at 0.5 to 5 spg, 1.03$\pm$0.15 for x = seed coat infection 2 days after planting, 0.70$\pm$ 0.13 for x= seedling infection (2 day), and 1.06$\pm$0.21 for x = soil immersion tube colonization (2 day). The slope values obtained for disease incidence and seedling infection could be taken to indicate a "spermoplane effect" (sensu R. Baker). However, the width of the spermosphere (calculated from seed volume, soil bulk density, and infection ID_{50}'s) greatly exceeded the diameter of P. ultimum propagules. The most plausible explanation for the observed slopes $\cong$ 0.70 is heterogeneity of susceptibility in the host population.

^{14}C-EXUDATION BY FUNGAL PROPAGULES INTO SOILS OF DIFFERENT TEXTURES IN RELATION TO FUNGISTASIS. A. B. Filonow and J. L. Lockwood. Botany and Plant Pathology, Michigan State University, East Lansing, MI 48824.

^{14}C-exudate lost over 4-16 h from fungal propagules to soils was used to estimate the microbial nutrient sink of the soils. Two sandy loams, a loam, and two clay loams of different organic matter contents were studied. Propagules were sclerotia of Macrophomina phaseolina, chlamydospores of Thielaviopsis basicola, and conidia of Cochliobolus victoriae and Stemphylium sarcinaeforme. ^{14}C-exudate losses from the 4 fungi to the sandy soils and the loam were much greater than losses to the two heavier-textured soils. Respiration of the soil microflora over 2-12 h, when soils were pulsed with ^{14}C-glucose, showed a similar trend. Losses of ^{14}C-exudate from M. phaseolina sclerotia and C. victoriae conidia to soils were greater than diffusive losses artificially imposed, aseptically, on these propagules. Relative fungistatic capacities of the soils were estimated by germination responses to added nutrients. Heavier-textured soils required more nutrients for germination than did sandy soils.

REDUCTION OF PYTHIUM ULTIMUM POPULATIONS IN SOIL AMENDED WITH SOYBEAN SEED MEAL. A. B. Filonow and D. Chun, Department of Botany and Plant Pathology, Michigan State University, East Lansing, MI 48824.

Loamy sand soil infested with sporangia of Pythium ultimum was amended with 1% (w/w) soybean seed meal. In closed containers, initial Pythium populations of 1.1 x 10^3 colony forming units (CFU)/g soil were reduced to 20 CFU/g within 4 days. Pythium was not recovered after 8 days. In open containers the Pythium population doubled within 4 days, as soil dried; when re-moistened, the population declined over time to an undetectable level. Gas chromatographic analyses of headspaces above soybean seed-amended soil consistently detected ammonia. Monitoring of water traps adjacent to amended soils in closed containers showed ammonia produced by amendments in the following order: soybean seed > linseed > cottonseed > alfalfa. Germination of Pythium sporangia was reduced in the enclosed trapping solutions. Reduction in germination followed the same order as ammonia production by meal-amended soils.

PRESERVATION OF CULTURES OF FUSARIUM SPECIES. N. L. Fisher, T. A. Toussoun and P. E. Nelson, Fusarium Research Center, The Pennsylvania State University, University Park 16802.

The Fusarium Research Center, PSU, maintains a collection of approximately 5,000 isolates of Fusarium species. Long-term preservation of the collection is crucial, as well as maintenance of the original cultural type of each isolate. Several storage methods have been used, with lyophilization being the present procedure. Isolates are grown from a single spore for 7-10 days on carnation leaf agar and checked for adequate growth and lack of bacterial contamination. Colonized leaf pieces are transferred to a sterile vial, and sterile skim milk (Difco) added. Loosely stoppered vials are quick-frozen with liquid nitrogen, and lyophilized using a Virtis drying chamber with a vacuum stoppering tray on a refrigerated freeze-dryer. As a check for viability and possible contamination, one replicate vial of each isolate is cultured on water agar. This lyophilization method has proven successful with all species of Fusarium collected, although some, such as F. nivale, may require special handling.

FURTHER CHARACTERIZATION OF A TOXIC POLYSACCHARIDE PRODUCED IN VITRO BY COLLETOTRICHUM TRIFOLII. Kurt A. Frantzen and Lowell B. Johnson. Dept. of Plant Pathology, Kansas State University, Manhattan, KS 66506.

Filtrates from shake cultures of C. trifolii Bain were precipitated with 3 volumes of cold acetone. Ultrafiltration of the resuspended precipitate using an Amicon PM-10 membrane yielded a high molecular weight polysaccharide that induced chlorosis and wilting in excised leaves of Medicago sativa L. Fractionation on an Ultrogel AcA34 column (42 x 2.6 cm) yielded a broad anthrone-positive peak, a portion of which was biologically active. Ultrafiltration retentates were stable to autoclaving (2 hr.), freezing and pronase. Preliminary monosaccharide analysis suggests the presence of galactose, glucose, mannose and an N-acetylated amino sugar. Symptom inducing polysaccharides were found in filtrates of the 1 Kansas and 2 North Carolina isolates of C. trifolii tested. 'Arc' (resistant) and 'Kanza' (susceptible) leaves responded similarly to the polysaccharide of the Kansas isolate and also expressed comparable symptoms when fed commercial dextran solutions (40 to 500 x 10^3 daltons .

MUTANTS OF CEPHALOSPORIUM GRAMINEUM. Dennis W. Fulbright and Alvin V. Ravenscroft, Dept. of Botany & Plant Pathology, Michigan State University, East Lansing, MI 48824.

C. gramineum mutants that do not produce graminin A or extracellular polysaccharides are being selected to evaluate potential determinants of disease. Morphological mutants and mutants that did not inhibit certain bacterial and fungal species were produced by exposing conidia to UV-light. One morphological mutant, CG18, produced a yeast-like colony on PDA and Davis' minimal agar but retained normal mycelial growth on water agar or minimal agar without $(NH_4)_2SO_4$. CG18 produced < 0.1 as much extracellular polysaccharide as did the wild type isolate, but was still pathogenic to wheat. When reisolated on PDA, CG18 still produced yeast-like colonies. Wild type isolates inhibited Escherichia coli, and species of Bacillus, Streptococcus, and Rhodotorula. Some mutants did not inhibit Bacillus and Streptococcus, but inhibited E. coli and Rhodotorula. These mutants will be tested for ability to produce graminin A and for pathogenicity.

OBSERVATIONS ON SOME VIRUSES INFECTING COWPEAS IN LOUISIANA. C. J. Gabriel, L. L. Black, and K. S. Derrick, Dept. of Plant Path. & Crop Physiol., La. State Univ. Agric. Expt. Sta., Baton Rouge, LA 70803.

Blackeye cowpea mosaic (BlCMV), southern bean mosaic, cowpea severe mosaic, bean yellow stipple, and cucumber mosaic (CMV) viruses were identified from a survey of commercial cowpea plantings. Seed lots of cowpeas were screened for BlCMV using serologically specific electron microscopy (SSEM). SSEM assays indicated that virus particles could be detected from seed lots with 1 to 2% infected seed. Attachment of virus particles to SSEM grids was reduced when seed extracts more concentrated than one part seed to four parts extraction buffer (w/v) were used, presumably, due to the high ionic strength of the concentrated extracts. Some field samples of cowpea plants with severe symptoms were found to contain unusual filamentous particles of variable length, up to about 700 nm. These particles reacted specifically to CMV antiserum in SSEM assays. Mechanical transmission from these plants resulted in typical CMV infections and the usual isometric particles of CMV.

USE OF MUTAGENESIS AND TWO-DIMENSIONAL ELECTROPHORESIS IN A SEARCH FOR THE PRIMARY PRODUCT OF A P GENE. Dean W. Gabriel and Albert H. Ellingboe. Dept. of Botany and Plant Pathology, Michigan State University, East Lansing, Michigan 48824.

Several mutations of Erysiphe graminis f. sp. tritici were obtained using nitrosoguanidine (NTG). Mutants were selected which exhibited greatly increased virulence against host lines with single Pm genes. Their proteins were analyzed on 2-d gels. Since proteins are separated by charge in the first dimension, mutations of genes determining pathogenicity should be detectable as changes in charges of their peptide products. Unlike mutants of Colletotrichum lindemuthianum, which exhibit great variation in peptide charge after NTG mutagenesis, E. graminis displays very little variation amongst survivors. Amongst three mutants and the wild-type, there appear to be no differences in the 400 most prevalent peptides visualized by Coomassie blue. A single spot difference has been detected between the wild-type isolate (including its three mutant derivatives) and another field isolate of the fungus. This difference appears to be a charge change of the same gene product.

CONTROL OF BLACK BLIGHT (MYCOSPHAERELLA BRASSICICOLA) OF CABBAGE SEED CROPS WITH BENLATE. R. L. Gabrielson, Western Washington Research and Extension Center, Washington State University, Puyallup, WA 98371 USA; J. Robak, and M. Robak, Research Institute of Vegetable Crops, 96 - 100 Skierniewice, Poland.

Black blight or ringspot disease has caused serious losses in cabbage seed yields in western Washington. With increasing acreage of cabbage seed fields it has been difficult to maintain adequate isolation to prevent spore transfer from crop to crop. Nineteen fungicides were tested for their effectiveness in preventing ascospore germination. Five effective fungicides were field tested in small replicated field trials. Benlate provided the best silique protection. Manzate had some effect. Dyrene, Difolitan, and RP 26019 were ineffective. In a large field trial 5 applications of Benlate, 50% a.i. at 2 and 4 lb from early bolting to near swathing provided excellent control. Three sprays starting at full bloom consistently reduced silique infections. A single application at full bloom had no effect.

THE MAJOR PROTEIN OF CAULIFLOWER MOSAIC VIRUS-INDUCED INCLUSION BODIES IS CODED FOR BY VIRAL DNA. C.O. Gardner, Jr., U. Melcher, and R.C. Essenberg, Department of Biochemistry, Oklahoma State University, Stillwater, OK, 74074.

A 61 kilodalton (kd) polypeptide is the major protein associated with inclusion bodies isolated from turnip leaves infected with cauliflower mosaic virus (CaMV). Poly(A)-containing RNA was isolated from a crude inclusion body fraction obtained from CaMV infected turnip leaves and translated in vitro using a wheat germ system. The major translation product was a polypeptide which co-migrated with the 61 kd inclusion body protein on SDS polyacrylamide gel electrophoresis. The synthesis in vitro of this polypeptide was specifically inhibited by hybridizing the mRNA fraction with heat denatured CaMV DNA for 20 min at 65° prior to translation. The 61 kd polypeptide was translated, however, if the hybrids were melted at 100° for 1 min. The synthesis of other polypeptides translated from this RNA population was unaffected by hybridization with CaMV DNA. These results indicate that sequences coding for the 61 kd protein are contained in CaMV DNA.

RELATIONSHIP OF CORN TO THE SPREAD OF WHEAT STREAK MOSAIC VIRUS IN WINTER WHEAT. Wayne S. Gardner. Department of Plant Science South Dakota State University, Brookings, SD 57007

Over 20 years' research in South Dakota demonstrated that mid-September planting provided significant control of wheat streak mosaic virus (WSMV) in winter wheat. From 1971 to 1975 WSMV did not occur as expected in August planted wheat at Presho and Highmore, and removal of corn from the rotation was suspected to be a factor in the failure of WSMV to develop. In the first year of a replicated and randomized wheat-corn-fallow rotation at Highmore, 7% WSMV developed in corn inbred SDp2 but no WSMV appeared in HRW wheat. In the second year Aug.21, 1978-planted wheat developed 39% WSMV and yielded 1814 kg/ha while Sept. 20, 1978-planted wheat developed 23% WSMV and yielded 3427 kg/ha. Corn inbred N28 developed 51% WSMV in 1979. The results indicated that corn did provide an oversummering host for WSMV and its vector to transmit the virus, infect and reduce yield of early planted winter wheat. Delayed planting produced less WSMV, better winter survival and much higher yield. At Brookings neither corn nor wheat developed WSMV in a similar rotation.

ULTRASTURCTURE OF ZEA MAYS 'N28' NATURALLY INFECTED WITH MAIZE DWARF MOSAIC VIRUS AND WHEAT STRIATE MOSAIC VIRUS. W. S. Gardner, R. G. Timian and V. L. Jons. Dept. of Plant Science, SDSU, Brookings, SD 57007 and SEA-AR and APHIS-PPQ, Dept. of Plant Pathology, NDSU, Fargo, ND 58105.

At Beresford, SD 273 corn hybrids and inbreds planted July 3, 1979, showed mosaic symptoms Aug. 18, 1979. Twenty-nine N28 corn plants indexed positive for maize dwarf mosaic virus strain B(MDMV-B) and one for strain A. On Sept. 21, 1979, leaves from six of the N28 plants showing fine chlorotic streaks were fixed, dehydrated and embedded for electron microscopy. These symptoms were similar to those observed in wheat striate infected N28Ht plants in an earlier study. All six plants contained cells with chloroplasts showing unusual vesicular networks generally located inside the limiting membrane, and some cells had dense cytoplasm and granular material suggesting cell breakdown. All samples had characteristic MDMV inclusions, including pinwheels, bundles, tubes, scrolls and laminated aggregates having extensive brush-like fibrils attached. One sample contained cytoplasmic rhabdovirus particles, both singly and in clusters, assumed to be wheat striate mosaic virus.

PREPARATION AND STABILITY OF INFECTIOUS CITRUS TRISTEZA VIRUS (CTV). S. M. Garnsey, R. F. Lee, and R. H. Brlansky. U.S. Horticultural Research Laboratory, AR-SEA-USDA, Orlando, FL 32803 and University of Florida, AREC, Lake Alfred, FL 32850.

To obtain unbroken CTV particles, young citrus bark was diced in extraction buffer (0.05 M Tris, pH 7.6, 10% (w/v) sucrose and 0.5% 2-mercaptoethanol). Extracts were filtered, clarified by low-speed centrifugation, and concentrated on sucrose step gradients (19 ml extract, 5 ml 25% sucrose and 5 ml 60% sucrose). Virus fractions were located by ELISA and particle integrity evaluated by SSEM. Infectivity was assayed by stem-slash inoculation of Etrog citron plants. Infectivity remained after lyophilization, and after incubation at -60°C for 5 days, at 4°C for 5 days, at 25°C for 24 hr, and at 40 and 50°C for 10 min, but not after incubation at 60°C for 10 min. Infectivity was destroyed by RNase, but not by DNase. Infectivity persisted after a 2-hr incubation in 0.005 M EDTA, 0.5 M NaCl and 0.005 M Mg Cl_2 and treatment with 1% (v/v) Triton X-100. Virus dialyzed against pH 6.0 and 9.0 buffers was infectious, but it precipitated when dialyzed to pH 5.0.

POD AND STEM BLIGHT OF SOYBEAN: THE RELATIVE IMPORTANCE OF SEED-BORNE AND SOIL-BORNE INOCULUM. D. M. Garzonio and D. C. McGee, Department of Plant Pathology, Seed and Weed Sciences, Iowa State University, Ames, IA 50011.

Other workers have suggested that soybean crop residues are an important inoculum source for *Phomopsis* spp., the cause of pod and stem blight. The relative importance of seed-borne inoculum has not, however, been determined. During 1979, two seed lots each of the varieties Amsoy 71, Wells and Beeson, with either low (0-2%) or high (6-10%) amounts of *Phomopsis* infection were planted in fields with continuous soybean, corn-soybean or continuous corn rotational histories. Disease progression data taken throughout the growing season showed that pod and stem blight severity on plants and seeds was highest in the continuous soybean rotation and lowest in the continuous corn rotation. Seed-borne inoculum was not related to pod and stem blight severity in any of the rotations. These data suggest that soil is a more important source of inoculum than seed for pod and stem blight.

TEMPERATURE SENSITIVE GENES FOR STRIPE RUST RESISTANCE IN TRITICUM DICOCCOIDES INDIGENOUS TO ISRAEL. Gerechter-Amitai, Z.K., (1), E.L. Sharp and Mareike Reinhold(2). [1]Volcani Institute, P.O.B. 6, Bet-Dagan, Israel. [2]Department of Plant Pathology, Montana State University, Bozeman, Montana 59717.

Different reactions to stripe rust with specific temperature regimes indicated the presence of temperature sensitive genes for resistance in six accessions of wild emmer. At a relatively low temperature profile the wild emmers were susceptible to both Israel and Montana isolates of stripe rust but they showed a definite shift toward resistance at a higher temperature. In domesticated wheats this type of shift indicates the presence of minor genes. The reaction patterns indicated different resistance genes and a crossing program is in progress to determine the nature of the resistance. One of the six lines also showed evidence of major gene resistance. The presence of both resistance types in natural populations should contribute to effective resistance.

A COMPARISON OF SOME BIOLOGICAL AND BIOCHEMICAL CHARACTERISTICS OF SEVERAL TOBACCO RINGSPOT VIRUS ISOLATES. R.C. Gergerich, D.C. Ramsdell, Michigan State University, East Lansing, MI, 48824.

Seven different isolates of tobacco ringspot virus (TRSV) were collected from grape, cherry, 2 cultivars of blueberry, tobacco, soybean, and watermelon. These isolates were characterized on the basis of 1) symptomatology on herbaceous indicator host plants, 2) temperature of inactivation, 3) electrophoretic mobility, and 4) serological properties. Three TRSV isolates which showed distinct differences in the above tests were selected for further study. The RNA from these three isolates was extracted, purified, and used to direct protein synthesis in a wheat embryo cell-free protein synthesis system. The tritium-labeled protein products were separated by SDS-polyacrylamide gel electrophoresis. The number of protein products and their approximate molecular weights on SDS-polyacrylamide gels were the same regardless of the TRSV isolate used as the source of RNA. Efforts are currently being made to determine small differences in molecular weight between the protein products of the different TRSV isolates using a double-label technique.

A HOST PROTEIN IN INFECTED CUCUMBERS AND ITS RELATION TO INDUCED RESISTANCE. C. Gessler and J. Kuć, Department of Plant Pathology, University of Kentucky, Lexington, Ky. 40545.

Electrophoretic analyses of extracts of cucumber leaves infected with Colletotrichum lagenarium, Pseudomonas lachrymans or tobacco necrosis virus revealed the presence of a protein band which was not evident in extracts of healthy or mechanically wounded leaves. Extracts were prepared in pH 2.8 phosphate-citrate buffer. The Rf of the protein band on a 7.5% gel was ca 0.9. Detection of the protein was coincident with the appearance of necrosis in leaves infected with the above pathogens. If only half leaves were infected, small amounts of the protein were detected in the uninfected halves. The protein was not detected in leaves above the inducer leaf although those leaves showed good protection against subsequent challenge. Few lesions developed in protected leaves challenged with C. lagenarium yet the levels of the protein were comparable to those in unprotected infected leaves. Leaves from plants severely wilted from root infection with Fusarium oxysporum f. sp cucumerinum also contained the protein.

WINTER SURVIVAL OF PSEUDOMONAS TOMATO IN MICHIGAN, Susan Getz, Christine Taylor Stephens, and Dennis W. Fulbright, Department of Botany and Plant Pathology, Michigan State University, East Lansing, MI 48824

An isolate of P. tomato resistant to rifampicin was selected to evaluate the ability of the pathogen to overwinter in Michigan. In September, 1979, tomato leaves were infected by spray inoculation. Infected leaves in nylon mesh bags were placed in field soil at depths of 0, 8, or 17 cm. Leaf samples were removed at monthly intervals until the soil became frozen, and then resistant bacterial colonies were isolated from leaves at each depth on King's B agar with 100 µg/ml cycloheximide. These findings suggest that infected tomato leaves are a source of inoculum in Michigan tomato fields.

FUSARIUM CROWN ROT OF ASPARAGUS: SOURCES OF INOCULUM, Robert L. Gilbertson, John P. Damicone, and William J. Manning, Dept. of Plant Pathology, University of Massachusetts, Amherst, MA 01003.

Crown rot of asparagus (Asparagus officinalis L.) is caused by Fusarium moniliforme and F. oxysporum. Incidence of both fusaria in commercial and locally-collected seed lots may reach 10%. Fusarium infections in storage roots and crowns of 1-year-old dormant plants, used to plant new fields, may exceed 50%. F. oxysporum, pathogenic to asparagus, was readily found in 10 local soil samples from cultivated fields, a pasture, a meadow and a woodland. Soils with previous asparagus histories had the highest inoculum potential. Both fusaria, especially F. moniliforme, sporulate abundantly in lesions on aboveground senescing asparagus stems. Some F. oxysporum isolates from roots of a variety of annual weeds were pathogenic to asparagus. Adult asparagus miner flies (Ophiomyia simplex Loew.) and spotted asparagus beetles (Crioceris duodecimpunctata L. may also aid in the dissemination of both fusaria.

RELATIONSHIP OF THE ASPARAGUS MINER FLY TO FUSARIUM STEM ROT OF ASPARAGUS AND INOCULUM INCREASE BY FUSARIUM. Robert L. Gilbertson and William J. Manning, Dept. of Plant Pathology, and David N. Ferro, Dept. of Entomology, University of Massachusetts, Amhert, MA 01003.

The asparagus miner fly (Ophiomyia simplex Loew.) is common in asparagus in Massachusetts. Larvae feed on cortical tissue beneath the stem epidermis, proceeding from just below ground upward in a narrow zigzag "mine." Several mines may occur on each stem. Fusarium moniliforme and F. oxysporum can be read-

ily isolated from decayed cortical and epidermal tissues in stem mines below active larvae. Both fusaria can be isolated from whole and crushed surface-sterilized (10% Clorox) and non-surface-sterilized larvae, pupae, and puparia of O. simplex. Increased Fusarium stem rot of asparagus is associated with stem feeding by O. simplex larvae. Abundant sporodochial formation by both fusaria on aerial plant parts leads to inoculum increase for both. Both fusaria can also survive the winter in puparia in asparagus stalks.

EFFECT OF CROWN ROT FUNGI ON YIELD COMPONENTS AND STAND PERSISTENCE OF NONDORMANT ALFALFA IN CALIFORNIA. D. G. Gilchrist A. N. Martensen, Dept. of Plant Pathology, and L. R. Teuber, Dept. of Agronomy, University of California, Davis, CA 95616

The impact of crown rot fungi on seasonal and long term yield components of nondormant alfalfa (cv. Moapa-69) in relation to stand persistence was assessed under field conditions. Plots (32 m^2), in separate water controlled basins, were treated factorially with several fungicides and inoculated with Stagonospora meliloti and an unidentified Phoma sp. Plants were evaluated for the presence of the inoculated fungi plus Colletotrichum trifolii, Phoma medicaginis, and Phytophthora megasperma. In the first two production years forage yields in plots treated with Chlorothalonil, active against all aforenamed fungi except P. megasperma, increased 35-50% in the first cut and 20-25% for the full season. Yield increases were associated with time dependent differences in presence of specific fungi and related to per unit area differences in stems, healthy crown weight, and total plants. Impact of specific fungi on plant persistence will be discussed.

COMPARATIVE MORPHOLOGY AND SEROLOGICAL RELATIONSHIPS AMONG ISOLATES OF THE RATOON STUNTING DISEASE (RSD) BACTERIUM IN CULTURE. A. G. Gillaspie, Jr., R. W. Harris, R. H. Lawson, and M. J. Davis, USDA, SEA-AR, Beltsville, MD 20705 and Rutgers University, New Brunswick, NJ 08903.

Sugarcane strains of the RSD coryneform bacterium from Louisiana (L) and Japan (J) and a bermudagrass (BG) strain from Taiwan grown in culture were similar in size and shape. The bacterium measured 0.25 to 0.35 x 1 to 4 µm by electron microscopy in sodium phosphotungstate, pH 7.0. RSD bacteria were branched and straight, curved, or swollen at the tip or in the middle, seemed to be undergoing septate division, and contained mesosomes. In ultrathin section no differences were observed in cell wall structure of the strains in culture and of bacteria from xylem extracts from diseased plants. Bacteria from cultures of the BG, J, and L strains and of sugarcane strains from Brazil and South Africa were serologically indistinguishable using the indirect immunofluorescent antibody test. Gel double-diffusion test results showed that all sugarcane strains were related but that the BG strain showed only partial identity.

EFFECTS OF LANDFILL GENERATED GAS ON ROOT DISTRIBUTION OF AMERICAN BASSWOOD. E. F. Gilman, I. A. Leone, and F. B. Flower.

Root systems of 8, 4-year old American basswood (Tilia americana L.) trees growing in 60 cm of cover soil placed over a completed sanitary refuse landfill and 4 basswoods in a non-landfill control area were excavated and mapped. Elevated levels of CO_2 and CH_4 emanating from decomposing refuse, in conjunction with low O_2 concentrations, appear to be partially responsible for causing a decrease in total root length and a reduction in the depth of root penetration. In areas of high landfill gas concentrations 30cm below the soil surface, basswood roots ceased growing; however, in areas of moderate gas concentrations, the roots grew toward the soil surface, away from the source of CO_2 and CH_4. Roots reaching the soil surface proliferated there and rarely grew down to the deeper soil layers. Concentrations of soil CO_2 and O_2 were highly correlated with total root length.

AGGRESSIVENESS AND CULTURAL CHARACTERISTICS OF 10 NORTH AMERICAN ISOLATES OF CERATOCYSTIS ULMI. Asimina Gkinis, Department of Plant Pathology, University of Minnesota, St. Paul, MN 55108; and E.B. Smalley, University of Wisconsin, Madison, WI 53706.

Ten C. ulmi isolates of North American origin caused wilt on American elm and limited wilt on resistant elms. On clones of intermediate resistance, however, three isolates were classified as "aggressive", four as "semiaggressive", and three as "nonaggressive". Aggressive and semiaggressive isolates grew equally fast on potato dextrose agar (PDA), Oxoid malt extract agar (MEA), and Feldman's agar (FA), whereas nonaggressive isolates grew significantly slower. Cultural morphology was unrelated to aggressiveness and growth rate. Cultures were fluffy on PDA, appressed to waxy on MEA and appressed on FA. All isolates yielded significantly less dry weight in potato dextrose broth than in Feldman's liquid medium. Nonaggressive isolates yielded significantly greater dry weight than the other isolates on the latter medium.

INHERITANCE OF AGGRESSIVENESS IN CROSSES BETWEEN AGGRESSIVE AND NONAGGRESSIVE NORTH AMERICAN ISOLATES OF CERATOCYSTIS ULMI. Asimina Gkinis, Department of Plant Pathology, University of Minnesota, St. Paul, MN 55108; and E.B. Smalley, University of Wisconsin, Madison, WI 53706.

Single ascospore progeny from a cross between a wild-type aggressive, and a nonaggressive, North American isolate of Ceratocystis ulmi could not be classified culturally in terms of parental types. Most single ascospore lines grew on media at rates between those of the parents. Culturally, they could be classified as fluffy, intermediate or waxy. Wilting of an intermediately resistant elm clone inoculated in the greenhouse with ascospore lines of various cultural characteristics showed no correlation with morphological characters. In the field, few lines approached the virulence of the aggressive parent, whereas the majority were even less pathogenic than the nonaggressive parent.

TRANSPIRATION OF HEALTHY AND INFECTED ELM TREES VARYING IN RESISTANCE TO DUTCH ELM DISEASE. Asimina Gkinis, Department of Plant Pathology, University of Minnesota, St. Paul, MN 55108; and E.B. Smalley, University of Wisconsin, Madison, WI 53706.

The stomatal resistance to water vapor diffusion (SR) of elm trees resistant, intermediate and susceptible to Dutch elm disease was measured with a diffusion porometer during disease development in inoculated trees. SR of susceptible and intermediate resistance trees increased sharply 6 to 8 days after inoculation with a concomitant appearance of disease symptoms. However, SR of inoculated resistant trees remained low throughout the study and such trees developed no symptoms. SR of control healthy trees remained low and was similar in all resistance categories. The pathogen, Ceratocystis ulmi, was reisolated from the entire stem length and most leaves of susceptible elms, from the entire stem length and about half of the leaves of intermediate resistance trees, and from a short stem portion and none of the leaves of resistant trees.

VESSEL DIAMETER AND STOMATAL DENSITY OF ELM CLONES VARYING IN RESISTANCE TO DUTCH ELM DISEASE. Asimina Gkinis, Department of Plant Pathology, University of Minnesota, St. Paul, MN 55108; and E.B. Smalley, University of Wisconsin, Madison, WI 53706.

Vessel diameter of the second and third year rings of several healthy elm clones varying in resistance to Dutch elm disease did not correlate with their degree of resistance. Resistant trees had the smallest vessels but their size was not significantly different ($P = 0.05$) from susceptible trees. Vessels in intermediate resistance trees were significantly larger than in either resistant or susceptible trees. Stomatal density (stomata/mm^2) of the lower leaf surface of susceptible and resistant elm clones did not differ significantly ($P = 0.05$), but was significantly lower than that of intermediate resistance clones.

EUTYPA DIEBACK OF GRAPEVINE IN WASHINGTON STATE. D. A. Glawe, C. B. Skotland, and W. J. Moller. Irrig. Agric. Res. and Ext. Center, Wash. State Univ., Prosser, WA 99350, and Dept. of Plant Pathology, Univ. of Calif., Davis, CA 95616.

The occurrence of Eutypa dieback of grapevine in Washington state is reported. Eutypa armeniacae was consistently isolated from diseased Concord grapevines growing in the semi-arid Yakima Valley. The fungus formed a Cytosporina state in culture, but did not sporulate in darkness. When cultured and compared to a California isolate, Washington isolates formed more stromata, fewer pycnidia with smaller spore masses and larger spores, discolored the culture medium less, and required more light to sporulate. A California apricot isolate was more virulent on apricot than Washington grape isolates in a test conducted at Prosser, WA. In a similar test at Davis, CA, Washington grape isolates and a California grape isolate did not differ in virulence. In the field the perfect stage has not been found on grapevines in Washington and the imperfect stage was found only once.

INDUCTION OF TELIOSPORE GERMINATION OF BEAN RUST, UROMYCES PHASEOLI VAR. TYPICA. R.E. Gold, and K. Mendgen. Lehrstuhl für Phytopathologie, Universität Konstanz, D-7750 Konstanz, F.R.G.

Refrigerator-stored teliospores of bean rust were induced to germinate and form basidiospores using heat shock. Spores were spread on 2% water agar and treated at 31.6 ± 0.1°C for 1, 2, 3, or 4 d. Heat-treated spores and controls were incubated at 18.0°C under 1000 lux (18h light; 8h dark). Spore samples were evaluated for % germination and for cytoplasmic changes in the form of vesicles or degeneration for 15 d after heat shock. A direct relationship was found between length of heat shock and % germination. At 15 d, no significant differences were found between controls and the 1 d treated spores, but 2, 3, or 4 d treatments induced a 4-fold (=4X), 7X, or a 10X (75%/7.5%) increase, respectively. In all treatments and controls, the number of spores containing vesicles increased rapidly to a maximum peak (60%) ca. 4 d after the shock; their possible role in the germination process is unknown. Heat shock caused a 2X, 2X, 3X, or 6X (15%/2.5%) increase in spore mortality over the controls 15 d after the 1, 2, 3, or 4 d treatments, respectively.

CONJUGAL TRANSFER OF AN INDIGENOUS PLASMID OF PSEUDOMONAS SYRINGAE. C.F. Gonzalez, R.H. Olsen, Dept. of Microbiology, Univ. of Michigan, Ann Arbor, MI 48104 and A.K. Vidaver, Dept. of Plant Path., Univ. of Nebr., Lincoln, NE 68583.

The lack of a transfer system for resident plasmids of Pseudomonas syringae has hampered genetic study. We report construction of a recombinant plasmid pCG133 in P. syringae strain HS191, formed by recombination between plasmid pCG131 and pRO1610. The holcus spot producing strain HS191 (pCG131) was transformed with a transfer deficient (tra^-) derivative of the P-group plasmid RP1 designated as pRO1610. Experiments designed to determine the presence of transfer functions on plasmid pCG131 resulted in mobilization of pRO1610 at a frequency of 10^{-4} transconjugants per donor and formation of the recombinant plasmid pCG133. Transfer of pCG133 to other plasmid-free P. syringae was at a frequency of 10^{-6} transconjugants per donor. The recombinant plasmid was incompatible with the parental pCG131. Other experiments indicate pCG133 does not encode for production of syringomycin.

EFFECT OF CO_2 ATMOSPHERES ON POSTHARVEST DECAY INCIDENCE OF BLUEBERRY FRUITS. W.R. Goodwine, M.J. Ceponis, and R.A. Cappellini, USDA-New Jersey AES Postharvest Research Center, P.O. Box 231, New Brunswick, New Jersey 08903.

Sound, freshly harvested blueberry fruits were artificially inoculated with spore suspensions of Botrytis, Alternaria, or Gloeosporium and stored in atmospheres of 10, 20, and 30% CO_2 in air immediately and 4, 8, and 16 hours later. The berries were removed from the CO_2 atmospheres after 4 days at 1.7°C and then incubated at 21°C for 3 days. Postharvest infections by the three fungi were reduced 44% or more when the 20 and 30% CO_2 atmospheres were applied within 16 hours of inoculation. A similar reduction of Alternaria and Gloeosporium decays was obtained by the 10% CO_2 treatment. The lowest CO_2 level reduced Botrytis decays by 30% when applied within 8 hours of inoculation, but was ineffective when applied after 16 hours. Decreasing sensitivity of the fungi to CO_2 atmospheres was Gloeosporium, Alternaria, and Botrytis.

AN ASSESSMENT OF THE FACTORS CONTRIBUTING TO THE DECLINE IN NET PHOTOSYNTHESIS OF SUGAR BEET LEAVES INFECTED WITH POWDERY MILDEW. T. R. Gordon and J. M. Duniway, Department of Plant Pathology, Univ. of Calif., Davis, CA 95616.

Rates of CO_2 and H_2O vapor exchange by leaves were used to evaluate the physiological impact of powdery mildew (Erysiphe polygoni) infection on sugar beet (Beta vulgaris). The rate of net photosynthesis declined steadily with time after inoculation to less than 30% of the value for healthy leaves. During the same period, leaf resistance to water vapor loss increased slightly, while stomatal aperature, as determined by viscous flow porometry, was not significantly altered by infection. Increases in respiration by mildewed leaves accounted for less than 5% of the reduction in net photosynthesis. Mesophyll resistance to CO_2 assimilation, as estimated by passing air of various CO_2 concentrations directly through the leaf blade, increased substantially as the disease progressed. Thus it appears that mildew acts chiefly by reducing the photosynthetic efficiency of mesophyll cells.

INOCULUM DISPERSAL AND LATENCY OF SYMPTOM EXPRESSION OF ANISOGRAMMA ANOMALA CANKER OF EUROPEAN FILBERT IN THE PACIFIC NORTHWEST. T. R. Gottwald and H. R. Cameron. USDA-SEA, SE Fruit and Tree Nut Research Laboratory, Byron, GA 31008 and Dept. of Botany and Plant Pathology, Oregon State University, Corvallis, OR 97331.

Ascospores of A. anomala hypodermically infiltrated into buds infested with Phytocoptella avellanae, and into non-infested-buds, resulted in 46.5 and 29.0 percent infection respectively. Percent infection increased as inoculation dates approached the natural infection period from February through late May. Infection of trap plants correlated with the duration of rainfall during the same season. Data from trap slides indicate that ascospore release is at least 6 months in duration extending well beyond the natural infection period. Heaviest ascospore discharge was recorded during periods of constant wetting of the stromata which induces inoculum discharge that is further dispersed by rain splash. Following infection there was a 12 to 16 month latency period for symptom expression in the orchard. However in the greenhouse only 6 months was required from inoculation to symptom expression.

PREDICTIVE MODELS FOR DISEASE INCREASE OF ANISOGRAMMA ANOMALA CANKER OF EUROPEAN FILBERT IN THE PACIFIC NORTHWEST. T. R. Gottwald and H. R. Cameron. USDA-SEA, SE Fruit and Tree Nut Research Laboratory, Byron, GA 31008 and Dept. of Botany and Plant Pathology, Oregon State University, Corvallis, OR 97331.

The rate of disease increase and the geographical pattern of spread from the original focus of infection were studied. Disease occurrence correlates with the amount of filbert bud gall, incited by an Eriophyid mite, Phytocoptella avellanae. Filbert bud gall was found to be the primary infection court of A. anomala. Regression analysis of disease progress curves gives disease increase values of r=0.265, r=1.085, r=1.236 per unit per year for growth of individual cankers, disease increase within a single tree and disease increase within an orchard, respectively. The original focus was a group of 5 orchards in the northwest quadrant of the diseased area from which the disease spread south and west to 44 additional orchards and now threatens the main filbert growing area of Oregon.

TAN SPOT DEVELOPMENT IN THE WHEAT CULTIVAR TRIUMPH 64 GROWN UNDER THREE TILLAGE SYSTEMS. F. J. Gough, L. L. Singleton, T. S. Lee and R. K. Mibey. USDA, SEA-AR and Department of Plant Pathology, Oklahoma State University, Stillwater, OK 74078

Pseudoperithecia of Pyrenophora trichostoma, the cause of wheat tan spot, survive from one crop season to the next in crop residue on or above the soil surface. A moderately resistant cultivar, Triumph 64, was grown in plots having three levels of wheat residue on the soil surface. Fall tillage treatments of 1) a mold board plow and disk, 2) a sweep and disk, and 3) a sweep and spring tooth harrow resulted in 8.0, 55.0, and 106.0 g of surface residue/m^2, respectively, when Triumph 64 was at growth stage 5 (Feeke's scale). Plant leaves in plots of treatment 1 developed significantly fewer lesions in growth stages 5 through 10 than did leaves of plants in treatments 2 and 3. But differences were not significant at growth stages 10.4 and 10.5.4, presumably due to lateral transmission of ascospores. Lesion numbers/unit leaf area in the two reduced tillage systems did not differ significantly at any growth stage.

A SELECTIVE MEDIUM FOR PSEUDOMONAS SOLANACEARUM. G. A. Granada and L. Sequeira. Dept. of Plant Pathology, UW, Madison, WI 53706

A new selective medium was used to isolate P. solanacearum from infected plant tissue, rhizosphere soil, soil leachates and infested soil. The medium is prepared by adding to Kelman's tetrazolium chloride (TZC) medium (Phytopathology 44:693-695) the following: crystal violet (50ppm), merthiolate (0.005%), polymixin B sulfate (100ppm), tyrothricin (20ppm) and chloromycetin (5ppm). When fungal contaminants are a problem, cycloheximide (50ppm) or chlorothalonil (80ppm) may be added. After 2-3 days growth at 30 C colonies are round, pulvinate, fluidal and tan in color. When certain bacterial antagonists are present, however, colonies of P. solanacearum may be flat, small, and the color changes to lavender. Plating efficiency of P. solanacearum on this medium is considerably greater than that on TZC. The efficiency of recovery from soil may range from 80 to 100%, depending on the antagonistic bacteria present. Strains representative of the three known races of P. solanacearum have been recovered efficiently on this medium.

MAIZE WHITE LINE MOSAIC - A NEW DISEASE OF CORN IN WISCONSIN. C.R. Grau, G.A. deZoeten, D.C. Arny, S.M. Saad and G. Gaard, Department of Plant Pathology, University of Wisconsin, Madison, Wisconsin 53706.

In 1979, field and sweet corn plants with mosaic symptoms strikingly different from maize dwarf mosaic were found in four counties of eastern Wisconsin. Plants were stunted and leaves showed a vivid mosaic of white to yellow and yellow-green chlorotic rectangular to linear patches and stripes. Symptoms were present on all leaves and persisted after tasseling. Leaf dip preparations for EM showed a consistant association of icosahedral particles (35 nm in diameter) with the disease. Purification of the virus-like particles revealed a single nucleoprotein component. Mechanical transmission failed, but transmission was achieved by growing sweet corn in soil from fields where infected plants were present. Green foxtail and winter wheat are also hosts. Fungal structures similar to those of Olpidium and Polymyxa were observed in roots of infected plants. Serological tests, particle morphology, and symptoms indicate the disease is similar to the one found in Ohio, Vermont and New York.

DUTCH ELM DISEASE THERAPY OF AMERICAN ELM BY INJECTION OF ARBOTECT-20S AND LIGNASAN-BLP. Garold F. Gregory, USDA-Forest Service,Forestry Sciences Lab.,Box 365, Delaware, Ohio 43015.

Fifty-two street-lawn American elms, Ulmus americana L., with 10% or less foliar symptoms of Dutch elm disease were injected with either: 1) Arbotect-20S (1.98 g of a.i./cm dbh); 2) Lignasan-BLP (same dosage as 1); or 3) Lignasan-BLP (0.22 g a.i./cm dbh). Elms were injected at 2.7 atmospheres into sites about 1 cm deep into the sapwood, spaced about 15 cm apart near ground level (into root flares wherever possible). Approximately 10 days after treatment all symptomatic limbs were removed at the first major crotch, 1.5 m or more beyond pathologically discolored sapwood if possible. Data taken 1 year after injection revealed that fungicide solutions 1 and 2 gave essentially the same apparent therapeutic success, 89 and 88% respectively, whereas solution 3 gave lower, 76%, but still acceptable disease control. Published studies report moderately good results from symptomatic limb removal from lightly infected elms. Therapeutic injection without symptomatic limb removal thus seems of questionable value.

THE EVALUATION OF RELATIVE PARASITIC FITNESS OF ISOLATES OF HELMINTHOSPORIUM MAYDIS RACE T. L. V. Gregory, M. H. Royer, J. E. Ayers and R. R. Nelson. Department of Plant Pathology, The Pennsylvania State University, University Park, PA 16802.

Three field isolates and the same 3 isolates with reduced parasitic fitness resulting from 10 serial passages on resistant normal cytoplasm corn were used to initiate epidemics resulting from a point source in field plots of corn hybrid PA887P x B14 t-cms. There were significant reductions in whole plot severity at the latter dates of disease assessment in plots inoculated with isolates having reduced parasitic fitness. Disease severities at point sources and at distances from the point source reflected similar trends. Use of orthogonal comparisons to test combinations of isolates revealed significant differences among field isolates and isolates conditioned on normal cytoplasm. Reduced disease severity induced by the least fit of the conditioned isolates appears to reflect a reduced sporulation capacity. An intra-racial source of pathogen variability was detected which has not been considered in disease management strategies involving host resistance and yield loss assessment.

INHERITANCE OF SEEDLING RESISTANCE TO FUSIFORM RUST IN FIVE SLASH PINE PARENTS. M. M. Griggs and C. H. Walkinshaw, SO. Forest Expt. Stn., USDA Forest Service, Box 2008-GMF, Gulfport, MS 39503

Selfed, intercrossed, and wind-pollinated progenies of 5 slash pine parents with varying degrees of resistance were artificially inoculated with 3 spore collections of Cronartium quercuum f. sp. fusiforme. Two spore collections were single gall cultures on slash pine, while the third collection was a composite derived from 10 single galls. Percent galled and gall length were subjected to analyses of variance and diallel analyses. Significant variation existed among crosses for percent galled for the 3 spore collections. General combining ability effects were highly significant while specific combining ability effects were non-significant. Gall length was significant among crosses for one spore source. Crosses with a field-resistant parent were easily infected by the culture collected from progeny of that parent. This culture also was highly pathogenic on susceptible parent crosses, suggesting that the fungus had not undergone specialization. Crosses with a second resistant parent were resistant to all 3 spore collections. This indicates that at least 2 types of resistance occur in slash pine.

TRANSFORMATION OF PSEUDOMONAS SYRINGAE BY PLASMID DNA. D. C. Gross and A. K. Vidaver*, Dept. of Plant Pathology, Wash. State Univ., Pullman, WA 99164, and *Dept. of Plant Pathology, Univ. of Nebraska, Lincoln, NE 68583.

In Pseudomonas syringae HS191, there is an association between the indigenous plasmid PCG131 (34 Mdal) and ability to produce syringomycin and cause holcus spot of corn. The plasmid-less derivative, AO111, was successfully transformed (verified by agarose gel electrophoresis) using either plasmid PRO161 (26 Mdal; Cb^R, Tc^R, tra-) or RSF1010 (5.5 Mdal; Sm^R, tra-) by calcium treatment followed by a heat pulse. Optimal conditions for transformation included the use of 150 mM $CaCl_2$, 10% glycerol, and 4 µg/ml DNA per 10^8 cells followed by a two minute pulse at 45°C. Frequencies of transformation ranged from 10^{-4} to 10^{-6} depending on the plasmid. However, attempts at transforming AO111 with PCG131 were unsuccessful either using PCG131 alone or by co-transformation with PRO161 or RSF1010. Transformation was strain dependent; most strains of P. syringae were incompetent or of low competence relative to AO111, others were highly competent.

VESICULAR-ARBUSCULAR MYCORRHIZAL INFECTION OF MAIZE AS AFFECTED BY ROTATION, FERTILIZATION, AND METALAXYL. D. E. Groth and C. A. Martinson, Dept. of Plant Pathology, Seed and Weed Sciences, Iowa State University, Ames, IA 50011.

Root samples were collected in maize plots from a 30 year rotation experiment with fertilizer subplots. Vesicular-Arbuscular (VA) mycorrhizal infection was expressed as the percent of 1 cm root segments infected. Three different rotations of maize, oats, and alfalfa had no significant effect on infection. Manure and phosphorus fertilization decreased infection to 44% compared to the average 63% infection of the unfertilized plots; combined they decreased root infection to 35%. An experimental fungicide, metalaxyl, when incorporated into field soil in a greenhouse experiment at 1.4 and 2.9 mg/Kg, increased VA infection from 57% to 62 and 72% respectively after 30 days. When inoculum of Glomus fasciculatus was added to the soil VA infection increased 16% but metalaxyl had no additional effect on infection.

APICAL CHLOROSIS OF SUNFLOWER INCITED BY PSEUDOMONAS TAGETIS. T. J. Gulya, R. R. URS, and E. E. BANTTARI, USDA-SEA-AR, Department of Plant Pathology, North Dakota State University, Fargo, ND 58105, Dalgren and Co., Crookston, MN 56716, and Department of Plant Pathology, University of Minnesota, St. Paul, 55108.

A severe apical chlorosis on both oilseed and confectionary sunflowers was observed in MN and ND in July, 1979. A gram-negative, fluorescent bacterium, identified as Pseudomonas tagetis, was determined to be the causal organism. Attempts to isolate pathogenic fungi or viruses were unsuccessful. Affected leaves, including the veins, were pale-yellow to white, and remained chlorotic; necrotic spots with chlorotic halos were observed infrequently. Chlorotic plants occurred singly or in small patches randomly through the fields, with little spread from original loci. After four to six weeks, subsequent leaves on infected plants were normal in color. Seed transmission was verified on several seed lots. Screening of inbred lines and commercial hybrids for resistance is being pursued.

INCIDENCE OF SCLEROTINIA STALK ROT OF SUNFLOWER IN THE DAKOTAS AND MINNESOTA. T.J. Gulya and V.L. Jons. USDA-SEA-AR and APHIS-PPQ, Department of Plant Pathology, North Dakota State University, Fargo, ND 58105.

A systematic survey of principal sunflower growing areas of ND-SD-MN was conducted in September, 1979 to determine incidence of stalk rot incited by Sclerotinia sclerotiorum. Ninety-seven fields at forty-five locations were inspected for occurrence of Sclerotinia stalk rot, and prevalence of infected weed species. Sclerotinia-infected sunflowers were found in 33% of the fields. Disease severity in individual fields was generally less than 0.5%, although three fields with 10% or more infection were found. Disease prevalence and severity were highest in fields in the Red River Valley, where the history of production of sunflower and other susceptible crops is longest. Several common weeds, including wild mustard, Canada thistle, marsh elder and lambsquarters were infected by S. sclerotiorum, stressing the importnace of adequate weed control in addition to crop rotation for control of Sclerotinia.

PROTEIN SYNTHESIS IN BARLEY INFECTED WITH BARLEY STRIPE MOSAIC VIRUS. By G.D. Gustafson, J.E. McFarland, and A.O. Jackson. Department of Botany and Plant Pathology, Purdue University, West Lafayette, Indiana 47907.

Protein synthesis was examined in barley infected with two strains of barley stripe mosaic at different stages of infection. Four viral-specific proteins with molecular weights of 19, 25, 67, and 120 kilodaltons were resolved by polyacrylamide gel electrophoresis. Polypeptides synthesized in a cell-free system derived from wheat germ contained the four viral-specific proteins found in infected plants plus a major polypeptide of 28 kilodaltons and minor polypeptides of 71 and 82 kilodaltons. Synthesis of viral specific polypeptides was detected as early as two days after inoculation and continued for at least ten days. Changes in polypeptide synthesis were correlated with the transition from an acute to a chronic stage of infection. A particularly striking alteration was a reduction of about 2000 daltons in the size of the BSMV coat protein synthesized by the wheat germ system primed with polyribosomes from plants infected more than six days.

BEAN GOLDEN MOSAIC VIRUS: COMPOSITION AND GENOME STRUCTURE. S. Haber, G. R. Bowers, and R. M. Goodman, Department of Plant Pathology, University of Illinois, Urbana, IL 61801.

Bean golden mosaic virus (BGMV) is a geminivirus with closed circular single-stranded DNA (ssDNA) (MW $8x10^5$) and one major coat protein subunit (MW 27,400). BGMV was found to contain 20% DNA, indicating one ssDNA molecule is contained in each geminate particle. Unfixed virus examined by electron microscopy in 1% sodium phosphotungstate (pH 4.0) was predominantly geminate. These results establish that geminate particles are the native form of the virus. Nucleotide composition of BGMV DNA was 32%A, 33%T, 22%G, 13%C. Restriction endonuclease Hae III (GG$\downarrow$CC) produced many small fragments indicating a surprising multiplicity of this sequence considering the small size of the genome and the relatively low GC content. Nuclease Hha I (GCG$\downarrow$C) produced several fragments whose total molecular weight exceeded that of the intact ssDNA. The genome of BGMV may thus be multipartite.

VIROID SPECIFIC RIBONUCLEIC ACID IN CELLS INFECTED WITH POTATO SPINDLE TUBER VIROID: DETECTION AND CHARACTERIZATION. A. Hadidi and J. Hashimoto. Plant Virology Laboratory, PPI, SEA, U.S. Department of Agriculture, Beltsville, MD 20705.

Cells infected with potato spindle tuber viroid (PSTV) contain RNA species which hybridize to ^{125}I-labeled PSTV probe in liquid and on diazobenzyloxymethyl (DBM) paper. Most or all PSTV cRNA molecules are found as RNA·RNA duplexes in isolated RNA preparations. Two cRNA species were observed. These species are approximately 1-2 times the size of PSTV. To search for PSTV sequences represented in cellular RNA, ^{32}P-labeled PSTV cDNA probe was hybridized to RNA from PSTV-infected and uninfected cells on DBM paper. In addition to PSTV, larger RNA species containing PSTV-specific sequences were observed in RNA preparations from infected cells. These RNA species are approximately 2-5 times the size of PSTV and are detected at a very low concentration relative to the total amount of PSTV. RNA from uninfected cells did not hybridize to ^{32}P-labeled PSTV cDNA probe.

THE PRESENCE OF "CHITOSAN-LIKE" COMPOUNDS IN WHEAT-PUCCINIA STRIIFORMIS INTERACTIONS. Lee A. Hadwiger & R. F. Line, Dept. of Plant Pathology, Wash. State Univ., Pullman, WA 99164

The hexosamine polymer, chitosan, is a potent fungicide. Nitrous acid-cleaved chitosan (125 µg/ml) inhibited urediospore germination and germ tube elongation. Stripe rust resistant (infection type 2) and susceptible (infection type 8) isolines of wheat (developed by R. E. Allan, USDA-SEA geneticist at Wash. State Univ.) were inoculated with urediospores of Puccinia striiformis. Chitosan-like material was monitored histologically with a hexosamine-specific stain or fluorescein-conjugated antichitosan antiserum. Mature urediospores stained positively for hexosamine. Hexosamine components were also found in urediospores and germ tube cell walls following germination. Disproportionate hexosamine accumulations occur in the distal end of mycelia in which growth was terminated. In substomatal and subepidermal regions hexosamine staining was less intense for mycelia in susceptible plants tissue but hexosamine positive material accumulated in spores maturing in the pustule.

BIOASSAY OF FUNGICIDE RESIDUE PERSISTANCE ON LEAVES OF KENTUCKY BLUEGRASS. Austin Hagan and P. O. Larsen. Dept. of Plant Pathology, The Ohio State Univ., Columbus, OH 43210 and OARDC, Wooster, OH 44691.

Iprodione, anilazine, and cycloheximide were applied at label rates to 4 m^2 replicated field plots containing a blend of 'Park' and 'Delta' Kentucky bluegrass. Uniform samples were removed from each treatment plot 0, 1, 3, 5, 7, 14, and 21 days after fungicide application. Samples were inoculated with a suspension of 10,000 Drechslera poae conidia/ml and incubated at 18 C for 24 hrs. Conidium germination, germ tube elongation, and appressorium formation on leaves of Kentucky bluegrass were evaluated using the collodion leaf impression technique. All fungicides effectively suppressed pre-penetration events several days after fungicide application. Anilazine and iprodione persisted throughout the observation period while no evidence of cycloheximide residue activity was noted after seven days. The collodion leaf impression technique proved to be a simple means of assaying fungicide residue activity on leaf surfaces.

INFLUENCE OF TEMPERATURE ON PRE-PENETRATION EVENTS OF DRECHSLERA POAE AND COLONIZATION OF KENTUCKY BLUEGRASS LEAVES. Austin Hagan and P. O. Larsen. Dept. of Plant Pathology, The Ohio Univ., Columbus, OH 43210 and OARDC, Wooster, OH 44691.

Pots containing 6 month old Kentucky bluegrass plants were inoculated with a suspension of 10,000 Drechslera poae conidia/ml, sealed in plastic bags, and incubated at 6, 12, 18, 24, and 30 C. Fungal pre-penetration events were monitored 2, 4, 6, 8, 12, 16, and 24 hrs after inoculation using the collodion leaf impression technique. Penetration and colonization of leaf tissue were also observed. Conidium germination began within four hrs at all temperatures. Conidium germination, germ tube elongation, and appressorium formation had been completed within 24 hrs of inoculation at 18 and 24 C. All pre-penetration events were inhibited at 6, 12, and 30 C. Approximately 60-70% of the appressoria examined on leaves of the 12, 18, and 24 C treatments produced infection pegs which penetrated the cuticle and produced hyphal filaments. Few appressoria penetrated into leaf tissue at 6 or 30 C. The optimum temperature range of D. poae activity is between 12-24 C.

SALIVARY SYNDROME IN HORSES. W. M. Hagler, R. F. Behlow and P. B. Hamilton. Dept. of Poultry Sci., Dept. of Animal Sci., and Dept. of Poultry Sci., N. C. State University, Raleigh, NC 27650.

Rhizoctonia leguminicola, the pathogen causing Black Patch, was observed in and isolated from red clover (Trifolium pratense) hay implicated in salivary syndrome in horses. The clover caused slobbering when fed to guinea pigs, and purified clover extracts caused slobbering when injected intraperitoneally. Slaframine (1-acetoxy-6-aminooctahydroindolizine) was identified in extracts of the toxic clover by gas-liquid chromatography (GLC) after preparative thin-layer chromatography. Derivatization of slaframine to deacetylslaframine, N-acetylslaframine, N-acetyl-O-deacetylslaframine and trimethylsilyl derivatives of slaframine, deacetylslaframine, or N-acetyl-O- deacetylslaframine was also used for GLC. GLC-mass spectrometry provided unequivocal evidence of slaframine in extracts. This is the first verified case of slobbers in horses and the first identification of slaframine, a metabolite of R. leguminicola, in toxic clover.

PHOSPHORYLATED PROTEINS IN CAULIFLOWER MOSAIC VIRUS. Peter Hahn and R. J. Shepherd. Department of Plant Pathology, Univ. of Calif., Davis, CA 95616

Gel electrophoretic separation of proteins from P^{32} labeled cauliflower mosaic virus, followed by autoradiography revealed that two of the minor coat protein components are phosphorylated. Acid hydrolysis of virus followed by thin layer separation of amino acids and autoradiography confirmed that the phosphorus moiety was associated with serine and threonine. The two phosphorylated proteins of 44 and 58 kilodaltons were found to be present in virions in varying amounts depending on method of virus purification, age of leaves used as starting material and the strain of virus being used. The two phosphorylated proteins present in minor amounts and the major 37 kilodalton polypeptide were found to have a high degree of homology as shown by tryptic peptide fingerprinting. The major 37 kilodalton coat protein and the 44 kilodalton minor component may both be derived from a 58 kilodalton precursor by proteolytic degradation of the latter.

ASSOCIATIONS OF MICROORGANISMS WITH COTTONSEED EXPOSED TO WEATHERING AND ACCELERATED AGING John M. Halloin. National Cotton Pathology Research Laboratory, P. O. Drawer JF, College Station, Texas 77840

The involvement of microorganisms in the deteriorative processes in cottonseed, commonly referred to as weathering and accelerated aging, was studied. Separate samples of seeds were exposed to field conditions for up to three months, or were incubated in the laboratory at 40C and 100% relative humidity or at 35C and 20% seed moisture for periods up to 25 days. Fungi were the microorganisms most frequently found in association with "weathered" seeds and those subjected to "accelerated aging" at 20% seed moisture; those seeds exhibited slow accumulation of free fatty acids and slow decreases in viability. In seeds subjected to "accelerated aging" at 40C and 100% relative humidity, bacteria were the most frequently occurring microorganisms. Seeds under these conditions rapidly decreased in viability, but accumulated almost no free fatty acids. Seeds containing fungi commonly were viable, but all seeds yielding bacteria were nonviable.

THE INFLUENCE OF EDAPHIC FACTORS ON THE SUPPRESSION OF GAEUMANNOMYCES ROOT ROT OF WHEAT BY NH_4CL+KCL. Mark E. Halsey and R. L. Powelson, Dept. of Botany and Plant Path., Oregon State University, Corvallis, OR 97331.

In a greenhouse study, suppression of root rot by the addition of NH_4Cl+KCl to soil was influenced by soil pH and previous cropping history. Gaeumannomyces graminis var. tritici was introduced into three Oregon soils: a sand (dry-land wheat-fallow, pH 7), a clay loam (3rd yr wheat, pH 5.4) and a sandy loam (not cropped to wheat, pH 6.4). Treatments for each soil were: (1) NH_4Cl+KCl (.01+.005 gm cm^{-2}, resp.), banded with the seed, (2) same, banded 2 cm below the seed and (3) unamended. Plant growth and soil pH were measured at three times; root rot severity was estimated and plant dry weights were obtained at the completion of the 5 wk experiment. Severe (22-47%) root rot occurred in the pH 5.4 clay loam in all treatments. Addition of NH_4Cl+KCl, either with or below the seed, suppressed root rot in the sand and sandy loam. There was less root rot in the dry-land wheat-fallow sand (16%) than in the non-wheat sandy loam (37%), when these were left unamended.

MORPHOLOGICAL GROUPS OF PHYTOPHTHORA MEGASPERMA FROM DOUGLAS-FIR AND THEIR PATHOGENICITY TO SOYBEAN AND ALFALFA. P. B. Hamm and E. M. Hansen, Dept. of Botany and Plant Pathology, Oregon State University, Corvallis, OR 97331.

Two groups of P. megasperma, separated on host range and morphological differences, were isolated from root-rotted Douglas-fir seedlings. Pathogenicity of the Douglas-fir isolates were compared to isolates of P. megasperma from soybean and alfalfa by inoculation on all three hosts. Stem tests were used on Douglas-fir and on the seven soybean race differential cultivars and cultivar Tracy. Root inoculations were used on Douglas-fir and Vernal alfalfa. Group 1 isolates from fir were pathogenic to fir in both soil and stem inoculations and pathogenic to all soybean cultivars. Group 2 isolates from fir were pathogenic to fir only when stem inoculated. Soybean and alfalfa isolates were pathogenic only on their original hosts. In culture, the fir Group 1 isolates grew more rapidly than Group 2 isolates over the temperature range 5-30°C. Group 1 isolates grew at 35°C but Group 2 isolates did not. Fir Group 1 formed smaller oogonia (ave. dia. 41 µm vs. 51 µm) and sporangia (ave. 52 X 35 µm vs. 62 X 43 µm) than Group 2 isolates.

EVIDENCE SUGGESTING IDENTITY BETWEEN ALFALFA LATENT AND PEA STREAK VIRUSES, R. O. Hampton, USDA SEA-AR, Dept of Bot & Plant Pathol, Oregon State Univ, Corvallis, OR 97331.

Alfalfa latent virus (ALV), reported to have a capsid subunit molecular weight (c.s.m.wt.) of 27,000 d, was differentiated from a type isolate of pea streak virus (PSV) having a c.s.m.wt. of 33,500 d. This PSV type isolate was serologically cross-reactive with red clover vein mosaic virus (RCVMV), with an equal c.s.m.wt. Conversely, Corvallis reference isolates of PSV had c.s.m.wt. maxima of 29,000 d, and were serologically distinct from RCVMV. In this study, ALV and PSV isolates comprised a single particle length (630 nm), cross-reacted serologically, and were serologically distinct from RCVMV. Tests of 63 alfalfa field samples and 25 PSV reference isolates by enzyme linked immunosorbent assay, and selected virus isolates by SDS-gel serology, indicated that these antisera contained a single virus-specific antibody. ALV was distinguishable from PSV only by symptomatology in Pisum and other selected hosts. These results suggest that ALV is a mild strain of PSV, and perhaps should be considered nominally as the alfalfa latent strain of PSV.

SOIL-RELATED GREENHOUSE SPREAD OF BEAN MILD MOSAIC VIRUS, R. O. Hampton and C. L. Hancock, USDA SEA-AR, Dept of Bot & Plant Pathol, Oregon State Univ, Corvallis, OR 97331.

Bean mild mosaic virus (BMMV) was received at Corvallis in 1975 in mixture with peanut stunt virus. After separation, identification, and reference-storage, we intended to discontinue work with BMMV. However, this virus recurred sporadically and inexplicably in subsequent greenhouse plantings of beans. Following preliminary tests, virus transmission was readily demonstrated by root contact. Transmission also occurred when healthy plants were grown in 'infested soil' from which most of the infected bean roots had been removed. Finally, transmission occurred when healthy plants were grown in non-cleansed 'infested containers'. Time required to detect soil-related transmission by gel serology ranged from 54 to 90 days. BMMV-transmitting soils contained Paratylenchus, Pratylenchus, Dorylaimus, Tylenchus, and saprozoic nematode species, but no recognized vectors of plant viruses. Soil transmission suggests a means by which BMMV may have become established as a contaminant with peanut stunt virus in the initial inoculum.

CHARACTERISTICS OF SURVIVAL OF PYTHIUM ULTIMUM IN SOIL. J. G. Hancock, Dept. of Plant Pathology, University of California, Berkeley, CA. 94720

The decline in natural soil populations of Pythium ultimum in the field occurred in logistic fashion. Following population growth in crop residues, an initial rapid population decline occurred over 2 to 3 months with an average half-life ($t_{\frac{1}{2}}$) of ca. 30 days. The average rate of decline in the second phase was slower with a $t_{\frac{1}{2}}$ of 125 days. Reproductive bodies formed naturally in cotton leaves or from culture showed initial logistic population declines ($t_{\frac{1}{2}}$ = 25 to 30 days) for 2 to 3 months in sandy loam or clay soils held at -70 mbar matric potential and 19 ± 2 C. Initial logistic declines were followed by stable or increased populations of P. ultimum. Population increases noted after the initial decline coincided with oospore ripening or conversion from endogenously dormant spores to exogenously dormant ones. The initial decline in propagules (sporangia) was less evident and the subsequent increase in population (oospore ripening) was more prominent if soils were sterilized prior to amendment with P. ultimum reproductive bodies.

PURIFICATION AND PARTIAL CHARACTERIZATION OF A SOUTH CAROLINA ISOLATE OF ARABIS MOSAIC VIRUS. M. K. Handley and O. W. Barnett, Jr., Dept. of Plant Pathology and Physiology, Clemson Univ., Clemson, SC 29631.

Arabis mosaic virus was found in a native dogwood tree near Clemson, SC. Various purification procedures were investigated with the following procedure giving the most consistent results. Infected Nicotiana clevelandii tissue was homogenized in 1 volume of cold 0.05 M sodium phosphate, pH7 with 0.002 M EDTA and 1% 2-mercaptoethanol. The homogenate was emulsified with an equal volume of cold 1:1(v/v) butanol:chloroform. Low speed centrifugation was immediately followed by PEG precipitation (1% NaCl and 10% PEG-6000). One or two cycles of differential centrifugation, and banding in a 10-40% sucrose gradient further purified the virus. The relative amounts of bottom, middle, and top components, as well as host contaminants, varied with season, propagative host, purification procedure, and age of infection. The coat protein molecular weight was about 53,000 daltons. Two major RNA species were found, with molecular weights of approximately 2.6 x 10^6 and 1.9 x 10^6 daltons.

CHARACTERIZATION OF SPORE-COLOR MUTANTS OF BIPOLARIS SOROKINIANA H. Harding, Research Station, Agriculture Canada, 107 Science Cres., Saskatoon, Sask. S7N 0X2

Approximately 40 spore-color mutants of Bipolaris sorokiniana including some produced experimentally as well as several isolated from wheat subcrown internodes from plots and commercial fields, have been characterized for several attributes. All produce at least some toxin and all are pathogenic to a degree although there is a wide range of reaction. There are marked differences in colony morphology on a range of culture media containing different protein hydrolysates. They appear to be similar in the production of anthraquinone pigments and in their electrophoretic protein profiles. Both mating types are present in approximately equal frequencies.

TWO DIMENSIONAL ELECTROPHORESIS OF LEAF PROTEINS. V. Hari. Dept. of Biological Sciences, Wayne State University, Detroit, MI 48202

SDS-PAGE has served as a powerful tool in the detection of virus related proteins in infected tissues. The 2-D electrophoretic technique of O'Farrel (1976) as applied to the separation of proteins from animal, bacterial and non-pigmented plant tissues was

found to be unsuitable for separation of proteins from uninfected and virus-infected leaves due to the generation of pigment-protein interactions and consequent generation of artifacts. Several different modifications of the O'Farrel (1976) method were tried. Best results were achieved by extracting the proteins from the virus-infected or healthy leaves with a solution containing 5mM K_2CO_3, 9.5M urea, 0.5% dithiothreitol, 2% NP-40 detergent, 500µg/ml L-Lysine, and a 5% mixture of ampholines, followed by de-pigmenting the proteins by several extractions using 70% acetone. The de-pigmented proteins were treated with DNase and RNase and then resuspended in the extraction buffer and used for IEF in the first direction followed by SDS-PAGE in the second direction. The method has been applied to tobacco mosaic virus (TMV) infected leaves and the results are now being analyzed.

SPORULATION OF BIPOLARIS MAYDIS ON INFECTED CORN LEAVES: ROLE OF LEAF LEACHATES. T. J. Harrison and M. O. Garraway. Dept. of Plant Pathology, The Ohio State University, Cols., OH 43210, and Ohio Agri. Res. and Dev. Cent., Wooster, OH 44691.

Electrolyte leakage from and sporulation on B. maydis race T-infected Texas male-sterile cytoplasm (Tms) corn were ten times higher than from race T-infected normal cytoplasm (N) corn or B. maydis race O-infected Tms and N corn. Sporulation of race T was low and comparable on water agar containing only leachates from healthy and infected Tms and N corn. However, when these agar plus leachate media were amended with carbohydrate (glucose, amylopectin, or xylan), sporulation was increased. The greatest increase in sporulation occurred on those leachates from race T-infected Tms corn. Thus, for high sporulation on infected Tms corn, B. maydis race T requires a source of carbohydrate in addition to that present in nutrients which leak from the cell cytoplasm. This extra source of carbohydrate appears to be the corn cell wall. Moreover, the production by B. maydis of cell wall degrading enzymes, such as xylanase, appears to be an intermediating factor in this phenomenon.

EFFECT OF LEAFSPOT FUNGICIDES CHLOROTHALONIL AND CAPTAFOL ON GROWTH, OXALIC ACID PRODUCTION AND VIRULENCE OF SCLEROTINIA SCLEROTIORUM. F. C. Hau and M. K. Beute, Dept. of Plant Pathology, N. C. State University, Raleigh 27650.

Maximum growth of Sclerotinia sclerotiorum in glucose succinate yeast salt (GSYS) medium (25 ml/125 ml flask, pH 5.8) was reached after 12, 16, and 18 days, respectively, on nonamended, 0.2 ppm chlorothalonil-amended, and 0.2 ppm captafol-amended medium. In nonamended GSYS medium, oxalic acid production increased as mycelial dry weight increased (maximum of 13.5 mg oxalic acid/flask). In GSYS medium amended with either chemical, oxalic acid production was not correlated with mycelial dry weight but after 8 days reached peaks of 29.0, 28.5 and 11.5 mg/flask with 0.2 ppm chlorothalonil, 0.2 ppm captafol and nonamended medium, respectively. Inoculation of 2-cm peanut stems with chlorothalonil-treated (0.25 ppm) and nontreated oat grain inoculum resulted in electrolyte conductance readings of 155 and 45 µmho, respectively, when stems were placed in deionized water for 70 min. Inoculation of 2-month-old peanut plants with chlorothalonil-treated inoculum enhanced virulence of S. sclerotiorum, compared to nontreated inoculum, in greenhouse tests.

RELATIONSHIP OF SPROUT DIAMETER TO CANKER AREA AND INCIDENCE OF BLIGHT ON AMERICAN CHESTNUT. F.V. Hebard, G.J. Griffin & J.R. Elkins, Dept of Plt Path & Physiol, VPI&SU, Blacksburg, VA, 24061.

Blight incidence (no. diseased sprouts/total no. of sprouts), sprout diameter at breast height (dbh) and stromatal area (sporulation) per canker were measured in two 20X20 m plots for each of 14 sites clearcut 4 to 11 yr previously. Incidence in 4-yr-old clearcuts was about 20%, similar to incidence in mature-forest areas. It increased, approximately linearly with time, to about 100% in 9-yr-old sites. Canker area, and thus stromatal area per canker, was proportional to dbh squared. Dbh was proportional to age of the clearcut. Hence, stromatal area per plot was proportional to age squared. Vanderplank's equation for compound-interest disease could account for the major features of the observed disease-progress curve when a time-squared term was included. Additional modifications optimized the fit. Therefore, of factors previously identified (Phytopathology 69: 1030), differences in sprout diameter may be a principal cause of the low incidence in mature-forest sites and of the epidemics in recently clearcut sites.

REDIRECTION OF PHENOLICS IN CORN MESOCOTYLS AFTER INOCULATION. Dale R. Heim and R. L. Nicholson, Dept. Botany and Plant Pathology, Purdue University, W. Lafayette, IN 47907.

Corn seedlings, resistant and susceptible to Bipolaris maydis and Bipolaris carbonum were grown in the dark for 4.5 days. Seedlings inoculated with spores ($2x10^5$ spores/ml) were incubated at 100% relative humidity for 16 hrs and were then subjected to a photoperiod of 15 hr light (20,000 lux), 9 hr dark. Uninoculated mesocotyls accumulated anthocyanins. Mesocotyls susceptible to B. carbonum and B. maydis failed to accumulate anthocyanins subsequent to inoculation and exhibited lesion development in five days. Mesocotyls exhibiting resistance synthesized anthocyanins 15 to 35 hr later than uninoculated controls. Also, no anthocyanin production occurred at the site of infection or in tissue directly surrounding those sites. There are at least two possible effects on metabolism occurring in the resistant combination; a temporary blockage in the pathway leading to anthocyanins or a temporary redirection of this pathway. In susceptible combinations these same effects may be occurring but are either amplified or permanent.

A PATHOGENIC ENDOMYCORRHIZAL FUNGUS. James W. Hendrix and Hakam Modjo, Dept. of Plant Pathology, University of Kentucky, Lexington, Kentucky 40546.

Tobacco, like most crops, undergoes yield depression unless rotated with other crops. In problem fields, yields can be increased dramatically by soil fumigation; but known pathogens such as Thielaviopsis and Pratylenchus have been eliminated as the cause of poor growth. We obtained from two problem fields pure cultures of Glomus macrocarpus which severely inhibited the growth of tobacco seedlings. Plants inoculated with two or four spores and grown for 40 days were 26-38% the size (fresh wt) of uninoculated plants. The fungus sporulated profusely on the roots of severely stunted plants, but roots were not necrotic. Supported by R.J. Reynolds Tobacco Company.

BASIDIAL STAGE OF RHIZOCTONIA SOLANI, ANASTOMOSIS GROUPS 2 AND 4, ON SUGARBEETS IN OHIO. L. J. Herr, Dept. of Plant Pathology, Ohio Agric. Res. and Development Center, Wooster, OH 44691.

Hymenia of Rhizoctonia solani Kuhn (Thanatephorus cucumeris (Frank) Donk) were found on the underside of Rhizoctonia-diseased sugarbeet petioles in the field in mid-August, 1979. Hymenia were appressed, felty, white to beige in color, loosely attached to the host and grew on sound tissue adjacent to lesions. Later, September 1-7, a foliage blight developed on leaf blades. Hymenia occurred on the lower leaf surface on sound tissue adjacent to lesions. Mass isolates from petioles and leaves consisted of two anastomosis groups, AG-2 and AG-4; AG-2 isolates predominated (50 of 57). Hitherto only AG-4 (R. practicola Kotila) has been associated with occurrence of the basidial stage on sugarbeet and with sugarbeet leaf blight. In greenhouse tests, AG-2 isolates (10 tested) were highly virulent on 7-wk-old sugarbeets, (av. disease rating=3.8 on the scale, 0=healthy, 5=dead). Additionally as expected, AG-2 isolates (50 tested) were less virulent on beet seedlings (av. of 11.2 surviving seedlings out of 25 seed planted) than were AG-4 isolates (7 tested, av. of 3.1 surviving seedlings out of 25 seed planted).

RELATIVE VARIATION, SENSITIVITY, AND FEASIBILITY OF TWO COMMONLY USED METHODS TO ASSESS ASCOSPORE PRODUCTIVITY OF V. INAEQUALIS. C. Heye, J. Andrews, Plant Path., UW, Madison, WI 53706.

To evaluate the standard water bubbler and tower aspirator techniques to quantify ascospores, 36 samples, each of 50 ($2.27cm^2$) discs were cut randomly from scabby McIntosh leaves in the spring and 18 processed once by each method. The bubbler was used following standard procedures; the tower was modified by collecting spores in a cup ($159mm^3$) for later suspension in liquid. Hemocytometer counts (10 subsquares/sample) were adjusted for unit area and normalized (square root). Means, variances (among samples) and coefficients of variation (C) for each method were determined. Tower results varied proportionally less (C=.038=5.39/141.71) than bubbler data (C=.054=15.86/294.57). Results were similar for counts per dry weight. The tower was less sensitive, in that spore yield per unit leaf was smaller. The assay using the tower was 30% faster, and can be further enhanced by enumerating harvested ascospores with a Coulter® Counter. Such enumeration is impossible with samples from the bubbler due to the presence of debris and alien spores.

EFFECT OF TEMPERATURE AND STORAGE OF SOLANUM TUBEROSUM ssp. TUBEROSUM AND SOLANUM TUBEROSUM ssp. ANDIGENA ON SOFT ROT CAUSED BY ERWINIA CHRYSANTHEMI. Oscar Hidalgo and Eddie Echandi. Dept. of Plant Pathology, N. C. State Univ., Raleigh 27650.

Tubers of 12 cultivars of S. tuberosum ssp. tuberosum (STT) and 11 clones of S. tuberosum ssp. andigena (STA) were stored immediately after harvest at 4 and 25 C for 6 and 16 wk. One

group of tubers was inoculated with water suspensions of E. chrysanthemi (10^4, 10^5 and 10^6 cfu/ml). A second group of non-inoculated tubers was tested for electrolyte leakage (EL), total sugars (TS), reducing sugars (RS) and dry matter (DM). At 4 C soft rot incidence increased over time in most STT cv. and STA clones. However, at 23 C soft rot incidence did not increase significantly over time in the same cv. and clones. In STA, soft rot was positively correlated with EL, TS and RS while negatively correlated with DM; correlations were higher when tubers were stored at 4 C. However in STT, soft rot was positively correlated only with EL.

A GENETIC MAP OF THE POTYVIRAL GENOME. Ernest Hiebert and W. G. Dougherty, Plant Pathology Dept., University of Florida, Gainesville, FL 32611.

Product analyses of the in vitro translations of five potyviral RNAs were used to construct a genetic map of the potyviral genome. Four of six distinct translation products detected were identified as virus-specific proteins found in vivo. Translation products presumed to be gene readthroughs on the basis of serological reactions and size were useful in linking the six genes in the potyviral genome. The proposed genetic map for the potyviral RNA is as follows: 5'end-77 to 90 x 10^3 daltons (77 to 90 kd) protein gene - 49 kd protein gene - 41 to 50 kd protein gene - 68 to 70 kd cylindrical inclusion protein gene - 54 to 56 kd protein gene - 30 to 33 kd capsid protein gene - 3' end. The proposed genetic map accounts for nearly all of the estimated coding capacity of the potyviral RNA.

CONVERSION OF THE PHYTOALEXIN MEDICARPIN TO DEMETHYLMEDICARPIN BY COLLETOTRICHUM COCCODES. Verna J. Higgins and John L. Ingham, Dept. of Botany, Univ. of Toronto, Toronto, Canada, M5S 1A1; and Phytochemical Unit, Dept. of Botany, Univ. of Reading, Reading, RG6 2AS, England.

The structure and antifungal activity of CPI, a product formed from medicarpin (3-hydroxy-9-methoxypterocarpan) by Colletotrichum coccodes (=C. phomoides) (Phytopath. 60:269) was, reinvestigated. The product was identified as demethylmedicarpin (3,9-dihydroxypterocarpan) by mass spectrometric, chromatographic and spectrophotometric comparisons with a standard, by methylation to form homopterocarpin (3,9-dimethoxypterocarpan), and by formation of the expected diacetoxy derivative on acetylation. Contrary to the earlier report, demethylmedicarpin was considerably less inhibitory than medicarpin in germination and germ tube growth bioassays with C. coccodes. Tests with the vital stain fluorescein diacetate confirmed that the effect of demethylmedicarpin on metabolic activity of growing germ tubes was less severe than that of medicarpin.

POLYSACCHARIDE-DEGRADING COMPLEX ISOLATED FROM WOOD DECAYED BY PORIA PLACENTA. T. L. Highley, K. E. Wolter, and F. Evans. Forest Products Lab., FS, USDA, Box 5130, Madison, Wis. 53705

An enzyme preparation from sweetgum decayed by the brown-rot fungus, Poria placenta, was active on carboxymethylcellulose, xylan, mannan, α- and β-glucosides, α- and β-galactosides, and β-xyloside, but was inactive on insoluble celluloses. Fractional precipitations, column chromatography on Sepharose 6B, Sephadex G-100 and 200, Ultragel AcA-34, hydroxylapatite, DEAE Bio-Gel A, and isoelectricfocusing did not separate any of the above enzyme activities. A single band removed from thin-layer isoelectricfocusing plates at a pH of 1.8 to 2.0 was found to contain all the polysaccharide-and glycoside-degrading activities. Ampholytes below pH 2.0 may resolve this carbohydrolase-complex into additional bands, however, such ampholytes systems are presently unavailable. The complex eluted from a column of Ultragel AcA-34 with a molecular weight of 180,000 daltons but migrated on SDS-polyacrylamide gels into a number of subunits of lower molecular weights. Apparently the native enzyme is composed of an aggregate of polypeptides.

EPIDEMIOLOGY OF ONION DOWNY MILDEW. P.D. Hildebrand and J.C. Sutton, Dept. of Environmental Biology, University of Guelph, Guelph, Ontario, N1G 2W1, Canada.

A field plot (18.5 x 10 m) of onions was established to study an epidemic of downy mildew caused by Peronospora destructor (Berk.) Casp. in relation to weather variables. For initial inoculum, artificially inoculated plants were maintained in the center of the plot after 14 June. P. destructor sporulated in the source plants 15 times at 1-6 d intervals before 8 August. Downy mildew developed explosively in two major waves, on 8-16 and 17-22 August, respectively. The first wave probably was initiated by spores produced in source plants on 26-30 July. Mildew developed as a diffuse focus which intensified until 25 August when all foliage was destroyed. Weather factors that favored sporulation were night temperatures of 7-20C, mean daytime temperatures <22C, relative humidity >90% beginning before 0300 hours EST, and the absence of rain. Dew periods persisting until 1000 or 1100 hours favored infection in late July and August.

EFFECTS OF RHIZOCTONIA SOLANI (AG3) ON POTATO. Curtis B. Hill and Neil A. Anderson. Department of Plant Pathology, University of Minnesota, St. Paul, MN 55108.

In field tests at 3 locations in Minnesota, natural infestation of potato seed tubers with Rhizoctonia solani or inoculation of "clean" seed with the fungus generally reduced yields and increased black scurf on the resulting crops. Average yield from "clean" Kennebec seed was 240.2 cwt/acre on irrigated sand. Average yields when Kennebec seed tubers were inoculated with 3 and 6 corn kernels infested with R. solani were 185.4 and 117.4 cwt/acre respectively; average yield reductions were 27.4% and 40.4% for Russet Burbank and 28.4% and 36.6% for Red Pontiac. Tubers with black scurf produced by "clean" seed inoculated with 3 and 6 corn kernels containing the fungus were 1.2, 70.0 and 72.7% for Russet Burbank; 1.9, 71.4 and 49.6% for Kennebec; 0.9, 77.8 and 66.8% for Red Pontiac. Emergence was delayed by inoculating tubers but not by using naturally infested tubers. The above treatments had no effect on grade.

UTILIZATION OF PURIFIED ANTI-SOYBEAN MOSAIC VIRUS-IgG IN ENZYME-IMMUNOASSAY. John H. Hill, G. R. Bryant, and D. P. Durand, Depts. of Plant Pathology, Seed and Weed Sciences, and Bacteriology, Iowa State University, Ames, IA 50011

Non-specific background reactions can be a problem in detection of plant viruses with the enzyme-linked immunosorbent assay. Initial tests to detect soybean mosaic virus (SMV) using electrophoretically pure anti-SMV-IgG revealed little difference in background reaction between healthy sap in 0.05M Na borate, pH 7.2(BB) and the BB control. This suggested background was caused by non-blocked sites on the IgG-coated polystyrene wells. Addition of a second ovalbumin coat (generally 1.0%) reduced reaction of healthy extract. Binding ratios of the reaction of SMV to reaction of healthy extract were 3.12 (0.2%) ovalbumin), 4.33 (1.0% ovalbumin), and 4.50 (5.0% ovalbumin). A classical first order kinetics curve related alkaline-phosphatase-labeled IgG concentration to OD_{405} with a clear optimum (maximum binding ratio) near saturation at 50 µg/ml. Using the optimal IgG coating concentration of 1 µg/ml, 2.5 ng/ml SMV were detected in BB and seed extract prepared in BB.

THE LOGNORMAL DISTRIBUTION OF EPIPHYTIC BACTERIAL POPULATIONS. S. S. Hirano, E. V. Nordheim*, D. C. Arny and C. D. Upper#, Dept. of Plant Pathology, *Depts. of Forestry and Statistics and #SEA, USDA, University of Wisconsin, Madison, WI 53706

Total populations of epiphytic bacteria and selected components thereof were determined on 24 to 36 individual leaves (corn, rye) or leaflets (beans, soybeans, tomatoes) at selected times during the growing season by washing and dilution plating. Populations of fluorescent bacteria or ice-nucleation-active bacteria (i.e. component populations) were quantitatively more variable from leaf to leaf within a set than were total populations. Populations of a given component frequently varied over a range of 100 to 1000-fold within a set of leaves; total bacterial populations usually varied by 10-fold. For each set of leaves, total and component populations were found to approximate a log-normal distribution by the Wilk-Shapiro test for normality. Due to the lognormal distribution of bacterial populations, numbers of epiphytic bacteria determined from bulked samples (i.e. wherein several leaves are washed together) will overestimate the mean $\log_{10}$ population by a factor of $\simeq 1.15s^2$.

TOXICITY OF CERATO-ULMIN (CU) TO WHITE ELM. S. Takai[1] and Y. Hiratsuka[2]
[1]Great Lakes For. Res. Ctre., Sault Ste. Marie, Ont. P6A 5M7 and [2]Northern For. Res. Ctre., Edmonton, Alta. T6H 2S6. Can. For. Serv.

Toxicity to cuttings was evaluated through change in transpiration (TR) and wilting. The lowest concentration of CU for significant reduction in TR was 30 µg/ml in 2 h treatment. Xylem wood discoloration began within 5 h of the start of CU treatment at 60 µg/ml; coating over the vessel wall and bubble formations, common symptoms of DED, were observed by SEM. Based on MW,

culture filtrates for both aggressive and non-aggressive C. ulmi strains were fractionated. Of the fractions tested for the aggressive strain the UM2-R fraction containing CU was the highest in toxicity and similar to the unfractionated filtrate; on the contrary the toxicity of both the UM2-R and unfractionated filtrate of the non-aggressive strain were considerably less. Dextran T10 (10,000 MW) which is in the same molecular weight range as the UM2-R fraction was non-toxic, thus toxicity of CU may not be attributed by its MW.

DIAPORTHE DIEBACK OF SOYBEAN CAUSED BY DIAPORTHE PHASEOLORUM VAR. CAULIVORA. Thomas W. Hobbs, A. F. Schmitthenner, and C. Wayne Ellett. Dept. of Plant Pathology, The Ohio State University, Columbus, OH 43210 and OARDC, Wooster, OH 44691.

Diaporthe phaseolorum var. caulivora (Dpc) causes a top dieback of soybean. The disease develops late in the season and is distinct from soybean stem canker, which is also incited by Dpc. Symptoms of Diaporthe dieback appear as premature death of the five or six uppermost internodes. The pathogen was consistently isolated from pods and seeds taken from nodes in the dieback area of affected field plants. In field studies, isolates of Dpc induced dieback in tip-inoculated plants and stem canker in lower internode-inoculated plants, and the pathogen was consistently re-isolated from these plants. The incidence of Dpc in seeds of field-grown soybeans was higher when debris containing Diaporthe (including D. phaseolorum var. sojae) perithecia was present than when the debris was absent. Levels of Dpc were higher in seeds from upper nodes than from lower, but dieback symptoms were not observed.

DIRECT ISOLATION OF NEW RACES OF PHYTOPHTHORA MEGASPERMA VAR. SOJAE FROM NW OHIO SOILS. M. A. Hobe and A. F. Schmitthenner, Dept. of Plant Pathology, The Ohio State Univ., Columbus, OH 43210 and the Ohio Agric. Res. and Devel. Center, Wooster 44691.

Phytophthora megasperma var. sojae (Pms) was isolated from soil samples of nine Ohio soybean fields observed to have a high incidence of Phytophthora rot. Soil was sieved, adjusted to a standard soil matrix potential with ice, packed into short lengths of PVC tubing, stored at 7 C for 3 mo, frozen (-20 C) for 1 wk, and incubated at 25 C for 1 wk. Then 9 g of soil was placed in a 50 ml beaker and flooded with distilled water. Floating organic debris was removed. Leaf discs from the unifoliates of 2-wk-old 'Amsoy' soybeans were floated for 90 min, blotted, and placed on a new selective medium to isolate Pms. Races were identified by hypocotyl inoculation of 10 soybean cultivars. The most prevalent was race 7; 24 new races were found. 'Tracy' and 'Kingwas', which are resistant to most races, were susceptible to many of the new races. Pms isolated from diseased soybeans from the same fields did not reveal any new races or as many different races as did the soil isolations.

STANDARDIZED TRANSMISSION PROCEDURE FOR NEMATODE SWARMING VIRUS. J. P. Hollis, I. K. A. Ibrahim and M. M. Joshi. Dept. Plant Path. & Crop Physiol., La. State Univ. Agric. Expt. Sta., Baton Rouge, LA 70803.

Swarming populations of Tylenchorhynchus martini Fielding 1956 (worms and eggs) were isolated from greenhouse pots on a 500-mesh screen. Suspensions, treated with 20 percent chlorox for four minutes to kill worms and sterilize eggs, were added to Styrofoam-soil cups of rice seedlings, incubated under gro-lux lamps and watered by movement of distilled water through basal perforations. After 45 days, populations were extracted and manual pairing and grouping of hatched larvae showed only non-swarmers. This population was transferred to new Styrofoam-soil cups of rice seedlings and then extracted again after 51 days (96 days after removal of the original population from greenhouse pots). Swarmers were manifest in this second extraction. Results showed: (a) three month induction period (nonswarming to swarming), (b) nontransmission of virus through or upon egg stage, (c) six week time frame in which transmission tests of the virus can be made from greenhouse swarmers to nonswarming egg-hatched larvae.

DYE DISTRIBUTION IN TRUNK-INJECTED VS. ROOT-INJECTED ELMS. Francis W. Holmes, Shade Tree Laboratories, University of Massachusetts, Amherst, Mass. 01003.

To try to account for variable success in control of Dutch elm disease with injected fungicides, we pressure-injected 1% acid fuchsin dye at 1.1 kg/cm^2 in June 1978 and July 1979 into 10-cm dbh American elms. Each year certain elms were injected through hollow, tapered, plastic spiles driven into holes drilled in their trunks ("ERI method") and other elms were injected through the cut ends of severed roots ("Kondo method"). In trunk cross-sections made later the same day at various heights, staining in the ERI-method elms was very slightly or not at all in the current year's wood, but it appeared in the rings of the preceding 4 to 6 years. In the trunks of the Kondo-method elms, on the other hand, the dye appeared almost entirely in the current season's wood. The Kondo method, therefore, seems the more likely to place a fungicide on target, since in newly infected elms Ceratocystis ulmi ordinarily occurs only in the current year's xylem vessels.

CHARACTERISTICS OF KRAFT PAPER MADE FROM *SEPTORIA* CANKERED *POPULUS* GROWN UNDER SHORT-ROTATION, INTENSIVE CULTURE. K.E. Holt, H.S. McNabb, Jr., M.A. Rothlauf, F.G. Manwiller, and M.E. Ostry. Bessey Hall, Iowa State Univ., Ames, IA 50011 and North Cent. For. Exp. Sta., Folwell Ave., St. Paul, MN 55108.

A 0.144-ha, central Iowa plantation of 4 hybrid *Populus* clones including NC5272, *P. nigra* X *P. laurifolia*, highly susceptible to cankers caused by *Septoria musiva*, was planted in June 1977 and partially coppiced in winter 79-80. Cankers often are invaded by other fungi that girdle and cause stem breakage. Therefore *Septoria* cankers can not be tolerated in pulp stands of *Populus* beyond 3-year rotations. To determine effect of cankers on paper quality, comparable normal and cankered material from coppiced NC5272 was chipped, characterized and made into kraft paper handsheets in accordance with TAPPI Standard T205; and tested following Standard T220 M-60. Cankered material produced paper that stretched significantly further; had lower tensile and bursting strength, burst factor and breaking length; and had higher lignin and extractive content than normal wood. Cankered material is an unsatisfactory sole source of pulp fiber. Amount of cankers allowable in chip batches is being determined.

"WHITE BLOTCH " OF WHEAT CAUSED BY BACILLUS MEGATERIUM. R. M. Hosford,Jr. Dept. Plant Pathology, North Dakota State University, Fargo, ND 58105

Severe white spots and streaks ("white blotch") on wheat leaf blades and sheaths have appeared on an increasing number of spring, winter and durum wheats at several locations in North Dakota since 1971. A variant of Bacillus megaterium was isolated from 10 to 100% of the blotches when infected leaves were washed in warm tap water with detergent then rinsed in warm tap water. It was isolated from 10 to 90% of surface sterilized seed of three susceptible cultivars. Koch's postulates were successfully completed with eight strains of the variant using leaf dip, air brush, syringe and leaf smear inoculations. Pseudomonas syringae from winter wheat produced greenish-white to white to very light tan streaks and spots that closely resembled "white blotch". In contrast to the initial water-soaked green streaks produced by P. syringae, the initial symptom of B. megaterium was a diffuse yellow coloration without water congestion. Expression of symptoms in the glasshouse was often erratic; high temperatures and light intensities apparently accelerated and intensified symptom expression of "white blotch".

PROPERTIES OF CAULIFLOWER MOSAIC VIRUS DNA LABELED IN VIVO WITH TRITIATED URIDINE. Alan J. Howarth and Robert J. Shepherd, Department of Plant Pathology, Univ. of Calif., Davis, CA 95616

Cauliflower mosaic virus DNA labeled by incubation of leaf slices in [5-^{3}H] uridine (as described by Daubert, S. D., et al. 1978. Eur. J. Biochem. 92, 45) acquired a specific activity about one-fifth that of DNA similarly labeled with [methyl-^{3}H] thymidine. Incorporation of the radioactive label was 5-fold higher when leaf slices were incubated at 14°C than at 19°C. When the four common deoxyribonucleosides were added to the ^{3}H-uridine solution to a molar equivalent concentration, or to 100 times the molar equivalent concentration, labeling was reduced by about one-half. Segments of the labeled DNA cleaved by restriction endonucleases followed by gel electrophoretic separation and autofluorography showed uniform distribution of the uridine label. The ^{3}H-uridine label was more sensitive to removal by alkali, RNase A, and DNase 1 than was ^{3}H-thymidine label.

BIOLOGICAL CONTROL OF PYTHIUM ULTIMUM AND RHIZOCTONIA SOLANI INDUCED DAMPING-OFF OF COTTON SEEDLINGS WITH GLIOCLADIUM VIRENS C. R. Howell, National Cotton Pathology Research Laboratory, P.O. Drawer JF, College Station, Texas 77840.

Cottonseed planted in soil infested with Pythium ultimum or Rhizoctonia solani were treated in the furrow with cultures of

Gliocladium virens grown on Peat Moss medium. This treatment resulted in significnt increases in the number of emerged and surviving seedlings over the nontreated controls.

On synthetic media, G. virens exhibited antibiotic activity toward P. ultimum and acted as a mycoparasite on both pathogens. Two antibiotics were isolated from culture filtrates of G. virens: the first exhibited antibacterial activity, but was not antifungal; the second was highly inhibitory to P. ultimum, but was inactive against R. solani.

UV induced mutants of G. virens deficient for antibiotic production did not suppress damping-off of seedlings by P. ultimum when used to treat cottonseed in infested soil. Mutants with enhanced antibiotic activity were better biocontrol agents than the parent isolate.

IMMUNOSORBENT ASSAYS FOR TOMATO RINGSPOT VIRUS IN STONE FRUIT TREES. J. W. Hoy, S. M. Mircetich, and R. J. Shepherd, USDA/SEA, AR, Dept. of Plant Pathology, Univ. of Calif., Davis 95616

We investigated the efficiency of enzyme-linked immunosorbent assay (EIA), radio-immunosorbent assay (RISA) and mechanical transmission (MT) for detection of tomato ringspot virus (TomRSV) in Prunus spp. TomRSV was detected directly by EIA and RISA in cambium extracts of sweet, Mahaleb, and Manchu cherries, Myrobalan and Japanese plums, peach, apricot, and almond. Trees of 4 Prunus spp. were graft inoculated with TomRSV stem pitting strain, and virus was detected in cambium extracts in 4 of 30 (13%) by MT compared with 57 of 60 (95%) by EIA. MT, EIA, and RISA efficiencies were compared using cambium extracts from prune trees naturally affected with brownline disease. TomRSV was detected by MT in 4 of 32 (12%), by EIA in 18 of 35 (51%) and by RISA in 34 of 35 (97%) samples. These results indicate that RISA and EIA are much more reliable than MT for detecting TomRSV in stone fruit trees.

EFFECTS OF TEMPERATURE ON TOBACCO ETCH VIRUS (TEV) AND ASSOCIATED INCLUSION BODIES. H. T. Hsu, R. H. Lawson, and J. A. Aebig, American Type Culture Collection, Rockville, MD 20852, and USDA, SEA-AR, Beltsville, MD 20705.

Tobacco etch virus-infected Nicotiana tabacum "Xanthi", plants were grown at 21, 26, and 32 C with 2000 ft-c fluorescent illumination on a 16-hr light period and processed about 2-3 weeks after inoculation. Serological tests of crude sap showed that plants grown at 21 C contained 9-18 times more virus than those grown at 32 C, whereas plants grown at 26 C contained 4-13 times as much as at 32 C. About 40 and 30 times more purified virus was recovered from plants grown at 21 and 26 C, respectively, than at 32 C. Cytoplasmic cylindrical inclusions were observed in thin section microscopy at all three temperatures but nuclear inclusions were present only in plants grown at 21 and 26 C. Inclusion yields from plants grown at all three temperatures were similar as measured by inclusion antiserum (a gift from Dr. D. Purcifull) and protein determination. The virus concentration in inclusion extracts of plants at all three temperatures was similar when tested serologically.

PRESERVATION AND COMPARATIVE USE OF POLYSTYRENE BEADS AND PLATES FOR ENZYME-LINKED IMMUNOSORBENT ASSAY TESTING. H. T. Hsu and F. P. Simione, American Type Culture Collection, Rockville, MD 20852

Enzyme-linked immunosorbent assay procedures were compared using different preservation methods in tests with tobacco ringspot, carnation ringspot and potato X viruses. Polystyrene beads of 3/16 or 1/4 inch in diameter, or polystyrene plates pre-coated with viral-specific antibodies could be stored lyophilized at 22-24 C for two months or at 4 C for six months without noticeable loss of sensitivities. After storage for five to six months at 4 C, satisfactory results were obtained using the reconstituted lyophilized alkaline phosphatase-antibody conjugates. Similar results were also obtained for those enzyme-antibody conjugates stored at 4 C in suspension form in 50% saturated $(NH_4)_2SO_4$ solution, pH 7.2 containing 1mM $MgCl_2$ and 0.1 mM $ZnCl_2$. Polystyrene beads sensitized with hepatitis B virus antibodies are used for clinical tests. This is the first report on the use of such beads for plant virus serology.

SYNTHESIS OF PROTEINS DURING DIFFERENTIATION OF BEAN RUST FUNGUS. Bor-Fuei Huang and Richard C. Staples, Boyce Thompson Institute for Plant Research, Cornell University, Ithaca, NY 14853.

Three types of proteins were synthesized in six hours when uredospores of the bean rust fungus (Uromyces phaseoli (Pers.) Wint.) were germinated and induced to differentiate. These proteins were either related to germination, germ tube elongation or formation of the appressorium. The synthesis of differentiation-related proteins was closely synchronized with nuclear DNA synthesis and the appearance of the appressorium. Synthesis of polyadenylic acid did not begin until later when vesicles began to form. These results suggest that the contact stimulation received by the germ tube reprograms the synthesis of proteins for the construction of infection structures.

PURIFICATION AND CHARACTERIZATION OF A BACTERIOCIN FROM CORYNEBACTERIUM MICHIGANENSE STRAIN 15-2. Jeng-sheng Huang and Eddie Echandi, Department of Plant Pathology, North Carolina State University, Raleigh, N. C. 27650.

Corynebacterium michiganense strain 15-2 was grown in semi-synthetic potato broth for 3 days. Cells harvested by centrifugation were suspended and sonicated in 0.05 M Tris-HCl buffer, pH 7.2. After clearing the sonicated suspension by repeated centrifugations, a protein fraction was precipitated with 30-60% ammonium sulfate, dialyzed and centrifuged at 150,000 g. The pellet was then resuspended in buffer, applied to a Bio-Gel A-50m column and the active fractions pooled, concentrated and applied to a second column. Active fractions were pooled again and referred to as purified bacteriocin. The purified bacteriocin migrated as a single band in agarose-acrylamide composite gel during electrophoresis and had specific activity of 40,000 arbitrary units/mg protein against an indicator, C. michiganense strain 14-4. The purified bacteriocin was trypsin and pronase-sensitive, DNase and RNase-resistant, heat-labile at 80 C for 15 min, and had hexagonal morphology as revealed by electron microscopy.

YIELD AND QUALITY OF SOFT RED WINTER WHEAT INFECTED WITH RHIZOCTONIA SPRING BLIGHT. Don M. Huber, Botany and Plant Pathology, Purdue University, W. Lafayette, IN 47907.

This study was conducted to determine the relationship of Rhizoctonia spring blight severity to yield and grain quality. Abe winter wheat seeded in 2.5 m rows at 132 kg/ha in soil naturally infected with Rhizoctonia varied from 40 to 100% of the plants killed. Ten randomly selected rows, each with 95, 80, 70, 60, or 45% of the plants killed, were harvested and grain yield, protein, and thousand kernel weight determined. Grain yield was directly proportional to the remaining plant population; however, the increased thousand kernel weight as disease increased indicates injured plants partially compensate for fewer kernels by producing larger ones. Grain protein sharply decreased as disease severity increased (from 13 to 12%) with the exception of markedly higher protein content (13.6 to 14.7%) when fewer than 5% of the plants survived. The lower grain protein with increased disease probably reflects the loss of nutrients in necrotic foliage which is not available for translocation during fruiting.

ELECTRON MICROSCOPY OF SOYBEANS INFECTED WITH TWO ISOLATES OF SOYBEAN MOSAIC VIRUS. P.L. Hunst and S.A. Tolin, Department of Plant Pathology & Physiology, Virginia Polytechnic Institute & State University, Blacksburg, Virginia 24061.

A virus isolate, collected in 1979 from a 'Mitchell' soybean plant at Orange County, VA, was serologically identified as soybean mosaic virus (SMV). Numerous flexuous rods in membrane-bound bundles were observed in leaf dip preparations. Samples of primary and trifoliolate leaf tissues from 'Essex' soybean plants, mechanically inoculated with the 'Mitchell' isolate, were examined by electron microscopy and compared to tissue samples infected with a type isolate of SMV. Cytoplasm of cells infected with the 'Mitchell' isolate had an abundance of scroll-type pinwheels and aggregates of SMV particles. Cytoplasmic strands, with SMV-like particles between the membranes, were frequently observed traversing the vacuoles of the spongy and paraveinal mesophyll cells. In contrast, no cytoplasmic strands were observed in the type isolate-infected tissue samples.

VARIATION IN VERTICICLADIELLA WAGENERII. R.S. Hunt, Pac. For. Res. Centr., Victoria, B.C. V8Z 1M5, Canada.

A diverse collection of Verticicladiella wagenerii could be separated from V. procera by large hyphae, 2-6 μm wide on PDA, and lack of a strong odour like methyl valerate. Conidiophores were in tufts or randomly rather than in concentric circles and

rhizoids were rare and small. Heads of V. wagenerii typically became "club-shaped", and spores were oval to obovate 2.1-4.2 x (3.2)5.3-8.4(12.6) µm on PDA. Slow growing isolates had spherical heads and spores pyriform to oval, 1.5 x 2.1 µm - features more typical for V. procera. Within V. wagenerii there were isolate gradations for colour; hyphal growth, looped, sinuous or straight, slow to rapid; and optima, 15-22 C. Spore colour en masse, varied with isolate and age. Spore heads varied among and within isolates, from compound to a single conidiophore, or sterility; also, in many isolates secondary spores budded-off primary spores. At the species level V. wagenerii is variable, with no morphological characters splitting it into subgroups. Single conidiospore isolates resemble the parent, suggesting stability within a clone.

DESIGN OF AN ACOUSTICAL PARTICLE COUNTER AND ITS USE IN PHYTOPATHOLOGICAL RESEARCH. Martin W. Imhoff and S. C. Coover, Dept. of Plant Pathology, N. C. State University, Raleigh, NC 27650 and Dept. Environmental Sciences and Engineering, University of North Carolina, Chapel Hill, NC 27514.

An acoustical particle counter and rotorod samplers were used to monitor spores of Uromyces phaseoli on snapbean during the course of four epidemics in controlled environment chambers. Acoustical counts and rotorod counts were highly correlated (r=0.98), with approximately one acoustical count for every 26 rotorod counts. Disease increase as measured by a visual rating scale was highly correlated with both acoustical counts (r=0.94) and rotorod counts (r=0.96). Immediate digital readout, simplicity of design, and large sampling volume give the acoustical counter advantages over other particle counting methods for some phytopathological investigations. The description, performance characteristics, theory of operation, and application of the acoustical counter are discussed.

EFFECT OF TEMPERATURE, DEW PERIOD, AND AGE OF LEAVES, SPORES, AND SOURCE PUSTULES ON GERMINATION OF BEAN RUST UREDIOSPORES. Martin W. Imhoff and C. E. Main, Department of Plant Pathology, N. C. State University, Raleigh, NC 27650.

Urediospores of Uromyces phaseoli were germinated on wetted snapbean leaf disks on water agar in seed germination chambers. Minimal germination occurred at 10C and 25C; none occurred at 4C and 27.5C. Maximal germination, 93%, occurred from 17.5C to 22.5C. Within the first 6-8 hr of wetness, 90% of all germinations occurred. Spores stored 14-21 days in growth chambers showed little or no reduction in germinability. Spores from old leaves or pustules germinated only two-thirds as well as spores from young leaves or pustules. Germinability after interrupted wetting periods was reduced for well-spaced spores and increased for clumped spores. Spores wetted at least 2 hr continued germination if relative humidity remained greater than 85%. Spores produced at 24-27C germinated about half as well as those produced at 16C or 21C. Equations describing temperature-dew period interactions were developed. Effects of all other treatments could be expressed as fractional responses of the maximal germination at a given temperature and dew period.

IMPROVED DIFFERENTIAL MEDIUM FOR DETECTION AND ENUMERATION OF ERWINIA AMYLOVORA. C. A. Ishimaru, and E. J. Klos, Department of Botany and Plant Pathology, Michigan State University, East Lansing, MI 48824.

A new differential medium (CCT) was developed which improves detection of Erwinia amylovora. When cells of E. amylovora are incubated on CCT at 27°C for 72 h distinct pulvinate, transparent blue colonies with radiating lines of deeper blue appear. These colonies are easily distinguishable from E. herbicola. The medium consists of sucrose, 100 g; sorbitol, 10 g; tergitol anionic 7, 30 ml 1% aqueous solution; crystal violet, 2 ml 0.1% solution in absolute alcohol; nutrient agar (Difco), 23 g. After autoclaving, 2 ml of a 1% (w/v) thallium nitrate solution and 50 mg cycloheximide are added. E. amylovora plating efficiency on CCT and standard nutrient glucose medium are not significantly different. Selectivity of CCT was tested with numerous bacterial species. Those species able to grow on CCT produced colonies unlike E. amylovora. In vitro studies demonstrated CCT enables enumeration of E. amylovora when concentrations of E. herbicola are 10^4 times that of E. amylovora.

ETIOLOGY OF AN APPLE REPLANT DISEASE. B. A. Jaffee, G. S. Abawi*, and W. F. Mai. Departments of Plant Pathology, Cornell University, Ithaca, NY 14853 and *Geneva, NY 14456.

A replant disease of apple was reproduced under controlled conditions. Small amounts (2 or 5%, v/v) of untreated soil from a disease-prone area were incorporated into pasteurized (70 C for 30 min) portions of the same soil. Ten-day-old apple seedlings were transplanted into these soils and maintained for 6 wks in a growth chamber (20 C, 15 h of 21 klux/day). Shoot dry weights were reduced 40 and 50% by 2 and 5% additions of untreated soil, respectively. Roots were stunted and had black and orange lesions. Treatment of this soil with chloropicrin (0.5 ml/l), gamma radiation (2.4 Mrad), or pasteurization (60 C) resulted in total disease control. *Pratylenchus* was the most abundant genus of plant parasitic nematode, but its highest density at transplant was only 3/100 cc soil. It was concluded that the detrimental principle in the diluted, disease-inducing soil was a biological agent(s) other than a nematode.

A MODEL FOR PREDICTING ASCOSPORE MATURATION FOR VENTURIA INAEQUALIS. J. R. James and T. B. Sutton, Department of Plant Pathology, North Carolina State University, Raleigh 27650.

Histological studies indicate that temperature and moisture are the predominent factors affecting pseudothecial maturation of Venturia inaequalis. During 3 winters, from leaf fall until mature ascospore development, apple (Malus sylvestris) leaf discs naturally infected with V. inaequalis were collected at 2-wk intervals. Leaf discs were incubated at 4° intervals from 0-32 C with variable durations of leaf wetness and levels of relative humidities. At 4 locations over the same 3-yr period, pseudothecial ontogeny in the field was analyzed using cardinal temperatures, degree days, rainfall, relative humidity and leaf wetness in order to interrelate laboratory and field temperature and moisture levels. Equations to predict rate of pseudothecial development were computed from laboratory data and evaluated using field data.

ENVIRONMENTAL FACTORS INFLUENCING PSEUDOTHECIAL DEVELOPMENT AND ASCOSPORE MATURATION OF VENTURIA INAEQUALIS. J. R. James and T. B. Sutton, Department of Plant Pathology, North Carolina State University, Raleigh 27650.

Histological studies of Venturia inaequalis indicate that pseudothecial ontogeny occurs in two distinct phases. Ascogonia developed after leaf fall until the lumen of the pseudothecia were filled with pseudoparaphyses. Development of asci and ascospores was initiated only after a dormancy or rest period during which no microscopic development was detected regardless of temperature or moisture treatments. Laboratory and field studies over a 3-year period indicated that moisture is a limiting factor for pseudothecial maturity. No pseudothecial development occurred in air dried apple (Malus sylvestris) leaves. Optimum temperature for ascogonium development was 8 to 12 C; 16 to 18 C was optimum for ascospore maturation. Equations were developed to predict stages of pseudothecial development as a function of temperature and moisture.

FIELD INFECTION OF SUDAN GRASS BY MDMV: RANDOMNESS OR RESISTANCE? Stanley G. Jensen and H.J. Gorz, USDA/SEA/AR, Univ. of Nebr., Dept's. of Plant Path. and Agronomy, Lincoln, NE 68583.

Attempts were made to determine if some sudan grass plants in the field did not develop symptoms of MDMV because they were random escapes or because they possessed resistance. One third of 200 plants in an isolation nursery were showing symptoms of natural infection with MDMV by early August, 1979. Progeny from 20 plants showing symptoms and 20 not showing symptoms were grown in the greenhouse, challenged with MDMV-A or MDMV-B and ranked on a scale of zero to 5 for severity of symptoms. Seedlings scoring 0, 1 or 2 were termed resistant; higher scores were classified as susceptible. The proportion of resistant progeny was 2 to 3 times greater from symptomless plants than from plants showing symptoms. It was concluded that symptom expression was not random, but was related to resistance. Removal of diseased plants from the field prior to anthesis will concentrate genes for resistance, but greenhouse screening is more efficient. Resistance in this population resulted in reduced infection and in delayed symptoms.

RELATIONSHIP BETWEEN FUSARIUM OXYSPORUM F.SP. MEDICAGINIS AND CORYNEBACTERIUM INSIDIOSUM IN ALFALFA ROOTS. L.E.B. Johnson, F.I. Frosheiser and R.D. Wilcoxson. Department of Plant Pathology, University of Minnesota, St. Paul, MN 55118.

Corynebacterium insidiosum was adversely affected by Fusarium oxysporum f. sp. medicaginis during disease development in the field, during early disease development in the glasshouse, and

in vitro. In the field, bacterial wilt developed less in alfalfa roots inocultaed with a mixture of both pathogens than in roots inoculated with C. insidiosum alone. This effect was more apparent in Glacier and Salton (susceptible to bacterial wilt) than in Agate and MnPL-4 (resistant to bacterial wilt). In early disease development, C. insidiosum grew less in roots of Glacier alfalfa inoculated with both pathogens than in roots inoculated with C. insidiosum alone. Occasional bacteria were found in vascular cells when vessel elements contained F. oxysporum. In vitro, 18 isolates in 5 species of Fusarium produced a substance only in the presence of mycelium that inhibited C. insidiosum and Rhizobium meliloti.

THE DISCRIMINATORY NATURE OF THE RESISTANCE OF T.I. 1406 TOBACCO TO THREE POTYVIRUSES. Mark C. Johnson and Thomas P. Pirone, Department of Plant Pathology, University of Kentucky, Lexington, Ky. 40546

The nature of the response of the tobacco introduction 1406 (T.I. 1406) to infection by three potyviruses [potato virus Y (PVY), tobacco etch virus (TEV), or tobacco vein-mottling virus (TVMV)] is dependent on the specific virus or virus strain present in the inoculum. Inoculation with TVMV or the type strain of TEV (TEV-R) did not result in the production of detectable symptoms, while inoculation with PVY or a field isolate of TEV (TEV-F) resulted in mild symptom development. This range of symptom production appeared to be correlated with the degree of virus multiplication within the T.I. 1406 plant. Resistance in T.I. 1406 to TVMV and TEV-R was characterized by drastically reduced virus multiplication and limited virus movement. In contrast, there appeared to be no inhibition of virus multiplication or movement in T.I. 1406 plants infected with PVY or TEV-F.

EFFECT OF SEPTORIA NODORUM ON PHOTOSYNTHESIS OF WHEAT FLAG LEAVES WHEN APPLIED SINGLY OR COMBINED WITH TWO BACTERIA. J. B. Jones, Univ. of Georgia, Athens, GA 30602, C. W. Roane and D. D. Wolf, V.P.I. & S.U., Blacksburg, VA 24061.

The effect of Septoria nodorum on the apparent photosynthetic rate (APR) of Olaf wheat flag leaves when applied alone or with either Pseudomonas cepacia or Xanthomonas translucens was studied. Treatments were: 1) S. nodorum, 2) X. translucens (10^8 cells/ml), 3) S. nodorum and X. translucens, 4) S. nodorum and P. cepacia (10^8 cells/ml), 5) control. At 24 C with 10^6 spores/ml of S. nodorum the average APR's (averaged over 14 days) were 11.3, 14.8, 9.8, 14.1, and 13.1 mg $CO_2/h/dm^2$ for treatments 1-5, respectively. With 5 x 10^6 spores/ml the average APR's were 13.0, 15.7, 11.1, 14.3 and 15.7 mg $CO_2/h/dm^2$ for the five treatments. With plants incubated at 21 C and with 5 x 10^6 spores/ml, treatments were not significantly different. At 3 x 10^6 spores/ml and with a 12 h cycle of 24 C day and 21 C night, the average APR's were 6.8, 12.8, 10.8, 12.0, and 11.8 mg $CO_2/h/dm^2$ for five treatments. Based on statistical analysis, X. translucens (at 24 C) and P. cepacia may interact synergistically and antagonistically, respectively, with S. nodorum.

EFFECT OF XANTHOMONAS TRANSLUCENS AND PSEUDOMONAS CEPACIA ON GROWTH AND SPORE GERMINATION OF SEPTORIA NODORUM. J. B. Jones, Univ. of Georgia, Athens, GA 30602, and C. W. Roane, V.P.I. & S.U., Blacksburg, VA 24061.

Interactions of Pseudomonas cepacia and Xanthomonas translucens on Septoria nodorum were investigated. An inhibition zone was observed when S. nodorum was seeded on wheat extract agar 96 h after inoculating a chord of the petri dish with P. cepacia; none was produced by X. translucens. Spore germination of S. nodorum was completely inhibited by P. cepacia 1 cm from the bacterial front; X. translucens had no effect. Mycelial growth was inhibited 75 and 79% at 21 and 25 C by wheat extract broth in which P. cepacia was previously grown whereas X. translucens broth caused a slight reduction. Spore germination in phosphate buffer of four isolates of S. nodorum ranged from 66-90% and was reduced by X. translucens and P. cepacia to 26-42 and 0-1%, respectively. After 48 h incubation on excised Olaf wheat leaves, spore germination was unaffected by X. translucens, but P. cepacia reduced germination to 81% of the control. Germ tube development was reduced by both bacteria. In nature, X. translucens may be inhibitory to S. nodorum.

WHEAT STRIATE MOSAIC VIRUS FOUND IN CORN IN SOUTH DAKOTA. V.L. Jons, R.G. Timian and W.S. Gardner, USDA, APHIS-PPQ and SEA_AR, Dept. of Plant Pathology, NDSU, Fargo, ND 58105; and Dept. of Plant Science, SDSU, Brookings, SD 57007.

American wheat striate mosaic virus (WStMV) was recovered from naturally infected N28Ht corn leaves showing distinct, thin, white streaks. Endria inimica leafhoppers were fed on infected corn leaves for 24 hr, then transferred to durum wheat. Following a 12 day incubation period on durum, leafhoppers were fed on Mindum durum, Olaf wheat, and N28Ht, N28, and Golden Bantam corn, respectively. Symptoms were reproduced only on N28Ht, N28, Mindum and Olaf. The N28Ht field isolate of WStMV was serologically indistinguishable from a stock culture of WStMV. Corn leaf tissue, collected from border rows of N28 with symptoms similar to those on N28Ht, was fixed in glutaraldehyde and osmic acid, thin sectioned and examined by electron microscopy. Bacilliform particles like those described for WStMV were found. This is the first known report of WStMV occurring naturally in corn. Flint corn was artificially infected with WStMV in the greenhouse (Can. Plant Dis. Surv. 42:135-142.)

FUNGI ASSOCIATED WITH SOYBEAN SEEDS GROWN IN ILLINOIS. Edward G. Jordan. USDA, APHIS, PPQ, Dept. of Plant Pathology, University of Illinois, Urbana, IL 61801.

Sixteen soybean cultivars grown at 9 locations in Illinois in 1979 were assayed for seed borne fungi. Seeds were surface sterilized in 0.5% NaOCl for 4 minutes, rinsed in sterile distilled water, and placed on potato-dextrose agar for 10 days. Fungi belonging to the genera Phomopsis and Diaporthe were most commonly observed. Other fungal genera recorded were: Alternaria, Aspergillus, Cercospora, Chaetomium, Colletotrichum, Curvularia, Epicoccum, Fusarium, Macrophomina, Nigrospora, Penicillium, Phoma, Rhizoctonia and Trichoderma. New records include Gliocladium roseum, Verticillium albo-atrum, Phialophora sp., Eurotium sp., Rhinotrichum sp. and Acremoniella sp. Trichothecium roseum, previously reported from soybean seed in Poland, was found at one location in Northern Illinois. Nematospora coryli, the yeast spot organism, was isolated from seed grown at two locations and is reported for the first time in Illinois.

EFFECT OF WATER POTENTIAL ON THE SURVIVAL OF RHIZOBIUM JAPONICUM IN TWO SOILS. M. M. Joshi, S. N. Hillebrenner, and G. R. Goss. Kalo Laboratories, Inc., 525 Kentucky Street, Quincy, IL 62301.

Streptomycin-resistant mutants of Rhizobium japonicum (RJ) strains 6 and 138 were introduced into sterile (S) and non-sterile (NS) Seaton-Urban silt loam (SSL) and Port-Byron silt loam (PSL) soils adjusted to 0.3, 1, and 15 bars of moisture tension. The soils were incubated at 25 C and survival of RJ was monitored over a 180-day period. All interactions, except strain 6 x soils, were significant ($P = 0.01$). Fewer RJ survived in NS than in S soils. In PSL, strain 138 survived better than strain 6 but there was no difference between strains in SSL. Strain 138 persisted longer in soil than strain 6. Survival of these strains was best at 0.3 bar followed by 1 and 15 bars of tension; however, strain 6 declined faster at 15 bar tension than strain 138. This is consistent with the better survival of strain 138 at elevated temperatures in soils.

RESPONSE OF CEREAL ROOTS TO BARLEY YELLOW DWARF VIRUS INFECTION IN A MIST CULTURE SYSTEM. M. Kainz and J. Walter Hendrix, Dept. of Plant Pathology, Wash. State Univ., Pullman, WA 99164.

The effect of barley yellow dwarf virus (BYDV) on root development of spring wheat, barley, and oat cultivars was determined in mist culture. Plants were positioned in a mist chamber such that their roots hung inside the chamber bathed in a nutrient mist while the tops were exposed to ambient greenhouse conditions. Root dry weight, root length, and root numbers were reduced up to 90%, 80%, and 50%, respectively, depending on the stage of development at the time of infection and the susceptibility of the cultivar. Root development of infected plants was almost entirely halted at the time of symptom expression in the shoot. The roots of a BYDV resistant barley line, WA7792-74, were significantly less affected than were those of a susceptible cultivar, Steptoe. However, root response of BYDV resistant and susceptible oats was approximately the same. Our data indicate that the degree of root suppression is not necessarily correlated with BYDV resistance of barley and oat cultivars.

THE RELATIONSHIP BETWEEN INFECTION OF CORN SEEDLINGS AND STALK ROT CAUSED BY FUSARIUM MONILIFORME. R. P. Kaiser and P. E. Nelson. Department of Plant Pathology, The Pennsylvania State University, University Park, PA 16802.

Corn plants (Zea mays) were grown in a chamber maintained under

positive air pressure and sampled at 7 dates for F. moniliforme between 22 to 80 days after planting in infested soil. Plants were sampled at each node and at internodes; up to 38 samples from a single plant. All seedlings were infected 22 days after planting and thereafter. Infection first appeared in the kernel and in the root and shoot within 3 cm of the kernel. In older plants, the infection spread in both a continuous and noncontinuous manner to other parts of the stalk through the xylem vessel elements or by airborne conidia. The presence of airborne conidia was indicated by the rapid contamination of control pots and by trapping of spores on growth medium. Crown tissue and the lower 30 cm of the stalk in mature plants were infected, suggesting that seedling infections may later develop into stalk rot. The variation in the number and location of infections in the upper portion of the stalk suggests that multiple isolations are required to determine the extent of fungal colonization.

PREEMERGENCE DAMPING-OFF OF CHICKPEA IN THE PALOUSE REGION OF EASTERN WASHINGTON CAUSED BY PYTHIUM ULTIMUM. Walter J. Kaiser and Richard M. Hannan. Regional Plant Introduction Station, Washington State University, Pullman, WA 99164.

Chickpea (Cicer arietinum), also called garbanzo or gram, is a potential crop in the dryland areas of the Palouse region of the Pacific Northwest. Emergence of several white-seeded chickpea lines in 1979 field trials at various locations in the Palouse region was erratic and reduced due to a preemergence damping-off disease caused by Pythium ultimum. The pathogenicity of several isolates of P. ultimum to chickpea was demonstrated in greenhouse inoculation studies. White-seeded chickpeas planted in soil infested with P. ultimum failed to emerge. Isolates of other Pythium-like fungi from Palouse soils were weakly pathogenic or nonpathogenic to chickpea. In Palouse soils naturally infested with P. ultimum, emergence of several white-seeded chickpea accessions treated with captan or metaxanin (CGA 48988) was increased by 60-80% over nontreated seeds. Sources of resistance to P. ultimum were found in several plant introduction (PI) lines of brown and black-seeded chickpeas.

A COMPARATIVE STUDY OF SELECTIVE MEDIA FOR ISOLATION OF VERTICILLIUM DAHLIAE FROM SOIL. J. E. Kantzes & R. J. Green, Jr. Botany & Plant Pathology Dept., Purdue Univ., Lafayette, IN 47907

Nine media selective for isolation of V. dahliae from soil were compared. Both direct soil dilution (5g soil sample) and selective wet sieving (200g soil sample) prior to dilution were used. The soil was Chelsea loamy fine sand (clay-2% silt-10%, sand-88%, organic matter-1.6%, pH 6.6) infested with microsclerotia from naturally infected potato stems. Media with a low nutrient base, especially those with dilute soil extract, and containing sodium polypectate were most effective for recovery of viable propagules of V. dahliae from soil. Regardless of the selective medium used, recovery was greater with the selective wet sieving than with direct soil dilution.

WATER RELATIONS OF SUGARCANE PLANTS WITH RATOON STUNTING DISEASE. J. Kao, and K. E. Damann, Jr., Dept. of Plant Path. & Crop Physiol., La. State Univ. Agric. Expt. Sta., Baton Rouge, LA 70803.

The transpiration rate of detached sugarcane shoots with ratoon stunting disease was significantly lower than that of detached healthy shoots. Root pressure also decreased in diseased plants. Intact plant transpiration was measured by weight loss experiments from well watered pots containing healthy or diseased canes which were not watered for 7 days. Diffusive resistance of leaves to water vapor loss was measured daily. Diseased plants had a significantly lower transpiration rate than healthy plants; however, no significant differences in diffusive resistance between healthy and diseased plants was detected. This implied that the stomatal behavior of the plants was not affected by the disease, and that the lower transpiration rate in diseased plants appeared to be the consequence of the physical plugging of the xylem vessels by the RSD-associated bacterium and the gel matrices which we described previously.

ACQUIRED RESISTANCE TO DITHANE M-45 AND OTHER FUNGICIDES OF BIPOLARIS ORYZAE AND B. SOROKINIANA, THE CAUSAL ORGANISMS OF BROWN SPOT OF WILD RICE. M.K. Kardin and J.A. Percich. Department of Plant Pathology. University of Minnesota, St. Paul, MN 55108.

There were no isolates of B. oryzae or B. sorokiniana that could grow at 100 µg/ml of dithane M-45. However, after 9 passes through a medium prepared with increasing concentrations of dithane M-45, several colonies of each species grew at 6000 µg/ml. One isolate of B. sorokiniana produced colonies at 8000 µg/ml. No isolates of B. sorokiniana grew at 100 µg/ml sisthane in the first transfer, with several subcultures on a medium containing sisthane, two isolates of B. sorokiniana and of B. oryzae produced colonies at 200 µg/ml. Thus, tolerance of these fungi to dithane M-45 and sisthane was increased on a medium containing increasing concentrations of these chemicals. A pattern of enhanced tolerance of the test fungi on a medium amended with increasing bravo-6F was not clearly established.

ISOLATION OF PHYTOPHTHORA CITROPHTHORA FROM COCOA IN BRAZIL. M. K. Kellam and G. A. Zentmyer. Department of Plant Pathology, University of California, Riverside, California 92521

Four Phytophthora isolates identified as P. citrophthora have been recovered from trunk cankers, diseased seedlings, and rotted pods of Theobroma cacao in Brazil. Fairly coarse hyphae produced finely radiate and dense rosette patterns on cornmeal and V8 agars, respectively. Subsurface, noncaducous sporangia, often distorted and frequently with 2 papillae, formed on carrot agar. Sporangia averaged 69 X 34 µm with a length/breadth ratio of 2.0. The hemispherical papillae averaged 5.3 µm in depth and 7.0 µm width. No sex organs were observed in pairings with A1 or A2 isolates of P. palmivora or P. capsici. Abundant chlamydospores were produced in carrot agar. Isolates did not grow at 33 C, but grew at 9 C. Neither gummosis nor stem lesions were induced when sweet orange seedlings were inoculated with these isolates. Based on these criteria, these isolates are designated as cocoa strains of P. citrophthora. The relative importance of this species as a causal agent of black pod disease of cocoa is unknown.

POST-INFECTION CONTROL OF APPLE SCAB WITH CGA-64251, BILOXAZOL AND PHENAPRONIL. R.D.Kelley and A.L.Jones, Dept. of Botany and Plant Pathology, Michigan State Univ., East Lansing, MI 48824

In greenhouse tests, fungicides were applied 48,72,96,108,120 and 132 hr after McIntosh trees were inoculated with about 3 X 10^5 conidia/ml of Venturia inaequalis and held in a moist chamber at 20 C for 47 hr. 1-[(2-[2,4-Dichlorophenyl]-4-ethyl-1,3-dioxolan-2-yl)methyl]-1H-1,2,4-triazole (CGA-64251 at .019g a.i./liter) and phenapronil (.6 g) were similar to fenarimol (.04 g) in after-infection control. At 96 hr, chlorotic scab lesions but few sporulating lesions developed. With biloxazol (.3 g) and phenyl mercuric lactate (PML) (.05 g), chlorotic lesions were present at 72 hr but normal lesions were fewer with biloxazol than PML. In orchard tests, CGA-64251 (.019 g) applied 1)weekly, 2)within 3 days after the start of an infection period, 3)2 days before lesions were predicted, 4)2 days before lesions and 1 wk later, 5)2 days after lesions were visible, and 6)2 days after lesion and 1 wk later gave 100,94,26,91,62, and 96% control, respectively, of foliar scab. Treatments 2,4 and 6 denote after-infection, pre-symptom and post-symptom control activities.

EFFECT OF TRIADIMEFON ON MYCORRHIZAE OF SOUTHERN PINES. W. D. Kelley, Dept. of Botany, Plant Pathology and Microbiology, Auburn Univ. Agric. Exp. Stn., Auburn, Alabama 36830.

Effect of the systemic fungicide triadimefon (Bayleton) on growth and development of ectomycorrhizal fungi of loblolly and slash pines was determined in laboratory and field studies. In the laboratory, colony areas of the following mycorrhizal fungi were decreased by 50% or more after 3 wk on triadimefon-amended modified Melin-Norcrans agar: > 10 µg/ml, Cenococcum graniforme, Suillus luteus, and Thelephora terrestris; > 5 µg/ml, Laccaria laccata; and < 1 µg/ml, Pisolithus tinctorius. In the nursery, loblolly and slash pine seedlings received Bayleton 50 WP as a foliar spray (3 applications at 3-wk intervals beginning in early May at 0.28, 0.42, and 0.56 kg ai/ha) or a preplant, soil incorporated treatment (applied in late April at 0.56 and 1.12 kg ai/ha). In mid-July no significant differences in numbers of short roots or short roots with mycorrhizae were observed among the treatments. Data indicate that triadimefon has activity against mycorrhizal fungi but its effect on these non-target fungi under field conditions is negligible.

RELATIONSHIP OF DAMAGE BY THREE BACTERIAL BEAN BLIGHTS TO TIME AND METHOD OF INOCULATION. B.W. Kennedy. Department of Plant Pathology, University of Minnesota, St. Paul, MN 55108.

Field plots of navy bean were inoculated with Xanthomonas

phaseoli and Pseudomonas phaseolicola by vacuum infiltration of seeds, inoculation of one first unifoliolate leaf, inoculation of stems of seedlings, and inoculation of one young leaf of half-grown plants. Neither pathogen caused appreciable seed yield damage if plants were half-grown when inoculated, but stem inoculation resulted in seed yields of 48% (P. phaseolicola) and 8% (X. phaseoli) of controls. Vacuum inflitration of seeds gave inconsistent results and unifoliolate leaf inoculation of seedlings resulted in loss comparable to inoculation of stems. Damage to soybean inoculated similarly with Pseudomonas glycinea was less and infection was more inconsistent than that resulting from inoculation of navy bean with X. phaseoli or P. phaseolicola.

ULTRASTRUCTURE OF BEAN HYPOCOTYLS INFECTED WITH RHIZOCTONIA SOLANI. Leigh Ann Kenning and Penelope Hanchey. Department of Botany and Plant Pathology, Colorado State University, Fort Collins, CO 80523.

Phaseolus vulgaris 'Red Kidney' hypocotyls inoculated with Rhizoctonia solani (isolate RB) were examined by transmission electron microscopy. Infection cushion hyphae were surrounded by a mucilaginous material and contained glycogen. Hyphae within lesions contained less glycogen and hyphal damage was not common except in mature lesions. Cuticular swelling was not found, although host cell walls within lesions were extensively swollen and the cytoplasm was collapsed. Cytoplasm accumulated toward the infection site 2-4 cells from the pathogen and the middle lamella was densely-granular. Cytoplasmic changes, evident in regions beyond cells with swollen walls, included displacement of the plasmalemma, dilation of endoplasmic reticulum and cytoplasmic vacuolation. Similar changes occurred in tissue infected with a weakly virulent strain which did not cause extensive wall swelling, suggesting that host cell death is not simply the result of loss of cell wall integrity.

A MOSAIC DISEASE OF COLLARDS (Brassica oleracea 'Acephala') IN GEORGIA. Mushtaq A. Khan, Department of Plant Pathology, University of Georgia, Georgia Station, Experiment, Ga. 30212.

Symptoms such as vein chlorosis, vein banding, chlorotic ringspot, and severe mosaic with dark green blisters were observed in 5-60% of the plants in commercial fields and home-grown collard plantings in Georgia. Two mechanically transmissible viruses were isolated from infected plant samples. These were identified by their host range, physical properties, inclusion bodies, and serology as cauliflower mosaic virus and turnip mosaic virus. The collard isolates of turnip mosaic virus were distinct from the type isolate in that they infected legumes (Lupinus albus, L. angustifolius, Pisum sativum, and Phaseolus vulgaris 'Bountiful'). Aphis craccivora, Brevicoryne brassicae, and Myzus persicae transmitted the virus in a stylet-borne manner from and to lupins, collards, and mustard. A latex agglutination test (Am. Potato J. 55:627), comparable to bioassay and more sensitive than SDS-agar double diffusion test, was useful in indexing field samples for turnip mosaic virus. This is the first report of natural infection of collards by these viruses.

NATUTAL INFECTION OF FORAGE LEGUMES WITH PEANUT MOTTLE VIRUS IN GEORGIA. Mushtaq A. Khan, and J. W. Demski. Department of Plant Pathology, Georgia Station, Experiment, Georgia 30212.

Virus isolates, from naturally infected clovers (Trifolium subterraneum, T. vesiculosum), and Desmodium canum, were mechanically transmitted to Phaseolus vulgaris 'Topcrop'. Characteristic red local lesions that spread dendritically along the veins on Topcrop bean were suggestive of peanut mottle virus (PMV). Identity of these isolates as PMV was also confirmed by host range, physical properties, and serology. In host range tests the virus was also transmitted to T. incarnatum, and T. hybridum but not to T. pratense and T. repens. This is the first report of PMV naturally infecting forage legumes. Field observations during 1978 and 1979 indicated that the PMV is quite prevalent in some forage legumes (particularly in L. albus and L. angustifolius) grown in Southern Georgia.

EFFECT OF PRE-INCUBATION OF SOIL EXTRACTS ON SPORANGIUM PRODUCTION BY PHYTOPHTHORA CINNAMOMI. G. D. King and G. A. Zentmyer, Dept. of Plant Pathology, Univ. of Calif., Riverside, CA 92521.

Incubation of nonsterile soil extracts (SE) for 4 d before autoclaving greatly increased their stimulation of P. cinnamomi sporangium production (SP), compared to SE autoclaved just after extraction. Fungal mats grown 1 d in V8 broth were incubated in water (W), SE, or autoclaved SE (ASE). For SE, 10g fresh avocado soil was mixed with 1L water, filtered through #1 paper, and incubated 0-16 d at 24C. For ASE, extracts were then autoclaved 25 min. When extracts were used immediately after preparation (0 d), SP per mat averaged 0 in W, 130 in SE, and 40 in ASE. When extracts were incubated for 4 d before use, SP per mat was 0 in W, 1.9×10^4 in SE, and 3.8×10^3 in ASE. Changes in bacterial concentration during pre-incubation were closely followed by proportional changes in SP. SP in SE correlated (R=0.99) to production in ASE incubated nonsterile for the same times before autoclaving. Passage of ASE through 0.2 μm filters removed stimulatory factors. Our results suggest that bacterial metabolites in SE stimulated SP and survive autoclaving.

SCREENING MAIZE FOR RESISTANCE TO KERNEL INFECTION BY ASPERGILLUS FLAVUS. S. B. King and G. E. Scott, AR-SEA-USDA Research Plant Pathologist and Research Agronomist, respectively, Mississippi State University, Mississippi State, MS 39762.

Aspergillus flavus can infect and produce aflatoxin in nondamaged maize kernels, but high levels of aflatoxin contamination are usually associated with insect damaged kernels. Although low levels of A. flavus infection can produce unacceptably high levels of aflatoxin contamination, higher levels of infection are necessary to detect differences among genotypes in a resistance identification and breeding program. In attempts to develop field inoculation techniques to identify genotypes with resistance to A. flavus infection in nondamaged kernels, we investigated 1) placement of inoculum, 2) time of inoculation, and 3) effect of host stress on infection. A laboratory technique to differentiate genotypes based on A. flavus growth on mature kernels in petri dishes was also investigated. Our research shows some statistical differences among genotypes. These differences are apparently not correlated with kernel hardness.

REACTION OF SUNFLOWER GENOTYPES TO INFECTION BY VERTICILLIUM DAHLIAE PATHOTYPES IN GROWTH CHAMBER AND GREENHOUSE TESTS. J. M. Klisiewicz, SEA, AR, USDA, Dept. of Plant Pathology, University of California, Davis, CA 95616.

Sunflower genotypes were tested for resistance to Verticillium dahliae Kleb. pathotypes from North Dakota (ND) and California (T-1 and SS-4). Seeds were planted in vermiculite-V8 juice medium in 500 ml beakers with a 2-week growth of Verticillium. Plants were transplanted 11 days after emergence to autoclaved loam soil and kept in a growth chamber illuminated (21,000 lux) 14 hours daily, for 7 days at 21 C then 14 days at 28 C and thereafter in the greenhouse at 20-28 C night- and daytime temperatures, respectively. Severity of disease induced by ND was significantly greater on cultivars and inbred lines than that induced by T-1 or SS-4 except for inbred Ha89 which was resistant to ND but susceptible to T-1. ND caused extensive stunting and killing. Five of 10 hybrids that had high resistance to T-1 and SS-4 were resistant to ND. Apparently good progress toward resistance to Verticillium has been achieved in sunflower breeding programs.

ENHANCED PLANT GROWTH BY SIDEROPHORES PRODUCED BY PLANT GROWTH-PROMOTING RHIZOBACTERIA. J. W. Kloepper[1], J. Leong[2], M. Teintze[2], and M. N. Schroth[1]. [1]Dept. of Plant Pathology, Univ. of California, Berkeley, CA 94720, and [2]Dept. of Chemistry, Univ. of California, San Diego, La Jolla, CA 92093.

A fluorescent siderophore (microbial iron transport agent) named pseudobactin has been isolated from plant growth-promoting Pseudomonas strain B10 and purified to homogeneity. Treatment of potato seedpieces with B10 prior to planting caused a statistically significant growth increase of 130% compared to water-treated controls. When planted potato seedpieces were watered with 10 µM pseudobactin on alternate days, a similar enhancement of growth was obtained. Fungal populations on the rhizoplane were significantly reduced in treatments with strain B10 and pseudobactin compared to water-treated controls. The above data suggest that plant growth-promoting rhizobacteria (PGPR) exert their plant growth-promoting activity by depriving native microflora of iron. PGPR produce extracellular siderophores which efficiently complex environmental iron making it less available to certain native microflora, thus inhibiting their growth.

IRON REGULATION OF PLANT GROWTH-PROMOTING RHIZOBACTERIA. J. W. Kloepper and M. N. Schroth, Dept. of Plant Pathology, Univ. of California, Berkeley, CA 94720, and J. Leong, Dept. of Chemistry, Univ. of California, San Diego, CA 92093.

In vitro antibiosis of specific strains of fluorescent pseudomonad plant growth-promoting rhizobacteria (PGPR) against test bacteria was related to fluorescence. Amendment of 1 μM $FeCl_3$ to King's medium B eliminated fluorescence and antibiosis. PGPR also exhibited antibiosis against a mutant of E. coli which does not produce a siderophore (microbial iron transport agents) but not against the siderophore-producing parent. When PGPR were used as potato seedpiece treatments in soils amended with iron, plant growth was not promoted. However, the same PGPR significantly increased plant growth from 47 - 283% in soils without added iron. Iron amendments did not affect root colonization by PGPR (averages of 4.4×10^3 cfu/cm root with iron and 3.2×10^3 cfu/cm root without iron). These results indicate that in vitro antibiosis and plant growth promotion by PGPR are related to siderophore activity rather than classic antibiotics.

PSEUDOMONAS SIDEROPHORES: A MECHANISM EXPLAINING DISEASE-SUPPRESSIVE SOILS. J. W. Kloepper and M. N. Schroth, Dept. of Plant Pathology, Univ. of California, Berkeley, CA 94720; J. Leong and M. Teintze, Dept. of Chemistry, Univ. of California, San Diego, CA 92093.

The addition of either fluorescent Pseudomonas strain B10, isolated from a take-all suppressive soil, or its siderophore, pseudobactin, to both Fusarium wilt and take-all conducive soils inoculated with Fusarium oxysporum f. sp. lini or Gaeumannomyces graminis var. tritici, respectively, rendered them suppressive. Disease suppressiveness is caused in part by microbial siderophores which efficiently complex iron (III) in soils, making it unavailable to pathogens, thus inhibiting their growth. Amendment with exogenous iron (III) of Fusarium wilt and take-all suppressive soils in the greenhouse and to Fusarium-wilt suppressive soils in field tests converted them to conducive soils by repressing siderophore production.

A SIMPLIFIED TECHNIQUE FOR PRODUCTION OF PYTHIUM OOSPORES. K. M. Kobriger and D. J. Hagedorn, Department of Plant Pathology, University of Wisconsin, Madison, WI 53706.

A simplified technique for the production of Pythium oospores has been tested and found effective. Kentucky bluegrass (Poa pratensis) was grown in the greenhouse at 24 C. Fifteen grams of clipped grass were placed in 1000 ml Erlenmeyer flasks and 500 ml of distilled H_2O added per flask. The flasks were autoclaved for 45 min under 20 psi 121 C, allowed to cool for 24 hr and re-autoclaved as before. Cooled supernatant was decanted into flasks or bottles to give a large surface area/volume ratio. Discs (1 cm dia.) of Pythium mycelium growing on corn meal agar were placed in the bluegrass broth and incubated in the dark at room temperature (±22 C). Oospores typically began to form within 4-8 days, and large numbers were observed after about 4 weeks. Pythium myriotylum, P. ultimum, P. irregulare, as well as several unidentified isolates showed good oospore production.

THE INCIDENCE OF COLLETOTRICHUM COCCODES IN INDIANA POTATO FIELDS AND INTERACTION OF C. COCCODES WITH OTHER POTATO PATHOGENS. D. A. Komm and W. R. Stevenson, VPI & SU, Southern Piedmont Center, Blackstone, VA 23824, and Dept. of Plant Pathology, University of Wisconsin, Madison, WI 53706.

In a survey of 10 potato fields at mid-season, C. coccodes was found to be infecting 40 to 100% of the plants, depending on the cultivar and density of soil-borne inoculum. Although C. coccodes was detected most consistently, Fusarium oxysporum, F. solani, Verticillium dahliae, and Pratylenchus penetrans were also found alone or in mixed infections with C. coccodes. In greenhouse trials, rooted potato cuttings of cv. Superior were transplanted into soil containing C. coccodes and either P. penetrans, F. oxysporum, or V. dahliae. Dieback symptoms at 33 and 41 days after planting were more severe when inocula contained C. coccodes plus V. dahliae than C. coccodes or V. dahliae alone. In addition, an index of root infection was highest for Superior plants inoculated with C. coccodes plus P. penetrans at 53 days after planting.

COMPARISON OF ACETONE INFUSION TO SLURRY APPLICATION OF FUNGICIDES TO PEA SEED. John M. Kraft, USDA SEA/AR, Irrigated Agriculture Research and Extension Center, Prosser, WA 99350.

Acetone infusion of seed treatment fungicides was compared to the standard slurry plus sticker method of treating pea seed. Chemicals, combinations of chemicals, and rates used were based on previous greenhouse and field results. In general, acetone infusion was advantageous only in reducing the amount of fungicide needed to effectively control seed rot and damping off. The highest seed yields in gms/plot occurred when seed was treated with Terrachlor (pentachloronitrobenzene) in acetone at 2.5 g/kg seed. Other treatments also effective were the combination of Thiabendazole (2-(4'-Thiazolyl)-benzimidazol plus Ridomil (Methyl D,L-N-(2,6-dimethylphenyl)-N-(2'-methoxyacetyl)-alaninate at 5.0 and 0.6 gms/kg seed, respectively, and Ridomil at 0.3 g/kg seed in acetone.

RED MAPLE BUD INJURY ASSOCIATED WITH AMBIENT PARTICULATE AIR POLLUTION AS DETECTED WITH SCANNING ELECTRON MICROSCOPY AND X-RAY ANALYSIS. Charles R. Krause, USDA,SEA,AR, Delaware, OH 43015

Red maples, Acer rubrum, were grown from May, 1979 through March, 1980 under ambient field conditions either in clean air (i.e. low background levels of air pollution, Delaware, OH) or in polluted air (i.e. phytotoxic levels of air pollution, Cleveland, OH). In March, terminal vegetative buds of maples grown in clean air appeared uniform in color while those grown in polluted air were mottled. Buds from each site were compared with a scanning electron microscope equipped with an x-ray energy dispersive spectrometer (EDS). Epidermal bud cells grown in clean air showed turgidity with uniform cuticular textures whereas particulate air pollution, including heavy metals, was not present at significant levels. Buds grown in polluted air showed epidermal cell injury, distorted epicuticular wax patterns and fly ash-like particulates. EDS detected significant levels of Fe in particulates and in lesions. Phytotoxicity induced by iron particulates during dormant periods might, in part, adversely affect growth of foliage during the growing season.

GERMINATION OF CYLINDROCLADIUM CROTALARIAE MICROSCLEROTIA IN THE RHIZOSPHERES OF SUSCEPTIBLE AND RESISTANT PEANUT CULTIVARS. D. T. Krigsvold, G. J. Griffin, and M. G. Hale, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061.

In artificially infested nonsterile soil, microsclerotia of C. crotalariae were tested for germination in the inner 1 mm of the rhizospheres of peanut cultivars resistant (Argentine) and susceptible (VA-72-R) to the pathogen. Germination was significantly higher in the rhizosphere of the susceptible versus the resistant cultivar. The influence of crude root exudates, from axenically grown peanut plants, on microsclerotial germination in soil was investigated using an artificial root system. Microsclerotial germination was higher in response to crude root exudate of the susceptible than of the resistant cultivar. Carbon analyses indicated higher levels of carbon were required for Argentine root exudate than for VA-72-R root exudate to support similar levels of microsclerotial germination in soil. For each cultivar, percentage germination was directly related to carbon levels in the root exudate.

FACTORS INVOLVED IN A PEPPER COLLAPSE SYNDROME. J. Krikun, B. Bar-Joseph, J. Haas, A. Nachmias and Irena Dishon, Agricultural Research Org., The Volcani Center, POB 6, Bet Dagan 50-200, Israel.

Studies were performed to determine if soilborne plant pathogens were implicated in a severe collapse of pepper plants and fruit observed in Israel during the winter of 1977. Experiments over a two-year period which involved soil fumigation, solarization, and fungicide drenches suggested that the syndrome observed was caused by Pythium elongatum. Root rot was controlled by methyl bromide, Ridomil and Previcur, but was very prevalent in the control and solarization plots. Tissue analysis from plants in plots which had no root rot showed that their chloride content was normal, whereas comparable tissues from plants which eventually had rotted root systems had a 100% increase in the chloride content. These findings suggest that decreased water uptake, due to root rot, and the abnormally high chloride content led to the observed symptoms.

THE APPLICATION OF VAPAM TO FIELD SOILS IN A SPRINKLER IRRIGATION SYSTEM. J. Krikun, Z. Frank and D. Orion, Agricultural Research Org., The Volcani Center, POB 6, Bet Dagan 50-200, Israel.

Preliminary laboratory studies, using soil columns, suggested that to obtain an even distribution of methyl-isothiocyanate throughout the soil profile the chemical should be applied continuously into the irrigation system during the entire duration of a preplant irrigation period. Among others,

studies were performed on the control of Pratylenchus thornei (up to 100% kill); Verticillium dahliae (up to 95% kill) and a disease of peanuts caused by Pythium myriotylum and Rhizoctonia solani (500% increase in healthy pods). Depending on the soil type, and pathogens, effective Vapam rates of 250-750 l/ha were needed to obtain good control; best control being obtained in sandy soils. This method of applying Vapam has been widely adopted in Israel because it is easily applicable and its cost is 15 to 30% of comparable control methods.

INCIDENCE OF CANKER-FORMING FUNGI FROM SIBERIAN ELM CANKERS IN NORTHERN GREAT PLAINS WINDBREAKS. J. M. Krupinsky, USDA-SEA-AR. Northern Great Plains Research Station, P.O. Box 459, Mandan, ND 58554.

In 1979, isolations were made from Siberian elm (SE) cankers collected from trees located in 90 SE windbreaks in 52 counties (32 in North Dakota, 9 in eastern South Dakota, 6 in western Minnesota, and 5 in eastern Montana). Percent recovery of Botryodiplodia hypodermia, Tubercularia ulmea, Cytospora sp., and other fungi from 401 stem cankers less than 2.5 cm in diameter was 30, 21, 36, and 13 respectively. Percent recovery of B. hypodermia, T. ulmea, Cytospora sp. and other fungi from 26 branch cankers between 2.5 and 12.5 cm in diameter was 73, 8, 15, and 4 respectively. Percent recovery of B. hypodermia, T. ulmea, Cytospora sp. and other fungi from 172 basal cankers was 69, 10, 10, and 11 respectively. B. hypodermia and T. ulmea were the only fungi capable of producing cankers on SE under our inoculation conditions.

NEMATODES ASSOCIATED WITH A GERMPLASM COLLECTION OF BLUE GRAMA AND WESTERN WHEATGRASS IN WESTERN NORTH DAKOTA AND SOUTH DAKOTA. J. M. Krupinsky, R. E. Barker, and P. A. Donald, USDA-SEA-AR. Northern Great Plains Research Station, P.O. Box 459, Mandan, ND 58554; 3rd author, 2505 W. Plum, Fort Collins, CO 80521.

A cooperative effort between USDA-SEA-AR and USDA-SCS was undertaken in 1977 to make a germplasm collection of blue grama (BG), Bouteloua gracilis, and western wheatgrass (WWG), Agropyron smithii, from the short- and mixed-grass prairies of the western Dakotas. Plant parasitic nematodes were found in 59% of the 3,099 soil samples analyzed. The genera, Helicotylenchus, Pratylenchus, Xiphinema, and Tylenchorhynchus were common. Hoplolaimus, Criconemoides, Pratylenchus, and an unknown tylenchid appeared in less than 1% of the samples. The frequencies of the nematode genera present were similar for BG (1,606 samples) and WWG (1,493 samples). Pratylenchus was the most common genus in North Dakota whereas Helicotylenchus was the most common in South Dakota.

ENVIRONMENT AND HOST SUSCEPTIBILITY AFFECT SPERMATIAL FORMATION BY CRONARTIUM QUERCUUM F. SP. FUSIFORME. E. G. Kuhlman, Southeastern Forest Experiment Station, USDA Forest Service, Forestry Sciences Laboratory, Research Triangle Park, NC 27709.

In studies of the effects of temperature and light on rust development on pine, data on spermatial formation during the 9 months following inoculation were recorded. In a Phytotron greenhouse, temperatures varied <±1°C and daylength was extended with 3 hours of incandescent light from 11 pm to 2 am. When nighttime temperatures were at 18°C, 9-12% of the infected loblolly pine seedlings had spermatia, whereas only 0.5-2% had spermatia if night temperatures were 22°C. In a greenhouse with fluctuating night-day temperatures of 18-30°C but with the same extended daylength, 27% of the infected loblolly seedlings had spermatia. Geographic source of loblolly pine seedlings did not influence sporulation. However, in the environment with fluctuating temperatures, spermatia were observed on 26% of the infected slash pine seedlings from a susceptible half-sib family but on only 6% of those from a resistant half-sib family.

PURIFICATION OF RICKETTSIA-LIKE BACTERIA (RLB) FROM PHONEY PEACH TREES BY RENOGRAFIN DENSITY GRADIENT CENTRIFUGATION. W. E. Kuriger, N. W. Schaad, Georgia Station, Experiment, GA 30212, and W. J. French, University of Florida, IFAS, Agricultural Research Center, Monticello, FL 32344.

RLB were obtained by vacuum extraction of peach roots with either phosphate buffered saline or 0.1M KOH, and centrifuged at 10,000Xg for 20 minutes. Pellets were suspended in 1 ml of 30% Renografin (Squibb, Princeton, NJ), layered on 30-45% linear Renografin gradients and centrifuged at 85,000Xg for 1 h. Two visible bands were produced; one at the top, and another ca 3.5-4.2 cm from the bottom of gradients. Pierce's disease RLB, from a liquid culture, sedimented as one band similar to the position of the lower band of peach RLB suspensions. Phase contrast microscopy and immunofluorescent staining showed RLB present in the lower bands. Plant peroxidase activity was greatest in fractions from the upper band of gradients layered with peach RLB suspensions. The results show that phoney peach RLB can be separated from most host materials by Renografin density gradient centrifugation.

A COMPARATIVE STUDY OF DISEASE DEVELOPMENT IN BROWN STEM ROT RESISTANT AND SUSCEPTIBLE SOYBEANS. C. C. KUSEK AND H. Tachibana, Dept. Plant Path., Seed and Weed Sciences, Iowa State University, and USDA-SEA-AR, Ames, IA 50011.

The development of brown stem rot (BSR) of soybeans in recently developed and/or released lines with resistance derived from PI 84.946-2 was studied under field conditions in Phialophora gregeta infested soil in Iowa. Both resistant and susceptible soybeans of early and late maturity groups were compared at two locations. Early resistant soybean lines included A3 and A77-116013 in maturity Group I; and late varieties included BSR 301 and BSR 302 in maturity Group III. Susceptible soybeans were Coles and Weber in Group I and Oakland and Williams in Group III. The most significant difference between these resistant and susceptible soybeans was in percentage of stem infected, or extent of stem browning, particularly during pod formation and filling. A3 and BSR 302 were the most resistant soybeans; both had similar disease development patterns that indicated slower rates of BSR development than in BSR 301 and all the susceptible soybeans.

VERTICICLADIELLA PROCERA PATHOGENIC ON PINUS STROBUS AND P. TAEDA. A. L. Lackner and S. A. Alexander, Department of Plant Pathology and Physiology, VPI & SU, Blacksburg, VA 24061.

The pathogenicity of an isolate of Verticicladiella procera, the causal organism of white pine root decline, was tested on 40 Pinus strobus and 12 P. taeda two-year-old seedlings. The root systems of the seedlings were washed free of soil and then dipped in a spore suspension (6 x 10^6 spores/ml). In addition, 8 P. strobus seedlings were also inoculated with V. procera by inserting colonized wood blocks into root wounds. Control seedlings were dipped in either sterile water or a block of uncolonized wood was inserted into a root wound. After 10 wk, 30% of the P. strobus and 17% of the P. taeda seedlings inoculated by the root-dip treatment died, and 25% of the P. strobus inoculated with the colonized blocks died. When seedlings died, root and stem chips were plated on malt extract agar with cycloheximide to verify the presence of the pathogen; V. procera was isolated from all dead seedlings. These results indicate that this isolate of V. procera is pathogenic on P. strobus and P. taeda seedlings.

CHANGES IN FOLIAR SYMPTOMS IN PEAR DECLINE-DISEASED PEAR TREES RELEASED FROM OXYTETRACYCLINE-HCl (OTC) THERAPY. George H. Lacy and John L. McIntyre. The Connecticut Agricultural Experiment Station, Box 1106, New Haven, Connecticut 06504.

Pyrus communis L. "Bartlett" pear trees on domestic rootstock were infused postharvest for 1 yr or consecutively for 2 yr with 0.1, 0.5, 1.0, or 2.0 g a.i. OTC/tree for control of pear decline. The growing season following OTC treatment, foliar symptoms were reduced on treated trees. In the second season following the last treatment, and regardless of previous OTC rate or number of infusions, the intensity of foliar symptoms increased, but was not as high as pre-treatment ratings. Additionally, the number of trees with moderate or severe symptoms ($\geq$ 10 - 100% of leaves red and curled) was reduced compared to pre-treatment ratings. This indicates that symptom intensity increases slowly after OTC treatment ends. Thus, if only trees with moderate or severe symptoms are infused, the number of trees requiring treatment in subsequent years will be reduced.

SEASONAL OCCURRENCE OF LEAFHOPPER VECTORS OF THE CAUSAL AGENT OF X-DISEASE IN METHOXYCHLOR SPRAYED AND UNSPRAYED PEACH BLOCKS. George H. Lacy. The Connecticut Agricultural Experiment Station, Box 1106, New Haven, Connecticut 06504.

Leafhopper (LH) populations were monitored with yellow sticky traps from June to August 1979 in a peach (Prunus persicae) orchard. Eight blocks of 10 trees were untreated and 8 blocks were sprayed with methoxychlor (605 g a.i./378 liters of water/0.4 ha). Weeds were controlled by disking and paraquat applications.

Of the 1870 LH trapped, 5 species known to transmit the mycoplasmalike causal agent of X-disease (X-vectors) were recorded: Scaphytopius acutus, 221 adults; Paraphlepsius irroratus, 82; Colladonus clitellarius, 48; Cyponana lamina, 25; and Norvellina seminuda, 22. In sprayed blocks, totals of all LH, all X-vectors, (398), and S. acutus, the most abundant X-vector, were reduced by 47.4, 39.9, and 57.5%, respectively. During periods of peak LH activity, total LH, total X-vectors, and S. acutus were reduced 56.2-73.1, 22.2-48.1, and 61.9-85.1% respectively. The value of reducing X-vectors, especially S. acutus, for disease control is unknown, but may be important in integrated pest management.

SURVEY OF X-DISEASED PEACH AND NECTARINE TREES IN CONNECTICUT. George H. Lacy. The Connecticut Agricultural Experiment Station, Box 1106, New Haven, Connecticut 06504.

In July 1979, peach and nectarine trees (Prunus persicae and P. persicae var. nectarine) were surveyed for symptoms of X-disease in 17 orchards and 33 plantings in Connecticut. Symptoms occurred on 14.8% of 9835 trees. No difference in symptom incidence was noted on peach versus nectarine trees. Symptoms were found on 0.2% of 1688 trees in eastern, 1.0% of 2488 trees in coastal, 19.2% of 3501 trees in central, and 34.8% of 2158 trees in western areas. Chokecherry (P. virginiana or CC), a wild reservoir of the mycoplasmalike causal agent of X-disease (XMLO), is rare in the coastal areas where the incidence of X-disease is low. Both healthy CC and apparently X-diseased CC (XCC) are common in the other areas. In plantings within 73 m of XCC, symptoms were found on 24.3% of 3846 trees in central and western areas and only 0.2%, of 875 trees in the eastern area. The difference in incidence could be due to (1) a different agent or strain of XMLO affecting eastern XCC; or (2) differences in eastern XMLO vector leafhopper populations, distributions, or species.

A SOURCE OF RESISTNACE IN CELERY TO SEPTORIA LEAF("LATE") BLIGHT. M.L. Lacy and S. Honma, Botany & Plant Pathology, and Horticulture respectively, Michigan State University, East Lansing, MI 48824.

Resistance to Septoria leaf blight (Septoria apiicola) has been unknown in Pascal celery (Apium graveolens var. dulce) or in the genus Apium. Parsley (Petroselinum hortense) is immune to Septoria leaf blight, and had been successfully crossed with celeriac (Apium graveolens var. rapaceum). We made an intergeneric cross between parsley and celery cv. "Golden Saprtan", using celery as the seed parent. Honey bees were used for pollination in the greenhouse. Petiole color (green being dominant over yellow) was used as a genetic marker to determine which progeny were actually the result of a cross. Of about 1,000 F_1 seedlings, three had green petioles, indicating that the intergeneric cross had occurred. These three plants were selfed, and the F_2 segregated 3 green:1 yellow for petiole color. The F_2 showed a range of disease reaction from susceptible to highly resistant. This is the first instance of the successful introduction of acceptable resistance into Pascal celery.

DETECTION OF VIRUSES AND NUCLEIC ACIDS BY FLUORESCENCE. Leslie C. Lane and D. Cuppels. Dept. of Plant Pathology, Univ. of Nebraska, Lincoln, NE 68583.

Binding to nucleic acids enhances the fluorescence of certain dyes (e.g. ethidium bromide). It should be possible to detect, by fluorescence, bands that contain less than 100 nucleic acid molecules on polyacrylamide gels. By matching the wavelength of the UV light source to the dye excitation maximum using the appropriate barrier filter, and using low dye concentrations (5 ng/ml) to eliminate stray light, we have detected RNA bands containing less than 100 picograms of nucleic acid on 3-10% polyacrylamide gels. Virus-containing precipitin bands in Ouchterlony double diffusion plates can also be detected using this technique, provided the virus can be rendered permeable to ethidium bromide. Similar fluorescence techniques offer potentially improved detection sensitivity for DNA, proteins, and carbohydrates.

OVERWINTERING OF TOMATO MOSAIC VIRUS IN INFECTED PLANT DEBRIS AND SOIL. J. Lanter, J. M. McGuire, and M. J. Goode. Dept. of Plant Path., PS-217, Univ. of Ark., Fayetteville, AR 72701.

In 1978, the fruit necrosis strain of tomato mosaic virus (FN-ToMV) caused severe necrotic fruit lesions in 4 fields of staked tomatoes in southeastern Arkansas. The following year the disease recurred in the only two fields which were replanted, and 6 other fields had plants showing fruit necrosis symptoms. FN-ToMV was recovered from 88% of fruit and foliage samples taken from these fields. Tomatoes in an experimental plot were infected with FN-ToMV in 1978 to study the overwintering of the virus. Debris was taken from the plot at monthly or bimonthly intervals from February through August 1979, and remained infectious through June. Seventeen percent of tomato seedlings transplanted into soil taken from the plot in February became infected with ToMV which was identified serologically as FN-ToMV. Half of the test plots was planted in tomatoes in 1979 and ca 5% showed fruit symptoms. Electron microscopy of leaves, roots, and purified preparations showed typical ToMV rods.

ARE LATENT INFECTIONS OF COLLETOTRICHUM COCCODES IMPORTANT IN TOMATO ANTHRACNOSE EPIDEMICS? Larry D. Lathrop and S. P. Pennypacker. Department of Plant Pathology, The Pennsylvania State University, University Park, PA 16802.

C. coccodes, the causal agent of tomato anthracnose, has been reported to penetrate green fruit directly, but lesion development is delayed until fruit ripening (latent infection). This study was designed to determine if latent infections influence naturally occurring anthracnose epidemics. Healthy appearing mature green, ripening, and full ripe tomato fruit, cv. Merit, were harvested from field plots August 12, 16, and 21, 1979. Surface sterilized and unsterilized samples from each fruit growth stage incubated in moist chambers at 27 C for 24 hr and unsterilized nonincubated samples were stored in the laboratory at room temperature. Anthracnose symptom development was observed for 2 wk. Analysis of the number of fruit that developed symptoms relative to treatment and fruit growth stage at harvest revealed latent infections would have minimal influence upon the studied portion of the anthracnose epidemic.

EFFECTS OF MULTIPLE SHORT DURATION, VARIABLE CONCENTRATION, SO_2 EXPOSURES ON LESION DEVELOPMENT BY XANTHOMONAS PHASEOLI VAR. SOJENSIS. J. A. Laurence, Boyce Thompson Institute, Ithaca, NY 14853

Soybean plants [Glycine max (L.) Merrill cv. 'Hodgson'] were exposed to 3930 $\mu g\ m^{-3}$-hr dose of SO_2 (mean conc.=1310 $\mu g\ m^{-3}$, peak:mean=2.0) on all combinations of four exposure days. Between exposures 2 and 3, the trifoliate leaflets were inoculated with 0.5 ml of a 10^7 cfu ml^{-1} suspension of X. phaseoli var. sojensis. This design resulted in exposures on the first two days of the week, inoculation on the third, and exposures on the fourth and fifth days. After the onset of symptoms, periodic measurements were made of lesion diameters. At the conclusion of the experiment, leaves present during exposure were analyzed for total S. In 2 of 3 experiments, plants exposed only on day 2 or on days 1, 2, and 3 consistently developed smaller lesions than those exposed on other days. In the third experiment, each of the 4 single exposures resulted in smaller lesions, as did 2 of the multiple exposures. These data indicate that for the most part, the exposures acted independently. Differences in S did not correlate with effects on lesions.

A MYCOPLASMALIKE ORGANISM ASSOCIATED WITH MILD HYDRANGEA VIRESCENCE SUPPRESSES MULTIPLICATION OF THE MLO ASSOCIATED WITH SEVERE VIRESCENCE. R. H. Lawson and F. F. Smith, USDA, SEA-AR, Florist & Nursery Crops Lab., Beltsville, MD 20705.

Symptomless leaves on plants Hydrangea macrophylla, (florists' hydrangea) with mild virescence, contain a low concentration of a mycoplasmalike organism (MLO). Only a few round bodies were detected in sieve tubes of less than 10% of the samples. More than 75% of the samples from leaves of plants that showed small leaves and vein yellowing with severe virescence contained MLO's. Plants infected with the mild virescence agent and subsequently infected with the severe agent contained only a low concentration of MLO's. Infection by the mild virescence agent suppresses development of the severe disease MLO. Suppressed development of the severe MLO agent was correlated with reduced severity of disease symptoms in doubly infected plants.

HYPERSENSITIVITY AND GLYCEOLLIN PRODUCTION IN SOYBEANS TREATED WITH RIDOMIL TO CONTROL PHYTOPHTHORA ROT. G. Lazarovits, P. Stössel and E.W.B. Ward. Research Institute, Agriculture Canada University Sub P.O., London, Ontario, N6A 5B7

Application of the systemic fungicide Ridomil (N-(2,6-dimethyl)-N-(methoxyacetyl) alanine methyl ester) to roots of soybean seedlings prevented the development of typical disease symptoms following inoculation of hypocotyls with Phytophthora megasperma

var. sojae. In treated plants lesions were restricted to necrotic flecks and resembled those typical of the hypersensitive response to incompatible races of the pathogen. Levels of the phytoalexin, glyceollin, increased in the presence of Ridomil and where control was complete approached those in incompatible interactions. The possibility that host defence mechanisms may contribute to disease control during Ridomil treatment will be discussed.

SPORE RELEASE STUDIES: INFLUENCE OF HUMIDITY AND RED-INFRARED RADIATION ON LEAF SURFACE CHARGES. C. M. Leach, Dept. of Botany and Plant Pathology, Oregon State University, Corvallis, OR 97331

In further studies on the electrostatics of active conidium discharge, leaf surface charges were measured for several plant species under conditions known to affect spore release. Potentials were continuously monitored (field mill 27 mm above leaves) while varying relative humidity (RH) and red-infrared radiation (IR). Field potentials were profoundly influenced by changes of RH. Under still air conditions at saturation, leaf surfaces became highly unipolarly charged (e.g. $-550 Vcm^{-1}$). Conversely, when these same leaves were subjected to moving air at saturation, there was a rapid loss of potential frequently to near zero. In contrast, decreasing the RH of a moving air stream caused rapid increases of leaf potentials (e.g. $-750 Vcm^{-1}$). Exposure of leaves to IR, particularly at saturation, caused significant increases in field potentials. Magnitude of leaf potentials generally was related to the preceding growing conditions, particularly the light regime. These results support an electrostatic hypothesis for active spore release.

HETEROKARYOSIS AND ALLELIC DOMINANCE OF RACE O IN HELMINTHOSPORIUM MAYDIS. J. Leach and O. C. Yoder, Department of Plant Pathology, Cornell University, Ithaca, NY 14853.

Heterokaryons formed when auxotrophic isolates were paired on minimal medium, as indicated by the presence of 0.5% heterokaryotic conidia (all hyphal tips were homokaryotic). Cross-feeding was not a complicating factor, because growth did not occur when paired isolates were separated by dialysis tubing or when single isolates were incubated in medium in which a complementary isolate had grown. Balanced heterokaryons between near-isogenic race O and race T isolates produced no detectable race T toxin in vitro but caused lesions characteristic of race T on Texas male sterile cytoplasm corn. Cultures isolated from lesions included heterokaryons and both parental types. Race T lesions were probably due to heterokaryon breakdown as similar sectoring occurred when the heterokaryon grew on complete medium in vitro. It appears that the race O allele is genetically dominant to the race T allele. This is consistent with the hypothesis that race T arose in the field as a mutant of race O.

BACTERIAL AGGLUTININS FROM POTATO: A COMPARATIVE STUDY. J. E. Leach, M. A. Cantrell, and L. Sequeira, Dept. of Plant Pathology, University of Wisconsin, Madison, WI 53706.

A lectin extracted from Katahdin potato tubers by a modification of the procedure of Marinkovich [J. Immun. 93:732 (1964)] and purified by ion exchange chromatography agglutinates avirulent (B-1) strains of Pseudomonas solanacearum. Initially this agglutinin was considered to be identical to the lectin isolated from King Edward potatoes by Allen and Neuberger [Biochem. J. 135:307 (1973)]. Analyses of the protein constituents of the Katahdin agglutinin and its physical properties indicate that it differs substantially from the King Edward lectin. The Katahdin agglutinin is larger and has a higher isoelectric point. Furthermore, the protein moiety of the Katahdin agglutinin has more hydroxyproline, lysine, and tyrosine, but less aspartate, glutamate, and glycine. Unlike the King Edward lectin, the sedimentation coefficient of the Katahdin agglutinin was dependent on concentration. The deglycosylated Katahdin agglutinin retained the agglutinating activity of the parent glycoprotein.

ROOT ROT OF ALFALFA AND RED CLOVER CAUSED BY MYROTHECIUM spp. K. T. Leath and W. A. Kendall. U.S. Regional Pasture Research Laboratory, USDA, SEA-AR, University Park, PA 16802

Myrothecium spp. are not considered to be part of the root rot complex of forage legumes, although they have been isolated from alfalfa and red clover roots. In greenhouse and growth chamber pathogenicity tests several isolates caused severe rot of fibrous and tap roots of alfalfa and red clover; wounding was not necessary for infection. The rot symptoms progressed up the roots from the point of inoculation, and caused systemic symptoms, e.g. leaf curling, mottling and death, within 6 days. Isolates differed in their ability to cause systemic symptoms, but all caused root rot. Top growth of plants was severely stunted when tap roots were infected. Myrothecium was reisolated from roots but not from leaves or petioles of plants exhibiting systemic symptoms. Red clover is more susceptible than alfalfa, but Myrothecium spp. likely contribute to the crown and root rot complex of both forage species.

CONTROL OF PSEUDOMONAS LACHRYMANS IN CUCUMBER SEED BY A TEMPERATURE-RELATIVE HUMIDITY METHOD. Curt Leben. Department of Plant Pathology, Ohio Agricultural Research and Development Center and The Ohio State University, Wooster 44691.

Lots of 500 cucumber seeds were vacuum-infiltrated with cell suspenions of P. lachrymans, dried, and planted in moist vermiculite in film-covered pans, which were held at 24 C under lights. Cotyledons were badly lesioned after 8-10 days. Disease was prevented or nearly prevented by treating seed by the "50-75" method (seed kept at 50 C and 75% relative humidity (RH) for 3 days and then dried). Germination of inoculated seed was reduced ca. 9% by the treatment. The 50-75 method was effective for controlling the seedling phase of the disease in two field tests with two cultivars, but there was more germination inhibition. Keeping inoculated seed as long as 3 mo at a lower temperature (24 C) and 75% RH did not eliminate P. lachrymans. The 50-75 treatment killed soybean seeds.

AN IMPROVED PURIFICATION PROCEDURE FOR CITRUS TRISTEZA VIRUS. R. F. Lee, S. M. Garnsey*, and R. H. Brlansky. AREC, University of Florida, Lake Alfred, FL 33850, and *USDA Horticultural Research Laboratory, Orlando, FL 32803.

The procedure for purification of citrus tristeza virus (CTV) (Gonsalves, et al. 1978. Phytopath. 68:533-559) was modified by adding 0.2% (w/v) polyvinylpyrrolidone 40,000 M.W. (PVP) or 0.1% (v/v) Triton X-100 to the extraction buffer and by using an isopycnic Cs_2SO_4 gradient. The Cs_2SO_4 at 0.5, 1.0, 1.5, and 2.0 m was layered on in steps, the virus suspension added, and centrifuged for 15 hr at 36,000 rpm in a SW 41 Spinco rotor. The quantity and quality of CTV throughout the purification procedure was monitored using ELISA and serologically specific electron microscopy. PVP or Triton X-100 in the extraction buffer approximately doubled the yield of thread-like particles (TLP) as compared to the normal extraction buffer (0.1 M Tris, pH 8.4). The isopycnic Cs_2SO_4 gradient permits better separation of TLP from plant material and from severely fragmented CTV particles.

POPULATIONS OF SHARPSHOOTERS IN HEALTHY AND BLIGHT AFFECTED CITRUS GROVES IN FLORIDA. R. F. Lee, L. W. Timmer, and D. P. H. Tucker, AREC, University of Florida, Lake Alfred, FL 33850

The sharpshooters Oncometopia nigricans (Walker) and Homalodisca coagulata (Say) were studied as possible vectors of citrus blight. Populations were estimated in citrus groves on the central Ridge and East coast flatwoods by counting the number of insects trapped on yellow plastic 603 can closures coated with Tack Trap. Populations were high from May through June in the Ridge and from May through August in the flatwoods. The maximum number per trap/wk was 6.1 in June on the Ridge and 20.4 in July on the flatwoods. They averaged 0.45/trap/wk from August through April on the Ridge and 2.0 from September through April on the flatwoods. Paired groves (same age, management, and scion variety on rough lemon stocks) with high and low incidence of blight were examined in both areas. None of the groves with a low blight incidence had high populations of sharpshooters. O. nigricans was the predominant species in both areas and was more common in groves with high blight incidence, while H. coagulata populations were low and did not vary between groves.

TOXIC COMPONENTS OF FUSARIUM ROSEUM ISOLATED FROM OVERWINTERED BARLEY. Yin-Won Lee and C.J. Mirocha. Department of Plant Pathology, University of Minnesota, St. Paul, MN 55108

An isolate of Fusarium roseum (Lk.) emend. Snyd. & Hans. obtained from overwintered barley in Alaska, was grown on 300 g autoclaved rice for 3 weeks at 21-22 C. The cultures were extracted with methanol-water (1:1, v/v), concentrated in vacuo, and partitioned with petroleum ether. The aqueous phase was applied to XAD-2 column, washed with water, and eluted with chloroform-methanol (3:1, v/v). XAD-2 eluate was concentrated, applied to a Florosil column and eluted with chloroform--methanol (3:1, v/v) and then separated by TLC.

All fractions were collected and examined for toxicity to one-day-old broiler chicks. The toxic band contained 12 components and caused hemorrhaging in the gastrointestinal tract and swelling of the kidney. In addition, the crude culture caused tibial dyschondroplasia in chickens. The above toxins caused symptoms in animals different from those reported for T-2 toxin.

SURVIVAL OF SCLEROTIA OF SCLEROTIUM CEPIVORUM IN MUCK SOIL IN BURNABY, BRITISH COLUMBIA. M.E. Leggett, J.E. Rahe and R.S. Utkhede, Pestology Centre, Department of Biological Sciences, Simon Fraser University, Burnaby, British Columbia, V5A 1S6.

Sclerotia of Sclerotium cepivorum were tested for their ability to survive in muck soil. The sclerotia were harvested from infected onions and buried in nylon mesh bags (80 µ Nitex) on a commercial vegetable farm in Burnaby, British Columbia. They were arranged in a randomized block design with three replications. The proportion of surviving sclerotia in all treatments declined with time. After 16 months 8.9, 11.7, 2.1 and 23.6% of the sclerotia were viable in the dried-surface, dried-buried, not-dried-surface and not-dried-buried treatments respectively. Dried sclerotia decayed more than those which were not dried and those on the surface decayed more than buried ones.

EFFICACY OF NEMATICIDES IN CORN IN WESTERN KANSAS. V. H. Lengkeek, G. E. Sanden and L. D. Lash, Assistant Professor, Associate Professor and Research Assistant, respectively, Department of Plant Pathology, Kansas State University, Manhattan, Kansas 66506.

Nematodes, especially Pratylenchus spp., of irrigated corn were reduced by an average of 45.2% after application of seven chemical treatments. These chemical tests were conducted for two seasons at nine western Kansas sites. Aldicarb reduced nematode numbers by 65.4%; carbofuran by 63.6%; ethoprop by 40.3%; oxamyl by 74.9% and terbufos by 40.9%. Nematode numbers in plots treated with fonofos and fothietan were higher than in nontreated plots. Pratylenchus spp. populations in the various sites ranged from 183 to 6966/g dry root wt. Pratylenchus spp. identified were P. scribneri, P. alleni, P. neglectus and occasionally P. hexincisus. Other plant parasitic nematodes found in low numbers were Helicotylenchus pseudorobustus, Hoplolaimus galeatus, Tylenchorhynchus martini and Xiphinema americanum. No significant differences (P = .05%) in yield due to nematode control were obtained at any of the sites tested.

FUNGUS DISEASES OF TROPICAL FORAGE LEGUMES IN CENTRAL AND SOUTH AMERICA. Jillian M.Lenné, Centro Internacional de Agricultura Tropical, CIAT, Apartado Aéreo 6713, Cali, Colombia.

Fungi representing the Myxomycetes, Phycomycetes, Fungi Imperfecti, Ascomycetes and Basidiomycetes cause most diseases of tropical forage legumes in Central and South America. Anthracnose, incited by *Colletotrichum* spp., is the most serious disease. It affects many legumes with forage potential. *Synchytrium phaseoli*, known as False Rust, is also widespread, often devastating stands of *Glycine*, *Macroptilium* and *Vigna* spp.
Camptomeris Leaf Spot defoliates *Leucaena* spp. in several countries while Sphaceloma Scab damages *Zornia* spp. in Colombia. *Sclerotium rolfsii* is sporadic in occurrence but often kills mature plants of *Stylosanthes* spp. Diseases of lesser importance include Cercospora Leaf Spot, Rhizoctonia Blight, Rust, Powdery Mildew and several leaf spots. Disease screening methodology for evaluating resistance of tropical forage legumes in their centers of diversity is briefly discussed.

EFFECTS OF BUFFER AND AMENDMENTS ON INFECTION OF SOYBEAN CALLUS PROTOPLASTS WITH BEAN POD MOTTLE VIRUS (BPMV). M. S. Lesney and H. H. Murakishi, Department of Botany and Plant Pathology, Michigan State University, East Lansing, MI 48824.

The effect of adding amendments to the inoculum on infection in the BPMV/soybean protoplast system is highly dependent on the pH of the K-phosphate buffer used. At pH 5.6, the optimum pH for infection without amendment, the addition of $CaCl_2$ further increased infection. At pH 6.3, the addition of $CaCl_2$ plus poly-L-ornithine resulted in a synergistic increase in infection. Increasing the concentration of the buffer gave increased infection at pH 5.6 but inhibited infection at pH 6.3. The stimulatory effects at pH 5.6 occurred only when the virus was exposed to the buffer prior to inoculation of the protoplasts, indicating that the buffer effects are primarily on the virus rather than the cells.

INTERIOR TREE TEMPERATURES FAVOR CERATOCYSTIS FAGACEARUM SURVIVAL DURING SUMMER IN TEXAS. R. Lewis, Jr., South. For. Exp. Stn., P. O. Box 227, Stoneville, MS 38776.

Ceratocystis fagacearum causes oak wilt or "decline" in Texas. It does not grow, and may die, at temperatures above 31 C but can survive summer where ambient occasionally exceeds 38 C. Ambient and interior tree temperatures were measured at root-collars and d.b.h. (1.2 m above ground level) on 4 cardinal sides of wilt-affected and healthy live oaks at Kerrville, Texas, over a 2-day period in July 1978. The mean highs were 37.8 C ambient; 33.9 C at d.b.h. wilt; 28.9 C root-collar wilt; 30 C at d.b.h. healthy; and 26.5 C root-collar healthy. Interior temperatures were consistently lowest and most favorable for oak wilt in healthy trees. Root-collar temperatures were near optimum for C. fagacearum growth and root-graft transmission in both healthy and wilt-affected trees. The fungus was isolated from roots in July 1978 but initial wilt in apparently healthy trees did not develop until late August or September.

CORYNEFORM BACTERIA IN RATOON-STUNTED SUGARCANE AND IN WHITE-LEAF DISEASED BERMUDA GRASS: ISOLATION, CULTIVATION, AND PATHOGENIC ROLE. C. H. Liao and T. A. Chen, Department of Plant Pathology, Rutgers University, New Brunswick, NJ 08903.

Coryneform bacteria present in sugarcane and sudangrass infected with ratoon stunt disease (RSD) and in bermuda grass (BG) infected with white leaf disease were successfully isolated and cultivated in an artificial medium. This medium containing Muller-Hinton agar, hemoglobin, Isovitalex, amino acids, and inorganic salts, is derived from media used for culturing the Legionnaires' disease agent and mycobacteria. Cultured RSD and BG bacteria exhibit characteristics of immotility, absence of endospores, nonacidfastness, gram-positive reaction but often irregular staining, aerobic growth, and a filamentous-rod (0.25-0.35 X 4-8 µm) or clublike morphology. Tiny colonies were observed after 8-19 days' incubation (30°C). The BG bacterium can be distinguished from the RSD bacterium by a faster growth rate and the formation of yellowish orange pigments. Cultured bacteria infect and multiply in sudangrass-sorghum hybrid uprights, and can be reisolated at high titers (10^9-10^{10} cells/ml, expressed juice) 6-8 weeks after inoculation.

DISSEMINATION OF CABBAGE BLACK ROT ASCERTAINED BY PHAGE-SPECIFIC XANTHOMONAS CAMPESTRIS STRAINS. K.W. Liew, A.M. Alvarez, and J.J. Cho. Department of Plant Pathology, University of Hawaii, Honolulu, HI 96822.

Three Xanthomonas campestris strains were used as inocula for studying development of black rot in a cabbage field. Differentiation by phage-typing and response to streptomycin enabled simultaneous comparisons of disease originating in the field from either soil inoculum or infected plants. Spatial distributions of plants differentiated by three infection modes (hydathodal, intralaminal, and atypical) were compared over time. Tests for homogeneity using doublet analysis showed them to be aggregated. Most black rot lesions developed at hydathodes from the strain originating on infected plant debris. Strains from inoculated plants were disseminated much later in the growing season. Irrespective of inoculum source, average infection rates for all three strains were lower (ca. 12%) under Hawaiian conditions than published rates for black rot. Results reinforce the importance of reducing original inoculum to delay onset of disease.

COMPARATIVE YIELDS OF SOYBEAN LINES, NEARLY ISOGENIC FOR YELLOW AND GREEN SEED COLOR, INFECTED WITH SEPTORIA GLYCINES. S. M. Lim, USDA, SEA/AR, Department of Plant Pathology, University of Illinois, Urbana, IL 61801.

The effect of brown spot, caused by Septoria glycines, on yields of three soybean lines nearly isogenic for yellow (Clark-L-1) and green (L64-2545d_1d_2-G and L62-1027Cyt-G) seed color was studied in 1978 and 1979. Two distinct lesion types were observed: angular reddish-brown spots surrounded by yellow areas (chlorotic) associated with plants grown from yellow seeds and angular dark-reddish-brown spots without the surrounding yellow areas (non-chlorotic) associated with plants grown from green seeds. In both years, no significant differences in brown spot severity were found between isolines for yellow and green seed color. Yield reductions in these isolines inoculated with S. glycines ranged from 9.5 to 10.5% in 1978, and 10.7 to 13.7% in 1979 when compared to yields of the same isolines from fungicide protected plots. Differences in yield reductions were not significant for either year. Resistance to brown spot cannot, therefore, be characterized by these lesion types.

THE POTENTIAL ROLE OF LECTINS IN THE RESISTANCE OF TOMATO TO PSEUDOMONAS SOLANACEARUM. C.Y. Lin. 145, Ta-Nan, Shinshieh, Taichung, Taiwan 426, Republic of China.

Tomato plants prior to inoculation contain relatively low amounts of lectins which agglutinate P. solanacearum regardless of their susceptibility to this pathogen. Plants inoculated with incompatible isolates of P. solanacearum show a significant increase in lectin titer 48-72 hr after inoculation. Susceptible (C-28) plants inoculated with the virulent isolate (#64) of this pathogen show only slight increases in lectin titer even after prolonged incubation. Titers of lectin preparations from tomato inoculated with the avirulent (#64-B) isolate are similar and much higher when lectins are mixed with five P. solanacearum isolates avirulent to tomato than when mixed with ten isolates virulent to tomato.

CROPPING PATTERN, EPIPHYTIC POPULATION OF PSEUDOMONAS SYRINGAE AND THE INCIDENCE OF BROWN SPOT ON SNAP BEANS. J. Lindemann, D. C. Arny and C. D. Upper*. Department of Plant Pathology and *SEA, USDA, University of Wisconsin, Madison, Wisconsin 53706.

Bean seed infested with P. syringae pathogenic to bean (Psb) was planted in 11 small plots in central WI. The plots were located either in an area 21 km wide where ca. 20% of the land is planted to beans annually (C), 16 km west (W) of, or 27 km east (E) of C. To quantify epiphytic bacterial populations, 4 samples of symptomless bean leaflets were taken from each plot on 3 dates. The 323 P. syringae isolates obtained were tested for pathogenicity to bean pods. Psb was detected on beans in 9 of 11 plots, disease in 6 of those 9. Harvest time disease ratings (% leaves diseased x # lesions/leaf) of $\geq$ 300 occurred only in those 4 plots in C where at least 1 of 8 leaflets had $\geq 10^4$ Psb per gram leaf within 2 weeks of harvest. Two other C plots surrounded by trees were disease free as were 3 of 5 plots in E and W. The other 2 plots in E and W had disease ratings $\leq$ 25. The incidence of high Psb populations and the brown spot disease were associated with plot location and cropping pattern.

FROST DAMAGE TO PEAR REDUCED BY ANTAGONISTIC BACTERIA, BACTERICIDES, AND ICE NUCLEATION INHIBITORS. S. E. Lindow, Dept. of Plant Pathology, University of California, Berkeley, CA. 94720

Populations of ice nucleation active bacteria and ice nuclei active at -5 C or -9 C were lower on trees treated with 16 of 20 bacteria antagonistic to ice nucleating bacteria or with 2 bactericides than on untreated trees. Populations of antagonists (marked with spontaneous rifampicin resistance), when applied once at 50% bloom, were found in excess of 10^5 cells/g fr. wt. plant tissue and comprised more than 50% of the total epiphytic bacteria for 30 days following inoculation. Reductions in populations of E. amylovora on pear flowers were observed in trees treated with 16 antagonists which were either aggressive colonizers of plant surfaces or inhibitory to E. amylovora in vitro. During a mild frost (-3 C) treated trees sustained less frost injury (injury index = 0.11-0.66) than untreated (injury index = 0.95). Frost damage was correlated significantly ($P < 0.001$) with the number of ice nuclei present rather than the number of ice nucleating bacteria.

ISOLATION OF ICE NUCLEATION DEFICIENT MUTANTS OF PSEUDOMONAS SYRINGAE AND ERWINIA HERBICOLA AND THEIR TRANSFORMATION WITH PLASMID DNA. S. E. Lindow and B. J. Staskawicz, Dept. of Plant Pathology, University of California, Berkeley, CA. 94720

Ice nucleation deficient mutants of Pseudomonas syringae and Erwinia herbicola were detected and isolated by a replica freezing technique at a frequency of ca. 4×10^{-3} from ethyl methane-sulfonate mutagenized cells. The nucleation characteristics of 53 P. syringae and 27 E. herbicola mutants, measured as the fraction of cells active in the ice nucleation as a function of temperature (nucleation frequency) were determined. Mutants exhibited reduced threshold temperatures of nucleation (-3 C to -8.4 C) compared with parental type strains (-1.2 C) and a reduction of nucleation frequency by a factor of 10^3 to 10^8 at temperatures above -5 C or at -9 C compared with parental strains or a combination of both of these characteristics. P. syringae and E. herbicola were tested for their ability to be transformed by DNA cloning vectors. P. syringae and E. herbicola were successfully transformed by the plasmids RSF1010 (10^2 to 10^3 transformants/µg DNA) and pBR322 respectively.

ISOLATION AND CHARACTERIZATION OF HOST-SELECTIVE TOXIN FROM HELMINTHOSPORIUM SACCHARI. R. S. Livingston and R. P. Scheffer, Department of Botany and Plant Pathology, Michigan State University, East Lansing, MI 48824.

A structure for the host-selective toxin from H. sacchari was proposed (J. Biol. Chem. 246:4350), but has never been confirmed. Highly purified toxin was isolated from cultures by a new procedure, using activated charcoal plus thin-layer, gel, and ion exchange chromatography. The procedure separated toxin from several closely related, non-toxic compounds. Toxin, the related compounds, and derivatives were characterized by gas chromatography, mass spectroscopy, and nuclear magnetic resonance. The NMR, MS, and hydrolysis data showed that toxin contains galactose plus a $C_{15}H_{21}$ moiety. Spectroscopic and hydrolytic data indicated that toxin and the non-toxic compounds differ in the number of galactose residues present in each. A major revision is required for the previously proposed structure.

RESISTANCE OF PONDEROSA PINE TO BLUE-STAIN FUNGI IN THINNED AND UNDISTURBED STANDS IN NEW MEXICO. W.H. Livingston, Department of Entomology and Plant Pathology; and G.M. Southward, Department of Exp. Statistics, New Mexico State University, Las Cruces, NM 88003.

Pole-size ponderosa pine were inoculated with two blue-stain fungi (Ceratocystis adjuncti and Leptographium pyrinum five years after three stands were either moderately thinned, lightly thinned, or left undisturbed. Resin-soaked sapwood associated with the inoculations was found to be an indicator of host resistance to infection by these fungi. Lesions associated with fungi were 2.6 times longer and 1.8 times wider than in controls. There were more ponderosa pine showing resistant reactions to blue-stain fungi in the moderately thinned stand than the lightly thinned or undisturbed stand.

ROOT DISEASES AND BARK BEETLES ON PONDEROSA PINE IN NEW MEXICO. W.H. Livingston and A.C. Mangini, Department of Entomology and Plant Pathology, New Mexico State University, Las Cruces, NM 88003; and M.E. Mielke, U.S. Forest Service, Albuquerque, NM 87102.

Root diseases were found on 20 recently killed ponderosa pine trees examined in four locations in south-central New Mexico. Eighteen trees had been attacked by bark beetles and root scolytids. Armillaria mellea, Fomitopsis annosa and Verticicladiella spp. were isolated from diseased roots. In another study, three of six live ponderosa pines had diseased roots before beetle attack. There were more diseased roots and insects (bark beetles and root scolytids) in the 6 dying trees than in live ones. Fomitipsis annosa and Verticicladiella spp. were isolated from the roots. Verticicladiella spp. were repeatedly isolated from adult root scolytids (Hylurgops planirostris and Dendroctonus valens) suggesting that these insects are vectors of these root-staining fungi. Root diseases appear to predispose ponderosa pine to bark beetle attack.

TRANSLATION AND TRANSCRIPTION OF SEPARATED BROME MOSAIC VIRUS RNAS IN BARLEY PROTOPLASTS. L.S. Loesch-Fries, P.A. Kiberstis, and T.C. Hall. Department of Horticulture, University of Wisconsin, Madison, Wisconsin 53706.

Brome mosaic virus RNAs were separated by sucrose density gradient centrifugation into RNA 1+2, RNA 3, and RNA 4 preparations. All RNAs were very active in cell-free translation systems. The separated RNAs adsorbed to barley protoplasts during inoculation as efficiently as mixtures of all four RNAs. When protoplasts were inoculated with RNA 3 alone or RNA 4 alone, no synthesis of viral proteins or RNAs could be detected. When RNA 1+2 was inoculated, a low percentage of protoplasts became infected, presumably due to contamination by RNA 3. There was, however, a predominate synthesis of the 110,000 and 100,000 dalton viral proteins along with trace amounts of the 34,500 dalton viral protein and coat protein. These results suggest that RNA 1 and/or RNA 2 are necessary for the initiation of infection, perhaps by the synthesis of a replicase protein.

GUAIACOL STIMULATION OF RHIZOMORPH PRODUCTION BY ARMILLARIA MELLEA IS RELATED TO ENHANCEMENT OF POLYPHENOLOXIDASE. Debra Longworth and M. O. Garraway. Department of Plant Pathology, The Ohio State University, Columbus, OH 43210 and OARDC, Wooster, OH 44691.

Growth (dry weight/thallus) of A. mellea after 21 days on an agar medium containing glucose, L-asparagine, mineral salts and 0 or 100 mg/l guaiacol was 15 and 19 mg respectively. No rhizomorphs were formed. When this medium was supplemented

with ethanol, rhizomorphs formed and growth was 46 and 78 mg respectively. Thus, guaiacol enhances the stimulatory effect of ethanol on growth of mycelia and rhizomorphs. Since guaiacol is a substrate for phenol oxidizing enzymes, polyphenoloxidase (PPO) was measured 24 hours after transfer of young undifferentiated thalli to fresh liquid media. On a basal medium with 0 and 100 mg/l guaiacol, PPO (ΔOD/min/mg dry weight x 10^{-1}) was 2.0 and 10.0 respectively. When ethanol was added, corresponding PPO activities were 7.0 and 15.0. These data show that PPO activity is enhanced by levels of ethanol and guaiacol that stimulate rhizomorph production.

FIELD SAMPLING PATTERNS FOR DETERMINING THE CRITICAL DISEASE LEVEL FOR INITIATING FUNGICIDAL CONTROL OF BOTRYTIS LEAF BLIGHT OF ONION. J. W. Lorbeer and T. W. Jares. Dept. of Plant Pathology, Cornell University, Ithaca, NY 14853.

A number of different sampling patterns used for determining means of Botrytis leaf blight lesions/leaf on onion plants at the three-leaf stage were tested in a 24 acre commercial field, three 8 acre sections of the field, and a 0.65 acre plot in one corner of the field. Mean lesions/leaf detected in each sample area (100 leaves, 33 plants) for all sample areas (sa) in each pattern (A-G) in the 24 acre field were: A, Double Line, 14 sa - 0.93; B, Single Line, 7 sa - 1.09; C, X, 5 sa - 1.97; D, Triple X, 15 sa - 1.40; E, Triple Line, 9 sa - 1.39; F, Total, 63 sa - 1.08; and G, Complete, 99 sa - 1.21. Sampling time, in minutes, for each pattern was: A, 82; B, 47; C, 41; D, 101; E, 72; F, 371; G, 584. Similar results were obtained for similar patterns in the three 8 acre sections and the 0.65 acre plot. Although all patterns were equally sensitive in detecting a critical disease level of 1 lesion/leaf for initiating a weekly fungicide application program, the Single Line pattern proved to be the most efficient.

POPULATIONS OF SCLEROTIA OF SCLEROTINIA MINOR IN NEW YORK ORGANIC SOILS CROPPED TO LETTUCE AND ONION. J. W. Lorbeer, A. A. Abd-Elrazik, and L. A. Wymore. Department of Plant Pathology, Cornell University, Ithaca, NY 14853.

In 9 lettuce fields sampled (4-11 samples/line quadrat/field) during 1979, the 9 means of the populations of sclerotia of S. minor (sclerotia/100 g oven dry soil) ranged from 0-113 in the top 2.5 cm of soil. The mean viability of the sclerotia extracted from each of these fields ranged from 14-86%. In 3 commercial onion fields not recently cropped to lettuce, the 3 means (8-36 samples/field) were 0, 1, and 2 and the mean viability ranged from 8-55%. In an onion field cropped to lettuce in 1978, the means of the populations of sclerotia at 12 sample locations ranged from 0-75. In additional samplings of this same field, the means of the populations of sclerotia for two samples from the top 2.5 cm were 6 and 13 while in two core samples taken to a depth of 20 cm the mean was 65 for each. Growing onions for several years appears to reduce populations of sclerotia of S. minor in the top 2.5 cm of natural organic soils, but sclerotia may survive deeper in the soil.

DISPERSAL OF USTILAGO TRITICI TELIOSPORES AND SUBSEQUENT LOOSE SMUT INFECTION AS INFLUENCED BY ENVIRONMENTAL FACTORS. R. Loria and A. L. Jones, Department of Botany and Plant Pathology, Michigan State University, East Lansing, MI 48824.

Numbers of airborne U. tritici teliospores, various environmental parameters, and loose smut infection were monitored in naturally infested wheat fields, and in fields where a point source of inoculum was introduced. Spore dispersal was correlated positively with rain and wind speed, and negatively with relative humidity. A diurnal dispersal pattern often occurred, with spore catches being highest during midday. The total number of spores trapped was related to the number of smutted heads in the field. Infection in seeds harvested randomly throughout naturally infested fields was 0-.01%, but infection in seed samples from within 30 cm of individual smutted heads was 0-1.5%. In fields where a point source of inoculum was introduced, spore catches at 0.9 m from the source were usually greater than at 2.7 m, and were highly correlated with wind speed and direction. Infection levels were highest where the largest number of spores was trapped.

EVIDENCE FOR DE NOVO SYNTHESIS OF PEA PHENYLALANINE AMMONIA-LYASE DURING THE HOST-PARASITE INTERACTION. David Loschke and Lee Hadwiger, Plant Pathology, Wash. State Univ., Pullman, WA 99164.

A specific antiserum was prepared against pure phenylalanine ammonia-lyase (PAL). Immature pea pods were pulse labelled with [^{3}H]-L-leucine after specific time periods following inoculation of the pod endocarp surfaces with macroconidia of Fusarium solani. Immunoprecipitates isolated from each time group were analyzed with SDS disc electrophoresis and found to contain a radioactive protein with an electrophoretic mobility identical to that of the PAL subunit (82,000 d). The radioactivity, which was interpreted as a measure of the rate of synthesis of PAL, increased from a low in uninoculated pods to a 6 to 10 fold greater level after four hours of contact with spores. The higher rate of synthesis was induced by the pathogenic form, pisi as compared to the nonpathogenic form, phaseoli. The interpretation of the in vivo study was confirmed by using pea mRNA to direct protein synthesis in vitro in a rabbit reticulocyte system. Results show a time dependent increase of translatable PAL mRNA in pea tissue during the host-parasite interaction.

INFLUENCE OF DISEASE SEVERITY AND ENVIRONMENTAL CONDITIONS ON LOW RECEPTIVITY OF OATS TO CROWN RUST. H. H. LUKE, USDA; SEA, Agri. Res.; Dept. of Plant Pathology; Univ. of Florida, Gainesville, FL 32611.

Low receptivity (LR) is characterized by the development of fewer pustules on slow rusting than on fast rusting cultivars. When the disease severity incited by Puccinia coronata was > 20%, LR was not observed. Spore germination, appressoria formation and appressoria penetration were not correlated with LR indicating that the events that control LR occur after penetration. Spores that settled on the leaves quickly (1 min.) were not as infective as the lighter spores that settled more slowly (2 min.). When spores at comparable densities (about 50/cm^2) germinated on leaves under growth chamber and field conditions, the cultivar with LR had 55 fold fewer pustules in the field than in the growth chamber. About the same number of pustules developed on the fast rusting cultivar under both conditions. These results illustrate the magnitude of the differences in LR under growth chamber and field conditions.

FLEXIBACTER ASSOCIATED WITH ROOT ROT OF ALFALFA. F. L. Lukezic, R. G. Levine and M. G. Bookbinder. Department of Plant Pathology, The Pennsylvania State University, University Park, PA 16802.

Gliding bacteria have been reported to occur in plant tissue, however, there have been no reports showing that these organisms affect the tissue. Strains of gliding bacteria isolated from rotted alfalfa crowns caused internal necrosis of alfalfa roots and crowns, induced a hypersensitive response in tobacco leaves, and rotted potato slices, celery stalks and lettuce leaves. These bacteria produced amylase, pectinase, protease and catalase. They were neither able to liquify agar, cellulose, or chitin, nor tolerate more than 2% salt. The bacteria were Gram-negative, flexible rods, 0.4 µm wide and 3 to 5 µm long. The G+C content of the DNA of the strains examined was 32 mole % (T_m). These characteristics classify these gliding bacteria from alfalfa as members of the genus Flexibacter.

EFFECT OF SLUDGE COMPOST ON SELECTED SOILBORNE DISEASES. R. D. Lumsden, J. A. Lewis, R. E. Werner and P. Millner. U.S.D.A., S.E.A., Beltsville, MD 20705.

Compost was added at the rate of 10% (w/w) to soils naturally as well as artificially infested with several individual soilborne pathogens. Compost consistently and significantly decreased Aphanomyces root rot of peas by 75-80%. Damping-off of cotton caused by Rhizoctonia solani and Sclerotinia drop of lettuce were both decreased by up to 50%. Variable control or no effect occurred with Thielaviopsis root rot of cotton, Fusarium wilt of melon, Pythium blight of bean, and Phytophthora blight of pepper. Disease was sometimes increased with Pythium and Fusarium root rots of pea and Thielaviopsis root rot of beans. Numbers of surviving propagules of R. solani decreased to ca. 50% of a control soil in compost-amended soil after 9 wk, but numbers of oospores of P. ultimum did not similarly decrease. Sludge compost may enhance disease suppression by increasing the soil microflora antagonistic to selected pathogens and may be useful as a soil amendment to decrease the severity of certain important diseases.

PHYTOALEXIN SYNTHESIS BY BIOCHEMICALLY SPECIALIZED PARAVASCULAR PARENCHYMA CELLS IN COTTON STEM. M. E. Mace, National Cotton Pathology Research Laboratory, P. O. Drawer JF, College Station, Texas 77840.

Stem xylem tissue of the Verticillium-resistant cotton cultivar

'Seabrook Sea Island' (Gossypium barbadense) infected with Verticillium dahliae showed localization of terpenoid aldehyde phytoalexins, detected histochemically, in paravascular parenchyma cells 2 days after inoculation. Both discrete localization and diffuse deposition of phytoalexins occurred during a 2 week infection period. The diffuse deposits appear to arise by diffusion from initial, localized sites. Infiltration of stem segments with 10^{-3} M $CuCl_2$ also induced localized deposits of the terpenoid aldehydes in paravascular parenchyma cells 3 days after infiltration. This indicates that the paravascular cells responding to both biotic and abiotic factors are biochemically specialized for terpenoid aldehyde synthesis and therefore are distinct from adjacent, morphologically similar cells.

A PROPOSED CROP LOSS FORECASTING SYSTEM FOR POWDERY MILDEW OF WHEAT. D. R. MacKenzie, W. L. Pedersen and E. D. King. Department of Plant Pathology, The Pennsylvania State University, University Park, PA 16802.

The severity of wheat powdery mildew (PM) caused by *Erysiphe graminis tritici* at crop maturity is linearily related to grain yield. However, for decision strategies for integrated pest management based on expected crop losses due to PM, one needs to project epidemics into the future. Our pest management system utilizes the relationship of disease incidence to severity sampled over time. The estimated logits of disease severities are projected by regression to crop maturity and interpreted by our crop loss model. All computations can be done on a hand-held programmable Texas Instrument Model 59 calculator. Applications to other crop/disease models are obvious.

PREDICTING APPARENT INFECTION RATES OF RICE VARIETIES TO BLAST. D. R. MacKenzie, R. L. Villareal, R. R. Nelson, and J. Castano. The Pennsylvania State University, University Park, PA 16802 and The International Rice Research Institute, P.O. Box 933, Manila, Philippines.

Measuring horizontal resistance (HR) as a lessened apparent infection rate (AIR) has prompted a search for sources of such resistance for several diseases and, in our case, for rice blast. As an alternative to field plot testing for AIR, we assessed sporulation capacity, disease efficiency and latent period, as measured in a phytotron for 6 rice lines against three isolates of Pyricularia oryzae, as predictors of field AIR. Sporulation capacity was judged to be the best predictor of field AIR in two experiments (R^2 = 0.857 and 0.865). Multiple regression analyses using all three variables improved the predictability but appear to be superfluous for rapid screening of germplasm. We propose that sporulation capacity could be used to identify presumptive HR prior to field testing.

EVALUATION OF A GENERAL LOSS MODEL FOR CROPS. L. V. Madden, S. P. Pennypacker, and C. H. Kingsolver. Department of Plant Pathology, The Pennsylvania State University, University Park, PA 16802.

Crop loss data for two disease-host systems were statistically described by a general loss model and a multiple-point loss model. The general model utilized either final disease severity or area under the disease progress curve (ADPC) to make loss predictions; the multiple-point model used a weighted sum of disease levels throughout the epidemic to predict loss. Error mean square and coefficient of determination were used to compare models. The general loss model provided an equal or better fit to the data than the multiple-point model. The use of ADPC in the general model did not improve the fit of the data over simply using final disease severity. The superiority of the general model was attributed to the theoretical considerations used in developing the model and to the high correlation among successive disease variables in an epidemic.

EFFECT OF SOIL FUNGI ON PATHOGEN SURVIVAL AND INFECTION IN FUSARIUM CROWN ROT OF TOMATO. J. J. Marois and D. J. Mitchell, Department of Plant Pathology, Univ. of Florida, Gainesville, FL 32611.

Chlamydospores of Fusarium oxysporum f. sp. radicis-lycopersici were added to soils that were treated with methyl bromide-chloropicrin and recolonized by naturally occurring microflora or amended with conidia of Trichoderma, Penicillium, and Aspergillus. The soils were stored uncovered in the greenhouse to permit recolonization by airborne inocula. Every wk 1.5 kg of each soil were infested with the pathogen at 1000 chlamydospores/g of soil. Germinated 'Bonnie Best' tomato seeds were placed in the infested soil and examined for infection after 2 wk at 20 C. Ninety percent of the plants were infected in the freshly fumigated, nonamended soil, while only 25% were infected in the freshly fumigated, amended soil. In soils that were infested 46 days after fumigation, 1% of the plants were infected in both the amended and nonamended treatments. Percent infection and pathogen survival decreased with time after fumigation in both the amended and nonamended soils.

A SEROLOGICAL METHOD FOR DETECTING FUSARIUM MONILIFORME IN CORN STALK TISSUE BASED ON DIFFERENCES IN THE RIBOSOMAL PROTEINS OF HOST AND PATHOGEN. Michael R. Marshall and James E. Partridge Department of Plant Pathology, University of Nebraska, Lincoln, NE 68583.

Previous studies in our laboratory employing polyacrylamide gel electrophoresis have demonstrated that the ribosomal proteins of Fusarium moniliforme Sheld. and corn (Zea mays L.) are different, and that these differences allow ribosomal proteins of the pathogen to be identified in the composite pattern of ribosomal proteins from infected stalk tissue. In the present study, we have raised antibodies to both host and pathogen ribosomal proteins. These antibodies were found to be specific for their respective ribosomal preparations as shown by Ouchterlony double diffusion tests and sucrose density gradient analysis of the antigen-antibody reactions. The antisera were then employed in several qualitative serological tests to successfully assay for F. moniliforme in corn stalk tissue.

INFECTION INTENSITY IN THE JOHNSON DRAW PLANTATION AFTER 10 YEARS OF BLISTER RUST MANAGEMENT THROUGH PRUNING AND THINNING OF WESTERN WHITE PINE. N. E. Martin, R. E. Williams, and J. Y. Woo. USDA FS, Ogden, Ut. 84401, S&PF, FIDM, Boise, Id. 83706, USDA FS, Ogden, Ut. 84401.

Rogueing of diseased plants or infected plant parts is a sanitation principle vital to disease management. Pruning of all branches from the lower third of the tree height reduced the amount of fatal infections in all 6 replications of pruning and 10x10 spacing throughout a 42.5 ha plantation. Ten years after the initial pruning of 15 year old western white pine trees, which were again pruned at age 20, 39 percent of pruned trees were fatally infected whereas 78 percent of the nonpruned, nonthinned trees were so afflicted. No significant advantage (44 percent) resulted from also pruning the Douglas-fir, grand fir, and western larch in 3 of the replications. Sixty eight percent of nonpruned trees, thinned to 10x10 spacing, had fatal infections. The data illustrate the impact of pruning but also warn that the environment must be considered before pruning is indiscriminately applied to all stands.

LAMINATED ROOT ROT IN TREES ADJACENT TO DISEASED GRAND FIR AND DOUGLAS-FIR IN NORTH IDAHO. N.E. Martin, USDA-FS, Ogden, Ut. 84401, G.E. Long, WSU, Pullman, Wn. 99164, R.E. Williams, S&PF, FIDM, Boise, Id. 83706.

Grand fir (GF) and Douglas-fir (DF) are frequently killed by laminated root rot. In Western Red Cedar (WRC), Western Hemlock (WH), and GF habitats both are easily regenerated, have high site index, and demand thinning for stocking. Unfortunately, this naturalness in infected areas perpetuates the problem through root contact with infected trees and residual stumps being sources of inoculum. Western white pine and western larch (WL) are frequent serals in these habitats. Ponderosa and lodgepole are occasional. Analysis of the nearest neighbor with laminated root rot to similarly diseased GF showed their frequency to recede in the order GF, DF, WH, WL. Analysis of data for DF showed the order to be GF, DF, WL, and zero frequency for WH. The frequencies of diseased neighbors of similarly diseased WL receded DF, GF, WL, WH. In all cases the frequency of WRC as the nearest diseased neighbor was zero.

FUSARIUM WILT OF CHRYSANTHEMUMS: SYMPTOM DEVELOPMENT IS INFLUENCED BY NIGHT TEMPERATURES. D. G. Matteoni and R. K. Horst, Dept. of Plant Pathology, Cornell University, Ithaca, NY 14853.

Chrysanthemum morifolium cvs. Royal Trophy (RT), Mandalay (M), and Torch (T) were root-inoculated with conidia of *Fusarium oxysporum* f.sp. *chrysanthemi* which causes Fusarium wilt. Plants were grown with 14 h photoperiod at day:night temperatures of 35:13, 35:18, 35:24, 35:29, or 35:35 C. Symptoms were rated daily on a scale of 0 (no symptoms) to 5 (dead) for 28 days after inoculation. Daily ratings were totalled for each cultivar at each temperature regime and divided by the number of inocu-

lated plants to give an average total rating (ATR). ATR for RT and M increased with night temperature to 29 C and levelled off or decreased at constant 35 C. ATR for T increased with night temperature from 24 to 35 C. Although no symptoms developed on T below 24 C, plants were frequently infected. Night temperatures favorable for mycelial growth and sporulation of the pathogen on agar media were lower and higher, respectively, than that most favorable for symptom development.

QUICK PREVISUAL DETECTION OF MYCOPLASMAL DISEASES BY STOMATAL RESISTANCE MEASUREMENTS. J.A. Matteoni and W.A. Sinclair, Dept. of Plant Pathology, Cornell University, Ithaca, NY 14853.

Stomatal dysfunction in American elms (*Ulmus americana*) with phloem necrosis (PN) was suggested by the preliminary finding of significantly less negative xylem pressure potentials in diseased than in healthy trees (-7.8 and -17.8 atm., P = .01). Diffusive resistances (in sec/cm) of stomata of elms and periwinkle (*Catharanthus roseus*) infected with the PN agent, white ash (*Fraxinus americana*) and periwinkle infected with the agent of ash witches'-broom (AWB), and comparable healthy plants were then measured. Healthy and diseased plant stomatal resistances were 4.5 and 34.0 for elm, 2.7 and 22.9 for ash, 1.0 and 5.4 for periwinkle with the PN agent, 0.1 and 3.2 for periwinkle with the AWB agent. Each difference was significant at P = .05. Stomatal resistance in infected ash seedlings increased 4-6 wk before the onset of visible symptoms. These data implicate stomatal dysfunction in two mycoplasmal diseases. Stomatal resistance appears useful for previsual detection or quick corroboration of mycoplasmal infections.

CONTROL OF ROOT-KNOT NEMATODES AND THE COLORADO POTATO BEETLE ON POTATOES WITH IN-FURROW APPLICATIONS OF NEMATICIDES. P. G. Mawhinney, R. Rodriguez-Kabana, and P. S. King, Department of Botany, Plant Pathology, and Microbiology, Auburn University, Auburn, AL 36830

Aldicarb (Temik 15G), phenamiphos (Nemacur 15G), carbofuran (Furadan 10G) and oxamyl (Vydate 10G) were applied in-furrow at 1.1, 2.2, 3.4, 4.5 and 6.7 kg a.i./ha to determine their effectiveness for control of Meloidogyne arenaria, and the Colorado potato beetle (Leptinotarsa decemlineata) in potato. Significant control (P = 0.05) of M. arenaria was obtained with aldicarb 15G at all rates, phenamiphos 15G at 2.2, 3.4, 4.5 and 6.7 kg a.i./ha, and oxamyl 10G at 3.4 and 4.5 kg a.i./ha. All treatments with aldicarb 15G, phenamiphos 15G and oxamyl 10G resulted in significant yield increases. Treatments with carbofuran 10G did not reduce populations of root-knot nematode larvae or increase yield. Use of the nematicides resulted in significant control of the potato beetle irrespective of rate.

PROPERTIES OF ERWINIA STEWARTII PLASMID pDC250 CONTAINING BACTERIOPHAGE Mu cts pf7701 AND Tn10 INSERTIONS. S. L. McCammon, R. G. Rowan, and D. L. Coplin. Department of Plant Pathology, The Ohio Agricultural Research and Development Center, Wooster, OH 44691.

Erwinia stewartii harbors a derepressed conjugative plasmid, pDC 250. After transfer of this plasmid to E. coli, it was first labeled with the tetracycline resistance (TcR) transposon Tn10 (plasmid designated pDC251) and then with the kanamycin resistant Mu cts bacteriophage pf7701 (plasmid designated pDC251.1). When pDC251.1 was transferred to E. stewartii SS104 it was unstable; loss of either or both the drug resistance markers occurred. Selection for KmR transfer resulted in up to 90% TcS transconjugants, indicating possible transposition of pf7701 and subsequent plasmid loss. When TcR was selected, most transconjugants contained plasmids with pf7701 deletions. Three clones with possible Tn10 insertions into the chromosome were found. Autonomous pDC251.1 DNA was found in only 8/13 stable KmR TcR transconjugants. Therefore, pDC251.1 may prove useful for generating pf7701 and Tn10 transpositions and facilitating Hfr formation by pDC250 derivatives in E. stewartii SS104.

INDUCED PATHOGENICITY OF THE VESICULAR-ARBUSCULAR MYCORRHIZAL FUNGUS, GLOMUS FASCICULATUS, ON TOMATO SUBJECTED TO ENVIRONMENTAL STRESS. P. M. McCool. Department of Plant Pathology, University of California, Riverside, California 92521.

Tomato seedlings were inoculated with soil containing the mycorrhizal fungus, Glomus fasciculatus while control seedlings received no inoculum. Three weeks after inoculation, the plants were subjected to .30 ppm ozone once weekly for a period of 5 weeks while controls received only filtered air. Plants were harvested twice weekly and analyzed for mycorrhizal infection and total dry weights. When the experiment was run during conditions of optimal temperature, light and daylength, ozone eliminated the beneficial growth response due to the mycorrhizal fungus. However, when environmental conditions were sub-optimal, mycorrhizal control plants were smaller than the non-mycorrhizal controls. The growth of mycorrhizal plants exposed to ozone was further reduced as compared to non-mycorrhizal controls. Growth depression in mycorrhizal control plants under conditions of environmental stress may result from an alteration of the symbiosis in favor of pathogenicity.

MICROORGANISMS ASSOCIATED WITH SYCAMORE CANKER STAIN. F. I. McCracken and J. R. Nicol. South. For. Exp. Stn., P. O. Box 227, Stoneville, MS 38776.

Ceratocystis fimbriata f. platani causes sycamore (Platanus occidentalis) mortality throughout its natural range and is often difficult to isolate from diseased trees. Aseptic samples from 8-month-old C. fimbriata-induced cankers were isolated on nutrient agars to determine associated microorganisms and improve primary pathogen recovery. Genera isolated from wood of four distinct areas associated with cankers in order of relative frequency were: (1) Unstained, Pestalotia; (2) Incipient stain, Botryodiplodia, Ceratocystis, Fusarium, Rhinocladiella, Pestalotia and Bacillus; (3) Stained, Botryodiplodia, Pestalotia, Basidiobotrys, Hansfordia, Bacillus, Ceratocystis, Candida, Fusarium, and Botrytis; (4) Decayed, a Basidiomycete, Candida, Pestalotia, Macrophoma, Botrytis, and Bacillus, but no Ceratocystis was found. Some unidentified fungi were found in all areas. Selected fungicides in various media did not improve recovery of C. fimbriata as compared to potato dextrose agar.

A PROPOSED ENZYME SPECIFIC ROLE FOR THE HOST-SPECIFIC TOXINS OF ALTERNARIA ALTERNATA F. SP. LYCOPERSICI. B. L. McFarland & D. G. Gilchrist, Dept. Plant Pathology, Univ. Calif., Davis 95616.

The host-specific toxins produced by Alternaria alternata f. sp. lycopersici, specifically pathogenic to certain genotypes of tomato, induce cell solute potential changes and genotype specific, dosage dependent electrolyte leakage in tomato leaf discs only after the onset of visible intracellular necrosis. Studies using ^{14}C-toxins gave no evidence for genotype specific degradation. Structural studies by pmr spectroscopy revealed a possible aspartate derived moiety in the toxin molecule. Studies of temporal protection against in vivo toxin induced necrosis revealed that only L-aspartate, members of the aspartate amino acid family and selected intermediates of aspartate metabolism afforded protection. The effectiveness of orotic acid protection indicated a possible antimetabolite role for the toxins involving aspartate transcarbamoylase (ATCase). Cell-free preparations of ATCase exhibited differential sensitivity to toxin inhibition within host genotypes (rr and RR) and between host and nonhost plant sources.

FACTORS AFFECTING THE OCCURRENCE OF WHITE-TIP OF RICE IN LOUISIANA. E. C. McGawley, Dept. of Plant Path. & Crop Physiol., La. State Univ. Ag. Expt. Sta., Baton Rouge, LA 70803

White-tip disease of rice (Oryza sativa L.) is caused by a seed-transmitted nematode, Aphelenchoides besseyi (AB). The nematode was found in less than 4% of 498 rice seed samples obtained from storage bins. Studies suggest that Phostoxin®, a chemical used for treatment of grain insects in stored rice, is effective against AB and aids in minimizing its dissemination. Reproduction of AB alone, and in combination with the stem-rot fungus, Sclerotium oryzae (SO), was measured after 14 weeks on 10 commercial rice varieties in a greenhouse. Green weights of Melrose plants inoculated with AB alone or AB and SO in combination were significantly less than those of controls; but, SO alone did not reduce green weight. Green weight of Nova '76 was not affected by either organism alone but was significantly reduced when AB and SO were combined. The occurrence of white-tip may be reduced by the use of Phostoxin and varietal resistance; however, on some varieties it may interact synergistically with the stem-rot fungus.

A DETECTION TECHNIQUE FOR PHOMOPSIS INFECTION ON IMMATURE SOYBEAN PODS. D. C. McGee and A. Wacha, Department of Plant Pathology, Seed and Weed Sciences, Iowa State University, Ames, IA 50011.

The sequence, whereby soybean pods are infected by *Phomopsis* spp., the cause of pod and stem blight, before seeds are infected offers the possibility of predicting the severity of seed infection at harvest time based on pod infection earlier in the growing season. Decisions then could be made on the need for fungicide control measures. A technique to rapidly detect infection on symptomless soybean pods has been developed. Detached pods brought in from the field, are surface sterilized in 1.3% sodium hypochlorite for 1 min, then dipped into a 24 mg/ml solution of the isopropylamine salt of N-(phosphonomethyl) glycine [Roundup] for 5-10 seconds. They then are incubated for 7 days at 25 C under continuous light on sterilized blotters moistened with sterile water containing 500 µg/ml of 2, 5 dichloro-6-nitroaniline (Botran 75W). *Phomopsis* pycnidia on infected pods then can be identified using a dissecting microscope.

RELATIVE SUSCEPTIBILITY OF ELM SPECIES TO BLACK SPOT. G. McGranahan and E. B. Smalley. Dept. of Plant Pathology. University of Wisconsin, Madison, WI 53706

Gnomonia ulmea (Schw.) Thum. causes leaf spots, premature defoliation and twig blight on elms. Since interspecific elm hybrids are being developed to replace the American elm, nine elm species of interest to breeders were examined at the elm arboretum in Arlington, WI to determine their relative susceptibility to black spot. Two methods of scoring were used. One was a descriptive rating based on the impact of the disease on the ornamental quality of the tree. The other utilized an objective scale of leaf damage based on number and size of lesions in two random samples of 10 leaves each per tree. Seven to 20 trees were scored for each species. A high coefficient of rank correlation indicated that either method may be used for rating disease impact. The descriptive rating, however, was less time consuming. Species were rated as follows in order of increasing susceptibility: Ulmus thomasii, U. laciniata, U.parvifolia, U. pumila, U. carpinifolia, U. japonica, U. americana, U. glabra and U. laevis.

HOST-SPECIFICITY OF VESICULAR-ARBUSCULAR MYCORRHIZAL FUNGI ON FIVE CROP SPECIES. A.-C. McGraw and N. C. Schenck, Dept. of Plant Pathol., Univ. of Florida, Gainesville, FL 32611

Seven species of vesicular-arbuscular mycorrhizal fungi were evaluated for their effects on the growth of five crop species in the greenhouse. Transplants of each host were grown in 15 cm pots filled with spore-infested (0.3 spores/g), autoclaved sandy soil having 69 ppm phosphorus and pH of 5.7. Growth parameters for both the fungi and hosts were monitored at 45,60,90, and 120 days (five plants/treatment/date). Glomus epigaeus, G. etunicatus, and G. mosseae provided a 50, 50, and 200% growth increase, respectively, in citrus after 120 days. Glomus etunicatus and G. fasiculatus increased tomato yields 200 and 300%, respectively. These two species caused earlier bloom and larger flowers in chrysanthemum. Peach responded well to each species in all growth parameters, whereas, podocarpus did not. Root colonization and sporulation of the mycorrhizal fungi were of little value in predicting plant response. Ranking of host response to fungal species varied with time emphasizing the need for serial monitoring.

EVIDENCE FOR PHLOEM TRANSLOCATION OF FACTOR(S) INDUCING SYSTEMIC RESISTANCE OF NICOTIANA TABACUM AGAINST DIVERSE CHALLENGERS. John L. McIntyre. The Connecticut Agricultural Experiment Station, Box 1106, New Haven, Connecticut 06504.

About 3 days after tobacco mosaic virus (TMV) inoculation of the first fully expanded leaf on a tobacco cultivar hypersensitive to TMV, local and systemic resistance develops against Phytophthora parasitica var. nicotianae (Ppn), Pseudomonas tabaci, and TMV. Removal of the TMV-inoculated leaf after, but not before, resistance occurs does not limit the response. To determine if factor(s) resulting in systemic resistance are phloem translocated, either the petiole of the TMV-inoculated leaf or the next youngest leaf was steam-girdled immediately after TMV-inoculation. Blockage of phloem but not xylem transport occurred since girdled leaves remained turgid but ^{14}C-compounds did not translocate from them. Local but not systemic resistance developed against all challengers if the TMV-inoculated leaf was girdled. If the leaf above the TMV-inoculated leaf was girdled, local and systemic resistance against Ppn developed in all leaves except the girdled leaf. The latter method has yet to be tested against the other challengers.

LOCALIZED INFECTIONS OF NICOTIANA TABACUM WITH TOBACCO MOSAIC VIRUS (TMV) INDUCES RESISTANCE AGAINST INSECTS. John L. McIntyre and J. Daniel Hare. The Connecticut Agricultural Experiment Station, Box 1106, New Haven, Connecticut 06504.

Localized infections of single leaves with TMV induces local and systemic resistance against diverse pathogens. On TMV-induced plants, local and systemic effects on insect growth and development were studied using 4th instar larvae of the tobacco hornworm, Manduca sexta. Systemic effects on insect reproduction were studied using the green peach aphid, Myzus persicae. The duration of hornworm larval development was extended 18% on locally protected leaves, and growth rate was reduced 27% and 16% on locally and systemically protected leaves, respectively. Aphid reproduction was reduced up to 12% on TMV-inoculated plants when aphids were placed on plants 7 days after, but not simultaneously with TMV inoculation. Resistance was not due to mechanical injury associated with virus inoculation, nor was local resistance to hornworms or systemic resistance to aphids related to changes in nutritional status of the plant. Systemic resistance against hornworms may, in part, be related to reduced nutritional quality of systemically protected leaves.

THE ONTARIO TOBACCO BLUE MOLD DISASTER OF 1979. McKeen, W. E. Department of Plant Sciences, University of Western Ontario, London, Ontario, Canada N6A 5B7.

From July 8 to 23 tobacco growers who had imported "speedlings" from Sun City, Florida, reported blue mold. On August 1, 2, 3, 13 and 25 blue mold was reported on 60, 350, 600, 900 and 1500 farms. Blue mold caused the most severe plague that ever has occurred in Ontario. The entire crop was cut down on 460 farms and the loss was about 100 million dollars. No effective control measures were used. Lessons should be learned from the blue mold disaster. Most important, plant pathologists are required in Canada and they cannot be replaced by biochemists, geneticists, plant physiologists and cell biologists. Second, plant pathologists should have been responsible for control recommendations. A medical officer, not the commanding officer, recommends the medication for his patients.

CHARACTERISTICS OF THE DOUBLE ANTIBODY SANDWICH ELISA FOR PLANT VIRUSES. M. R. McLaughlin, O. W. Barnett and P. M. Burrows. Clemson University, Clemson, South Carolina 29631 USA.

Clover yellow vein virus (CYVV) and its homologous antiserum were used in studies of time and temperature effects on ELISA in polystyrene substrate plates. Replicated lattice square and Youden square experimental designs accommodated variation due to well position within plates and appropriate adjustment of treatment means. Antibody at 2.5 µg/ml adsorbed rapidly to polystyrene, reaching optimum levels in 1 hr at 5 C. Longer times resulted in lower final reaction levels (A_{400}). Incubation of antigen and alkaline phosphatase-linked antibody (conjugate) for 2 hr each, allowed detection of CYVV at 0.2 µg/ml, but longer times resulted in higher A_{400} levels. With CYVV at 0.2 µg/ml, reduction of antigen incubation time by one-half was compensated by doubling conjugate incubation time and vice versa. Conjugate incubation at 5 C resulted in A_{400} levels more than double those at 30 C. Substrate hydrolysis followed first order kinetics. Antibodies produced later in a rabbit's immune response were shown to be more efficient in ELISA than those produced earlier.

CYTOPLASMIC INCLUSIONS INDUCED BY WHEAT STREAK MOSAIC VIRUS

Charles R. McMullen & Wayne S. Gardner, Departments of Biology and Plant Science, respectively, SDSU, Brookings, SD 57007.

Ultrastructural examinations of wheat streak mosaic virus (WSMV)-infected leaf tissue, using various fixation protocols, revealed cytoplasmic inclusions consisting of pinwheels, scrolls, laminated aggregates, nonviral crystals, virus aggregates and fibrous masses. Five to eight minutes in 5% glutaraldehyde followed by fixation in 1% osmic acid for 15 minutes resulted in well fixed, contrasty cytoplasm and compact WSMV aggregates. The morphology of pinwheels and associated structures was stable under varying conditions of fixation. Elongated elements, concluded to be WSMV particles, were observed in plasmodesmata and frequently terminated in extraprotoplasmic sacs or fan-shaped aggregates in the cytoplasm. Plasmodesmata were spatially related to pinwheel inclusions and may play a role in their ontogeny. Cell wall thickenings containing modified plasmodesmata occurred in WSMV-infected cells. WSMV-infected cells of wheat (Triticum aestivum L.) and green foxtail (Setaria viridis L.) were studied.

DIFFERENTIAL ISOLATION OF FUSARIUM SPECIES FROM GRASSLAND SOIL USING FOUR MEDIA AND FOUR METHODS. Marcia P. McMullen and

R. W. Stack. North Dakota State University, Fargo, ND 58105

Previous use of media and methods for recovering Fusarium species from soil have concentrated on particular species, but few comparisons among these media and methods have been reported for many species. Four agar media, general purpose potato dextrose, semi-selective Martin's rose bengal, selective Komada, and selective Nash-Snyder were tested in combination with four isolation methods, plating root pieces, plating sieved-out debris, soil dilutions, and soil plates. Comparisons of media and methods were based on recovery of 676 isolates representing 20 species and sub-species. Fusarium species were differentially isolated by the selective and non-selective media. Potato dextrose agar was least satisfactory due to overgrowth by other fungi. Each method of isolation favored certain species. Interaction between selective media and isolation method occurred only with F. oxysporum and F. equiseti. Use of several methods and media is necessary when surveying Fusarium soil populations because one method or medium alone will not give adequate representation of the variety and magnitude of species present.

FUNGICIDAL MANAGEMENT OF *SEPTORIA* CANKER OF *POPULUS* GROWN UNDER SHORT-ROTATION, INTENSIVE CULTURE. H.S. McNabb, Jr., M.E. Ostry, P.A. Tipton, R.S. Sonnelitter, J.M. Zito, and E.S. Caldbeck. Bessey Hall, Iowa State Univ., Ames, IA 50011 and North Cent. For. Exp. Sta., Folwell Ave., St. Paul, MN 55108.

A 1440-tree planting of *Populus* hybrids of varying susceptibility to *Septoria musiva* canker was established in central Iowa in 1977. Included were clones NC5272, *P. nigra* X *P. laurifolia*, Sus; NC5262, *P. candicans* X *P. berolinensis* and NC5331, *P. berolinensis* X *P. trichocarpa*, Mod Sus; and NC5271, *P. charkowiensis* X *P. deltoides*, Res. Trees were planted 1m x 1m spacing. Treatments were 3 fungicides on 3 spray schedules and a check replicated 4 times. Objectives were to determine growth impact of *S. musiva* leaf spot and fungicide efficacy. Tree ht (±6m) and density prevented complete canopy coverage with chemicals sprayed from ground level in 1979. No significant treatment differences in leaf spot ratings were noted in 1979, but canker ratings in winter 79-80 were highly significant. Captafol reduced cankering of susceptible trees to the negligible level in resistant trees. Practical fungicidal management of *Septoria* cankers in *Populus* plantings is being investigated further.

INTERACTION OF BACTERIA AND ZOOSPORES WITH A HYDROXYPROLINE-RICH GLYCOPROTEIN FROM TOBACCO CALLUS. Jay E. Mellon and J. P. Helgeson, USDA, SEA, AR Plant Disease Resistance Unit, Dept. of Plant Pathology, Univ. of Wisconsin-Madison, Madison, WI 53706

Tobacco callus tissues contain a glycoprotein that can be extracted by the acid-ethanol procedure of Marinkovich [J.Immunol. 93:732(1964)]. The material has an apparent MW of about 100,000 and contains about 50% each of protein and carbohydrate. The protein moeity is basic and contains 38% hydroxyproline. The hydroxyproline-rich glycoprotein (HPRG) will agglutinate some avirulent strains of Pseudomonas solanacearum (e.g., B-1) but not virulent isolates (e.g., K-60). Pronase (1mg/ml) or 0.1M periodate will eliminate the agglutinating activity. The HPRG is not a hemagglutinin. HPRG labeled with fluorescein isothiocyanate (FITC) will adhere to bacterial cells which are capable of agglutination as well as to zoospores or mycelia of Phytophthora parasitica var. nicotianae (Ppn). Bacterial lipopolysaccharide from P. solanacearum K-60 will inhibit agglutination of avirulent bacteria and adherence of FITC-labeled HPRG to Ppn. The interactions between bacteria and HPRG appear to be relatively weak.

DRY ROOT ROT OF CITRUS - A DISEASE COMPLEX. J.A. Menge, E.L.V. Johnson, D. Sibert, and R.M. Burns. Department of Plant Pathology, University of California, Riverside, CA 92521.

Dry rot of citrus is a serious, usually lethal, disease of citrus in California. It is characterized by a brown to purple discoloration of the wood in the roots or crown of citrus. The disease results in abrupt wilting and death of trees. Fusarium solani was isolated from 80 of 165 isolations made from 20 trees infected with dry rot and from only 2 of 50 isolations from apparently healthy trees. Troyer citranges were not damaged when planted in soil infested with F. solani. However, 60% of the Troyer citrange wilted and died and exhibited symptoms of dry rot when they were inoculated with Phytophthora citrophthora before being planted in F. solani infested soil. Citrange infected with P. citrophthora alone exhibited severe root rot and growth reduction, but did not wilt. Heating roots to 45 C for 1 min or burning roots resulted in death or severe growth reductions if planted in F. solani infested soil but not if planted in non-infested soil.

ELECTRON MICROSCOPIC OBSERVATION OF VIRUS ASSOCIATED WITH APHID STYLETS. R. L. Mernaugh and T. P. Pirone, Department of Plant Pathology, University of Kentucky, Lexington, 40546.

Aphids (Myzus persicae) were allowed brief (<20 sec) probes through a Parafilm^{R} membrane which contained about 1 mg/ml of the purified potyviruses potato virus Y or tobacco vein mottling virus. The aphids were then removed from the membrane and anesthetized immediately with CO_2. The stylets were excised with a micro-dissecting scissors, removed from the scissors with a microneedle, and placed onto dry, large-mesh, carbon-collodion coated grids. The specimens were shadowed with germanium and examined with an electron microscope. Numerous typical potyvirus particles were present in droplets which were apposed to the stylets of aphids which probed virus-containing solutions, while stylets from aphids which probed control solutions contained no such particles. This technique should be useful in studying the relationship between non-persistent viruses and their vectors.

PLANT/DS: AN EXPERIMENTAL COMPUTER CONSULTING SYSTEM FOR THE DIAGNOSIS OF SOYBEAN DISEASES. R. S. Michalski, J. H. Davis, V. S. Bisht and J. B. Sinclair, Depts. of Computer Science and Plant Pathology, University of Illinois, Urbana, IL 61801.

An experimental computer system was developed for consultation on diagnosis of soybean diseases in Illinois. The system uses a computer representation of the diagnostic decision rules used by plant pathologists. It can formulate also its own rules from examples of diagnostic decisions of these experts. Both kinds of rules are expressed as Generalized Variable-valued Logic System 1 Rules (GVL_1 Rules, Michalski and Chilausky. 1980. Policy Analysis & Informa. Systems Vol. 2). The system works by determining at each stage of the consultation, questions for a user, which are most informative in leading to a specific diagnosis. The system is equipped with human engineering features which simplify the use of the system and provide an explanation of the decision-making process of the system, e.g. why a question is being asked; why a diagnosis is prescribed, etc. Experiments with the system show a high level of correctness of the system's diagnostic decisions.

EFFECT OF MAIZE DWARF MOSAIC VIRUS ON GERMINATION OF SWEET CORN POLLEN. M. A. Mikel, Cleora J. D'Arcy, A. M. Rhodes and R. E. Ford. Department of Plant Pathology, University of Illinois, Urbana, IL 61801.

Sweet corn sterility at the butt end of ears is associated with maize dwarf mosaic virus strain B (M-B) infection. Pollen germ tubes must grow greater distances to fertilize ovules in the butt ends. Pollen from infected sweet corn of 7 cultivars was placed on a medium containing 15% sucrose, .03% calcium nitrate, .01% boric acid, and .6% bactoagar. After 2 hr at 25°C in vitro germination percentages and germ tube lengths were measured. M-B significantly reduced germination of pollen only from 'Sugar Loaf'. Germ tubes of pollen from M-B infected 'Aztec', 'Cherokee', 'Gold Cup', 'Seneca Scout', and 'Sugar Loaf' were significantly shorter than noninfected controls. In vivo germ tube lengths were measured for 'Sugar Loaf' and 'Wintergreen'. Within each cultivar germ tube lengths of the HxH cross were significantly longer than the HxV, VxH and VxV (H=non-M-B infected, V=M-B infected) crosses. Reduction in pollen vigor in M-B infected plants contributes to sweet corn sterility.

A SELECTIVE MEDIUM FOR CERATOCYSTIS ULMI. R. V. Miller, D. C. Sands, G. A. Strobel, Department of Plant Pathology, Montana State University, Bozeman, MT 59717.

A highly selective medium for the isolation of Ceratocystis ulmi, the causal agent of Dutch elm disease, was developed. The medium consisted of 500 mg linoleic acid (Na salt), 200 mg cycloheximide, 1 mg 2,6-dichloro-4-nitroaniline (DCNA), 10 mg triphenyltin hydroxide, 30 mg chloramphenicol, and 100 mg streptomycin sulfate per liter of potato dextrose agar. The medium, designated CUSM, eliminated contamination problems with the occasional exception of a species of Rhizopus. The medium facilitated the rapid isolation of C. ulmi from elm and bark beetle samples. An aggressive strain of C. ulmi retained pathogenicity and all strains of C. ulmi tested were able to grow on CUSM. An isolate of C. ulmi exhibited 70% loss of propagule viability on CUSM compared to viability on acid potato dextrose agar plates. This reduction was considered as an acceptable level considering the high degree of selectivity. The medium appears well suited for routine isolations of certain species of Ceratocystis, including C. ulmi.

CYTOLOGY OF THE INTERACTIONS OF ALFALFA (MEDICAGO SATIVA) SEEDLING ROOTS WITH PHYTOPHTHORA MEGASPERMA FROM ALFALFA AND SOYBEAN (GLYCINE MAX). S. A. Miller and D. P. Maxwell, Dept. of Plant Pathology, University of Wisconsin-Madison, Madison, WI 53706.

The cytology of nonhost resistance and host susceptibility of alfalfa seedlings was examined after inoculation of roots with zoospores of P. megasperma f. sp. glycinea(Pmg), a pathogen of soybean, or P. megasperma f. sp. medicaginis(Pmm), a pathogen of alfalfa. Zoospore attraction to roots, encystment, cyst germination and initial root penetration were similar for Pmm and Pmg. One hr after inoculation, cell wall appositions were observed in root cortical cells in contact with, but not penetrated by hyphae of Pmg, and electron-dense deposits were present between plant and fungal cell walls. Similar changes were not observed in Pmm-infected roots until 12-24 hr after inoculation. Early colonization by Pmm was characterized by disorganization of mitochondria in root cells in contact with hyphae. Hyphae of Pmm and Pmg were intercellular and intracellular, and haustorium-like structures were observed within 24 hr after inoculation. Colonization was less extensive in roots infected with Pmg than with Pmm.

DIFFERENTIAL RESISTANCE OF VARIOUS CHERRY ROOTSTOCKS TO PHYTOPHTHORA SPECIES. S. M. Mircetich and M. E. Matheron, USDA/SEA/AR, Dept. Plant Pathology, Univ. Calif., Davis, CA 95616

Phytophthora cambivora and P. megasperma cause more severe root and crown rot in sweet cherry trees on Mahaleb than on Mazzard rootstock in California. Thus, we studied relative resistance of different cherry rootstocks to P. cambivora and P. megasperma. One-year-old plants grown in steamed soil in 3.7 liter cans were inoculated by placing small bits of mycelium of Phytophthora spp. in bark wounds in the stems. The extent of stem cankers in plants 3 months after inoculation was used to assess the relative resistance of the rootstocks. In lathhouse tests, P. cambivora and P. megasperma induced a high mortality and 150 mm and 116 mm long stem canker, respectively, in Mahaleb and no mortality and significantly (P=0.01) 14 mm long) smaller stem cankers in Mazzard rootstock. In similar greenhouse tests, Mazzard was not significantly more resistant than Stockton Morello, Colt, Vladimir, Falstran, MxM2, MxM38, MxM60, and MxM97 whereas Mahaleb was significantly (P=0.01) more susceptible than any of these rootstocks to P. cambivora.

COLONIZATION OF POTATO STEMS BY PATHOGENS OF THE EARLY DYING COMPLEX. J. E. Mitchell, M. K. Rahimian, W. C. Warfield and D. I. Rouse, Dept. of Plant Pathology, University of Wisconsin-Madison, Madison, WI 53706.

Verticillium dahliae (Vd), Erwinia carotovora var. carotovora (Ecc), Fusarium spp (Fsp) and Colletotrichum coccodes (Cc) progressively colonized the lower stem of Russet Burbank (RB) from four commercial fields and of RB, Norgold Russet (NR) and Superior (S) from replicated experimental plots. Samples were collected at biweekly intervals in June, July and August, 1979. Vd developed most rapidly and achieved 100% infection more commonly than did the other pathogens. Ecc was the next most frequent colonizer with Fsp third. Cc, not known as a vascular colonizer, was the least frequently detected. There was a linear increase in log colony forming units (CFUs) over time for Vd and Ecc in all cultivars through July 25. During the next two weeks many plants of NR and S died. The CFUs of Vd but not Ecc decreased in the August 7 sample from surviving plants. The linear increase in CFUs with time for Vd in RB continued through the last sample, August 22.

ASSOCIATION OF NATURALLY OCCURRING AGROBACTERIUM RHIZOGENES WITH CARROT ROOTS. L. W. Moore, Department of Botany and Plant Pathology, Oregon State University, Corvallis, OR 97331.

Some strains of pathogenic agrobacteria seem particularly adapted to specific plants e.g. biotype 3 strains that infect grape. During a recent study of A. rhizogenes (Plasmid 2:617-626, 1979), agrobacteria, predominantly biotype 2, were isolated at a low frequency from inside peeled, surface sterilized carrot roots grown in CA and WA. Fifty percent of the interior biotype 2 strains were pathogenic; none of the biotype 1 strains was pathogenic. Twenty-four virulent biotype 2 strains each had 3 plasmids with electrophoretic patterns identical to each other and to A. rhizogenes A4, while 20 avirulent strains had a single plasmid of identical mobility to each other and to heat-cured avirulent mutants of A4. Electrophoretic patterns were diverse among 12 biotype 1 strains isolated from surface peelings. Apparently, the carrot root interior favors biotype 2 agrobacteria which also have very similar electrophoretic plasmid patterns in contrast to the diverse patterns from rhizoplane agrobacteria.

INTERACTION OF RHIZOBIUM MELILOTI AND AGROBACTERIUM RADIOBACTER K84. L. W. Moore, Department of Botany and Plant Pathology, Oregon State University, Corvallis, OR 97331.

Growth of two strains of R. meliloti (YA15 and YA2) isolated from nodulated field-grown alfalfa was inhibited by K84 in vitro. Agrocin 84 sensitivity of YA15 and YA2 has ecological implications relative to legume rotations with nursery stock inoculated with K84 to prevent crown gall. However, coinoculation of germinated alfalfa seed with K84 and each of the R. meliloti strains did not affect nodulation or plant yield. Yield and nodulation data were collected from four independent experiments in which seedlings were treated with one of the following: water, 0.05% KNO_3 (nitrogen source), K84, YA15, YA2, YA15+K84, or YA2+K84. Yield (fresh weight) and nodule number per plant were calculated as a percent of the mean combined yield and nodule number from YA15 and YA2. Mean yield comparisons were as follows: water--48%, KNO_3--89%, K84--32%, YA15+K84--116%, and YA2+K84--98%. Mean numbers of nodules/plant for the latter dual inoculations were 105% and 116%, respectively.

EVALUATION OF FUNGICIDES FOR CONTROL OF PEA ROOT ROT. F.C. Morgan, J.V. Groth, F.L. Pfleger, Department of Plant Pathology, University of Minnesota, St. Paul, MN 55108; and T.P. Reiling, Green Giant Company, Le Sueur, MN.

Green Giant production pea cultivar 9708 was planted at two locations in Minnesota in soil heavily infested with fungi that cause pea root rot. At location 1, seed treated with Dowco 444 (11LC) at 59, 118 and 237 ml a.i./45.4 kg seed as well as in-furrow applications of Dowco 5G at 2.2, 4.5 and 9.0 a.i. kg/ha resulted in significant increases in dry seed weights harvested. Propamocarb 10G applied in-furrow at the rate of 2.2 a.i. kg/ha provided significant control of root rot, whereas the propamocarb seed treatments and in-furrow applications did not. At location 2, only Dowco 444 (11LC) seed treatment at 237 ml a.i./45.4 kg seed provided significant disease control as reflected in dry seed weight. Dry seed weights from the remaining fungicide treatments were not significantly different from the control.

DIFFERENTIAL EXPRESSION OF THE PLASMID R68.45 IN ERWINIA. M.K. Morgan, A.K. Chatterjee, and T.C. Currier. Dept. of Plant Pathology, Kansas State University, Manhattan, KS 66506.

The plasmid R68.45 carries genes that specify resistance to tetracycline (Tc), ampicillin (Ap), kanamycin (Km), and its transfer (tra) during conjugation to bacteria of many genera. The plasmid is somewhat unstable and loss of Km resistance (Km^R) and transfer ability (tra) have been reported. Variants of this plasmid have been isolated from Erwinia chrysanthemi EC16 in which tra and Km^R have been lost and in Erwinia atroseptica EA153 in which only tra has been lost. Extensive deletions were found in these variant plasmids by comparing their Sma I restriction endonuclease digests with those of R68 from Pseudomonas aeruginosa and R68.45 from E. coli and E. chrysanthemi EC16. Since the plasmid RPI is very similar, if not identical to R68, it was possible by using the SmaI restriction endonuclease map of the RPI plasmid to locate the deletions in the R68.45 plasmid. Our results were consistent with the established position for Km^R on RPI and indicate the relative position of at least some of the genetic information involved in tra.

PROGRESS OF DISEASE INCIDENCE AND SEVERITY OF BACTERIAL BROWN SPOT, CAUSED BY PSEUDOMONAS SYRINGAE VAN HALL, ON SNAP BEAN (PHASEOLUS VULGARIS L.) FOLIAGE AND PODS. C.E. Morris, D.I. Rouse, & D.J. Hagedorn, Dept. of Plant Pathology, UW, Madison, WI 53706

Disease severity and incidence of brown spot on foliage and pods were observed at weekly intervals in artificially inoculated plots in Madison and in the central sands area of WI. Plots in the central sands area were subjected to either normal or above normal levels of irrigation. Replicated plots at both locations were treated with copper hydroxide at weekly intervals or left untreated. Disease severity progressed logarithmically; severity on foliage was significantly greater in untreated than in treated plots, and was initially greater in plots irrigated at above normal levels. Incidence on leaflets was significantly greater in untreated than in treated plots in the central sands area but not in Madison. Incidence on pods progressed logarithmically; the greatest incidence was observed in Madison where foliar severity had consistently been the lowest. There was no significant difference in pod incidence at harvest between treated and untreated plots.

A NEW SPLIT-GENOME VIRUS SIMILAR TO CARNATION RINGSPOT VIRUS. T. J. Morris and D. S. Teakle, Dept. of Plant Pathology, Univer-

sity of California, Berkeley, CA 94720, and Dept. of Microbiology, University of Queensland, Herston, Australia.

An isometric, 29 nm virus isolated from Trifolium repens L. and Medicago sativa L. in Australia was characterized. It has been tentatively named Clover Latent Ringspot Virus (CLRV). It displayed very similar biological and physicochemical properties to Carnation Ringspot Virus (CRSV). CLRV had an apparent sedimentation rate of 130S, a single capsid protein of 38,000 daltons, and two ssRNA components of 1.4 and 0.5 x 10^6 daltons, both of which were required for infectivity. CLRV showed no serological relationship to CRSV in immunodiffusion tests but a possible distant serological relationship was detected in indirect ELISA tests. Complementation between the separated RNA species of the two viruses suggested some genetic relatedness.

HOST RANGE AND PURIFICATION OF A NEW STRAIN OF SWEET POTATO FEATHERY MOTTLE VIRUS. J. W. Moyer, Department of Plant Pathology, North Carolina State University, Raleigh, NC 27650.

A newly recognized strain of sweet potato feathery mottle virus (FMV) was isolated from 'Jewel' sweet potatoes in North Carolina. The strain induced distinct chlorotic spots in 'Porto Rico' sweet potato leaves. It can be distinguished from the common and russet crack strains of FMV by distinct veinal chlorosis induced in Ipomoea nil, I. hederaceae, I. purpurea and I. trichocarpa. Chenopodium quinoa is a good local lesion host. Microprecipitin tests indicate a close serological relationship with the common and russet crack strains of FMV. The virus was purified by extraction in 0.1 M borate buffer pH 8.0 containing 0.5 M urea, clarification in 0.25 vol. chloroform followed by two cycles of differential centrifugation. Pellets were resuspended in 0.05 M borate buffer pH 8.0 containing 0.5 M urea. Final separation was obtained on a linear 10-50% sucrose gradient. Virion aggregation in concentrated preparations was prevented by the addition of 5 mM $MgCl_2$ to the final resuspension buffer and gradients.

DISSEMINATION AND SURVIVAL OF SCLEROTINIA SCLEROTIORUM IN BEAN FIELDS IN WESTERN NEBRASKA. R.D. Muckel and J.R. Steadman, Dept. of Plant Path., Univ. of Nebr., Lincoln, NE 68583.

Aerial sampling and falling rain water collections on acidified potato dextrose agar (APDA) demonstrated the presence of viable Sclerotinia sclerotiorum propagules in the atmosphere near bean fields after pod set. Honeybee activity on and in bean blossoms with subsequent isolation of S. sclerotiorum from 16% of bee samples indicated that this insect could disseminate the white mold fungus. Propagules other than sclerotia were isolated from irrigation water. When randomly collected bean blossoms were plated on APDA, 35% were found to have S. sclerotiorum. Whether insects, splashed water, or aerial dissemination was the source of S. sclerotiorum on blossoms could not be determined. White mold mycelium survived in the field on detached bean blossoms for the duration of a 33-day test period. Ascospores were more ephemeral than mycelium; they survived for 10 days when buried just below the soil surface, for 12 days when placed on attached bean leaves, and for 7 days on glass microscope slides placed in the plant canopy.

ASSOCIATION OF GLIOCLADIUM ROSEUM WITH SOYBEANS IN ILLINOIS. J. D. Mueller and J. B. Sinclair, Plant Path. Dept., U. of IL 61801.

Gliocladium roseum (Gr) was isolatedifrom 60% of stem and 63% of root segments of soybeans approaching physiological maturity from 25 IL fields. Five isolates were tested for pathogenicity using a root-dip inoculation of Amsoy 71 in the greenhouse. After 6 wk., 4 isolates differed among themselves but not from controls in their effect upon seedling epicotyl length and fresh weight, while epicotyl length with the 5th isolate was less than the control. Another isolate was tested alone or in combination with Rhizoctonia solani (Rs) in infested field soil. Emergence from Rs+Gr was less than Rs, which was less than the control. Rs or Rs+Gr reduced yield and the 1000-seed wt. of Rs+Gr and Rs were different from each other and the control. No difference existed between control and Gr for the 3 parameters. Germination of seed lots from Rs and Rs+Gr were less than the control or Gr. Percent Phomopsis infection from Rs+Gr seedlots was greater than Rs, which was greater than the control or Gr.

INCREASED RESISTANCE TO SEPTORIA NODORUM IN ALLOPLASMIC LINES OF A WHEAT CULTIVAR. E. J. Mullaney, Department of Plant Pathology, Montana State University, Bozeman, Montana 59717

Seven alloplasmic lines of the spring wheat cultivar, Chris C.I. 13751, were tested to determine their respective levels of resistance to Septoria nodorum. Based on a statistical analysis of the percent necrosis of the first leaf seven days after inoculation of 12 day old plants, 4 alloplasmic lines exhibited significantly fewer symptoms than Chris. The numerous backcrosses to Chris in [Triticum dicoccoides (PI 11140)/12*Chris] and [T. macha (PI 190923)/13*Chris], suggested that their greater resistance to S. nodorum might be attributed to their cytoplasms. Chris was then crossed to each of these 2 alloplasmic lines to recover the Chris cytoplasm. Reciprocal crosses also were made to produce alloplasmic lines having the same number of backcrosses to Chris as the Chris-recovered cytoplasmic lines had in their pedigree. Each recovered Chris cytoplasmic line will be tested with its respective alloplasmic line to determine what effect the different cytoplasms have on the cultivar's resistance to S. nodorum.

INFECTIVITY OF PSEUDOMONAS PHASEOLICOLA. E. N. Mulrean and M. N. Schroth, Dept. of Plant Pathology, University of California, Berkeley, CA. 94720

Chemotactic responses and infectivity (the capacity to enter a plant and incite disease) of Pseudomonas phaseolicola were influenced by pretreatment of bean leaves (Phaseolus vulgaris L. 'Red Kidney') with varying concentrations of 13 amino acids and 6 sugars. Leaves were infiltrated with 10^{-1}, 10^{-4} and 10^{-7} M solutions prepared in phosphate buffer (pH 6.8). Leaves infiltrated with buffer alone served as controls. Plants were immersed for 10 min in a 5.0 x 10^5 cfu/ml suspension of P. phaseolicola (HB-36) and the number of lesions/cm^2 that developed were counted 8 days later. L-alanine, L-methionine, L-tyrosine, L-asparagine, L-arginine, arabinose and glucose increased the infectivity of HB-36 on bean leaves compared to buffer treatment. L-threonine, L-glutamate and sucrose were repellent to P. phaseolicola at 10^{-1} M and reduced infectivity. This response was diminished at reduced concentration with a corresponding increase in infectivity. L-proline was strongly repellent at low concentrations (10^{-3} to 10^{-9}) reducing infectivity of HB-36 by 94.6%.

NATIVE BARK BEETLES AND AMERICAN ELM BARK AS POTENTIAL SOURCES OF BACTERIAL WETWOOD INOCULA. C.W. Murdoch, and R.J. Campana, Department of Botany and Plant Pathology, University of Maine, Orono, ME 04469.

Delayed bleeding from wounds made for chemical injection into elms suggests possible contamination of outer xylem tissue by wetwood bacteria from external sources. Hylurgopinus rufipes Eichh. and elm bark were evaluated as potential sources of inocula. One hundred thirty-two beetles were collected using stickum traps baited with pheromone; and samples were obtained from the outer bark (phellem) of twenty trees for isolation trials. Various fungi and bacteria were isolated from the beetles, but only an Erwinia sp. was isolated consistently. Erwinia was isolated from 112/132 beetles (85 percent). An Erwinia sp. and a Bacillus sp. were also associated with inner as well as outer phellem. The data suggest that H. rufipes may be a vector of wetwood bacteria, that apparently healthy bark may be a reservoir of such bacteria, and that injection holes for Dutch elm disease control may be contaminated with such bacteria.

ENDOPOLYGALACTURONASE BINDS TO PLANT CELL WALLS. Harry Mussell and Patricia Carroll, Boyce Thompson Institute at Cornell, Ithaca, NY 14853.

The binding of purified endopolygalacturonase to plant cell walls is pH dependent, maximal at pH 4.0, reversible, and does not occur above pH 7.5. The quantity of enzyme bound is also affected by the ionic strength of the incubation solution. The initial binding capacity of host cell walls is greater than the binding capacity of cell walls prepared from a wide range of non-hosts. The binding capacity of host cell walls is increased by prior exposure to endoPG. Bound enzyme is demonstrably active, solubilizing reducing sugars and proteins from particulate cell wall preparations. Virulent isolates of the pathogen produce an inducible factor which prevents binding. Immobilization of endoPG through binding to host cell walls may be an important aspect of the physiology of disease tolerance in Verticillium wilts.

CLUBROOT OF CRUCIFERS IN CALIFORNIA: GENERAL CHARACTERISTICS AND SOLAR HEATING AS A POSSIBLE CONTROL STRATEGY. D. F. Myers, R. N. Campbell, Department of Plant Pathology, Univ. of Calif., Davis, CA 95616, and A. S. Greathead, Univ. of Calif. Coop. Ext. Service, Salinas, CA 93901

Infestations of Plasmodiophora brassicae have been found in the Salinas Valley in about 25 A of acidic, sandy loam soil in four nearby farms. Soil in the most severely infested field contained up to 10^5 spores/g of dry soil and the fungus was race 16-3-31 by the European clubroot differential series. Known clubroot-resistant crucifers, "Badger Shipper," "4(7403-1)," "6(7404-1)," and "OSU-CR1," were susceptible to the Salinas isolate. To investigate the feasibility of control by solar heating of plastic-covered soil, soil was infested with 10^6 spores/g of dry soil, moistened, incubated at constant temperatures, and assayed in the greenhouse. The incidence of clubroot was not reduced after 12 da at 37° but it was reduced significantly by 72 hr at 42°. There was no clubroot after 45° for 40 hr or after 50° for 180 min.

THE RESIDUAL EFFECTS OF CERTAIN "DEFEATED" POWDERY MILDEW RESISTANCE GENES IN ISOLINES OF CHANCELLOR WINTER WHEAT. H. A. Nass, W. L. Pedersen, R. R. Nelson, and D. R. MacKenzie. Department of Plant Pathology, The Pennsylvania State University, University Park, PA 16802.

Six near-isogenic lines of winter wheat, each containing a different powdery mildew (Pm) resistance gene, and the recurrent parental variety Chancellor were inoculated with an isolate of Erysiphe graminis tritici possessing the virulence to induce type 4 lesions on each of the six isolines. Paired comparisons were made between each isoline and Chancellor for latent period, disease efficiency, and sporulation capacity (total number of spores produced during the life of a lesion). There was no significant difference for latent period when the isolines were compared to Chancellor. Disease efficiency and sporulation capacity were significantly reduced when the Pm3c, Pm4 or Michigan Amber gene was present. Thus, the current assumption that defeated resistance genes are of no value when confronted by matching virulence genes appears to be no longer of universal validity.

A RHABDOVIRUS ASSOCIATED WITH VEIN YELLOWING AND VEIN NECROSIS OF BALSAM POPLAR. S. Navratil, School of Forestry, Lakehead University, Thunder Bay, Ont. P7B 5E1 Canada.

Several selections of native balsam poplar (Populus balsamifera L.) from Southern and Northern Ontario and Manitoba maintained at the Ont. For. Res. Centre showed vein-clearing and vein-yellowing symptoms. Severe veinal necrosis and blotching developed in greenhouse propagated plants. Leaf dip preparations (1.5% PTA, pH 7.0) showed rhabdovirus particles 290 nm (266-346) by 77 nm (63-90). In ultra-thin sections of mesophyll and vascular tissue from leaves (glutaraldehyde-OsO_4, lead citrate), aggregates of the particles with an average size of 60x286 nm, n=70, were observed in: a) the perinuclear space; b) large membrane bounded vesicles in the nuclei; c) smaller vesicles scattered in the cytoplasma. The host range of this rhabdovirus associated with poplar vein yellowing (PVY) is not yet known.

WATER MOVEMENT IN VESICULAR-ARBUSCULAR MYCORRHIZAL ONION PLANTS. C. E. Nelsen and G. R. Safir, Department of Botany and Plant Pathology, Michigan State University, East Lansing, MI 48824.

Onion plants (Allium cepa, L.), with and without the mycorrhizal fungus Glomus fasciculatus, were grown under low phosphorus conditions (9 ppm P, Bray P-1 extractable) in the growth chamber. One half of the non-mycorrhizal (NM) plants were fertilized with P to increase the growth to levels similar to that of the mycorrhizal (MYC) plants. Transpiration rates of MYC and fertilized NM onions were similar (1.0 and 0.9 gm dm^{-2} hr^{-1}) under well-watered conditions; the rates of non-fertilized NM plants were about 50% lower (0.5 gm dm^{-2} hr^{-1}). Leaf water potentials of the MYC and fertilized NM onions were equal (-3.5 and -3.2 bars), while potentials of the non-fertilized NM plants were significantly lower (-6.7 bars). Calculated hydraulic conductances (x10^{-7} cm bar^{-1} s^{-1}) were: MYC = 4.6, fertilized NM = 4.5, and non-fertilized = 1.1. Stomatal resistances (s cm^{-1}) were: MYC = 3.2, fertilized NM = 3.6, and non-fertilized = 9.9.

A LETTUCE MOSAIC-LIKE VIRUS DISEASE IN ARIZONA. M.R. Nelson and R.E. Wheeler, Department of Plant Pathology, University of Arizona, Tucson, Arizona 85721.

During 1979, the lettuce industry throughout Arizona was seriously damaged as a result of a viral disease which has been tentatively identified as a strain of lettuce mosaic virus (LMV). The virus is mechanically transmissible and shows an average length of 785 nanometers. Several host plants, reported to be highly susceptible to and reliable indicators for the classic strains of LMV, have shown immunity to the Arizona lettuce isolate. At least one, naturally-occurring, alternate host for the virus (Lactuca serriola, 'prickly lettuce') has been identified. The results of tests with commercial seed lots were all negative for virus transmission. However, a virus strain was isolated from different sources of garden-packet seed (2% +) sold in Arizona and this strain was similar to that isolated from the Arizona lettuce.

A LOCAL LESION INDICATOR FOR POTATO VIRUS Y. M.R. Nelson and R.E. Wheeler, Department of Plant Pathology, University of Arizona, Tucson, Arizona 85721.

A genetically stable selection of chili pepper (Capsicum annuum L.), originating from the 'Anaheim' variety, was found to serve as a reliable, local-lesion indicator for potato virus Y (PVY). This new Anaheim-type was comparatively tested against isolates of PVY, tobacco etch virus (TEV), and pepper mottle virus (PeMV). Host symptoms remained consistent through the sixth generation (F6), with symptom-types different from those observed on the parent Anaheim. Such symptoms include necrotic local lesions within 7 days, followed by systemic necrosis and ultimate death, when infected by PVY; to TEV infection there is a severe systemic necrosis with subsequent recovery, followed by a severe mosaic; and PeMV induces only a mild mosaic effect on this new selection.

VARIATION IN PHENOTYPIC MIXING AMONG PEPPER-INFECTING POTYVIRUSES. M.R. Nelson and R.E. Wheeler, Department of Plant Pathology, University of Arizona, Tucson, Arizona 85721.

A mixed infection of tobacco etch virus (TEV, ATCC PV-69) and potato virus Y (PVY, NC-57) was experimentally induced in Datura metel L. and Capsicum annuum L., 'Anaheim'. Extracts of either plant infected with this mixture showed three types of particle conditions when mixed separately with antiserum specific to each virus and viewed in the electron microscope. These conditions consisted of 1) whole particles covered with antibodies, 2) whole particles unreactive to the antiserum, and 3) whole particles showing only a partial reaction. When antisera to TEV and PVY were combined and then mixed with the plant extracts, all particles reacted completely. Based on these observations we conclude that a significant number of particles in these mixed infections have hybrid coat proteins (phenotypic mixing). With various virus combinations, phenotypic mixing occurred in 10-30 percent of those particles present.

CARBOHYDRATE STATUS OF MYCORRHIZAL AND NONMYCORRHIZAL CITRUS ROOTSTOCKS. S. Nemec, USDA, SEA, AR, Orlando, FL 32803, and C. Guy, Dept. Hortic. Sci., U. Minnesota, St. Paul, MN 55108.

Carbohydrates were analyzed in leaves and roots of Glomus-inoculated and uninoculated citrus rootstock seedlings grown in Astatula fine sand in greenhouse studies. In a low phosphorus (P) soil (9-12 ppm), inoculated rootstocks grew taller and their leaves contained greater amounts of total soluble sugar, sucrose, reducing sugars, starch, and total nonstructural carbohydrate per gm tissue than noninoculated controls. Of these sugars, only reducing sugars increased in roots of inoculated rootstocks. Both fructose and glucose, the only reducing sugars examined, were present at higher levels in leaves of inoculated plants than controls, and at higher levels in leaves than roots. Uninoculated rootstocks grown in high P soil (210 ppm) were about the same height and their leaves contained levels of total soluble and reducing sugars similar to those in inoculated rootstocks grown in low P soil. It does not appear that Glomus mobilizes sugars as a sink for photosynthate in roots.

ELECTRICAL RESISTANCE AND STEM WATER POTENTIAL IN *VERTICILLIUM DAHLIAE*-INFECTED RED MAPLES. Dennis Newbanks and Terry A. Tattar. Harvard Forest, Petersham, MA 01366 and Dept. of Plant Pathology, Univ. of Massachusetts, Amherst, MA 01003.

An inverse relationship exists between stem water potential (ψ) and electrical resistance (ER), corrected to a standard temperature of 20°C (CST), in healthy red maple *Acer rubrum* L. (r= -.93 to -.98). Stem ER of red maple seedlings (CST) was measured at 1 to 2 day intervals during a 14 week course of infection by *Verticillium dahliae* Klebahn. In plants displaying moderate to severe wilt symptoms including extensive vascular discoloration,

no significant differences (P=.05) were found between the weekly mean ER of the infected and control ψ plants. However, stem ψ of the infected plants was significantly (P=.05) lower than the control plants. In plants which displayed only slight if any symptoms and in which no significant change in stem ψ occurred, the weekly mean ER of the infected plants was significantly lower than the control plants. We conclude that ER cannot be used effectively to measure stem ψ changes in *Verticillium*-infected maples due to the counteracting influence which vascular discoloration has on the stem electrical properties.

LIFE CYCLE AND CONTROL OF SIROCOCCUS STROBILINUS OF RED PINE. Thomas H. Nicholls, Darroll D. Skilling and Michael E. Ostry. North Cent. For. Exp. Stn., 1992 Folwell Avenue, St. Paul, Minnesota 55108 USA

Sirococcus strobilinus Preuss causes a disease of periodic importance on understory red pine (Pinus resinosa Ait.) in uneven-aged stands in Minnesota, Wisconsin, upper Michigan, New York, and Maine. Mortality occurs in young seedlings and saplings. Few large trees are killed, but many lower branches are. Infection of current-year shoots by rain-splash-disseminated spores occurs during the major spore release in May and June. Disease symptoms appear from late June through August. The fungus overwinters in dead shoots on infected trees. Studies show that removing infected overstory trees reduces or prevents infection of remaining understory trees. Planting and managing for immune or resistant tree species in high Sirococcus hazard areas is also an effective control. Of four fungicides tested for nursery control, chlorothalonil (tetrachloroisophthalonitrile) was the most effective.

INFLUENCE OF RESISTANT SOYBEANS ON THE DEVELOPMENT, REPRODUCTION, AND MORPHOLOGY OF THE SOYBEAN CYST NEMATODE, HETERODERA GLYCINES RACE 4. G. R. Noel and P. V. Bloor, USDA-SEA-AR, Dept. of Plant Pathology, University of Illinois, Urbana 61801.

The effects of nine soybean lines on Heterodera glycines race 4 were determined. As the level of resistance increased, fewer females developed. Those that did develop on highly resistant lines were smaller and produced fewer eggs. The number and size of egg masses also were reduced. The greatest reduction in development occurred on PI 209332, PI 88788, and L77-994. L77-994, an advanced MG III line, derives its resistance from PI 88788. Bedford also has PI 88788 as one of its resistant parents. The level of development was greater in Bedford than in L77-994, but the amount of reproduction was similar. PI 89772 and Bedford were similar in their effect. An intermediate level of development and reproduction occurred in Cloud and PI 87631-1. More development and reproduction occurred on PI 423871 than on Essex. Essex is commonly used as a susceptible line in race determinations and PI 423871 is resistant to some Japanese populations.

CONIDIA PERIODICITY AND DISPERSAL OF DRECHSLERA POAE. F. W. Nutter, Jr. and H. Cole, Jr. Department of Plant Pathology, The Pennsylvania State University, University Park, PA 16802.

Rotorod (RR), Kramer-Collins (KC), and live plant (LP) spore traps (variety 'Delta') were utilized to determine the seasonal and diurnal periodicity as well as the effect of mowing upon conidium dispersal of Drechslera poae on Kentucky bluegrass. The RR spore samplers were placed at sampling heights of 7 cm, 1 m, and 3 m above the soil line. The KC was operated at a height of 20 cm and the LP at 7 cm. Few conidia of D. poae were caught at the 1 m and 3 m heights. The RR, KC, and LP traps all indicated a seasonal periodicity from mid-Apr to mid-June with peak conidium production occurring in late May. Peak hours of conidium release occurred between 0900 and 1100 hours which was correlated with the time of rapid decrease in relative humidity. Daily condium counts from the RR (7 cm) were correlated with the LP spore data for the same time periods. When spore data was segregated into mowed vs non-mowed days, the LP and RR spore samplers caught 3.5 to 5 times the number of conidia on mowed days which may indicate that disease severity is related to mowing frequency.

CHEMICAL CONTROL OF X-DISEASE. G. Nyland, B. C. Raju, and S. K. Lowe. Dept. of Plant Pathology, University of California, Davis, CA 95616.

Peach (Prunus persica) and sweet cherry (P. avium) affected by peach yellow leaf roll and buckskin strains of X-disease, respectively, were treated with various chemicals to test their efficacy and phytotoxicity. The following chemicals were used: Terramycin, CA-Afn, TC-199, chloramphenicol, erythromycin, tylan, calcium chloride, sodium erythorbate and erythorbic acid. All the chemicals were injected into the trees using a pressure injector during October, December and February of 1978-79 and 3-15 trees were treated with each chemical. Trees were observed for symptom remission, growth, fruit set and phytotoxic effects associated with each chemical. Trees treated in October and December with 2-3 g of terramycin resulted in normal fruit with normal color, size and taste without phytotoxicity. Symptom remission also occurred with Ca-Afn, TC-199, chloramphenicol, erythromycin and tylan at 3-6 g/tree. The other chemicals tested had no effect on the disease.

TAXA OF FUNGI CAUSING RHABDOCLINE NEEDLE CAST IN MICHIGAN DOUGLAS-FIR PLANTATIONS. J.G. O'Brien and H.L. Morton. University of Michigan. S.T. Dana Bldg. Ann Arbor, MI 48109

Of 8 plantations examined in Emmet and Cheboygan counties, 7 contained Rhabdocline needle cast. Six were systematically sampled. Three infected needles from a total of 110 trees in the 6 plantations were examined both macro- and microscopically. A comparison of the two techniques revealed that the former was 94% accurate in determining the species of Rhabdocline. All 6 plantations were found to harbor Rhabdocline weirii Parker and Reid, but R. pseudotsugae Sydow was observed in only 4. In one plantation in which both species were present, 89% of the trees were infected. R. weirii was found on 84% (277/330) of the infected needles and represented 82% (941/1148) of the total apothecia, while R. pseudotsugae was present on 17% of the needles and accounted for 18% of the apothecia. R. weirii subsp. oblonga and R. pseudotsugae subsp. pseudotsugae were the only taxa found to be causing the disease in Michigan. The putative asexual stage, Rhabdogloeum spp. was not found.

MONITORING AND CONTROL OF BENOMYL-RESISTANT MONILINIA FRUCTICOLA. J. M. Ogawa, B. T. Manji, D. Rough, and R. M. Sonoda. Dept. of Plant Pathology, Univ. of Calif., Davis, CA 95616.

Benomyl-resistant Monilinia fructicola strains isolated from peach and nectarine orchards in California have lower levels of resistance (1-5 ug/ml) than those reported from other fruit-growing regions of the world. A single benomyl-captan combination or two captan spray applications failed to control brown rot blossom blight in an orchard with high populations of low-level, benomyl-resistant M. fructicola. Benomyl or benomyl-captan combination applications effectively controlled the disease in orchards with low populations of low-level resistant M. fructicola. In orchards with high populations of low-level resistant strains of M. fructicola the benomyl-captan combination failed, but triforine, dichlone or iprodione applied at 5% bloom and full bloom provided effective disease control. A monitoring program was developed to detect low populations of low-level, benomyl-resistant strains. When benomyl resistance is detected, nonbenzimidazole fungicides are used to prevent crop losses.

RHIZOPUS STOLONIFER ROT OF TARO. Jeri J. Ooka, Department of Plant Pathology, University of Hawaii, Kapaa, HI 96746.

Rhizopus stolonifer was consistently associated with a rot of harvested and stored taro corms of Bunlong variety on Hawaii Island. The rot had a cheesy consistency and was cream to light tan in color. It progressed rapidly completely rotting infected corms in 3 to 5 days. Inoculations of freshly cut corm surfaces with the fungus on 10% V-8 juice agar disks reproduced the disease at 20, 25, 30, 35 and 40 C after 5 days incubation. The rot was most severe at 25 C. Sporulation of the fungus on the taro disks was abundant at 25 C, sparse at 20 and 30 C and did not occur at 35 and 40 C. The fungus was recovered from the rotted tissues at all temperatures. Allowing the cut surface of the corm to dry for 2 hr before inoculation did not affect infection. Intact corm epidermis prevented infection. Wounds produced by removing suckers from the corm during the harvesting process provided the entry court for the fungus. Sanitation in the packing and processing area and drying of the washed corms before bagging effectively controls the disease.

COMPETITIVE SAPROPHYTIC ABILITY (CSA) OF FUSARIUM OXYSPORUM f. sp. APII. D. C. Opgenorth and R. M. Endo. Department of Plant Pathology, University of California, Riverside, CA 92507.

To determine the cause of rapid build up of fusarium yellows, Chino silty clay loam soil, naturally infested with the

fungus, was moistened 50% by weight. Celery petioles were placed in .5% NaOCl for 5 min. cut into 10 mm long pieces and placed with one end buried 3 mm deep in soil. Plates were incubated in the dark at 5, 12, 18, 24 and 30 C for 1 to 4 weeks. Isolations were made on PCNB media at weekly intervals from the ends of petiole pieces not in contact with soil and 34% were confirmed as F. oxysporum f. sp. apii by subsequent pathogenicity tests. Optimum temperature for saprophytic colonization of celery petiole pieces was 24 C; colonization occurred from 12 to 30 C. In other experiments, both severity and incidence of fusarium yellows was increased by adding increasing amounts of celery tissues to naturally infested field soil. These data suggest that under conditions of equal access to fresh, uncolonized fragments of celery tissue, F. oxysporum f. sp. apii possesses CSA.

BUTTERNUT CANKER: SCREENING SEEDLINGS FOR DISEASE RESISTANCE. L.P. Orchard, R.P. Guries, & J.E. Kuntz. UW, Madison, WI 53706

Butternut canker, induced by the fungus Sirococcus clavigignenti-juglandacearum, is the most destructive disease of butternut (Juglans cinerea), but the presence of healthy trees in infection pockets suggests that some trees may be resistant. To determine optimum conditions for screening selected progenies, young butternut seedlings from both healthy and diseased parents were inoculated with spore suspensions and held for 32, 56, or 80 hr in growth chambers at various combinations of temperature and relative humidity (RH). Infection occurred at leaf scars and stem wounds at 100% RH over temperatures from 16-32C. After 13 weeks, 38% of all inoculated trees had developed dark necrotic lesions. Analysis revealed no significant differences in symptom incidence among the experimental variables. Seedlings developed symptoms rapidly (ca. 3 wk), or they remained asymptomatic until harvest (10-13 wk). Nevertheless, the pathogen was reisolated from all inoculated trees, but from none of the noninoculated control trees. Asymptomatic infected trees may be resistant to the pathogen.

HYPODERMIC INOCULATIONS OF COLLETOTRICHUM TRIFOLII IN ALFALFA: RAPID RACE IDENTIFICATION AND HOST REACTION DETERMINATION FOR ANTHRACNOSE ISOLATES. S. A. Ostazeski and J. H. Elgin, Jr., Field Crops Lab., SEA, USDA, Beltsville, MD 20705.

Race 2 of C. trifolii has been discovered in Maryland, North Carolina and Virginia. There is now a need to 1) rapidly identify the race of new isolates, and 2) to nonlethally determine the differing resistance to Race 1 and Race 2 of plants in breeding and genetic studies. Stem inoculations with hypodermic syringes satisfy both needs. Inoculations are made with a 23-guage needle in suitable internodes with minimal plunger pressure. Conidial concentrations have varied from 1 to 9 million conidia/ml. Symptoms can be classified in 10-14 days. Susceptible stems form large lesions at the inoculation site and may wilt and collapse. Resistant stems continue growing normally with no lesion development. An intermediate reaction may be seen on some plants. We have isolated clones with the following resistant (R) and susceptible (S) reactions to Race 1 and Race 2, respectively: RR, RS, and SS. Plants with SR reaction have not yet been found.

IMPORTANT DISEASES OF INTENSIVELY GROWN POPLARS IN THE NORTH CENTRAL REGION. Michael E. Ostry, North Cent. For. Exp. Stn., 1992 Folwell Avenue, St. Paul, Minnesota 55108

Short-rotation, intensive culture systems are being developed for hybrid poplars in the north central region of the United States to produce wood biomass to meet future demands for fiber and energy. These systems are similar to those used for agronomic row crops. Such systems can favor the development and increase the severity of disease, particularly when genetically similar trees are grown in close spacings over large areas. Early test results show several potentially serious diseases affecting hybrid poplars. Among them are diseases that cause premature defoliation, e.g. leaf spots caused by Septoria musiva and Marssonina brunnea, and leaf rust caused by Melampsora medusae. Stem dieback and breakage at cankers caused by S. musiva and Cytospora chrysosperma have occurred in plantations and nursery stool beds. The incidence and severity of many of the diseases vary by location within the region and by clone. Planting resistant poplar clones will be the most effective control.

WATER STRESS EFFECT ON THE DEVELOPMENT OF BROWN STEM ROT OF SOYBEANS. V. Otazu, A. H. Epstein, and H. Tachibana. Dept. of Plant Pathology, Seed and Weed Sciences, and USDA-SEA-Ar, Iowa State Univ., Ames, IA 50011.

Soybean cultivar 'Ontario' was grown in the greenhouse in field soil naturally infested with brown stem rot (BSR) pathogen Phialophora gregata and was subjected to: 1) water stress, b) no stress, and c) a combination of no stress during vegetative growth and stress throughout the reproductive stages. The moisture levels were controlled by differential watering and monitored by use of an infra-red thermometer to maintain 1 to 2C difference between the no stress and stress treatments. Extent of stem browning symptom was measured and isolations made to confirm distribution of the pathogen in the stem. The combination of no stress followed by stress treatment produced greater extent of BSR at pod filling than either no stress or continued stress. Also stressed plants had less BSR than the no stress treatment. These results indicate adequate moisture early in the growing season and moisture stress later in the period significantly increase BSR.

THE HERBICIDE DCPA AND ECTOMYCORRHIZATION ON SEEDLINGS OF PINUS RESINOSA AIT. IN SOUTHERN WISCONSIN. J. G. Palmer, J. E. Kuntz, and J. G. Palmer, Jr., USDA/FS, Forest Products Laboratory, Madison, WI 53705, and Dept. of Plant Pathology, University of Wisconsin, Madison, WI 53706

Dacthal W-75 (dimethyl tetrachloroterephthalate) is used in tree nurseries as a selective pre-emergence herbicide. Three replicate plots (each 1/726 A) of seven treatments each were randomized in 1-0 (not yet emerged), 2-0, and 3-0 seedling classes. In April, water suspensions at rates of 5, 10, 20, 25, 30, and 35 lb/acre were overall sprayed and overhead irrigated on previously fumigated light sandy soil. Seed germination was not affected. In late October, clumps of seedlings were removed from three locations in each plot, and 10 plants of largest shoot growth were examined for short root tips and measured for shoot growth. Within each seedling class, neither the number of ectomycorrhizal tips nor seedling dry weights were markedly affected compared with those of untreated controls. In regard to age, mycorrhization was greatest in 2-0, reduced in 3-0, and least in 1-0 seedlings.

TIMING OF FUNGICIDE APPLICATION TO CONTROL DIPLODIA PINEA IN THE NORTH CENTRAL UNITED STATES. Marguerita A. Palmer, Thomas H. Nicholls and Daniel F. Palmer. North Cent. For. Exp. Stn., 1992 Folwell Avenue, St. Paul, Minnesota 55108 USA and Dept. of Ent., Univ. of MN, St. Paul, Minnesota 55108 USA

Diplodia pinea (Desm.) Kickx. causes a shoot blight of many conifer species in the North Central United States. An important host, red pine (Pinus resinosa Ait.), is grown extensively in this area and periodically serious losses occur, particularly in nurseries. Effective chemical control depends upon proper timing of sprays during May and June when shoots are most susceptible. Major spore release periods were determined using Vaseline®-coated spore trap slides. Weather and phenological data were also recorded. Peak spore dispersal usually coincided with the period of rapid shoot elongation. Periods of maximum spore dispersal were influenced by cumulative degree days and rainfall. This information can be used to predict the onset of maximum spore release and provide more effective spray schedules.

A SEEDLING EVALUATION METHOD FOR FUSARIUM WILT OF CUCUMBER INCITED BY FUSARIUM OXYSPORUM F. SP. CUCUMERINUM. M. J. Palmer and P. H. Williams, Dept. of Plant Pathology, UW, Madison, WI 53706.

Soil temperature, inoculum concentration, inoculation method, and plant age were studied to develop a method for evaluating resistance. Cucumber seeds were planted directly in pans of infested sand placed in controlled temperature tanks. At the optimum soil temperature and spore concentration, which were found to be 28°C and 10^5 spores/g sand, respectively, all Straight Eight (susceptible) plants had a disease index (DI) of 9, while all Wisconsin SMR18 (resistant) plants had a DI of 1 (1=healthy, 9=dead). Three inoculation methods were compared: 1) sowing seed directly in infested sand (10^5 spores/g), 2) dipping roots of 7-day-old seedlings in inoculum ($5x10^7$ spores/ml) and transplanting to sand, and 3) inoculating plants as in 2, but transplanting to infested sand (10^5 spores/g). Using these methods the average DI's of Straight Eight and SMR18 were 8.6, 7.7, 8.6 and 1.0, 1.0, 1.0, respectively. Plants were rated 3 wk after planting. The direct seeding method is faster and more efficient. Resistant plants can be evaluated for responses to other diseases.

INDUCTION OF NEW BIOTYPES OF TRICHODERMA HARZIANUM RESISTANT TO BENOMYL AND OTHER FUNGICIDES. G. C. Papavizas and J. A. Lewis, USDA, SEA-AR, Beltsville, Maryland 20705.

Aqueous suspensions of conidia of T. harzianum were placed on V8 juice agar and exposed to UV light for up to 100 min. Also, conidia from wild strains of T. harzianum or from strains previously adapted to fungicides were allowed to germinate for 18 hr and exposed to UV light. The irradiated plates were incubated at 25 C under fluorescent light and resulting colonies were isolated and tested for resistance to benomyl and other fungicides. Several biotypes were obtained which, in addition to tolerating high concentrations of benomyl (50-100 µg/ml), differed considerably from wild strains in appearance, growth habit, sporulation, and survival ability in soil. Certain UV-induced biotypes of strain WT-6 tolerant to benomyl had an increased ability to suppress saprophytic activity of Rhizoctonia solani in soil and to reduce damping-off of cotton (R. solani), white rot of onion (Sclerotium cepivorum) and pea seed rot (Pythium ultimum).

THE EFFICACY OF COPPER COMPOUNDS FOR CONTROL OF BACTERIAL SPECK IN ONTARIO. I.M. Parsons and L.B. Edgington, Department of Environmental Biology, University of Guelph, Guelph, Ontario. N1G 2W1.

Bacterial speck of tomato caused by Pseudomonas tomato has become a serious problem in the 8000 hectares of processing tomatoes in Ontario. The bacteria infect pedicels causing flower drop, and delay of harvest. Also fruit infection interferes with skin removal in the processing of the tomatoes. Field plots in Southern Ontario were sprayed with various copper fungicides, dithiocarbamate fungicides and combinations thereof. Untreated check plants developed 20% infected foliage by July 12th. Plants treated 7 times with fixed coppers beginning June 14th on a 7 to 10 day cycle receiving 15.2 and 30.8 kg/ha per season developed 15% and 10% infected foliage respectively. Neither of the dithiocarbamate fungicides maneb and mancozeb had an effect of disease when used alone but each enhanced the control when used in combination with the fixed coppers.

ELECTROPHORETIC COMPARISON OF RIBOSOMAL PROTEINS OF FUNGAL PATHOGENS OF CORN AND SORGHUM. J. E. Partridge, Dept. of Plant Pathology, University of Nebraska, Lincoln, NE 68583.

The proteins of purified ribosomes of Fusarium moniliforme, F. roseum 'Graminerum', F. roseum 'Equiseti', Helminthosporium maydis, H. turcicum, H. sorghicola, H. sativum, Periconia circinata, Macrophomina phaseoli, Diplodia maydis and Pythium ultimum were compared on SDS-polyacrylamide gradient slab gels. Patterns for ribosomal proteins from each species were highly repeatable and did not vary with age of mycelium or culture conditions. Major differences were observed between genera, and lesser differences between species of the same genus. The differences may be useful in the taxonomic classification of these fungi. The interspecific differences are sufficient to be of potential value in identifying fungal pathogens in infected tissue where mixed infections occur.

NON-HOMOLOGY OF ANTIBODIES PRODUCED AGAINST RIBOSOMAL PROTEINS OF FUSARIUM MONILIFORME AND FUSARIUM ROSEUM 'GRAMINEARUM'. J.E. Partridge and M.R. Marshall, Dept. of Plant Path., Univ. of Nebraska, Lincoln, NE 68583.

Gradient polyacrylamide gel electrophoresis revealed significant differences between the ribosomal protein patterns of Fusarium moniliforme and Fusarium roseum 'Graminearum'. Both of these fungi are often isolated simultaneously from corn stalks, but their relative importance in causing stalk rot is difficult to assess. Antibodies were produced against the ribosomal proteins of each of these fungi to confirm the differences suggested by electrophoresis and to examine their potential for differentiating them in stalk tissue extracts. Immunological cross reaction experiments revealed the antibodies produced against one species were not entirely homologous with the antibodies produced against the other. Therefore, utilization of these antibodies will enable both quantitative and qualitative estimation of each fungus in a mixed infection.

DETECTION OF GERANIUM VIRUSES BY INDEXING CALLUS. T. Pastalka and J.Berbee. Dept. of Plant Pathology, University of Wisconsin, Madison, Wisconsin 53706.

Sixteen geranium varieties were indexed for the presence of viruses by infectivity assays in 6 different herbaceous host plants. Viruses were detected in only 4 of these 16 varieties by infectivity assays of geranium leaf sap containing 5% polyvinylpyrrolidone (PVP). Geranium viruses were more readily detected in sap of young geranium calli than in leaf sap. The most suitable media for callus initiation from geranium petiole or leaf blade sections were C- and Murashige-Skoog- medium. Viruses were readily and consistently detected by infectivity assays of extracts of 15-day-old or younger calli. Inoculations of selected host plants with extracts of calli, induced from geranium petioles or leaf blades, revealed the presence of viruses in all 16 of the geranium varieties. Tomato ringspot virus (TmRSV) was detected in 2 varieties, tobacco ringspot virus (TRVS) was detected in 6 varieties and both TRSV and TmRSV were detected in 2 varieties. The remaining 6 virus isolates were not identified.

EFFECTS OF SEPTORIA BROWN SPOT ON YIELD COMPONENTS OF SOYBEAN. J. K. Pataky and S. M. Lim. Dept. of Plant Path. University of Illinois, and USDA-SEA, Urbana, IL 61801.

The effects of Septoria brown spot, caused by Septoria glycines, on the yield components of soybeans: number of pods per plant, number of seeds per pod and seed weight, were investigated in fields planted with Williams soybeans. Significant seed weight reductions of approximately 10% occured at all canopy levels of soybeans that were inoculated as compared to plants sprayed with fungicide. Mean seed weights of protected plants were approximately 180 mg in the upper and lower canopy and 200 mg in the middle canopy. For inoculated plants, mean seed weights were approximately 160 mg in the upper and lower canopy and 180 mg in the middle canopy. No significant differences were observed for number of pods per plant or number of seeds per pod. Brown spot severity, brown spot vertical progress (BSVP), and defoliation were significantly greater in inoculated plots during reproductive growth stages. During pod-fill stages, severity, BSVP and defoliation in inoculated plots were approximately 55, 50, and 30%, respectively.

FUNGICIDES FOR CONTROL OF BOTRYTIS DISEASES OF ORNAMENTALS A. O. Paulus, S. Besemer and J. Nelson, Plant Pathology Department, University of California, Riverside, California 92521

Three trials in 1980 showed that vinclozolin (3-(3,5-dichlorophenyl)-5-ethenyl-5 methyl-2,4-oxazolidinedione) and iprodione (3-(3,5-dichlorophenyl)-1-isopropylcarbamoylhydantoin) were significantly better than benomyl + maneb or benomyl + thiram for control of Botrytis gladiolorum on gladiolus. Severe inoculum potential was present during the first trial and moderate inoculum potential during the last two trials. Benomyl + thiram or benomyl + maneb were significantly better than no treatment in two of three trials. DuPont 4424 and vinclozolin were significantly better than Bordeaux mixture for control of Botrytis elliptica causing leaf blight of Easter lily. DuPont 4424 and vinclozolin significantly increased bulb weight compared to Bordeaux mixture or no treatment.

THE EFFECT OF LESION DENSITY ON THE SPORE PRODUCTION OF POWDERY MILDEW LESIONS ON WHEAT LEAVES. W. L. Pedersen, D. R. MacKenzie, H. A. Nass, R. R. Nelson, and V. J. Elliott, Department of Plant Pathology, The Pennsylvania State University, University Park, PA 16802.

In our efforts to quantify the components of rate limiting resistance in wheat to powdery mildew (caused by *Erysiphe graminis tritici*) it was observed that the amount of sporulation of a lesion on a susceptible leaf was inversely related to the density of lesions on that leaf. This observation was studied in detail for the susceptible wheat cultivar Chancellor because interpretation of sporulation capacity is critical to studies on rate-limiting resistance. Cumulative sporulation data were collected daily from lesions on leaves with lesion densities ranging from 2 to 40 per leaf. Analysis of the 8th day totals gave $\hat{y} = 120{,}572\ e^{-0.031X_1}$ ($R^2 = 0.84$) where $\hat{y}$ is the expected sporulation capacity and X_1 is the lesion density per leaf. Curve fitting of the cumulative sporulation data suggested lesion density influences rate of sporulation and perhaps infectious period. This phenomenon should be considered in future powdery mildew of wheat sporulation studies.

THE EFFECT OF NITROGEN FERTILIZER ON FOLIAR DISEASES AND YIELD OF SIX SOFT RED WINTER WHEAT VARIETIES. W. L. Pedersen, E. O. Hatley, D. R. MacKenzie, and R. R. Nelson. The Department of Plant Pathology and Agronomy, The Pennsylvania State University, University Park, PA 16802.

Four levels of ammonium nitrate fertilizer (0, 34, 68, and 103 kg N/ha) were applied to field plots of six soft red winter wheat varieties during the spring of 1979. All plots received 34 kg N/ha at fall planting. Bayleton was applied to one-half of the

plots (140 g A.I./ha) and the remaining plots were untreated. Disease readings for powdery mildew, Septoria leaf and glume blotch, and leaf rust were taken at growth stage 10.5 (Feekes scale) using a modified James scale. Maximum yields were obtained for five varieties at 34 to 68 kg N/ha, however one variety (S-76) had its maximum yield at 103 kg N/ha. Powdery mildew severities were positively correlated with nitrogen levels for the three susceptible varieties. Significant increases in yield occurred in plots treated with Bayleton where powdery mildew and leaf rust were controlled. Septoria leaf and glume blotch, and leaf rust were not significantly affected by nitrogen fertilizer in this study.

TEMPERATURE AS AN IN VITRO GROWTH PREDICTOR OF COLLETOTRICHUM COCCODES. S. P. Pennypacker, W. M. Thal, and R. E. Stevenson, Department of Plant Pathology, The Pennsylvania State University, University Park, PA 16802.

The relationship between growth and temperature was studied for Colletotrichum coccodes, the tomato anthracnose fungus. Four isolates were grown on 2% malt agar at constant temperatures ranging from 5 to 35 C. Constant conditions of relative humidity and light were assumed. Measurements of colony diameter growth were made after five days. A mathematical model was fit to the growth data for each isolate using least squares regression. The model gave an accurate fit of each data set (coefficients of determination > 0.90). This model was used to predict growth at fluctuating temperatures by summing the expected growths during each hour over the five day growth period. Growth predictions at fluctuating temperatures were generally within 10% of the observed values. Thus it was shown that growth of C. coccodes can be accurately predicted at both constant and fluctuating temperatures when other conditions are held constant.

THE EFFECT OF WEED DENSITY ON YIELD, RIPENING RATE, AND FRUIT ROTTING RATE OF PROCESSING TOMATOES. S. P. Pennypacker, R. N. Raid, A. A. MacNab, and L. V. Madden, Department of Plant Pathology, The Pennsylvania State University, University Park, PA 16802.

An experiment to determine the effect of weed density and biomass on tomato yield, ripening rate, and fruit rotting rate was conducted during the 1979 growing season. Six levels of mechanical weed cultivation were applied to field plots containing the cv. Merit in an effort to establish different weed densities. The one time treatment applied 25 days after planting consisted of 100, 95, 75, 65, 50, and 0 percent cultivation. Analysis of variance indicated the presence of significant differences in crop yield due to weed biomass. Yield reductions of 55 percent resulted when only 5 percent of the area was left uncultivated. Less cultivation produced correspondingly lower yields. Differences among both fruit ripening rates and rotting rates for the six treatments were not significant. There were also no significant differences in the time at which maximum useable yield was available.

CONTROL OF BROWN SPOT IN WILD RICE CAUSED BY BIPOLARIS ORYZAE and B. SOROKINIANA WITH TEN FUNGICIDES AND ADJUVANTS. J.A. Percich and L. Nickelson. Department of Plant Pathology, University of Minnesota, St. Paul, MN 55108.

Ten fungicides were each tested for their effectiveness in controlling spore germination and mycelial growth of B. oryzae and B. sorokiniana in fungicide-amended potato-dextrose broth. Benlate-50WP, dithane-M45, dyrene-50WP, RP 26019-50 Flowable, and sisthane-50WP were fungistatic at amounts equal to or less than recommended labeled field rates. These five fungicides and Bravo 6F-54WP, were applied on wild rice plants at 14-day intervals from early flowering until 26 days before harvest. The following fungicides significantly controlled brown spot (114 l/ha of spray): 1.1 kg/ha benlate-50WP, 11.4 kg/ha Bravo-6F, 2.27 kg/ha dithane-M45, 0.57 kg/ha sisthane-50WP, and 6.4 l/ha RP 26019-50 Flowable. Dithane-with 0.63 ml/l triton B-1956, 0.55 ml/l nufilm-17, or 1.25 ml/l rhoplex B-85 gave significantly better control than did the recommended 4 applications of dithane-M45 with 1.25 ml/l triton CS-7.

A PRELIMINARY REPORT ON THE HISTOPATHOLOGY OF VERTICILLIUM-INFECTED POTATO PLANTS. James W. Perry and Ray F. Evert, Department of Botany, Univeristy of Wisconsin, Madison, WI 53706.

The vascular pathogen, Verticillium dahliae, is a major component of the complex disease, early dying of potato. Plantlets grown from seed pieces were inoculated by dipping their root systems in a conidial suspension. Tissue samples were collected periodically for histopathological study. The fungus apparently entered the roots through wounds. Hyphae occurred both intra- and intercellularly in the cortex. Opposite penetration sites in cortical cell walls, protuberances, presumable composed of lignin, were observed. Lateral movement of the pathogen occurred when the fungus penetrated pit membranes of contiguous tracheary elements. Fungal entities have been found distributed throughout the xylem of the shoot system. In infected tracheary elements, an electron dense material coated the walls and pit membranes. This coating may prevent movement of water, disrupting normal physiological functions and contributing to disease symptomatology.

AGROBACTERIUM TUMEFACIENS BIOTYPES 2 AND 3 FROM RUBUS AND GRAPE IN CALIFORNIA. Keith L. Perry and C. I. Kado, Department of Plant Pathology, University of California, Davis, CA 95616

Fifteen A. tumefaciens strains isolated from Vitis vinifera and Rubus ursinus were characterized as to their biotype, host range, sensitivity to agrocin 84, opine catabolism, and plasmid content. Eleven of 12 strains from grape were biotype 3, a species subgrouping not previously reported in the U.S. All 3 Rubus strains were biotype 2. No host specificity was exhibited with any strain when pathogenicity was tested on grape, sunflower, tomato, Bryophyllum, tobacco, marigold, and Chenopodium. All but one strain were resistant to purified agrocin 84. Octopine was catabolized by all of the strains, with one exception which utilized nopaline. Some octopine strains also catabolized nopaline. High molecular weight plasmids (>100x10^6 daltons) were present in all of the strains. Plasmid masses ranged from 70 to 220x10^6 daltons, with 1 to 3 different plasmids harbored in each strain. The predominance of biotypes 2 and 3 from Rubus and Grape suggests that these biotypes may be more widely distributed than previously recognized.

RESISTANCE TO DOTHISTROMA PINI WITHIN PINUS PONDEROSA. Glenn W. Peterson, Rocky Mountain Forest & Range Expt. Stn., USDA Forest Service, Forestry Sci. Lab., Univ. of Nebr., Lincoln, NE, 68583

Infection by Dothistroma pini was evaluated within 50 geographic sources of Pinus ponderosa, in an experimental planting established in 1968, in eastern Nebraska. Infection of both first-year (current-year) and second-year needles was evaluated in approximately 60 trees of each source in November 1979 using a rating of 1 = slight or no infection, 2 = moderate infection, and 3 = severe infection. Trees of six sources showed universally high resistance; the average infection rating of first- and second-year needles did not exceed 1.1. Their average height at 10 years exceeded the plantation average. The areas where seeds for the six sources were collected are in New Mexico (geographic source nos. 766, 767, 768, 863), Arizona (869), and Nebraska (720) (information on geographic sources is in Deneke & Read, 1975, USDA Forest Service Research Note RM-297). These areas should be considered for seed collections for planting stock that will be used where Dothistroma blight is a threat.

DIELECTRIC PROPERTIES OF MOLD AND MYCOTOXIN DAMAGED PEANUTS. Robert E. Pettit and Randall L. Geiger, Department of Plant Sciences, Texas A&M University, College Station, Texas, 77843.

Within the peanut industry a need exists to develop an improved rapid nondestructive electronic technique for separating mold and mycotoxin damaged peanuts. Dielectric characteristics of good sound mature kernels and damaged kernels were investigated over a frequency range of 20KHz to 20MHz. Peanuts were placed in a test capacitor and measurements were made on a HP 4342A Q Meter. Equivalent moisture contents were maintained using humidity chambers as determined by the oven dry method. Preliminary results indicate that the real part of the dielectric constant (permittivity) is essentially independent of contamination levels whereas the imaginary part (alt. loss tangent) is strongly dependent upon contamination level. The simultaneous determination of kernel moisture content and degree of damage, based upon these dielectric characteristics, provides a means of detecting varying degrees of mold and mycotoxin damage.

EUTYPA DIEBACK OF GRAPEVINE: SEASONAL DIFFERENCES IN INFECTION AND DURATION OF SUSCEPTIBILITY OF PRUNING WOUNDS. C. H. Petzoldt, W. J. Moller, and M. A. Sall, Department of Plant Pathology, Univ. of Calif., Davis, CA 95616.

Grapevines growing in Davis, California were pruned at three different times (Dec. 19, 1978; Feb. 6, 1979; and March 12, 1979) and wounds on one-year-old wood were inoculated with 0, 100, or 1000 ascospores of Eutypa armeniacae at weekly intervals after pruning. The wounds were most susceptible to infection in

December and least susceptible in March. Duration of wound susceptibility results showed that wounds were susceptible for a longer period of time after pruning in December than after pruning in March. Wound size and relative position of a wound on a vine did not have a significant effect on infection after inoculation. Data showed that in most cases more infections resulted when wounds were inoculated with 1000 ascospores than when 100 ascospores were used. These findings suggest that to avoid Eutypa dieback in California regions where the disease is most prevalent, a late February or March pruning time may be desirable.

ATTEMPTS TO ELICIT ANTIBODY PRODUCTION IN RABBITS WITH PURIFIED POTATO SPINDLE TUBER VIROID. M. A. Pfannenstiel and S. A. Slack, Dept. of Plant Pathology, University of Wisconsin-Madison, Madison, WI 53706.

A severe strain of potato spindle tuber viroid (PSTV) was purified from tomato, Lycopersicon esculentum Mill. 'Rutgers'. Native PSTV was coupled to bovine gamma globulin and methylated bovine serum albumen (mBSA) and denatured PSTV was coupled to mBSA prior to injection into four New Zealand white rabbits (two per treatment). A total of 500 µg of PSTV was administered to each rabbit in 100-200 µg aliquots as three weekly injections followed by one or two booster injections. Sera were collected weekly and purified by Protein A chromatography to obtain ribonuclease-free immunoglobulin G. Antibody specificity for native or denatured PSTV was not demonstrated by Staphylococcus aureus immunoprecipitation, affinity chromatography, enzyme-linked immunosorbent assay, or radioimmunoassay.

APHANOMYCES ROOT AND STEM ROT OF SNAP BEANS. W. F. Pfender and D. J. Hagedorn, Department of Plant Pathology, University of Wisconsin, Madison, WI 53706.

In the summer of 1979, a new disease of snap bean caused by Aphanomyces sp. was discovered in central Wisconsin. The fungus causes severe rotting of roots and lower stem, stunting, and occasionally death. Isolates of the fungus from beans were compared with isolates of Aphanomyces from diseased peas grown in the same soil. Whereas the pea isolates infect both peas and beans, causing death of peas and moderate root rotting of beans, the isolates from beans are restricted to this host, being unable to infect peas. Besides having different host ranges, the bean and pea isolates differ morphologically. In comparison with the pea isolates, the bean isolates have a larger oogonium with a more markedly aplerotic oospore.

CERCOSPORA SOJINA RACE 5 ON SOYBEANS IN GEORGIA. D. V. Phillips and H. R. Boerma, University of Georgia, Georgia Experiment Station, Experiment, GA 30212.

Severe frogeye leafspot was found on soybeans [Glycine max (L.) Merr.] at widely separated locations in Georgia in 1978. The reaction of several cultivars to Cercospora sojina isolated from these plants indicated that it was different from previously described races. The race from Georgia, designated race 5, can be separated from other races on the reaction of the cultivars Hood and Roanoke which are resistant to races 1, 2, and 3 and susceptible to races 4 and 5; and the cultivars Lee and Hill which are resistant to races 1, 2 and 5, and susceptible to races 3 and 4. There were large differences in the number of lesions per plant among susceptible cultivars. In greenhouse inoculations two types of resistant reactions were observed. Some cultivars essentially developed no lesions, while others developed flecks or very small lesions. The flecking reaction was not observed in field inoculations. Many cultivars used in commercial production in the Southeast including Bragg, Dare, Essex, Forrest, and others are susceptible to race 5.

THE EFFECTS OF MONOCHROMATIC LIGHT ON THE GERMINATION OF OOSPORES AND THE FORMATION OF SPORANGIA OF PHYTOPHTHORA CITRICOLA. D. F. Plourde and R. J. Green, Jr., Botany and Plant Pathology Dept., Purdue University, W. Lafayette, IN 47907

The responses of oospore germination and sporangial formation of P. citricola to various bands of monochromatic light were studied. Acrylic filters with spectral transmission peaks at 450, 545, 650, and 750 nm were combined with aqueous filter solutions and various light sources to expose oospores to a radiant flux density of 20.0 ergs/cm^2/sec. Additional experiments showed the effects of time exposure and intensity on oospore germination and sporangial formation. Oospore germination and sporangial formation occurred in the dark but exposure to light greatly enhanced both processes, especially in the blue (400-420nm) and ultraviolet (350-400nm) portions of the spectrum. Increased exposure time enhanced sporangial formation but had little effect on oospore germination.

SELECTIVE MEDIUM FOR MEASURING RHIZOPUS STOLONIFER POPULATIONS IN SOILS. S. R. Podolsky and J. M. Ogawa, Department of Plant Pathology, University of California, Davis, CA 95616.

A medium selective for Rhizopus stolonifer contained (g/l) glucose 10, peptone 10, beef extract 3, oxgall 5 and (mg/l) crystal violet 2, benomyl 10, pyrogallol 25, Imazalil nitrate 0.75, streptomycin sulfate 100 and tetracycline HCl 100. On this medium R. stolonifer colonies could be recognized after 45 to 50 h at approximately 24°C. These colonies averaged 15.5 mm in diameter. The medium did not inhibit germination or development of R. stolonifer single spores into colonies. The efficiency of a dilution plate method for isolating R. stolonifer from soils with this medium, established by enriching autoclaved and natural field soils with a sporangiospore suspension, was 100% in four tests. This medium was not consistent for isolating R. arrhizus, R. oryzae or R. circinans from soils.

ENZYME-LINKED IMMUNOSORBENT ASSAY (ELISA) TO PRODUCE VIRUS FREE PLANTS FOR SOYBEAN GERMPLASM EXCHANGE. J. E. Polston and R. M. Goodman. Dept. of Plant Path. and the Intl. Soy. Program, University of Illinois, Urbana, IL 61801.

The International Soybean Program (INTSOY) and the International Institute of Tropical Agriculture (IITA) Ibadan, Nigeria, are cooperating to produce a diverse tropical soybean germplasm collection for W. Africa free of known viruses. To screen soybean lines for soybean mosaic virus (SMV), a seedborne virus frequently found in germplasm collections, seeds of 457 tropical lines were planted at an isolated location near Isabela, Puerto Rico, in December 1979. All plants were inspected five times and screened using the enzyme-linked immunosorbent assay; any infected-looking plants were rogued. Up to 20 leaflets per line, one from each plant, were sampled (6mm cork borer) and tested together by ELISA. SMV ELISA is sensitive enough to detect reliably one infected leaflet in 20. Lines giving a positive ELISA reaction were reinspected, rogued, and assayed again. Seeds of lines negative for SMV by ELISA and which produced healthy seedlings in a postseason sandbench inspection, were sent to IITA.

SEROLOGICAL COMPARISON OF ISOLATES OF TOMATO RINGSPOT VIRUS FROM DIFFERENT HOSTS. Charles A. Powell, Pennsylvania Department of Agriculture, Harrisburg, PA 17110.

Ouchterlony double-diffusion comparison of tomato ringspot virus (TmRSV) isolated from apple (A), blueberry (B), geranium (G), and cymbidium orchid (O) showed that all four isolates had at least one antigenic determinant in common, and A and B had at least one additional antigenic determinant in common which was not shared by G or O. An enzyme-linked immunosorbent blocking assay (EIBA), which compares the relative abilities of excess unlabeled heterologous and homologous antigen to block the binding of enzyme-lableled antigen to its immobilized homologous IgG, was developed to more closely scrutinize the serological relationships. EIBA revealed that O had at least one, and B had at least two, additional antigenic determinants not shared by A or G. I conclude that each of the four TmRSV isolates is serologically distinct, and that EIBA can detect antigenic determinants not detectable by Ouchterlony double-diffusion.

RESPONSE OF SOYBEAN CULTIVAR HODGSON TO OZONE. Gregory C. Pratt and Sagar V. Krupa. Department of Plant Pathology, University of Minnesota, St. Paul, MN 55108.

Acute ozone-induced injury to soybean (Glycine max (L.) Merr.) cultivar Hodgson was modeled using a log-probability model with pollutant concentration and exposure duration as the independent variables. The amount of visual injury was highly predictable, and a threshold (i.e., 1% mean injury) for a 1 hr exposure of 0.084 ppm was calculated. A reduction in leaf chlorophyll concentration was correlated with visual injury. Plants fumigated for two hours per day on five successive days with 0.08 ppm ozone showed few or no symptoms (mean injury less than 1%). However, a significant reduction in chlorophyll concentration was observed in these leaves. This loss in photosynthetic pigment may affect biomass production in the absence of symptom production.

SCLEROTIUM ROLFSII ON TURF IN CALIFORNIA: ATTEMPTED BIOLOGICAL AND CHEMICAL CONTROL. Z. K. Punja and R. G. Grogan. Dept. of Plant Pathology, Univ. of California, Davis, CA 95616; and T. Unruh, Del Paso Country Club, Sacramento, CA 95821

Sclerotium blight causes serious damage on golf course greens in N. California. Two Trichoderma spp. most antagonistic to S. rolfsii in vitro were selected for biological control, based on rapidity of growth and ability to degrade sclerotia. Inoculum grown on molasses-impregnated diatomaceous earth was sprayed in June 1979 onto 3 diseased greens at rates of 110 kg/ha and 140 kg/ha. Trichoderma populations were monitored weekly and disease was rated in September 1979. Treated plots had significantly more Trichoderma than untreated plots. However, significant reduction of disease was not consistent in all treated plots. Of 20 fungicides tested in vitro for inhibiton of sclerotial germination, Captan, Vitavax, Bravo, Dithane M-45, and CGA64251 at 50-200 µg/g were fungistatic; of 24 inorganic salts, six were fungistatic at 10-30 mM, and NH_4HCO_3 and $(NH_4)_2 CO_3$ were fungicidal. Field application of the most effective chemicals, in addition to Trichoderma, is underway.

REACTION OF OIDIUM BEGONIAE TO TEMPERATURE, LIGHT AND TRIADEMEFON. J. A. Quinn and C. C. Powell, Jr., Dept. of Plant Pathology, The Ohio State University, Columbus, OH 43210.

On susceptible Begonia x hiemalis the maximum temperatures for germination, haustorial formation, and sustained growth of Oidium begoniae are 32, 30, and 28 degrees C respectively. Colonies cease growth after 48 hr at 28 C, but at this temperature mycelium remains alive for 2 weeks or more on excised leaves. It survived for 4 weeks in buds on whole plants. Colonies exposed to 32 C for 3 days do not resume growth when returned to 21 C. On resistant species, such as Begonia x richmondensis, the maximum temperature for sustained growth and sporulation is about 15 C. Synchronous production of conidia is correlated with start of the light period. Continuous dark lessens synchrony. In addition, production of conidia is reduced in continuous light or dark. Triademefon (2.5mg/6 inch pot as a soil drench) prevented infection for 2 months. Bioassay of leaf disks from treated begonias using Sclerotinia homeocarpa demonstrated the presence of fungicide. The level of inhibition of the test organism remained constant for 70 days.

HELICAL, MOTILE MYCOPLASMAS ASSOCIATED WITH FLOWERS IN CALIFORNIA. B. C. Raju, G. Nyland, Dept. of Plant Pathology, Univ. of Calif., Davis, CA 95616. T. Meikle and A. H. Purcell, Dept. Entomol. Sci., Univ. Calif., Berkeley, CA 94720.

Spiroplasmas were cultured in vitro from nonsurface-sterilized flowers of Berberis thunbergii, Liriodendron tulipera, Mahonia aquifolium and Magnolia grandiflora. Spiroplasmas were also isolated from honey bees collected near Davis and Berkeley. Most of the isolates grew relatively slowly with an optimum temperature of 31 C. All isolates grew at 37 C. The flower isolates formed 'Satellite' colonies on agar whereas isolates from bees formed highly diffuse colonies. Triple-cloned flower and bee isolates were deposited at the American Type Culture Collection. Serological studies were performed by metabolic inhibition, organism deformation, and growth inhibition. Serologically the California flower isolates were indistinguishable from spiroplasma strain AS576 from honey bee from Maryland. Isolates from honey bees were serologically related to SR-3 (a flower isolate from Connecticut) but not identical.

EFFECT OF PYTHIUM POPULATIONS ON SEVERITY OF BEAN ROOT ROT IN WISCONSIN. R. D. Reeleder, Dept. of Plant Science, Univ. of Alberta, Edmonton, Alberta, Canada T6G 2E3, and D. J. Hagedorn, Dept. of Plant Pathology, Univ. of Wisconsin, Madison, WI 53706.

Pythium root rot is a limiting factor in snap bean production in the Central Sands area of Wisconsin. Several pathogenic species of Pythium were isolated from soil and diseased plants but there was a poor correlation (r=.48) between the total Pythium population and the severity of root rot in 7 commercial fields. There was a strong correlation (r=.88), however, between the population of Pythium ultimum and the severity of root rot in these fields. A linear regression was derived (Y = .02x + .52) which gave a significant fit (P=.01) to the data. Although there was also a high correlation (r=.86) between the population of P. ultimum and the yield, the linear regression in this case did not give a significant fit to the data.

IN VITRO SYNTHESIS OF PROTEINS DIRECTED BY RNA FROM TOMATO BUSHY STUNT VIRUS. By J.T. Reeves, B.A. Larkins and A.O. Jackson. Department of Botany and Plant Pathology, Purdue University, West Lafayette, Indiana 47907.

RNA isolated from tomato bushy stunt virus (TBSV) was translated in cell-free protein synthesizing systems derived from wheat germ and rabbit reticulocyte lysate. Proteins whose synthesis was specified by TBSV RNA in the wheat germ system separated in polyacrylamide gels into three intense bands with molecular weights of 37,33.4 and 29.6 kilodaltons. The 37 kilodalton product comigrated with radioactively-labeled viral coat protein. Five additional bands with molecular weights of 20.6, 17.8, 16.5, 12.5 and 12 kilodaltons were present in fluorographs of polyacrylamide gels. However, these bands varied in relative intensity in different experiments, so they may be premature translation products. Polypeptides whose synthesis was directed by TBSV RNA in the reticulocyte lysate were identical to products synthesized by the wheat germ system, except for the presence of three minor components with molecular weights of 46.7, 26.6 and 22.9 kilodaltons.

APHID POPULATIONS AND MAIZE DWARF MOSAIC VIRUS IN NORTHERN ILLINOIS. Ellen B. Rest, Cleora J. D'Arcy, and W.E. Splittstoesser. Departments of Horticulture and Plant Pathology, University of Illinois, Urbana, Illinois 61801.

Aphid populations were monitored in plexiglass horizontal ermine lime traps during the summer of 1979 at Rochelle, IL. Each trap (16x16x4 cm) contained a green tile covered with ethylene glycol. Traps were placed in a weed strip and in an adjacent sweetcorn plot, kept at canopy height, and emptied regularly. The number of aphids captured in both the weeds and corn remained at low levels until mid-July when there was a sharp increase. The number of aphids trapped in the weeds remained high until the end of August, while the number in corn declined steadily after the peak in July. Peaks of aphids trapped in both weeds and corn preceded the appearance of natural infections of maize dwarf mosaic by one week. Initially, widely scattered plants were infected. Three weeks later, 100% of the plants were infected in some fields. Aphid numbers, disease appearance and disease spread appear interrelated.

RESISTANCE TO RIDOMIL IN DOWNY MILDEW OF CUCURBITS. M. Reuveni, H. Eyal and Y. Cohen, Department of Life Sciences, Bar-Ilan University, Ramat-Gan, Israel.

A ridomil (CGA-48988, N-(2-6-dimthylphenyl)-N-(methoxyacetyl) alanine methyl ester) - resistant form of Pseudoperonospora cubensis, the incitant of downy mildew in cucurbits, was isolated in Dec 1979 from cucumber plants growing in plastic houses in the northern coastal plain of Israel. Two-leaf plants drenched with 15 mg a.i. Ridomil/0.5 l pot or sprayed with 500 µg/leaf became heavily mildewed when inoculated with the resistant form, whereas 50 µg/0.5 l pot or 25 µg/leaf efficiently controlled the disease in plants inoculated with the sensitive form. There are indications that the resistant form is more virulent to cucumbers in both nature and greenhouse. Both forms of the pathogen had identical physiological specialization when introduced on six members of the Cucurbitaceae.

EXCISED SEED COATS OF SOYBEAN: A SUBSTRATE FOR ISOLATING CERCOSPORA KIKUCHII. T.L. Richards and T.S. Abney. U.S. Department of Agriculture, SEA and Dept. Botany & Plant Pathology, Purdue Univ., W. Lafayette, IN 47907.

Cercospora kikuchii isolated from intact soybean seeds rarely sporulates in culture. Culture media, along with specific light and temperature conditions influenced conidial production of the occasional sporulating isolates obtained from intact non-viable seed, but none of the substrates or physical conditions induced sporulation in strains commonly isolated from germinating soybean seeds. Excised seed coats of purple stained seeds yield sporulating isolates regularly. With this isolation technique, we increased the recovery of sporulating isolates 100X, and the sporulating state has been maintained with subsequent transfers and growth on nutrient agars. However, non-sporulating isolates were not induced to sporulate when they were grown on excised seed coats from healthy seeds. This technique for isolating sporulating strains should prove valuable in screening for resistance to the pathogen and in confirming its taxonomic identification.

RECOVERY OF HERPOBASIDIUM DEFORMANS BASIDIOSPORES FROM LONICERA TATARICA LEAVES OVERWINTERED IN NURSERY BEDS. Jerry W. Riffle, Rocky Mountain Forest & Range Expt. Stn., USDA Forest Service, Forestry Sci. Lab., Univ. of Nebr., Lincoln, NE. 68583

Lonicera tatarica leaves infected with Herpobasidium deformans were placed at five ground locations in nursery beds at Lincoln-Oakes Nursery, Bismarck, N.D. on 21 October 1977 to overwinter. Five of these leaves were collected at monthly (January,February 1978), or weekly (March,April 1978) intervals. Spores were cast from collected leaves onto 2% water agar at constant 16 C until casting was complete. Basidiospores were cast from 20, 80, 100, and 100% of leaves from January, February, March, and April collections respectively. Conidia were not recovered from any leaves. Percent germination of basidiospores on 2% water agar at 24 C for 6 hours was 44, 31, and 34 from February, March, and April collections respectively. Lonicera tatarica seedlings were inoculated with basidiospores from two collection dates (27 February and 6 March). These seedlings became infected. Results suggest that basidiospores are the primary inoculum for infection.

EFFECT OF DICHLORAN, IPRODIONE, PROCYMIDONE AND VINCLOZOLIN ON THE GROWTH AND SPORULATION OF MONILINIA FRUCTICOLA. D. F. Ritchie, Department of Plant Pathology, North Carolina State University, Raleigh, NC 27650.

The effect of dichloran (Botran), iprodione (RP 26019, Rovral), procymidone (DPX 4424) and vinclozolin (BAS 352 04F, Ronilan) on mycelial growth and sporulation of fungicide sensitive and resistant strains of Monilinia fructicola was studied on potato dextrose agar (PDA) and peach slices. All sensitive strains tested grew on PDA amended with 100 ug/ml of the chemicals when incubated for 2 wk at 24 C. Fungal growth was atypical being raised and leathery rather than flat and mycelial. Few or no spores were produced. As much as a five-fold increase in sporulation occurred 4 days after transfer to nonamended PDA. Following two more transfers to nonamended PDA, sporulation was similar to that of strains not having grown on amended PDA. Similar results occurred when fungal plugs were incubated on fungicide-treated fruit slices. All resistant strains produced a uniform dark, black mycelium on both amended and nonamended PDA. Sporulation of resistant strains was reduced.

SOME HISTOLOGICAL EFFECTS OF COLLETOTRICHUM CAPSICI ON COTTON LINT. R. G. Roberts and J. P. Snow. Dept. Plant Path. and Crop Physiol., La. State Univ. Agric. Expt. Sta., Baton Rouge, LA 70803.

Histological effects of Colletotrichum capsici (Syd.) Butler and Bisby on the lint of Gossypium hirsutum L. were studied. Diseased lint was obtained from unopened bolls collected from plants in the greenhouse, inoculated either on the plant or detached. Attached bolls were inoculated with agar plugs and enclosed in plastic bags; the detached bolls were surface sterilized, inoculated with agar plugs or conidial suspensions, and held in sterile moist chambers. Infection of the lint occurred without capsule dehiscence. Single hyphae penetrated several lint strands in succession. Multiple penetration sites were observed on single lint strands. The individual lint strands were bound together by mycelia and remained in the locule as a tight, brittle mass. Penetration of lint walls occurred without the formation of appressoria. An area of discoloration was observed around penetration sites when lint was viewed with polarized light microscopy. Sclerotia-like masses were observed in the lumen of lint strands.

ISOLATION AND IDENTIFICATION OF SQUASH MOSAIC VIRUS FROM CUCURBITA FOETIDISSIMA HBK, BUFFALO GOURD. Martha E. Rosemeyer, W. P. Bemis, M.R. Nelson*, and R.E. Wheeler*, Department of Plant Sciences, *Department of Plant Pathology, University of Arizona, Tucson, Arizona 85721.

Squash mosaic virus (SMV) has been isolated from leaves of Cucurbita foetidissima, a potential crop for arid land agriculture. Diseased buffalo gourd leaves were mechanically inoculated onto Cucurbita pepo 'Sugar Pumpkin'. Transfers from C. pepo to the appropriate indicator plants produced symptoms identical to those produced by known SMV. Transmission Electron Microscopic Serology (TEMS) with the crude sap of isolated and known SMV combined with SMV antisera graphically demonstrated the serological agglutination reaction. With the same preparation there was no reaction when antiserum was absent or non-homologous antiserum was added. When buffalo gourd was inoculated with the field isolate, the TEMS test with SMV antisera showed a positive serological reaction. Cucumber beetles, vectors of SMV, are quite numerous throughout the summer. Other viruses have been isolated from buffalo gourd and are currently under study.

TRANSMISSION ELECTRON MICROSCOPIC SEROLOGY OF SQUASH MOSAIC VIRUS. M.E. Rosemeyer, W.P. Bemis, M.R. Nelson*, R.E. Wheeler*. Department of Plant Science, *Department of Plant Pathology, University of Arizona, Tucson, Arizona 85721.

A crude sap preparation of leaf tissue infected with squash mosaic virus (SMV) and combined with SMV antisera demonstrated a serological agglutination reaction clearly visible in the transmission electron microscope. Almost all the virus particles were in clumps which contained only virus particles and antibody. The few single particles that were visible were covered with a mantle of antibody. However, in the same crude sap preparation without antisera or with a non-homologous antisera, the virus particles were evenly spread, demonstrating that no reaction had occurrred. Crude sap preparations proved consistently successful, which made purification unnecessary. Other advantages of this technique are that it is rapid, requires only a small amount of antiserum, eliminates interpretation of banding on a gel plate and permits direct viewing of the reaction.

THE IMPORTANCE OF ANTIBIOSIS IN CONTROL OF TWO SOILBORNE PLANT PATHOGENS BY SELECTED STREPTOMYCES SPECIES. C.S. Rothrock and D. Gottlieb, Dept. of Plant Pathology, University of Illinois, Urbana, IL 61801.

Antagonism to Rhizoctonia solani and Phytophthora megasperma var. sojae (Pms) race 1 was studied using 10 Streptomyces spp.; five were antifungal antibiotic producers. S. griseus, S. hygroscopicus var. geldanus, and S. noursei produced wide zones of inhibition to R. solani and Pms. Similar activity was found for S. reticuli var. protomycicus to Pms. S. cellulosae controlled Rhizoctonia root rot of peas when sterile soil was infested simultaneously with the streptomycetes and R. solani. When the streptomycetes were added to soil 7 days prior to adding R. solani, S. hygroscopicus var. geldanus gave nearly complete control. S. herbaricolor and S. coeruleofuscus gave the most consistent control of Phytophthora root rot of soybeans. Antagonism of the Streptomyces spp. to the pathogens on nutrient media was poorly correlated with disease severity. A poor relationship was found between antibiotic producing ability and the ability to control disease.

MODELLING THE IMPACT OF PLANT STRESSES ASSOCIATED WITH POTATO EARLY DYING ON POTATO PLANT GROWTH AND TUBER YIELD. D.I. Rouse, J.E.Mitchell, W.Warfield, M.Rahimian, J.Kotcon, Dept. of Plant Pathology, University of Wisconsin, Madison, WI 53706

A quantitative description of potato plant growth as influenced by early dying stress factors was obtained using a mathematical plant growth model similar to one developed by Bajusz, et al. (Entomol. Soc. Amer. 1979, Abst.). Plant growth data were collected biweekly from 3 hills from each of 15 field plots for each of the cultivars Russet Burbank, Norgold Russet, and Superior between June 1 and Aug. 22, 1979. Plant growth data included dry weights of stems and leaves, leaf area, stem length, tuber number and tuber fresh weight. Disease intensity was estimated from assays of stem segments for the presence of early dying pathogens. Yields were obtained at the end of the season from undisturbed portions of the plots. Pathogens associated with potato early dying impose specific stresses on potato plant growth resulting in reduced plant growth, reduced leaf area, reduced transpiration, reduced chlorophyll concentrations, early senescence, and reduced yields.

INTERNAL SEED INFECTION BY PSEUDOMONAS PHASEOLICOLA IN SUSCEPTIBLE AND TOLERANT BEAN CULTIVARS. A. W. Saettler and S. J. Stadt, Department of Botany and Plant Pathology, Michigan State University, and USDA, SEA-AR, E. Lansing, MI 48824.

Internal infection by Pseudomonas phaseolicola (Pp, bean halo blight) was determined in seed harvested from susceptible Charlevoix cultivar and tolerant Seafarer and Montcalm cvs. Plants were inoculated in the seedling stage with a cell suspension of Pp isolate R13, resistant to 50 ppm rifampin (Phytopath. 68:778). Individual surface disinfested seeds were tested for presence of Pp R13 by shaker incubation up to 120 hr in liquid Kings Medium B supplemented with 50 ppm each of rifampin and cycloheximide. Infected seeds were found in both visibly-infected (23%) and symptom-free (3%) pods of Charlevoix. Of 250 symptom-free Montcalm and Seafarer pods, only one and none, respectively, yielded seed internally-infected with Pp R13. Presence of bean seed internally-infected with Pp in symptom-free pods suggests that field inspections for visible Pp symptoms may not be adequate in seed certification programs.

SORGHUM DOWNY MILDEW: REACTION OF MAIZE INOCULATED WITH OOSPORES AND CONIDIA. Salumu-Shabani and R. A. Frederiksen, Dept. Plant Sciences, Texas A&M Univ., College Station 77840.

Four selected maize cultivars were inoculated in the greenhouse using conidia and oospores of Peronosclerospora sorghi. Their response to inoculation was evaluated. Reaction of specific cultivars to infection with different spore forms of P. sorghi is important in a program of screening for resistance. Three distinct symptom patterns were revealed. Leaves of systemically infected seedlings of Tx508 and Tx601 exhibited a typical downy mildew chlorosis symptom; Tx508 was susceptible to infection with both spore forms while Tx601 was resistant. Tx127C showed a chlorosis accompanied by necrotic areas and was resistant to conidial and susceptible to oosporic inoculation. Tx441 had a mottled or mosaic pattern which was associated with host susceptibility to conidial and resistance to oosporic infection. This demonstrates that factors conditioning resistance to one spore form may not be effective against the other.

PATULIN SENSITIVITY OF WINTER WHEAT CULTIVARS.
D. C. Sands and G. A. Taylor, Department of Plant Pathology and Department of Plant and Soil Science, Montana State University, Bozeman, MT 59717

Patulin, a mycotoxin reportedly associated with straw decomposition, was differentially toxic to 15 cultivars of winter wheat. Seedling hypocotyl elongation on blotter paper containing 30 mg/l patulin was reduced 13% (Nugaines) to 57% (Froid). In field trials involving straw amended soil, Froid had reduced plant vigor and stand compared to the unamended control whereas Nugaines exhibited better plant vigor and stand in the same trials. A number of the cultivars showed similar rankings in both field and laboratory experiments. Eight cultivars, however, were not ranked consistently in field and lab tests, suggesting the involvement of other factors. Patulin resistance, at best, could only be one factor responsible for the varietal differences observed in high straw soils.

EFFECT OF SOIL MATRIC POTENTIAL ON INFECTION OF WHEAT BY TWO FUSARIUM ROSEUM cultivars. G. Sasi, J. P. Hill, and R. Baker, Dept. of Botany & Plant Pathology, Colorado State University, Fort Collins, CO 80523.

Two wheat (Triticum aestivum L) cultivars, Newton and Twin, were grown in plastic pots at 26C under matric potentials of -1/3, -1, -5, -10, and -13 bars. The amount of water added to air-dried soil establishing the matric potentials was determined from a previously developed matric potential-soil moisture curve. Pots were weighed every 2 days and water was added to restore initial weight and maintain the original matric potential. A 5 mm disk of water agar containing approximately 100 macroconidia of Fusarium roseum 'Culmorum' or F. roseum 'Graminearum' was applied to the cut end of the seedling after removing the plant top, 5 cm above the soil. Lesions developed on emerging leaves and were measured 7 days after inoculation. Lesion size peaked at -10 and -5 bars for 'Culmorum' and 'Graminearum', respectively. Significant differences in lesion size were found between wheat cultivars and between F. roseum cultivars.

THE DEVELOPMENT OF A RADIO-IMMUNOSORBENT ASSAY FOR BOTRYTIS CINEREA PERS. EX FRIES. S. D. Savage and M. A. Sall, Department Plant Pathology, Univ. Calif., Davis, CA 95616.

The radio-immunosorbent assay (RISA) for somatic antigens of the pathogen Botrytis cinerea Pers. ex Fries. can be used to detect the presence of Botrytis antigens in homogenized samples. As little as 100 ng of original fungal dry weight can be detected, and the sensitivity curve is log-log linear in response up to 10 mg/ml. The assay is highly specific for B. cinerea, although some reaction is obtained with members of the Sclerotineaceae. Botrytis allii showed 48% reactivity relative to B. cinerea, and species of Sclerotinia and Monilinia showed between 10 and 24% reactivity. All other fungi tested showed less than 0.1% reactivity. The usefulness of the assay for detection of the fungus within host tissue is demonstrated by the high correlation (r=.833) of the assay results with an estimation of rot weight from field infected lots. Artificially produced infection levels represent 0.1% infected tissue mixed with sound tissue homogenates are easily distinguished from background by the assay.

PREDISPOSITION OF CORN TO STALK ROT BY EARLY-SEASON WATER STRESS. R. W. Schneider, Dept. of Plant Pathology, University of California, Berkeley, CA. 94720

Stalk rot of corn, caused by Fusarium moniliforme, was enhanced following a mild early-season water stress even though symptoms were not apparent until near plant maturity. The immediate effect of stress was an increase in root colonization by the pathogen as determined after surface sterilization. Rates of soil water extraction and diurnal trends in plant water potential and diffusive resistance indicated that there was an increase in resistance to liquid water flow in previously stressed infected plants. This persisted for the duration of the season as compared to controls. Thus, under conditions of relatively high evaporative demand, translocation patterns in affected plants resembled those of chronically stressed plants in that stored carbohydrate was depleted to a greater extent from stalks of predisposed plants during reproductive development. This accelerated rate of stalk senescence, as measured by changes in pith density with time, has been associated with increased susceptibility to stalk rotting fungi.

A ROOT AND FOLIAR DISEASE OF SPATHIPHYLLUM 'CLEVELANDII' INCITED BY CYLINDROCLADIUM FLORIDANUM. C. L. Schoulties and N. E. El-Gholl, FDACS, P. O. Box 1269, Gainesville, FL 32602

Cylindrocladium floridanum is the incitant of a new root and foliar disease of Spathiphyllum 'Clevelandii'. The fungus is capable of destroying the root systems of seedlings and older transplants. As a result of root infection, foliar growth was retarded, the leaves eventually wilted, and the oldest foliage lost its color prematurely. Lowering of soluble salts by leaching decreased the amount of root infection based upon visual observation of roots, root weights, and recovery of the pathogen. The foliage disease which was monitored 7 days after inoculation, resulted in more lesions on the lower petioles near the soil line than on the upper petioles and leaves. Petiole lesions which were brown and elongate (3-5 mm x 1-2 mm) enlarged with time and frequently caused the leaf to collapse. Leaf lesions varied from a brown, circular (0.3-0.5 mm) spot surrounded by a sharp yellow halo to a brown, irregular (1-3 mm) spot surrounded by a diffuse yellow halo.

THE INFLUENCE OF "SWEATING" ON POSTHARVEST DECAY OF BLUEBERRIES. C.P. Schulze, M.J. Ceponis, and R.A. Cappellini, USDA-New Jersey AES Postharvest Research Center, P.O. Box 231, New Brunswick, New Jersey 08903.

The effect of condensation on decay development was studied in four tests with blueberry fruits after they were removed from cold storage. Freshly harvested, hand-picked berries were stored at 3°C for 4 and 10 days. Following their removal from cold storage, berries were rapidly warmed with forced hot air for 2 minutes to a pulp temperature of 20°C to prevent condensation, or placed directly at 20°C and 75-80% RH and moisture allowed to condense on the fruits. Both lots were then held for 3 days at 20°C and 75-80% RH. After 4 days in cold storage, test decay means ranged from 10.2 to 22.0% in the dry berries and from 7.9 to 23.0% in the berries that "sweated". Berries cold-stored for 10 days developed from 13.0 to 39.0% decay during the 3-day holding period when kept dry and from 10.7 to 40.0% decay after they had "sweated". Dry berries had more decay in 2 tests while the reverse was true in the other 2 tests. Decay was caused principally by Botrytis sp., Alternaria sp., and Gloeosporium sp.

BLACK ROT OF CRANBERRY CAUSED BY STRASSERIA OXYCOCCI SHEAR. M. R. Schwarz and D. M. Boone, Department of Plant Pathology, University of Wisconsin-Madison, Madison, WI 53706.

An examination of cranberries from New Jersey has revealed that Strasseria oxycocci Shear can cause a storage rot indistinguishable from black rot caused by Ceuthospora lunata Shear. S. oxycocci was isolated from 30% and C. lunata from 70% of black-rotted cranberries selected from New Jersey samples. S. oxycocci and C. lunata were never isolated from the same cranberry. The pathogenicity of S. oxycocci was assessed by inoculating sound cranberries (Searles variety) with single-spored isolates. Symptoms identical to black rot caused by C. lunata developed within three weeks of inoculation. The berry tissues turned black and softened in 90% of the berries incubated at 12°C and 55% of the berries at 24°C. Only S. oxycocci was reisolated from all of the inoculated cranberries with black rot symptoms.

THE EFFECT OF WOUNDING AND WET RAKING ON THE INCIDENCE OF BLACK ROT OF CRANBERRIES IN WISCONSIN. M. R. Schwarz and D. M. Boone. Department of Plant Pathology, University of Wisconsin-Madison, Madison, WI 53706.

Laboratory and field trials showed that Ceuthospora lunata

Shear, causal agent of black rot of cranberries, is primarily a wound-invading organism. In the laboratory, black rot developed in over 92% of cranberries wounded, by puncturing the epidermis, and dipped in a spore suspension, and a high incidence of black rot developed during storage in ripe cranberries that were wounded in the field. Control or bruised cranberries without a punctured epidermis showed little or no black rot. Harvest water was an important medium for dissemination of C. lunata spores to infectable sites on the fruit. Viable C. lunata spores, at concentrations of at least 50 spores/ml, were found at harvest in flood waters used for wet raking cranberries. Black rot developed in over 40% of wounded berries immersed in harvest water samples, whereas no black rot developed in comparable cranberries immersed in heat sterilized harvest water.

INDUCTION OF DOTHISTROMA BLIGHT SYMPTOMS WITH DOTHISTROMIN. Louis Shain and Robert A. Franich, Dept of Plant Pathology, University of Kentucky, Lexington 40546, and Forest Research Institute, Private Bag, Rotorua, New Zealand, respectively.

Dothistroma blight of radiata pine and other pine species caused by the fungus Dothistroma pini is characterised by red, necrotic bands through infected portions of needles. The red color of these necrotic lesions is due to the accumulation of dothistromin, a difuranoanthraquinone, during the infection process. This previously identified compound is produced by the pathogen. Although dothistromin has been shown to inhibit the growth of some microorganisms, toxicity to pine-needle tissue has not been demonstrated previously. Typical necrotic and red-band symptoms were induced by introducing 20-100 ng of dothistromin in acetone into puncture wounds in needles of radiata pine. Natural lesions contained 1-10 µg of dothistromin. Artificially induced lesions developed within 18 h as compared to necrotic flecks which developed during the same time after acetone alone was introduced into similar puncture wounds. Light was required for symptom development.

SCREENING PISUM SATIVUM FOR RESISTANCE TO STEM ROT CAUSED BY RHIZOCTONIA SOLANI. M.A. Shehata and D.W. Davis, Department of Horticultural Science, University of Minnesota, St. Paul, MN 55108; and Neil A. Anderson, Department of Plant Pathology, University of Minnesota, St. Paul, MN 55108.

Attempts to screen Pisum sativum for resistance to both seed- and stem rot caused by Rhizoctonia solani (AG4) resulted in the selection of only lavender colored lines. This past year field and greenhouse tests to obtain stem rot resistance to R. solani has resulted in the selection of 7 lines with disease resistance. Seedlings were inoculated using an infested corn kernel or a 6 mm agar disc on which the fungus had grown. Twenty plants per cultivar replicated three times were used in field tests and 16 plants per cultivar replicated 3 times were tested in the glasshouse experiments. The following pea lines have shown stem rot resistance to R. solani: Dark Skin Perfection, Freezer, Wando, P.I. 257593, 74SN3, 75 MG 90- 102 Bk, and 75 MG 75-89 Bk.

ANATOMY OF ORCHARDGRASS LEAVES INFECTED BY STAGONOSPORA ARENARIA. R. T. Sherwood, USDA, SEA-AR, U.S. Regional Pasture Research Laboratory, University Park, PA 16802.

Stagonospora arenaria penetrated long cells and guard cells via penetration pegs from appressoria or via hyphal wedges between lateral walls. Papillae formed at sites of unsuccessful penetration. Hyphae passed from penetrated cells into the palisade and spongy mesophyll and ramified between cells. Host responses began outside the margin of hyphal growth. Nuclei of adjacent epidermal cells often migrated toward infection centers, plastids enlarged and became amber, and palisade walls separated but retained their contour. An amber gel filled intercellular spaces and surrounded hyphae, and dark deposits and appositions formed inside epidermal walls. The mature "purple leaf spot" was about 1-3 mm diam. Large tan lesions developed on some leaf tips, leaves or plants. They were characterized by early disintegration of plastids, chloroplasts and nuclei, lack of dark amber pigmentation, collapse of mesophyll walls, and egress of hyphae from stomata followed by growth across the surface.

THE INFLUENCE OF SOIL TEMPERATURE AND INOCULUM DENSITY OF PHYTOPHTHORA CINNAMOMI ON ROOT ROT OF FRASER FIR. H. D. Shew and D. M. Benson. Department of Plant Pathology, N. C. State University, Raleigh, 27650.

The interaction of soil temperature and inoculum density on development of Fraser fir root rot was investigated. A steamed sandy loam soil was infested with culturally-produced chlamydospores of P. cinnamomi grown in 10% lima bean extract broth for 2-4 wk at 25C. Fir seedlings (.5 to 3 yr old) were transplanted into infested soils in 10-cm-diameter plastic pots. Seven pots at each inoculum density were maintained at 12,14,16,18,19 and 22C in a constant temperature water bath (± 1C). Pots were equipped with drainage to avoid excess soil moisture. Inoculum densities were .01, .05, .1, .5, and 1 chlamydospore/g (c/g) of soil. Seedling infection and death increased with increasing temperature and inoculum density. Little or no disease occurred at inoculum densities of .01 and .05 c/g of soil at any temperature. At 22C disease incidence was 29,43, and 57% at .1, .5, and 1 c/g of soil, respectively. Infection occurred at 12 and 14C but symptom development was not observed below 15C.

CARRYOVER AND CUMULATIVE EFFECTS OF FOLIAR APPLICATIONS OF BENOMYL TO SOYBEANS. B. J. Shortt, F. D. Tenne, S. R. Foor, and J. B. Sinclair, Dept. of Plant Path., Univ. of Illinois, Urbana IL 61801.

Bonus soybeans were nonsprayed or sprayed with benomyl at 0.6 kg/ha (0.5 lb/A) at mid-pod (R_3-R_4) and 2 weeks later in 1976. Seeds were harvested and then planted in 1977. During the 1977 season plants with nonsprayed or sprayed "parents" were nonsprayed or sprayed as in 1976. Seeds were harvested again and the process repeated in 1978, resulting in seedlots with 8 different spray histories over 3 years. Yields were recorded and seeds assayed on paper blotters or PDA after each season. Sprayed plants had varying increases in yield and seed quality each year which reflected the disease pressure. Seeds produced in 1977 from plants with sprayed "parents" grown in 1976 had a higher germination (86%) than those from plants with nonsprayed "parents" (81%). Percent Phomopsis sp. infection of seeds produced in 1978 from plants with sprayed or nonsprayed "parents" grown in 1977 was 2.3 and 4.6, respectively. The beneficial effects of benomyl sprays tended to be cumulative.

THE INFLUENCE OF VARIOUS ROOT KNOT NEMATODE POPULATIONS ON GENETIC RESISTANCE OF TOMATO TO WILT-FUNGUS. G.S. Sidhu and J.M. Webster, Department of Biological Sciences, Simon Fraser University, Burnaby, B.C., Canada V5A 1S6.

Many studies indicate that infection by root knot nematode (Meloidogyne incognita) induces susceptibility in tomato to the wilt fungus (Fusarium oxysporum lycopersici). The wilt severity, when measured in terms of disease index and propagule count, increases with the increase in nematode number until an optimum level is reached. This level differs in different cultivars possessing identical major genes for wilt resistance. It seems that the different genetic backgrounds affect the levels of nematode infection which induce maximum susceptibility to wilt in the different cultivars.

EFFECTS OF CULTURAL PRACTICES ON ROOT ROT IN SNAP BEANS. M.J. Silbernagel, USDA-SEA/AR, IAREC, P.O. Box 30, Prosser, WA 99350.

Field studies on the interrelationships between host response and cultural practices indicate that the severity of root rot damage (by *Pythium, Rhizoctonia, Fusarium*) is influenced by plant spacing, soil compaction and irrigation frequency. Root rot decreased yields 25%. Decreasing plant competition by wider spacing in narrower spaced rows (using same per acre populations) increased emergence 5-7%. Sub-soiling (18-20" deep) increased plant weights 17%. Rill irrigation every 10 days instead of 5 days, when combined with sub-soiling and narrow row spacing, increased seed yields 15% in root rot soils. The combination of best cultural practices increased seed yields in root rot soils 82% and reduced irrigation needs 40%. By integration of best cultural practices and minimal chemical and biological controls, with available genetic resistance, economically effective disease control should be possible.

EFFECT OF A CHEMICAL MUTAGEN ON CROWN RUST TOLERANCE OF DIPLOID AND TETRAPLOID OATS. M. D. Simons, SEA-AR, USDA, Dept. of Plant Pathology, Iowa State University, Ames, IA 50011.

Lines derived from seed of highly susceptible strains of diploid (Avena strigosa) and tetraploid (A. abyssinica) oats that had been treated with the chemical mutagen EMS (ethyl methanesulfonate) were subjected to severe infection of crown rust (Puccinia coronata) in the field for 2 years. Duplicate plantings of lines derived from both treated and untreated seeds were maintained rust-free with a fungicide. Genetic

variances for yield and seed weight in rust-free control plots were significantly (P = .05) greater than zero in all cases. In most cases, genetic variances for tolerance, as expressed in relative reduction in yield and seed weight attributable to crown rust, were also greater than zero. In both years a few diploid lines were higher in tolerance than the control, but a larger number were lower. A few tetraploid lines were higher in tolerance than the control in one year, but none were higher in the second year, and many were lower in both years.

A NEW SPECIES OF INSECT THAT FEEDS ON ERGOT SCLEROTIA. B. P. Singh, APHIS, USDA, Department of Botany and Plant Pathology, Michigan State University, East Lansing, MI 48824.

A new species of insect which feeds on sclerotia of Claviceps purpurea was found in many locations in Michigan. The insect was first observed in St. Clair County, feeding on sclerotia growing on Triticum aestivum and Secale cereale. Since then, the insect was collected from sclerotia on Agropyron repens at many locations. Most collections were made in June and July. The insect is a small, shiny, dark brown beetle (order, Coleoptera; family, Phalacridae; genus, Acylomus). The species and the life cycle of the beetle are unknown, although tests indicate that the larval and adult stages feed exclusively on ergot sclerotia, consuming large quantities. However, there was no preference for sclerotia produced on any specific host; the beetles from Triticum aestivum fed readily on sclerotia from Agropyron repens. Work in progress includes determination of possible vector relationship, studies on ergosterol relationships, and studies on excretion or detoxification of the alkaloids in sclerotia.

EASTERN DWARF MISTLETOE ON BLACK SPRUCE IN NEWFOUNDLAND. Pritam Singh, Newfoundland Forest Research Centre, Canadian Forestry Service, St. John's, Nfld., Canada.

Eastern dwarf mistletoe, Arceuthobium pusillum Peck, the causal organism of the witches'-broom of black spruce, has been known in Newfoundland since 1954. The parasite has since become widespread and is causing considerable damage in some parts of the island. Although patchy in distribution throughout central and western Newfoundland, the disease is severe in one area, approximately 750 km^2, in western Newfoundland. The parasite was observed in stands varying in age from a few years to 200 years, growing in moist to wet sites with moisture regime of 4 to 6, and with forest capability class of 4 to 7. The severity and impact of the parasite were determined through percent infection (67 to 86), loss in volume through reduction in growth (0 to 20% in height and 0 to 21% in radial growth), tree mortality (20 to 37%), malformation of stems, and reduction in the production of cones (10 to 22%) and seeds (up to 25%). Since the host is the second most important forest tree species in this region, the damage is causing concern to foresters and forest agencies.

EFFECTS OF SOIL FUNGI ON SEED YIELD AND SENESCENCE OF WHITE BEAN. D.W. Sippell and R. Hall, Dept. of Environmental Biology University of Guelph, Guelph, Ontario, N1G 2W1, Canada.

The effects of Fusarium oxysporum (O) at 1000 conidia/ml, Pythium ultimum (P) at 100 sporangia/ml and Fusarium solani f. sp. phaseoli (S) at 500 conidia/ml, singly and in all combinations on seed yield of white beans (cv. Seafarer) in field microplots were examined. Plants were grown singly from seed in 6 l of potting mix in aluminum cans. A split-plot layout was used with 3 replicates per treatment. Within each replicate of 12 plants, 6 plants were derived from seed treated with diazinon (15%), lindane (25%) and captan (15%). Check plants from untreated seeds produced an average of 21.7 g seed. Compared to check plants yields of inoculated plants were reduced 17.5% (O), 30.9% (P), 34.9% (S), 42.4% (O + P), 32.1% (O + S), 51.6% (P + S) and 47.0% (O,P + S). Similar results were obtained from treated seeds. Similar trends were observed in pods/plant and seed weight/pod. Yield reductions were accompanied by increased rates of plant senescence.

DEVELOPMENT OF AN INTERMEDIATE STRAIN OF GREMMENIELLA ABIETINA IN NEW YORK. Darroll D. Skilling, North Cent. For. Exp. Stn., 1992 Folwell Avenue, St. Paul, Minnesota 55108

Immunogenic studies show that the European strain of Scleroderris canker, caused by Gremmeniella abietina (Lagerb.) Morelet is the predominant strain present in pine plantations in northern New York State. The North American strain of G. abietina is occasionally found in this same area. Recent studies have identified an isolate of G. abietina that produces a positive immunogenic reaction against both the North American and European strains. This isolate produces the perfect stage of G. abietina characteristic of the North American strain. It also causes in large pine trees upper crown infection characteristic of the European strain. A possible explanation is field hybridization between North American and European strains. This hybrid would combine the ability of the North American strain to spread rapidly over long distances by wind-disseminated ascospores with the pathogenicity of the European strain. Genetic studies of this intermediate isolate are now in progress.

VIRUSES IN HOP, HUMULUS LUPULUS. C. B. Skotland and W. Kaniewski Irrig. Agric. Res. and Ext. Center, Wash. State Univ., Prosser, WA 99350.

The viruses in hop, Humulus lupulus, cultivars were surveyed using the ELISA technique. Antisera against Prunus necrotic ringspot virus isolated from hop, cherry, apple, and rose; against arabis mosaic isolated from grape and strawberry; and against hop mosaic virus, hop virus 24 and Danish line pattern virus were used. The cherry PNRV, arabis mosaic virus and DLPV were not detected. Two strains of PNRV virus were detected. One strain was found primarily in cultivars of American origin and reacted with antisera to PNRV from hop but not with apple or rose. The other strain of PNRV was found primarily in cultivars of foreign origin and reacted with PNRV antisera from hop, apple and rose. HMV was detected in the majority of the plants indexed of all cultivars. HV 24 was found in some plants of American cultivars but rarely in foreign cultivars. These results show that there are at least two strains of PNRV in hops and that antisera to a given strain of PNRV will not detect all strains.

CHEMICAL CONTROL OF BLACK SIGATOKA ON BANANA FOLIAGE. Walter R. Slabaugh, University of Arkansas, Southeast Research and Extension Center, Monticello, Arkansas 71655.

Wex (Conklin adjuvant) which has shown fungicidal activity against Mycosphaerella fijiensis var difformis was applied alone in water (0.09 to 1.88 l product/ha) and in combination with mancozeb (Dithane M-45-80WP, 1796g a.i./ha), benomyl (Benlate-50WP, 142g a.i./ha) and benomyl-mancozeb emulsions. Nine cycles (10-day intervals) were applied to 0.05 m^2 leaf areas using a spray tower and compared with unsprayed adjacent leaf areas. Disease severity was similar in the unsprayed treatment and adjacent leaf areas. However, disease severity was reduced significantly, from 2.7 to 34.6 %, when Wex concentrations in water sprays exceeded 0.93 l/ha. Benomyl, mancozeb and benomyl-mancozeb emulsions reduced disease severity 45.0, 61.5, and 68.2 %, respectively. However, the addition of Wex (0.93 l/ha) to benomyl and mancozeb emulsions reduced disease severity 66.9 and 91.1 %, respectively, suggesting a synergistic response.

IDENTIFICATION OF AN UNUSUAL STRAIN OF POTATO VIRUS S IN NORTH AMERICA. S. A. Slack, Dept. of Plant Pathology, University of Wisconsin-Madison, Madison, WI 53706.

The strains of potato virus S (PVS) found in North America and Europe cause a local infection in Chenopodium quinoa which is characterized by chlorotic lesions 8-12 days post-inoculation. I have recovered an aphid-transmissible strain of PVS from Solanum tuberosum L. 'Red LaSoda', however, which invades C. quinoa systemically after inducing the typical local lesion response. When 10 aphids per test plant were used, the rate of nonpersistent transmission by Myzus persicae was about 10% (7/69) from potato to potato and 13% (3/23) from C. quinoa to C. quinoa. The same strain of PVS was recovered when 'Red LaSoda' sources from Minnesota, Nebraska, North Dakota and Wisconsin were indexed. The virus was determined to be PVS on the basis of particle morphology and serological reactions. This strain of PVS conforms to an Andean strain of PVS reported from Europe (Potato Res. 16:244).

BACTERIOCIN PRODUCTION IN VITRO AND IN PLANTS BY STRAINS OF PSEUDOMONAS SYRINGAE. Mary Smidt and Anne K. Vidaver, Dept. of Plant Pathology, Univ. of Nebraska, Lincoln, NE 68583.

Pseudomonas syringae strain PsW-1 produces the bacteriocin W-1 in broth cultures. Accumulation of W-1 is enhanced by treatment of log-phase cultures with mitomycin C. W-1 has been purified from culture media of mitomycin C treated PsW-1 by gel filtration, ion exchange chromatography, and buoyant density centrifugation. Electron micrographs reveal the purified bacteriocin is a rod-shaped particle about 75 nm long and 20 nm wide, and

is composed of an outer sheath and inner core. The sensitivity of certain Pseudomonas syringae strains to W-1 and other bacteriocins produced by closely related strains has been tested in vitro and in Red Kidney beans and cowpeas.

CHANGES IN VESSEL MORPHOLOGY IN CERATOCYSTIS ULMI-INOCULATED AND GLYCOPROTEIN-TREATED ELMS. Joseph L. Smilanick and Penelope Hanchey. Dept. of Botany & Plant Pathology, Colorado State University, Fort Collins, Colo. 80523

One year old seedlings of Ulmus americana and U. plumila were inoculated with spore suspensions of Ceratocystis ulmi and examined by scanning electron microscopy. U. americana had large numbers of tyloses after one month and a thick amorphous material coating the vessel walls. Similar changes were found in field-collected stems of diseased U. americana. These changes were not found in U. plumila, although C. ulmi was recovered from throughout the stem. Eighteen month old seedlings were given uptakes of a 1000ppm solution of dextran (MW $2x10^5$-$3x10^5$) or partially-purified glycoproteins from C. ulmi culture filtrates. One week after either treatment, leaves of both species were cupped and necrotic from the margins inward. U. americana, but not U. plumila, contained tyloses and vessel walls coated with material similar to that found in inoculated seedlings. These results suggest that macromolecular products of the pathogen may contribute to changes in vessel morphology in diseased elms.

CHEMICAL CONTROL OF PHYTOPHTHORA ROOT AND CROWN ROT OF PETUNIA. Larry D. Smith, Plant & Soil Science Dept., Box 5102, Tenn. Tech Univ., Cookeville, TN 38501.

Three rates of Subdue 5W (.12, .25 and .50 oz ai/100 gal water) and one rate of Benlate 50W (16 oz ai/100 gal water) were applied as soil drenches to Petunia hybrida plants which had been inoculated with P. parasitica. Disease ratings were made by estimating the percent necrosis in the cross-sectioned area of the root or crown showing the greatest amount of rotted tissue. Mean ratings were: inoculated control-93.88%, Benlate-76.62%, Subdue .12-55.02%, Subdue .25-47.28%, Subdue .50-18.52%, and uninoculated control-10.00%. Disease ratings following Benlate treatments were not significantly different from those of the inoculated control. Ratings for the Subdue .50 were not significantly different from those of the uninoculated controls. No phytotoxicity was observed in any of the treated plants.

CHEMICAL CONTROL OF STORAGE DECAY OF BARE-ROOT TREES. Larry D. Smith, Plant and Soil Science Dept., Tenn. Tech. Univ., Cookeville, TN 38501.

Cold winter storage of bare-root trees is a common practice of the nursery industry. Conditions of storage are typically 1-4° C, 90-98% RH, with trees stacked tightly in racks in a poorly lighted shed. Under these conditions decay of roots and stems causes considerable losses in the quantity and quality of trees that can be sold. Studies of decaying bare-root trees revealed that Penicillium, Tricothecium, Botrytis and Alternaria are prevalent along with numerous types of soil-borne bacteria and other fungi. During a three month period, decay of Prunus persica 'Reliance' was reduced with fungicide dips of the trees prior to storage. Benlate 50W (1/2 lb), Captan 50W (2lb), Kocide 50W (2lb), and Dithane M-22 80W (2lb) were used alone and in combination with an anti-transpirant, Vapor-Gard, in 100 gal of water as fungicide dips. All treatments were effective in reducing the amount of storage decay.

SCREENING WOODY ORNAMENTAL CUTTINGS FOR RESISTANCE TO PROPAGATION DISEASE. Mary Ann Lila Smith and Dan Neely, Dept. of Plant Pathology, University of Illinois, Urbana, IL 61801.

During the mist propagation of woody ornamentals, cuttings are particularly susceptible to attack by fungal pathogens. Very little research has focused on specific cutting-pathogen interactions under mist. Cuttings from 16 woody ornamental species were evaluated under intermittent mist for resistance to 3 genera of cutting-rot pathogens: Pythium spp., Phytophthora spp., and Rhizoctonia spp. Sample cutting lots were inoculated with combined isolates from each fungal genus, and inserted into two media types--sand and peat:perlite. Biweekly observations of symptom and root development were made on each treatment for 10 weeks. Weighed ratings of symptom severity were collected, and incidence of surviving infected cuttings was noted. Severe disease losses resulted in 39 of the 96 cutting/pathogen/media treatment combinations. Moderate damage occurred in 26 treatments, and minor infection was noted in 18 treatments. In 13 treatment combinations, the cuttings showed trace amounts of damage or were nonhosts.

DRECHSLERA CATENARIA, THE CAUSE OF LEAF BLIGHT AND CROWN ROT OF AGROSTIS PALUSTRIS 'TORONTO'. Douglas A. Spilker and P.O. Larsen. Department of Plant Pathology, The Ohio State University, Columbus, OH 43210 and OARDC, Wooster, OH 44691.

A new disease of creeping bentgrass caused by Drechslera catenaria is reported. The fungus, originally isolated from 'Toronto' creeping bentgrass, caused severe blight of all cultivars of colonial and creeping bentgrass that were artificially inoculated. D. catenaria caused reddish-brown necrotic lessions or "flecking" of tall fescue, red fescue and perennial ryegrass. Kentucky bluegrass cultivars were unaffected. Conidia are thin-walled, obclavate with hemiellipsoidal basal cells and are produced in chains in culture on lactose casein hydrolysate medium in light. A yellow-orange pigment diffused from colony on sucrose proline agar at 15 C in the dark. Conidia germinated mroe rapidly at 25 C than at 15 or 20 C on water agar. However, nearly all conidia germinated after about 2 hr at all temperatures tested. Appressorium formation occurred within 24 hr on detached leaves and penetration occurred between cells and through stomata.

SUBCELLULAR LOCALIZATION AND PARTIAL CHARACTERIZATION OF ICE NUCLEATION ACTIVITY OF PSEUDOMONAS SYRINGAE AND ERWINIA HERBICOLA. M.L. Sprang, S.E. Lindow, Dept. of Plant Pathology, University of California, Berkeley, CA 94720.

The ice nucleation activity of Pseudomonas syringae and Erwinia herbicola was associated with the total membrane fraction following sonication of lysozyme digested cells. Inner and outer membranes were separated by differential centrifugation for 3 min at 40,000g in 10mM Mg-10mM KPO_4, pH 7.0 buffer. For P. syringae, 80% of the total 2-keto-3-deoxyoctonate (KDO), an outer membrane marker, and 10% of the total NADH dehydrogenase activity, an inner membrane marker, were found in the supernatant. The pellet, predominately inner membrane, contained 20% of the KDO and 90% of the NADH dehydrogenase activity. Further resolution of these fractions was obtained by sedimentation through a sucrose gradient. The ice nucleation activity, 80% of the total activity, purified with the outer membrane. A similar fractionation of the ice nucleation activity was observed for E. herbicola. Outer membrane ice nucleation activity was sensitive to heat, 2-mercaptoethanol, protease and sodium dodecyl sulfate.

EFFECT OF COMPOSTED HARDWOOD BARK ON DAMPING OFF OF APPLE SEEDLINGS INOCULATED WITH PHYTOPHTHORA CACTORUM. D. E. Spring, M. A. Ellis, and R. A. Spotts, first and second authors, Dept. of Plant Pathology, Ohio Agricultural Research and Development Center, Wooster 44691, third author, Oregon State University, Mid-Columbia Experiment Station, Hood River 97031.

Three-week-old apple seedlings were transplanted into pots filled with either a peat-perlite-sand mixture (2:1:1 v/v) or a bark compost-peat-perlite-sand mixture (5:2:2:1 v/v). Seedlings were then inoculated with several concentrations of Phytophthora cactorum zoospores or oospores in each container medium. Seedling kill in both container media increased with increasing inoculum levels, but always remained significantly lower in bark compost than in peat. The effect of aqueous bark compost and peat leachates on P. cactorum zoospore germination and sporangium production was also studied. Zoospore germination and sporangium production were significantly lower in leachates from bark compost than in leachates from peat. Results indicate that composted hardwood bark may have potential for biological control of apple collar rot.

D'ANJOU PEAR DECAY CAUSED BY A LOW TEMPERATURE BASIDIOMYCETE. R. A. Spotts and B. B. Peters, OSU Mid-Columbia Experiment Station, Hood River, OR 97031; and J. A. Traquair, Agriculture Canada Research Station, Lethbridge, Alberta T1J 4B1.

In 1979, a Coprinus sp. caused significant loss of controlled atmosphere-stored d'Anjou pears in Hood River, Oregon. Fruit lesions were firm, circular, and sunken with dark brown borders and lighter brown centers. Lesion diameter ranged from 0.5 to 25 mm, and number of lesions per fruit ranged from 1 to 20. White, raised mycelium covered fruit surface, wraps, and trays. Maximum mycelial growth was at 10 C. Attempts to induce sporulation failed. Decay occurred in inoculated Golden Delicious, Rome Beauty, and Delicious apple fruit at -1 C. Thirty-three fungicides were tested in vitro, and sterol inhibitors and

dithiocarbamates at 10 ppm reduced mycelial growth. Ziram, applied to trees 10 days before harvest, provided significant control. This is the first report of pear decay caused by a basidiomycete.

SEEDLING DISEASE RESPONSE NOT A GOOD INDICATION OF ADULT PLANT SUSCEPTIBILITY TO HELMINTHOSPORIUM ROOT ROT. R. W. Stack. North Dakota State University, Fargo, ND 58105.

In many diseases, screening of seedlings is a useful method to assess resistance. Wheat seedlings show heritable responses to infection by Helminthosporium sativum when tested under controlled conditions. Unfortunately, these responses do not correspond to the reactions of adult plants. One possible reason for this discrepancy is that the controlled environments fail to adequately measure field response. We tested seedling response in the field to see if it would better indicate adult plant susceptibility Three experiments were done using wheats of different adult susceptibility. Plots had uniformly high natural levels of inoculum. Disease response was determined by sub-crown internode indexing. There were 7, 10, and 13 cultivars in the three experiments. Relative disease levels of cultivars at seedling and at adult stages were not correlated ($r = -0.24$, $r = 0.15$, $r = 0.21$, respectively). It appears growing conditions alone are not responsible for differences between heritable seedling responses and adult plant responses of wheat to H. satium.

POPULATION TRENDS OF PSEUDOMONAS PHASEOLICOLA IN TOLERANT AND SUSCEPTIBLE BEAN GENOTYPES S. J. Stadt and A. W. Saettler, Department of Botany and Plant Pathology, Michigan State Univ., and USDA, SEA-AR, E. Lansing, MI 48824.

Pseudomonas phaseolicola (Pp, bean halo blight) growth was studied following inoculation of susceptible Charlevoix and tolerant Montcalm and Seafarer seedlings with rifampin resistant Pp R13 (Phytopath. 68:778). Total populations were determined on 1st, 3rd, and 5th trifoliolates and surface populations on 3rd trifoliolates. Dilutions of ground (total) and rinsed (surface) leaves were plated on Kings Medium B containing 50 ppm each of rifampin and cycloheximide. Pp R13 grew exponentially and remained at high stationary phase levels up to 15 days on all leaves of Charlevoix; on 3rd trifoliolates, 28% of the total population was surface-borne. Lower Pp R13 populations were found in leaves of Montcalm cv. and 5% was surface-borne. Seafarer cv. supported slightly higher Pp R13 populations than Montcalm, and 8% of the total was surface-borne. Tolerant bean cvs. may serve as symptomless carriers of Pp and secondary spread may occur prior to visible symptom development.

POPULATION DYNAMICS OF SELECTED SOIL MICROORGANISMS FOLLOWING SOIL SOLARIZATION. J. J. Stapleton and J. E. DeVay, Department of Plant Pathology, Univ. of California, Davis, CA 95616

Fallowed soil at 2 locations in the San Joaquin Valley, CA was irrigated and tarped with 1 mil polyethylene sheeting during July, 1979. Soil temperature reached 49 C at 15 cm depth during the 4-week treatment period. Following removal of the plastic sheeting, populations of selected microorganisms in tarped and untarped soil were periodically estimated at 3 depths (0-15, 15-30, 30-46 cm) using selective media. Significant initial overall reductions in tarped soil were noted for "total" fungi (84%, 90%), "total" gram-positive bacteria (69%, 84%), fluorescent pseudomonads (94%, 96%), and Agrobacterium spp. (98%, 98%). "Total" actinomycetes reacted differently at the two sites (+26%, -55%). No significant difference was detected for "total" thermophilic/thermotolerant fungi. Further changes in microbial populations during the 12-month period following the treatment will be discussed.

CURRENT STATUS OF THE NORTH CAROLINA NEMATODE ADVISORY SERVICE. J. L. Starr, Agronomic Div., NCDA, Raleigh 27611.

The numbers of samples received by the N. C. Nematode Advisory Service increased by 512% from FY 1974-75 to FY 1979-80. Growers utilizing the services have increased 212% over the same period, with an increase in the average number of samples/grower. An estimated 31% of the growers used the nematode assay service more than once during this period; exlusive of growers participating in structured integrated pest management (IPM) programs. During FY 1979-80 31% of the samples submitted were for corn as the crop to be planted, soybeans 22%, tobacco 21%, peanuts 7% and vegetables 5.5%. Assays from 13 Coastal Plain counties indicated that 39% of the corn samples had a moderate nematode-hazard level and 7% were in the high hazard category, tobacco had 15% in the moderate and 29% in the high hazard categories, for soybeans 30% and 31% were in the moderate and high hazard categories, respectively. Structured IPM programs submitted 2235 samples during the past year; numbers of samples from IPM programs is expected to increase substantially over the next several years.

EVIDENCE FOR THE MECHANISM OF IMMUNITY OF PSEUDOMONAS SYRINGAE PV. PHASEOLICOLA TO PHASEOLOTOXIN. B. J. Staskawicz and N. J. Panopoulos, Dept. of Plant Pathology, University of California, Berkeley 94720, and N. J. Hoogenraad, Dept. of Biochemistry, La Trobe University, Bundoora, Victoria 3083, Australia.

Cell-free extracts from phaseolotoxin-producing strains of P. s. phaseolicola grown at 18 C, the optimum temperature for phaseolotoxin production, contain OCTase activity that is insensitive to phaseolotoxin. Extracts from the same strains grown at 30 C, a temperature at which little or no detectable phaseolotoxin is produced, and from phaseolotoxin-nonproducing strains, contain phaseolotoxin-sensitive OCTase activity. The phaseolotoxin-insensitive OCTase activity is also less sensitive to N^{δ}-(phosphonacetyl)-L-ornithine than the phaseolotoxin-sensitive OCTase activity of the corresponding strain. The occurrence and properties of this phaseolotoxin-insensitive OCTase suggest that it plays a key role in the mechanism by which toxigenic strains of P. s. phaseolicola are immune to their own toxin.

GENETIC AND MOLECULAR CHARACTERIZATION OF AN INDIGENOUS CONJUGATIVE PLASMID IN THE BEAN WILDFIRE STRAIN OF PSEUDOMONAS SYRINGAE PV. TABACI. B. J. Staskawicz, M. Sato, and N. J. Panopoulos, Dept. of Plant Pathology, Univ. of California, Berkeley 94720.

Pseudomonas syringae pv. tabaci, strain BR-2 , causes the bean disease known as bean wildfire. The presence of a single plasmid (pBW) of ca. 30×10^6 daltons has been detected in this strain. To ascertain whether this plasmid was conjugative, $MgCl_2$ treated-heat shocked cells of BR-2 were transformed by the non-conjugative plasmid RSF1010 (5.5×10^6 daltons) which encodes for streptomycin and sulfonamide resistance. The newly constructed strain BR-2 (RSF1010) was then mated with Escherichia coli SK-1592 to test its ability to mobilize the non-conjugative plasmid RSF1010. Presumptive transconjugants were isolated and confirmed by agarose gel electrophoresis. A restriction endonuclease map of pBW has been constructed and attempts to introduce the transposon Tn7 onto this plasmid have been successful allowing us to genetically dissect this plasmid for its possible involvement in tabtoxin production, tabtoxin immunity, pathogenicity and fertility functions.

HYBRIDIZATION OF MELAMPSORA LINI FOR SELECTIVE PATHOGENICITY. Glen D. Statler. Department of Plant Pathology; North Dakota State University; P.O. Box 5012; Fargo, ND 58105

Races of Melampsora lini with specific virulence patterns were crossed and selfed to produce cultures to identify combinations of host genes L^{11}, M^3, M^6 and P^3. Nine cultures were developed which would identify one, two, or three gene combinations for resistance to M. lini in flax. These cultures possess virulence on additional host genes, therefore, they can be used to test host gene combinations of L^{11}, M^3, M^6 and P^3 even if other genes are present. This system effectively identifies the above genes when the genes of the parents are known. The manipulation of M. lini through hybridization provided cultures with selective pathogenicity to identify combinations of the above genes. Two cultures currently are being used by North Dakota State University and USDA flax breeding programs to identify host genes M^3 and P^3 in advanced breeding lines.

IDENTIFICATION OF PHYSIOLOGIC RACES OF BEAN RUST IN WESTERN NEBRASKA AND NORTHEASTERN COLORADO. J.R. Steadman, J.V. Cordoba and D.T. Lindgren, Depts. of Pl. Path. and Hort., Univ. of Nebr. Lincoln, NE 68583.

Five methods of inoculation were evaluated; a mixture of talc and urediospores applied with an atomizer to wetted bean leaves was the most effective. Five isolates of Uromyces phaseoli typica from western Nebraska and one isolate from northeastern Colorado were derived from single pustules, increased, and inoculated to the seven Harter and Zaumeyer (1941) differential bean cultivars plus Golden Gate Wax. The grading system of Davison and Vaughan (1963) was used in all cases. At least one

physiologic race, race 25, was confirmed in the Nebraska isolates. Race 20 or a new race also may be present in Nebraska. Difficulty in separating grades, especially 4 and 5, with a printed rust grading guide or using an ocular micrometer made race identification difficult. The standard differential cultivars and grade scales are not adequate for rust race differentiation. More cultivars and fewer grades are advocated.

PATHOGENICITY AND TOXIN PRODUCTION IN VIVO AND IN VITRO BY FUSARIA FROM CORN. T. C. Stebbins, L. P. Hart, and R. P. Scheffer, Department of Botany and Plant Pathology, Michigan State University, East Lansing, MI 48824.

Five randomly-selected isolates of Fusarium roseum from corn stalks were pathogenic to corn seedlings. The 5 isolates were used to inoculate young ears of 12 corn hybrids in the field; the hybrids were approximately equal in susceptibility to each of the isolates. Piglets refused to eat the infected grain. The grain was then extracted and analyzed for zearalenone and vomitoxin by use of thin-layer chromatography and gas chromatography-mass sepctroscopy. Grain infected by each isolate contained both mycotoxins. The 5 isolates were grown in a modified Fries solution; filtrates of all cultures contained both mycotoxins. Swine refused palatable grain and mice refused water after culture filtrates were added. A sixth isolate of F. roseum (from grain) was not pathogenic to corn but produced both mycotoxins in culture. Six randomly-selected isolates of F. moniliforme caused no visible infections in young ears, but were mildly pathogenic to seedlings.

DISTRIBUTION AND RETENTION OF ARBOTECT 20-S IN TREATED AMERICAN ELMS. Mark A. Stennes and D.W. French. Department of Plant Pathology, University of Minnesota, St. Paul, MN 55108.

Mature American elms (Ulmus americana) naturally infected with Ceratocystis ulmi and injected therapeutically in 1977 or 1978 with Arbotect 20-S were repeatedly bioassayed for three seasons after injection to determine distribution and persistence of fungitoxicant in newly formed wood. Two dosage rates equal to 3 and 4.8 times the therapy label rate were injected into exposed root flares with one injection site per 1.3 cm of trunk dia. Sixteen to 32 samples per tree were used to determine chemical distribution by bioassaying with C. ulmi. The samples (8 mm dia) were taken randomly from fully foliated branches in the periphery of the crown. The 3X rate provided 90 to 100% distribution between one and 12 months after treatment but distribution declined to 50% after 26 months. The 4.8X rate provided 95 to 100% distribution after 25 months.

SOURCE AND MODE OF INFESTATION OF DAMPING-OFF PATHOGENS IN A BEDDING PLANT GREENHOUSE. Christine Taylor Stephens, L.J. Herr, and A.F. Schmitthenner. Department of Botany and Plant Pathology Michigan State University, East Lansing, MI 48824, and the Ohio Agricultural Research and Development Center, Wooster, 44691

Dust and debris samples from pasteurized soils, recycled flats, greenhouse walkways, and a porous concrete floor were assayed using the beet seed colonization method to determine locations of introduced damping-off pathogens. Pythium spp. were isolated from 12.5% of pasteurized soil batches and from 30% of recycled flats, were recovered on 5 of 8 sampling dates from greenhouse walkways, and colonized 53% of beet seeds incubated in soil samples extracted from porous concrete. Rhizoctonia solani was recovered from 10% of the recycled flats, on 6 of 8 sampling dates from greenhouse walkways, and colonized 11% of beet seeds incubated in soil samples extracted from porous concrete. When greenhouse dust samples known from previous assays to contain R. solani and Pythium spp. were sprinkled over emerging seedlings, damping-off appeared in all treated flats after 6 days. A large reservoir of damping-off inoculum apparently exists in greenhouses.

ARGININE AMINOPEPTIDASE ACTIVITY OF CORN STUNT SPIROPLASMA AND SPIROPLASMA CITRI. C. Stevens, R. M. Cody, and R. T. Gudauskas, Dept. Botany, Plant Pathology, and Microbiology, Auburn Univ., Auburn, AL 36830

Corn stunt spiroplasma (CSS) and Spiroplasma citri hydrolized arginine-β-naphthylamide to arginine and β-naphthylamine (β-NA), as determined by the fluorometric method. When a 0.5 ml suspension of washed, concentrated cells was added to substrate in 0.1 M Tris-HCl, 16% sucrose buffer at pH 7.5 and incubated at 30 C, S. citri cultures released 18 X 10^{-7} mmole/ml/min β-NA while CSS released 2.9 X 10^{-7}. Growing CSS in the presence of 47 mM arginine resulted in a two-fold reduction in aminopeptidase activity. Results of these experiments suggest a possible biochemical basis for pathogenicity of spiroplasmas.

RELATION OF MAIZE DWARF MOSAIC VIRUS INFECTION TO INOCULUM POTENTIAL OF HELMINTHOSPORIUM MAYDIS. C. Stevens and R. T. Gudauskas, Dept. Botany, Plant Pathology, and Microbiology, Auburn Univ., Auburn, AL 36830

Conidia of Helminthosporium maydis race O produced in lesions on maize dwarf mosaic virus (MDMV)-infected corn leaves were compared with those produced on virus-free leaves. Sporulation began sooner and was more abundant in lesions on MDMV-infected leaves. Conidia from these lesions on the average were 24% longer, contained two more pseudosepta, and produced two-fold more lesions and 60% larger lesions when inoculated onto healthy corn seedlings than did conidia from lesions on virus-free leaves. This enhancement of inoculum potential was associated with increased levels of electrolytes, total carbohydrates, and orcinol- and ninhydrin-positive substances in leachates and washings from MDMV-infected leaves.

THE PATTERN OF PYROANTIMONATE DEPOSITIONS IN RHIZOCTONIA SOLANI-INFECTED BEAN HYPOCOTYLS. Virginia Stockwell and Penelope Hanchey. Dept. of Botany & Plant Path., Colo. State Univ., Fort Collins, CO 80523.

Cations were localized in Rhizoctonia solani-infected and noninoculated hypocotyls of beans (Phaseolus vulgaris, L.,) using potassium pyroantimonate (PPA). Tissues including young to mature lesions were compared with noninoculated (8 or 24 day old) control tissues. Electron-dense granules were found in the middle lamella of both infected and control tissues corresponding with regions that stained with ruthenium red. Walls of 24 day old controls contained more granules than 8 day old controls. No difference was found in granule patterns in diseased and healthy cell walls; however, deposits were also present on lesion cell membranes. Treatment of sections with 5 mM EDTA or EGTA removed all granules from walls of young control tissues. Granules were chelated from membranes in the lesion and walls distal to the lesion. However, they remained in swollen cell walls of inoculated tissue. The location of the granules and the effects of chelators suggest that they contain calcium.

GROWTH OF RACES OF PHYTOPHTHORA MEGASPERMA VAR. SOJAE IN SOYBEAN HYPOCOTYL TISSUE. Stössel, P., G. Lazarovits and E.W.B. Ward. Agriculture Canada, Research Institute, University Sub P.O., London, Ontario, N6A 5B7

Six-day old soybean hypocotyls were inoculated at the top and the bottom with P. megasperma var. sojae race 6 (compatible) and race 4 (incompatible). At the top hyphal growth was equally dense in the first few cell layers but race 4 hyphae decreased rapidly while those of race 6 became more abundant in deeper layers. Race 6 produced haustoria more frequently than did race 4. Race 6-produced haustoria were usually encased by extrahaustorial matrix and wall apposition but those of race 4 were not. Wall deposits marked attempted cell invasion by both races. Host cell plasmolysis was more extensive with race 6 than with race 4. At the bottom, growth was more restricted. Race 6 produced few haustoria, usually not encased; numerous host cells were plasmolysed. Race 4 did not form any haustoria; the epidermis became necrotic, while cells underneath remained intact.

COMPARATIVE DEVELOPMENT OF FUSARIUM ROSEUM ISOLATES IN ROOTS OF RED CLOVER. J. C. Stutz and K. T. Leath. Department of Plant Pathology, Pennsylvania State University and U.S. Regional Pasture Research Laboratory, USDA, SEA-AR, University Park,PA 16802

Penetration, hyphal growth, and induction of necrosis by several isolates of Fusarium roseum 'Acuminatum' were compared in roots of red clover. The biological activities of filtrates of solutions from cultures of the fungi on sterile roots were assayed. All pathogenic isolates penetrated intracellularly into epidermal cells. Runner hyphae grew intercellularly in the root cortex. Isolates differed in rates of epidermal penetration, and mesophyll colonization, and in their response to wounding of the root. The most virulent isolate penetrated and proliferated through the root tissue more rapidly than isolates of less virulence. Measurements of necrosis and hyphal growth in roots showed that necrosis did not extend beyond hyphal development with any of the isolates. Biological activities of culture filtrates were not different regardless of virulence differences among the isolates.

SYMPTOMS OF BACTERIAL LEAF SPOT OF MARIGOLD. D. J. Styer and R. D. Durbin, Dept. of Plant Pathology and Plant Disease Resistance Research Unit, AR, SEA, USDA, University of Wisconsin-Madison, Madison, WI 53706.

Pseudomonas tagetis has been reported to cause necrotic leaf spots sometimes accompanied by apical chlorosis. Recently we observed two additional symptoms: necrotic leaf spots with chlorotic halos (0.5-1 cm dia) and apical chlorosis without leaf spots. Chlorotic halos were seen on many cultivars, but only on young plants. Tall American cultivars (Tagetes erecta), which grow vegetatively throughout the season, generally have more leaf spots and chlorotic apices than dwarf American or French cultivars (T. patula) which, by contrast, have only a short vegetative growth period. Since symptoms occur only on new growth, the period of vegetative growth is critical for symptom expression; susceptible cultivars inoculated when the plants are mature do not exhibit symptoms. No internal symptoms were evident in plants with symptoms, although the bacteria can be isolated from the stem.

PRODUCTION OF NEUROTOXIN IN ANNUAL RYEGRASS PARASITIZED BY ANGUINA AGROSTIS AND CORYNEBACTERIUM RATHAYI. B.A. Stynes and A.F. Bird. Plant Pathology Branch, Department of Agriculture, Jarrah Road, South Perth, Western Australia, 6151, and CSIRO, Institute of Biological Resources, Division of Horticultural Research, GPO Box 350, Adelaide, South Australia, 5001.

Mature annual ryegrass (Lolium rigidum) pastures in southern Australia produce a neurotoxin that induces ataxia, convulsions, and death in grazing animals. Such pastures contain seed galls induces by Anguina agrostis, some of which become colonized by Corynebacterium rathayi. Comparison of plant and organism components of galls containing nematodes with those colonized by bacteria showed that the toxin was produced only in galls colonized by bacteria and was concentrated in the walls of those galls. Nematodes and secondary organisms other than C. rathayi were not essential for production of toxin in a cell culture of endosperm from L. multiflorum. However, failure to produce the toxin by growing the bacteria on artificial media suggests a dependence on living plant cells. The walls of galls colonized by bacteria were thinner than those containing nematodes. Particles 25-30 nm in diameter were abundant in the walls of these galls and were closely associated with the bacteria and their capsules. Because these particles are also found in bacterial cultures, their involvement is uncertain, but their distribution corresponds with that of the toxin.

TILLAGE PRACTICES, POPULATIONS OF SOIL FUNGI, AND ROOT DISEASES IN IRRIGATED, MULTIPLE-CROPPING SEQUENCES. Donald R. Sumner, E. D. Threadgill, C. C. Dowler, S. C. Phatak, D. Smittle, J. Young, G. A. Mitchell, and A. W. Johnson, Coastal Plain Experiment Station, Tifton, Georgia 31794.

Four or five successive agronomic and horticultural crops were grown two years in nine irrigated, multiple-cropping sequences with five tillage practices: (i) deep-turned with a moldboard plow 25-30 cm deep (DT), (ii) disk-harrowed 15 cm deep, (iii) subsoiled under the row 40 cm deep (SS) and planted, (iv) SS and bedded, and (v) chiseled 20-25 cm deep at 30 cm intervals across the beds. Populations of soil fungi in 15 cm of topsoil were assayed 15 times and root disease severity (RDS) was recorded in 33 crops. Burying crop debris by DT reduced RDS or post-emergence damping-off in one or more crops of lima bean, southern pea, snapbean, and corn; but not in squash, cucumber, tomato, turnip, spinach, grain sorghum, or soybean. Populations of Rhizoctonia solani (primarily AG-4) in soil were reduced by DT in 5 samplings, compared with other tillage treatments, but tillage practices rarely influenced populations of other fungi.

MULTIPLICATION OF PSEUDOMONAS GLYCINEA ON SOYBEAN LEAVES EXPOSED TO AEROSOLIZED INOCULUM. G. Surico, B.W. Kennedy, and G.L. Ercolani, Instituto di Microbiologia Agraria e Tecnica, Universita degli Studi, 70126 Bari, Italy.

An aerosol generated from a suspension of Pseudomonas glycinea was admitted into a stirred-settling aerosol chamber containing potted Acme soybean plants with young unifoliolate leaves. On leaves wetted gently with atomized water before exposure to aerosol and kept at 20 C without further wetting after exposure, epiphytic populations averaged 3.2, 1 X 10^3, and 1 X 10^4 CFU/cm^2 on leaves upon removal of plants from the aerosol chamber and after 9 and 14 days, respectively. Infection did not occur, but bacterial blight lesions developed consistently in 5-6 days on leaves that were wounded and wetted or watersoaked and wetted before exposure to aerosol. Interposition of an interval of up to 48 hr between watersoaking and exposure did not prevent infection if the leaves were gently wetted again immediately before exposure to aerosol.

INTERACTIONS OF GROWTH-PROMOTING RHIZOBACTERIA WITH DELETERIOUS RHIZOSPHERE BACTERIA AND FUNGI. T. V. Suslow and M. N. Schroth, Dept. of Plant Pathology, Univ. of California, Berkeley 94720.

The effectiveness of plant-growth-promoting rhizobacteria (PGPR) was associated with significant reductions in root colonization by deleterious rhizosphere bacteria and fungi. Reductions in total root colonizing fungi ranged from 21% to 72% ($P = 0.05$ or 0.01) on roots from PGPR treated plants. Species of Fusarium, Penicillium, Aspergillus, Cladosporium, and Trichoderma were the predominant fungi on roots of seedling sugar beets on both untreated controls and PGPR treated plants. The percentage of total colonization of each of these fungi was affected differently by specific PGPR strains. PGPR also decreased root colonization by deleterious rhizobacteria (DR) that caused reductions in fresh weight of sugar beet shoots and in root length ranging from 21% to 49% ($P = 0.05$ or 0.01) in greenhouse trials. DR included both gram-positive and gram-negative strains of Azotobacter, Enterobacter, Klebsiella, Pseudomonas, and several unidentified strains. PGPR seed treatment significantly increased sugar beet seedling growth as compared to DR treated controls.

SIROCOCCUS STROBILINUS:SEED-BORNE ON SPRUCE. J.R. Sutherland and W. Lock. Can. Forest. Serv., Victoria, B.C. V8Z 1M5.

Sirococcus blight affects specific Picea seedlots in B.C. container nurseries, suggesting a seed-borne disease. Accordingly, seedlots with positive (DP) or negative (DN) disease histories were assayed for the pathogen. In the first assay, five replicates of 100 seeds each from 21 DP and six DN seedlots were stratified then germinated either on moist blotting paper or in soil mix. For the second assay, 500 unstratified seeds from each of 12 Sirococcus-infested (determined from preceding experiment) seedlots were surface sterilized with 0.5% NaOCl for 5 min or 30% H_2O_2 for 30 min, and plated onto water agar. In both assays blight-affected germinants were recorded for 8 weeks. The pathogen was not detected in the blotting paper assay, but 57% of the DP seedlots yielded S. strobilinus in the soil mix assay. The pathogen was detected in 75 and 33% of the Sirococcus-infested seedlots in the H_2O_2 and NaOCl treatments, respectively. DN seedlots never yielded the pathogen.

CONIDIAL GERMINATION OF PERONOSPORA TABACINA ADAM. A. M. Svircev and W. E. McKeen, Plant Sciences Department, The University of Western Ontario, London, Ontario, Canada N6A 5B7.

Temperature, humidity and light play a key role in the development of Peronospora tabacina in the tobacco plant. The conidia of this obligate parasite germinate in a temperature range from 0 to 35 C. The optimum temperature is 15 to 20 C. Varying intensities of artificial light have no effect on the total percent germination. However the conidia are markedly affected by ultra violet irradiation. The influence of ultra violet on the germination of conidia is modified by temperature and humidity. We have demonstrated the influence of temperature, humidity and light on the germination of P. tabacina conidia. The response of our isolate of P. tabacina is different to that reported by other investigators.

FUNGI ASSOCIATED WITH CANKERS OF GREENHOUSE ROSES AND THEIR CONTROL. L.E. Sweets, F.L. Pfleger, F.C. Morgan, Department of Plant Pathology, University of Minnesota, St. Paul, MN 55108; and J.R. Mizicko, FMC Corporation, Box 2508, El Macero, CA 95618.

Attempts to establish pathogenicity of fungi isolated from rose canes on the rose cultivars Belinda and Golden Fantasy were unsuccessful with Alternaria alternata and Pestalotia palmarum. Botryodiplodia theobromae, Botrytis cinerea, Coniothyrium fuckelii, and Trichothecium roseum caused cankers on both cultivars, and Golden Fantasy was more susceptible to all fungi except Botryodiplodia theobromae. On Golden Fantasy, benomyl applied as a spray restricted canker development caused by Botryodiplodia theobromae, Botrytis cinerea, C. fuckelii, and T. roseum whereas on Belinda the fungicide was effective only on T. roseum. A chlorothalonil spray restricted canker development caused by Botrytis cinerea and T. roseum on Golden Fantasy, but only restricted canker development caused by T. roseum on Belinda.

A PROPOSED ROLE FOR LOW LEVEL ANTIBIOTIC ACTIVITY OF AN ECTOMYCORRHIZAL FUNGUS. D. M. Sylvia and W. A. Sinclair, Dept. of Plant Pathology, Cornell University, Ithaca, NY 14853.

The ectomycorrhizal fungus *Laccaria laccata* can protect premycorrhizal Douglas-fir (*Pseudotsuga menziesii*) seedlings from root rot by *Fusarium oxysporum*. The pathogen overgrows the mycorrhizal fungus in conventional paired culture tests on common media at room temperature, but we found evidence of antibiotic activity when *L. laccata* was grown 2 wk before introduction of *F. oxysporum*. Two strains of *L. laccata* produced diffusible, charcoal adsorbable metabolite(s) which retarded hyphal growth, altered hyphal form and delayed germination of chlamydospores and conidia of *F. oxysporum*. These influences, strongest at 15 C in media containing glucose (10 mM) at pH 4, diminished with rising temperature or pH. Metabolites from *L. laccata* also suppressed growth of primary roots of Douglas-fir and stimulated polyphenol deposition in them. On a primary root *L. laccata* may thus not only inhibit *F. oxysporum* directly but also indirectly through the induction of potentially fungistatic host phenolics.

POTENTIAL FOR BIOLOGICAL CONTROL OF CERCOSPORIDIUM LEAFSPOT OF PEANUTS BY HANSFORDIA. Ruth Ann Taber, Robert E. Pettit, Plant Sciences, TAES, Texas A&M Univ. College Station, TX 77843; Robert McGee and Donald H. Smith, Plant Disease Research Station, Yoakum, TX 77995.

The mycoparasite, Hansfordia, has been found colonizing the late leafspot fungus (Cercosporidium personatum) on peanuts in 5 counties in Texas-Wilson, Atacosa, Frio, Brazos and Lavaca. In the greenhouse, Hansfordia colonized Cercosporidium but not Cercospora nor Puccinia leafspots. SEM of late leafspots showed absence of sporulation of hyperparasitized Cercosporidium. Hansfordia penetrated stromatic cells and hyphae were inter- and intracellular. In pure culture Hansfordia grew best on 4 of 14 nitrogen sources, rapidly on peanut-oatmeal, V-8, PDA, PCDA agars and slowly on Czapek's agar. It responded to light. Late leafspot is prevalent in all peanut areas of the world. Fungicide-resistant strains of Cercosporidium have been reported. Biological control through the use of Hansfordia may be an alternative method of control.

IN VIVO PRODUCTION OF CERATO-ULMIN (CU) IN WHITE ELM WOOD BY CERATOCYSTIS ULMI. S. Takai[1], J. Krywienczyk[2], W.C. Richards[1], B. Mathieson[2].
[1]Great Lakes For. Res. Ctre. and [2]For. Pest Manage. Inst., Can. For. Serv., Sault Ste. Marie, Ont. P6A 5M7.

To examine in vivo production of CU sap was recovered from branch sections incubated with spores inoculated by flushing; water extracts were also recovered from discolored xylem wood from both artificially and naturally infected field grown trees. These fungus-free samples were then assayed with the antiserum against purified CU by means of either double diffusion or ELISA (enzyme-linked immunosorbent assay). Samples recovered from infected elm wood were positive, even at early stages of disease development, whereas non-infected were negative. These results strongly indicate that CU is produced in elm wood by C. ulmi.

SUSCEPTIBILITY TO BOTRYTIS LEAF BLIGHT IN RELATION TO AGE OF ONION HOSTS. M.R. Tanner and J.C. Sutton, Dept. of Environmental Biology, University of Guelph, Guelph, Ontario, N1G 2W1.

In Ontario, leaf blight caused by Botrytis squamosa Walker usually appears first as scattered lesions when 4 to 7 leaves have emerged and progresses rapidly when the bulbs enlarge. To examine blight susceptibility in relation to plant age, groups of 16 replicate plants were grown in controlled environment and inoculated with conidial suspensions (10^4/ml) at 14-d intervals after sowing. Inoculated plants were kept moist for 24 h at 21°C and disease was assessed at 48 h and 7 d. The numbers of lesions/cm^2 leaf in 2-, 4-, 6-, 8- and 10-wk old onions were 1.6, .98, .69, .17 and .07 respectively. Lesion numbers in plants inoculated at 12, 14, 16 and 18 wk were similar to those at 10 wk. Bulbs enlarged at 10-18 wk. On plants of all age groups, more lesions appeared and dieback was more extensive on older than on younger leaves, and more lesions developed in apical than in basal portions of leaves. The results indicate that rapid blighting in bulbing onions in the field is not associated with increased susceptibility to infection.

THE EFFECT OF PISATIN TOLERANCE AND DEMETHYLATION ON THE VIRULENCE OF NECTRIA HAEMATOCOCCA MP VI ON PEA. K. J. Tegtmeier and H. D. VanEtten, Dept. of Plant Pathology, Cornell University, Ithaca, NY 14853.

In a previous study it was found that field isolates of N. haematococca MP VI that are virulent on pea (Pisum sativum) are tolerant of pisatin and are able to demethylate this pea phytoalexin to a less toxic compound; the most sensitive field isolates are unable to demethylate pisatin and are low in virulence. To determine whether these three traits are genetically linked, a number of isolates were crossed. In all crosses, all of the pisatin-sensitive progeny were low in virulence whereas all virulent progeny were tolerant. In several crosses tolerance and demethylation showed absolute linkage. In one cross however both tolerant, nondemethylating and sensitive, demethylating progeny were recovered in addition to the parental types. Thus it appears that pisatin tolerance is necessary for even moderate virulence, but that pisatin tolerance does not depend on the ability to demethylate pisatin.

COMPARING INTEGRATIVE AND NON-INTEGRATIVE SIMULATION OF PLANT DISEASE EPIDEMICS. P.S. Teng, Department of Plant Pathology, University of Minnesota, St. Paul, MN 55108; and P. von Bretzel, Department of Plant Pathology, University of Arizona, Tucson, AZ 85721.

Time-advancement (clockwork), a basic element in the structure of epidemic simulation models, may be achieved by two methods: 1) non-integrative, exemplified by the use of the FORTRAN DO-loop, and 2) integrative, exemplified by numerical integration methods in CSMP and GASP IV. Using a barley leaf rust model, BARSIM-I, apparent infection rate, r, and percentage yield loss predictions showed no significant differences between clockwork method. Integration interval, dt, exerted more influence on simulated epidemic curves of barley leaf rust than did integration method. Runge-Kutta integration was found to be more flexible for modeling than either Rectilinear or Trapezoidal procedures. When EPIDEM, EPIMAY and EPIMUL were compared using r, with the same dt, method of time advancement was found to cause only small differences in simulation output.

EXPLORATORY AND OPTIMIZATION COMPUTER EXPERIMENTS FOR DESIGNING MANAGEMENT SYSTEMS OF BARLEY LEAF RUST. P.S. Teng, Department of Plant Pathology, University of Minnesota, St. Paul, MN 55108.

Using a barley leaf rust simulator, BARSIM-I, exploratory experimentation was conducted using, respectively, a structural, functional and experimental model. With the structural model, all state variables were found equally effective in altering system behavior. The functional model showed that latent period, spore production per day and penetration ratio had significant individual and interactive effects on modifying infection rate. The experimental model identified combinations of levels of the above three parameters that could be used for disease management by genetic manipulation. Exploratory experiments required much computer time and since an aim of management is to identify those values of the policy (independent) variables that will give optimum value of a dependent variable, Response Surface Methodology (RSM), exemplified by the method of Basic Steepest Ascent, was used for optimization experiments.

ORGANISMS ASSOCIATED WITH FRUIT ROT IN PENNSYLVANIA CANNING TOMATOES. G. G. Thomas, S. P. Pennypacker, and A. A. MacNab. Department of Plant Pathology, The Pennsylvania State University, University Park, PA 16802.

Field surveys were conducted in 1978 and 1979 to identify the organism most frequently isolated from tomatoes with fruit rot symptoms. Machine harvested processing tomatoes from 15 fields in Pennsylvania were sampled once in 1978. Colletotrichum coccodes was the organism most frequently isolated from fruit with rot symptoms. Alternaria tenuis, A. solani, Rhizoctonia solani, Fusarium roseum, and Phomopsis sp. were also isolated. In 1979 nine fields were sampled from the onset of fruit ripening until harvest. C. coccodes was the organism most frequently isolated from ripe fruit. However, in 2 of the nine fields A. tenuis was the most frequently isolated organism. R. solani, A. solani, and Botrytis were also isolated from both green and ripe fruit. Rhizoctonia was the most frequently isolated organism from green fruit lesions in contact with the soil. Soft rot bacteria were infrequently isolated and probably are therefore unimportant in initiating fruit rot.

A PROTEIN ASSOCIATED WITH MALE STERILITY IN MAIZE. D. W. Thornbury and D. R. Pring, Department of Plant Pathology

Univ. of Kentucky, Lexington, KY 40546 and SEA-USDA, Univ. of Florida, Gainesville, FL 32611.

Purified maize mitochondria were examined for proteins associated with cytoplasmic inheritance of male sterility and with susceptibility/resistance to Bipolaris maydis. There were no reproducible cytoplasm-specific protein differences between Texas male sterile, C male sterile, and normal mitochondria. One cytoplasm-specific protein, 134,000 dalton MW, was found in Scms mitochondria. The relationship of this S protein to male sterility was examined in restorer and non-restorer maize lines and in a line with a cytoplasmic mutation to male fertility. All Scms lines tested contained the S protein, except the cytoplasmic mutant. Scms mitochondria contain two plasmid-like DNAs, which have been shown to be absent in lines with the cytoplasmic mutation to fertility. Nuclear fertility restorer genes had no effect on the presence of either the S protein or the DNAs. The correlation between the presence of the S protein and the plasmid-like DNAs suggests that this protein may be a gene product of the DNAs.

ISOLATION AND CHARACTERIZATION OF THE OUTER MEMBRANE OF ERWINIA AMYLOVORA. K.K. Thurn, A.J. Trainer, and A.K. Chatterjee. Dept. of Plant Pathology, Kansas State University, Manhattan, KS 66506

The cytoplasmic membrane (CM) and outer membrane (OM) of E. amylovora and other Gram negative bacteria were fractionated by isopycnic sucrose density gradient centrifugation. Separation was confirmed by a differential enrichment of chemical and enzymatic markers. Triton X-100 solubilized the CM and OM of E. amylovora (E9), while sodium lauryl sarcosinate preferentially solubilized the CM. The protein composition of OM from E. amylovora (E9), E. coli (K12) and Pseudomonas syringae (955) were not similar in SDS-polyacrylamide gel electrophoresis. E. amylovora strains E9, E8, EA178, EA198, EA225 and EA273 had two major protein bands of molecular weights of 15,800 and 38,000 daltons in common in the OM. The OM protein profile of the virulent wild type E9 and the avirulent mutant E8 were identical but differed from other E. amylovora strains by the presence of an additional major protein band of approximately 41,000 daltons. Analysis of whole cells and fractionated OM of E9 and Salmonella typhimurium (LT2) revealed similar phospholipid contents.

DRY ONION STORAGE LOSSES IN NEW YORK. W.H. Tietjen and M.J. Ceponis, USDA-New Jersey AES Postharvest Research Center, P.O. Box 231, New Brunswick, New Jersey 08903.

Dry onion culls were sampled once weekly from onion packing operations in Orange County, New York during the 1979-80 storage season. Prior to packing, onions were graded twice. In the cursory initial grading, 0.62 metric tons (2.0%) were culled out from 30.66 metric tons of onions which were returned to common storage before the final grading operation. Pathogenic diseases accounted for about 50% of the culls and insect damage (23%) and mechanical injury (17%) for most of the remainder. Culls were sampled from nearly 1.0% of 575.8 metric tons in the final and more stringent grading operation. Pathogenic diseases, mainly Botrytis and bacterial rots, accounted for 35% of the culls. Mechanical injury (32%), insect damage (15%), and stained or discolored scales (12%) were responsible for most of the other culls.

DISTRIBUTION AND PERSISTENCE OF TETRACYCLINE APPLIED BY HIGH-PRESSURE TRUNK-INJECTION AND SOIL DRENCH TO BLIGHT-AFFECTED CITRUS TREES. L. W. Timmer, R. F. Lee, R. H. Young*, L. G. Albrigo, J. P. Syvertsen, and D. P. H. Tucker, Univ. Florida, AREC, Lake Alfred 33850 and *AR, SEA, USDA, Orlando, FL 32803.

Mature blight-affected sweet orange trees on rough lemon rootstock were trunk-injected with 10-30 g of tetracycline/tree using 17 kg/cm^2 of N_2 pressure. After 2-3 wk, 60-80% of the twigs had tetracycline activity as determined by bioassay against Bacillus cereus. Activity in twigs was high for 2-3 mo, gradually declined, and disappeared after 6-7 mo. Tetracycline was detected in young and mature leaves for 2-4 mo after injection, but not in small roots far from the trunk. In trees sacrificed 1-5 days after injection, tetracycline was detected in twigs, large branches, trunks, large roots, and in small roots near the crown. Mature blighted orange trees were transplanted into sand in tanks and drenched quarterly with tetracycline at 190 g/tree. Tetracycline was detected consistently in sand and roots, but rarely in twigs and never in leaves. Blighted trees have not as yet responded to treatments.

HOST RANGE AND DISTRIBUTION OF FUSARIUM OXYSPORUM f. sp. CITRI WITHIN CITRUS PLANTS. L. W. Timmer*, G. R. Grimm, and S. M. Garnsey. *Univ. of Florida, IFAS, AREC, Lake Alfred, FL 33850 and AR, SEA, USDA, Orlando, FL 32803.

Six-mo-old seedlings of 11 citrus species and hybrids were root-dip inoculated with Fusarium oxysporum f. sp. citri. Mexican lime developed severe chlorosis and wilt and the pathogen was isolated from roots, stems, and small twigs. Milam, Citrus amblicarpa, and C. volkameriana developed chlorosis, mild wilt, and stunting and the fungus was isolated from roots and main stems, but not from twigs. Rusk citrange, Rangpur x Troyer, Swingle citrumelo, Eureka lemon, limequat, sweet lime, and calamondin were symptomless and the pathogen was recovered only from roots and some stem bases. Sweet orange and rough lemon were symptomless when inoculated as seedlings, but developed severe symptoms when grafted on infected Mexican limes. The pathogen was isolated from the rough lemon and sweet orange scions. Potting mix from inoculated susceptible species generally had higher soil populations of the pathogen than that from resistant species.

SPORE LIBERATION AND DISPERSAL OF SIROCOCCUS CLAVIGIGNENTI-JUGLANDACEARUM. N. Tisserat, T.H. Nicholls, and J.E. Kuntz, UW, Madison, WI. 53706(1&3); USFS-NC For.Exp.Sta.St.Paul, MN 55108 (2)

Sirococcus clavigignenti-juglandacearum, the causal fungus of butternut canker, during humid conditions extrudes spores in cirri from pycnidia beneath loosening bark on both standing and felled trees. Spore liberation among butternuts, monitored by Vaseline-coated slide traps, occurred sporadically from mid-April through October. Spores were deposited on slides only during measurable rainfall. Spore trapping from cankers in mist chambers showed that conidia were released in splash droplets during simulated rain. Air movement alone did not liberate conidia even at 100% R.H. The distance of spore dispersal from a pocket of cankered butternuts was determined by placing rotorod spore traps at 7m intervals to a distance of 28m. Spores were trapped at the maximum distance tested; however, spore concentrations decreased exponentially at increasing distances from the sources of inoculum. Results have clarified observed canker incidence among butternuts and suggest modifications in cultural practices.

EFFECT OF PEANUT STUNT VIRUS ON YIELD OF SNAP BEAN (PHASEOLUS VULGARIS). S. A. Tolin and D. C. Bays, Dept. of Plant Pathology and Physiol., Virginia Polytech. Inst. & State Univ., Blacksburg, Va. 24061.

Peanut stunt virus (PSV) has become prevalent in Va., and causes yield loss on several crops. Its effect on the yield of snap bean was measured in 1978 and 1979. In both years, the cultivar 'Bush Blue Lake 274' was planted in 4-row plots, 3 m in length. A paired comparison design, with 2 treatments, was used. Plants in plots were air-brush inoculated with PSV or were not inoculated. Pods, at least 8 cm in length, were harvested 5 times over a period of 4 weeks from the center 2 rows of each plot. The percentage of plants infected with virus was 44 and 35 in the uninoculated plots, and 85 and 96 in the inoculated plots, in 1978 and 1979, respectively. The mean yields were 57 g and 105 g from the inoculated plots, and 5257 g and 3369 g from the uninoculated plots, for the same 2 years. These differences were statistically highly significant (P=0.025). Therefore, early infection by PSV can greatly reduce snap bean yield.

MULTIPLE ROOT INFECTIONS AND PROGRESSION OF CYLINDROCLADIUM BLACK ROT OF PEANUT. G. S. Tomimatsu and G. J. Griffin, Dept. of Plant Pathology and Physiology, VPI&SU, Blacksburg, VA 24061.

Results from field and greenhouse (GH) tests showed numerous Cylindrocladium crotalariae infections of asymptomatic tap and lateral roots of peanut. Forty-one percent of 80 15-wk-old plants from a 1979 field plot had progressive root infections (slight to severe rot), while 60% of the asymptomatic root systems were colonized and had a mean of 36.3 initial or non-progressive infections/plant (range: 1-114). For 9-wk-old plants grown in GH soil temperature tanks [25C, 10 microsclerotia (ms)/g soil], 46% of 54 root systems had progressive infections, while 100% of the asymptomatic root systems were colonized and had a mean of 34.9 initial or non-progressive infections/plant (range: 21-56). Using a root-slide technique in soil with washed 10 x 5 mm agar strips of ms, the mean rate of lesion growth on the taproot for 8 isolates of C. crotalariae was 1.4 mm/day (range: 0.07-3.8) over 21 days. These results provide evidence for the occurrence of multiple C. crotalariae root infections, only a portion of which appear to contribute appreciably to disease development.

A RAPID, QUANTITATIVE METHOD FOR IDENTIFYING GENERALIZED RESISTANCE TO PHYTOPHTHORA MEGASPERMA VAR. SOJAE IN SOYBEAN SEEDLINGS

P.W. Tooley and C.R. Grau, Dept. of Plant Pathology, Univ. of Wisconsin-Madison, Madison, Wi. 53706.

Cotyledons of 9-11 day-old seedlings were wound-inoculated with Phytophthora megasperma var. sojae (Pms) 5 mm from the point of attachment. A 10 ul drop containing encysted zoospores was delivered to each cotyledon using a Gilson Pipetman micropipette; a disposable tip was modified to allow simultaneous wounding and delivery of spores. After incubation for 5 days at 28C, plants were scored as dead or living. Resistance was characterized by the inability of the fungus to move into the hypocotyl and kill the plant. Based on inoculum density studies using this method with Pms race 7, LD50 values for the cultivars Steele, Harosoy 63, and Asgrow 2656 were 6.57×10^2, 2.05×10^6, and 1.06×10^7 spores/ml. When grown in the field in soils naturally infested with multiple races of Pms and rated on the basis of yield and disease severity, Steele has shown low, Harosoy 63 intermediate, and Asgrow 2656 high generalized resistance, in close agreement with rankings obtained by the cotyledon test in both greenhouse and growth chamber.

EPIDEMIOLOGY OF ALTERNARIA LEAF BLIGHT OF MAIZE. Mary J. Trainor and C. A. Martinson. Northrup King Co. 13410 Research Rd., Eden Prairie, MN 55344 and Dept. of Plant Pathology, Seed and Weed Sciences, Iowa State University, Ames, IA 50011

Alternaria alternata, a weak pathogen of maize, caused a progressive leaf blight after predisposition of host tissue by wounding and under proper environmental conditions. The temperature optimum for lesion expansion was 20 C; dew periods of 10 hr or more per 24 hr and 48 hr or more of total dew were required for lesion expansion. A continuous dry period of 24 hr or more stopped further lesion expansion during subsequent dew periods. Lesion size increased directly with inoculum density and leaf age. Alternaria alternata present on unwounded leaf tissue was able to colonize subsequently wounded tissue. Inbred maize lines were tested for disease resistance. B37, B79, and W22 were moderately susceptible while C103 and Oh43 were moderately resistant. A limited host range for the fungus was determined.

A PERFECT STATE FOR A SNOW MOLD PATHOGEN. James A. Traquair, Research Station, Agriculture Canada, Lethbridge, Alberta, Canada T1J 4B1.

A low temperature basidiomycete (LTB) causes significant snow mold damage to overwintering crops in areas of Western Canada where snow cover is heavy. Failure to observe a sexual stage in its life cycle has hindered efforts to completely identify the LTB and to develop satisfactory control procedures. Small and evanescent sporophores of an agaricoid basidiomycete developed on the blackened, necrotic crowns of alfalfa damaged by LTB. The fungus was tentatively identified as Coprinus urticicola (Berk. & Br.) Buller and was shown to establish a genetical relationship in di-mon pairings with stock isolates of LTB from various hosts, including alfalfa, grasses, and winter wheat. This compatibility evidence for the identity of LTB is supported by similarities in cultural features such as hyphal anatomy, colony morphology, growth at low temperatures, hydrogen cyanide production, and pathogenicity on alfalfa and winter wheat under controlled environment conditions.

PESTICIDE DEPOSITION AND DISTRIBUTION ON 'GOLDEN DELICIOUS' APPLE TREES. J. W. Travis and T. B. Sutton, Department of Plant Pathology, and W. A. Skroch, Department of Horticultural Science, North Carolina State University, Raleigh 27650.

Metiram, applied with an airblast sprayer at 4.5 g a.i./L (571 L/ha), was used as a tracer to follow pesticide deposition on 'Golden Delicious' apple trees. Three-leaf samples were collected at 30.5 cm intervals throughout the tree canopy and atomic absorption spectroscopy was used to analyze leaf samples for zinc, a component of metiram. Deposition of metiram was affected by distance from the sprayer and limb structure. Uniformity of deposit throughout the tree decreased with increased tree size. Deposition-distribution models were developed to predict pesticide distribution in a tree canopy based on a few leaf samples.

RELATIONSHIP BETWEEN PHYTOPHTHORA CAPSICI AND THE BLACK PEPPER ISOLATES OF 'P. PALMIVORA' MORPHOLOGICAL FORM (MF) 4. Peter H. TSAO, Azizollah Alizadeh, and Pamela W. Tsao. Department of Plant Pathology, University of California, Riverside, CA 92521.

All black pepper (BP) isolates studied (from Asia, Central America, and Africa) had similar morphological features and belong to 'P. palmivora' MF4. They also resembled the MF4 rubber (RU) isolate from Brazil, the macadamia (MA) isolate from Hawaii designated as P. capsici (PC) by Kunimoto et al. and the MF4 cocoa (CO) isolates recently considered also as PC by Zentmyer et al. Some BP isolates differed from authentic PC (Leonian's type culture, ATCC cultures and other typical isolates) which has round-based sporangia formed in the dark, relatively shorter (about 40-60 μm) sporangium pedicel, irregular sporangium ontogeny, and grows at 35 C. Other BP isolates and the RU and CO isolates had only some, but not all, of these PC features. The MA isolate, like the BP isolate from Thailand, differed greatly from PC in having sporangia with extremely tapered base and long (>100 μm) pedicel, umbellate ontogeny, and no growth at 35 C. The MA isolate also formed chlamydospores which are absent in PC.

HYPERPARASITISM OF GLIOCLADIUM VIRENS ON RHIZOCTONIA SOLANI. J. C. Tu, Research Station, Agriculture Canada, Harrow, Ontario NOR 1GO

A common soil fungus, Gliocladium virens, was shown to be a potent hyperparasite of Rhizoctonia solani using light and electron microscopy. The hyphae of G. virens parasitized those of R. solani by the formation of appressoria. The parasitized hyphal cells of R. solani progressively shrank and finally collapsed and died. In thin sections, numerous hyphae of G. virens were found intracellularly in the parasitized sclerotial cells of R. solani. In vitro, G. virens effectively inhibited sclerotia formation of R. solani. Greenhouse tests showed that addition of G. virens to the soil artificially infested with R. solani reduced the severity of Rhizoctonia root rot in white beans. Root rot severity decreased proportionately with increased level of G. virens in the R. solani infested soil. G. virens possessed many desirable characteristics of a hyperparasite such as rapid growth, abundant sporulation, and persistence in soil. G. virens is therefore, an effective hyperparasite of R. solani and may be useful in the biocontrol of root rot disease.

RESISTANCE OF ECOTYPES OF CANADA THISTLE TO PUCCINIA OBTEGENS S.K. Turner, J.H. France, P.K. Fay, and E.L. Sharp, Department of Plant Pathology, and Plant and Soil Science, Montana State University, Bozeman, MT 59717.

A major constraint of plant pathogens for use as biocontrol agents is genetic resistance of host-plant ecotypes to the pathogen. Ten ecotypes of Canada thistle, differing in leaf shape, were collected in Montana, planted in the greenhouse, and inoculated with spores of P. obtegens. Sporulation was observed on all the ecotypes, however infection types varied, indicating host-resistance is a factor limiting rust infection. There was no correlation between host plant susceptibility and the following factors: ecotype classification, stomatal density, or spore germinability on leaf surface. An additional constraint of fungal biocontrol agents is the necessity of dispersing spores at the right time, in numerous locations. For this purpose, a device was designed to load an aliquot of spores at high midday temperatures which were dispersed as temperatures declined in the evening.

CHEMICAL AND BIOLOGICAL CONTROL OF ONION WHITE ROT IN MUCK AND MINERAL SOILS. R.S. Utkhede and J.E. Rahe, Department of Biological Sciences, Simon Fraser University, Burnaby, British Columbia, Canada, V5A 1S6.

Isolates of Bacillus subtilis gave significant field control of white rot, caused by Sclerotium cepivorum Berk., on two onion cultivars grown on muck soil in 1978. These studies were extended in 1979 to include different soil types and combinations of chemical and bacterial treatments. Three chemicals as broadcast treatments and bacterial seed treatments were evaluated separately and in combination on the bulb cultivars Autumn Spice and Ailsa Craig on muck soil in Burnaby, B.C. Ronilan, Rovral, and bacterial seed treatment provided significant season-long protection on both cultivars. Combination of chemical and bacterial treatment generally provided slightly but not significantly higher levels of control than the corresponding chemicals tested singly. Three chemicals and bacterial seed treatments were also evaluated on the pickling-cultivar Silverqueen on mineral soil in Grand Forks, B.C. White rot was completely controlled by Ronilan and Rovral, and bacterial seed treatment significantly reduced infection.

INFLUENCE OF MAIZE CHLOROTIC MOTTLE AND MAIZE DWARF MOSAIC VIRUSES INOCULATED AT DIFFERENT PLANT GROWTH STAGES ON SYMPTOMATOLOGY AND CORN YIELDS. J.K. Uyemoto, L.E. Claflin, D.L. Wilson,

and R.J. Raney. Departments of Plant Pathology and Agronomy, Kansas State Univeristy, Manhattan, Kansas 66506.

Corn lethal necrosis disease (CLND) is caused by a synergistic interaction between maize chlorotic mottle (MCMV) and maize dwarf mosaic viruses. From two years of testing, we determined that double virus infections, occurring at 3- or 7-leaf growth stages, caused leaf chlorosis and necrosis, poor ear development, plant stunting and premature death; at the 14-leaf stage, MCMV and double infections caused chlorosis and necrosis of terminal growth of tasseled plants. Overall, single virus inoculations produced less severe disease symptoms. Irrespective of plant age, nearly all inoculations (i.e., with single and double virus inocula) significantly reduced grain yields, and highest yield losses (e.g., avg. yields were 3259 and 5923 kg/ha, respectively, for inoculated and uninoculated plants) occurred when corn plants were inoculated at or before the 7-leaf stage. Similar CLND symptoms were observed under natural field conditions and corn yields were also affected.

DEVELOPMENT OF COMMON ROOT ROT (COCHLIOBOLUS SATIVUS) LESIONS ON SUBCROWN INTERNODES OF WHEAT AND BARLEY CULTIVARS. P. R. Verma. Can. Agr. Res. Stn., Saskatoon, Sask. S7N 0X2.

The relative resistance of cereal cultivars to root rot is commonly based on disease intensity data collected only at plant maturity. Plants are grouped into arbitrary categories, clean, slight, moderate, and severe, depending upon lesioning of subcrown internodes. However, these studies do not provide information on the rate of disease development. A technique (Verma, P.R. et al. 1975. Can. J. Bot. 53:2568-2580) was used to follow progression of subcrown internode lesions on plants of three wheat and two barley cultivars. Successful infection occurred after a contact period of 48-72 hr. The vertical spread of lesions was much faster than the lateral spread, and generally lateral spread began after maximum vertical extension. The disease development was faster in barley than in wheat. The probabilities of plants both becoming infected, and also being transferred into more severe categories in the interval between observation was higher in barley than in wheat.

CONTROL OF A FUNGAL LEAF BLIGHT ON OIL PALM WITH INSECTICIDES. J. C. Vessey, Department of Tropical Research, United Fruit Company, La Lima, Honduras.

A complex of fungi including Pestalotiopsis spp., Oxydothis elaedis and Mycosphaerella sp. was associated with a leaf blight of oil palm in Honduras. Lesions appeared to start at insect feeding wounds. Weekly foliar applications to run-off of a mixture of Sevin 6 g/L active ingredient (a.i.) and Diazinon 4 g/L a.i. led to a reduction in the number of infected leaflets from 26% to 1% on 2 year old palms. In an experiment with 13 year old palms, five systemic insecticides were injected into the trunk or applied to soil at 10 week intervals for 40 weeks. Trunk injections with Monocrotophos at a rate of 10 g a.i. per tree was the best treatment with a reduction in the average number of fungal lesions per leaf from 427 to 50. It was concluded that control of the disease by application of insecticides was probably the result of a reduction in the number of infection courts caused by insect feeding.

A RATE REDUCING RESISTANCE EXPRESSED BY CERTAIN RICE VARIETIES TO RICE BLAST. R. L. Villareal, R. R. Nelson, D. R. MacKenzie, W. R. Coffman. The Pennsylvania State University, University Park 16802 and The International Rice Research Institute, P.O. Box 933, Manila, Philippines.

Sixteen rice varieties, reported in the Ivory Coast to exhibit low apparent infection rates (r) or reduced disease development of rice blast, were evaluated in field tests at the International Rice Research Institute, Los Banos, Philippines, for their r-values and disease severity ratings. Nine of the 16 varieties showed slow-blasting tendencies as evidenced by reduced r-values (.0235-.1197) compared to three susceptible varieties (r=.1958-.2272) and terminal disease severities (1.4-16.1% for slow blasting varieties vs 88% for the susceptible checks) when inoculated with a highly virulent and stable isolate of Pyricularia oryzae. The five varieties exhibiting the lowest r-values were evaluated in two additional field experiments, using three virulent isolates, with similar results. Isolate by variety interactions were detected but were modest compared to the main effects of the host resistance.

THE COMPONENTS OF SLOW BLASTING OF RICE. R. L. Villareal, D. R. MacKenzie, R. R. Nelson and W. R. Coffman. The Pennsylvania State University, University Park, PA 16802 and The International Rice Research Institute, P.O. Box 933, Manila, Philippines.

Five rice varieties exhibiting low apparent infection rates for blast development in field tests in Ivory Coast and Philippines were compared to a susceptible line in phytotron studies. Significant variety differences were observed for disease efficiency (DE) (i.e. proportion of lesions resulting from the application of a given number of spores), latent period (LP) (i.e. time from deposition of spores until resulting lesions begin sporulation), sporulation capacity (SC) (i.e. cumulative number of spores produced by a lesion), and lesion size (LS) (highly correlated with SC; r = 0.881**). Analysis of variance detected highly significant isolate x variety interactions for DE and LP but not for LS or SC although significant main effects for isolate differences were noted for LS, SP, and DE. The techniques could be useful in breeding for varieties with a disease resistance that restricts a pathogen's epidemic development.

ISOLATION OF DASHEEN MOSAIC VIRUS IN NIGERIA AND SCREENING COCOYAM SEEDLING POPULATIONS FOR RESISTANCE. R.B. Volin, G. Thottappilly, H.W. Rossel and E.R. Terry. Univ. of Florida AREC, 18905 SW 280 Street, Homestead, Florida 33031 and IITA, PMB 5320 Ibadan, Nigeria.

Dasheen mosaic virus (DMV) was identified infecting field grown Xanthosoma sp. (new cocoyam, tanier, yautia, malanga) and Colocasia esculenta (old cocoyam, taro, dasheen). Symptoms in cocoyam plants and inoculated philodendron seedlings, the presence of rod shaped virus particles in electron microscope leaf dips, stylet borne vector transmissibility and reactions of identity in immunodiffusion tests using DMV antiserum confirmed the virus identity. Seedlings of Xanthosoma sp. and Colocasia esculenta were grown from true seed. Symptoms were visible ten days after the 10-week old seedlings were mechanically inoculated with sap from infected plants. From 40 to 80% of the inoculated seedlings produced obvious symptoms of varying severity but virus transmission based on symptom expression was less than 10% with three species of aphid vectors. Through early detection of susceptible cocoyam plants perhaps good levels of resistance or tolerance can be identified at an early stage before selection for agronomically improved varieties.

DOES THE BLACK KNOT DISEASE REDUCE PIN CHERRY DENSITY ON REGENERATING FOREST SITES? R. E. Wall, Maritimes Forest Research Centre, Fredericton, N.B. E3B 5P7.

After clearcutting or burning, dense stands of pin cherry often suppress regeneration of conifers. The pin cherry usually becomes heavily cankered with black knot caused by Dibotryon morbosum, but the role of this disease in natural control is questionable. In dense thickets, cankering was associated with the more vigorous saplings. Adjacent paired 5-10 year old trees, one with numerous 1-2 year old cankers and the other with few or no cankers were selected from several locations and subjected to growth analyses. Recent ring widths, volume increments, stem surface areas, and specific volume increments were generally greater in the heavily cankered trees than in the relatively healthy trees. However, lengths of terminal leaders and the numbers and total lengths of previous years' twigs were usually greater in the healthy than in the diseased individuals.

EFFECT OF TISSUE AGE, HEAT AND OTHER TREATMENTS OF SPECIFICITY AND GLYCEOLLIN PRODUCTION IN THE HYPOCOTYL REACTION OF SOYBEANS TO PHYTOPHTHORA MEGASPERMA VAR. SOJAE. E.W.B. Ward, P. Stössel and G. Lazarovits, Research Institute, Agriculture Canada, University Sub P.O., London, Ontario, N6A 5B7.

Intact, six-day old soybean hypocotyls increased in resistance to inoculation with zoospores of Phytophthora megasperma var. sojae from the top (immature tissue) to the bottom (mature tissue). Compatible races developed typical incompatible lesions with necrosis and glyceollin production at the bottom of the hypocotyl while incompatible races caused very light necrotic flecking with low accumulations of glyceollin. These age related changes were reduced following wound inoculation, but no evidence was obtained from microscope studies that penetration was restricted in intact older tissue. Resistance and glyceollin production at all parts of the hypocotyl were temporarily eliminated by heat and solvent treatment. The evidence suggests that similar mechanisms govern the incompatible response both on the incompatible host and on mature tissue of the compatible host.

SOURCES OF RESISTANCE TO EXSEROHILUM TURCICUM RACE 2. H. L. Warren and S. K. Onken, SEA USDA, Department of Botany and Plant Pathology, Purdue University, West Lafayette, Indiana 47907

Resistance to Exserohilum turcicum (Pass) Leonard and Suggs races 1 and 2 was expressed as limited infected tissue after infection or as small oval to elongated lesions in an exotic maize synthetic (PI 209135) and in B1138T. Twenty lines from PI 209135 were selected as parents for studies of resistance to leaf blight organisms. Sporulation and the number, type and size of lesion were evaluated in the greenhouse. Isolates from the oval lesion type resistance did not produce spores, even when placed in moist chambers. The number of chlorotic flecks observed after inoculation was compared with the subsequent number of lesions. Under greenhouse conditions, some chlorotic flecks failed to develop into lesions. Isolates from chlorotic flecks, however, produced E. turcicum mycelium and conidia. Differences in resistance to root lodging, height, date of pollination, and multi-disease resistance were observed in the field. Germplasm developed with multi-disease resistance appears promising in reducing disease development.

FIELD REACTION OF KENTUCKY BLUEGRASS CULTIVARS AND BLENDS TO STEM RUST. J.E. Watkins, R.C. Shearman, J.A. Houfek and T.P. Riordan, Department of Plant Pathology, 448 Plant Science and Department of Horticulture, 377 Plant Science, University of Nebraska, Lincoln, NE 68583.

In September 1978 and October 1979, 60 Poa pratensis L. cultivars and experimental lines and 24 P. pratensis cultivar blends were evaluated for stem rust reaction under field conditions. Turfs were established in 1976 and maintained in fertilized and irrigated plots mowed at 5.0 cm. Blends were based on one-third by weight on three-way blends and one-half by weight on two-way blends. A complete range of stem rust reaction was found. All cultivars and experimental lines had at least 10% severity. Half of all cultivars showed less than 20% severity, and only 12 were rated at greater than 50% severity. Blending of susceptible and resistant cultivars reduced rust severity in plots. Rust severity in polystands approximated the average of the severity of the cultivars when grown separately. Rust severity was less than 50% for all blends as measured by % leaves infected per plot.

DIURNAL PERIODICITY OF BASIDIOSPORES OF CRONARTIUM QUERCUUM F. SP. FUSIFORME AND ASSOCIATED METEOROLOGICAL VARIABLES IN NORTH CENTRAL FLORIDA. R.S. Webb and R.A. Schmidt, School of Forest Resources and Conservation, University of Florida, Gainesville, FL 32611.

The diurnal periodicity of basidiospores of Cronartium quercuum f. sp. fusiforme during a 6-day period in May was analyzed relative to important meteorological variables. Hourly counts from a Kramer-Collins spore trap indicated that maximum numbers of spores were trapped during 0100-0800 hours with the minimum number trapped during 1200-1900 hours. Regression analyses indicated that leaf wetness, relative humidity, temperature and wind velocity comprised the optimum linear model (r^2=0.74). A more complex nonlinear model involving these and several interaction terms accounted for more of the variability (r^2=0.85) and increased the model's predictive capability. During another 5-day period in May, an early rainfall altered the typical nocturnal pattern and maximum spores were trapped during 1600-2300 hours.

GENOMIC HETEROGENEITY OF SOUTHERN BEAN MOSAIC VIRUS AND IN SITU RNA AGGREGATION WITH HEATING. K.A. Weber, S. El-Hassan and O.P. Sehgal, Dept. of Plant Pathology, University of Missouri, Columbia, Missouri 65211.

SBMV-RNA isolated by several methods, upon heat denaturation, sediments heterogeneously in sucrose gradients (28-10S) with ca. 60% RNA sedimenting slower than the native 28-25S RNA. SBMV-RNA denatured with urea or formamide behaves similarly. Only the 28-25S RNA is infectious and the addition of the slowly sedimenting RNAs to it causes no infectivity enhancement. Denatured RNA resolves into ca. 10-12 discrete species upon gel electrophoresis. RNA isolated from heat-inactivated (65 C, 10 min) virions is aggregated, migrates homogeneously upon electrophoresis, and sediments uniformly at 32.5S. Heating SBMV at 45 C for 2 hr causes no infectivity loss; although RNA aggregates, its sedimentation value is ca. 30S. Our results demonstrate a greater than expected genomic complexity for SBMV and a novel heat-inactivation mechanism of virions, namely an in situ alteration of RNA secondary structure.

EFFECT OF INOCULUM DENSITY ON FUSARIUM YELLOWS OF CELERY. K. E. Welch and R. W. Schneider, Dept. of Plant Pathology, University of California, Berkeley, CA. 94720.

Low soil populations of Fusarium oxysporum f. sp. apii were found to cause a significant incidence of disease in celery. To examine the relationship between pathogen inoculum density and disease incidence, infected celery was incorporated into field plots at differential rates. Inoculum densities ranged from 148 to 0.6 propagules per gram air dry soil (P/G). Cultivar 52-70 R, grown on these plots, was evaluated at 6, 10 and 14 weeks after transplant. The fraction of diseased plants (X), when corrected for multiple infections (ln 1/1-X), was directly proportional to inoculum density. The coefficients of correlation at the three sampling dates were .99, .96 and .95, respectively. Disease progress was exponential. Infection occurred in the marketable portion in about 60% of the plants exposed to the lower inoculum densities and in 100% of the plants grown in more heavily infested plots. Therefore, inoculum levels of less than one P/G reduced crop value.

PSEUDOMONADS FROM TAKE-ALL CONDUCIVE AND SUPPRESSIVE SOILS. David M. Weller and R. James Cook. USDA, SEA, AR, Washington State University, Pullman, WA 99164.

Soils from two fields (L and MV) not cropped to wheat during the past 3 yr and from a field cropped 21 consecutive years to wheat (R) were each diluted 1:10 (w/w) with fumigated soil. The mixture was amended with 1% (w/w) of oat kernels colonized by Gaeumannomyces graminis var. tritici (Ggt) and planted successively to wheat every 5 wk. Plants of the second cropping grown in the R soil treatment had significantly less take-all than plants in L or MV soil treatments or fumigated soil alone. Bacteria were sampled from the roots to determine a possible role in take-all suppression. Two samples from each of the R, L, MV, and fumigated treatments contained approx. 10^8 bacteria/0.1 g fresh root but fluorescent pseudomonads comprised an average of 15, 2, 1, and 4% of the populations, respectively. Thirty-nine of 46 pseudomonads from the R treatment but only 14 of 127 isolates from the other treatments produced inhibition zones against Ggt with distinct sharp edges, caused by abrupt cessation of Ggt growth. Twenty-one of 52 R treatment pseudomonads caused a hypersensitive response in tobacco, and were oxidase (+) and arginine dihydrolase (+) compared to 8 of 120 isolates from the other treatments.

ADDITIONAL HOSTS OF COLLETOTRICHUM TRIFOLII. R. E. Welty, Oxford Research Station, USDA-SEA-AR, Oxford, NC 27565.

Isolates of Colletotrichum trifolii are differentiated into two races according to disease reaction on three alfalfa cultivars. 'Saranac' and 'Saranac AR' are susceptible and resistant, respectively, to both races; race 2 overcomes resistance in 'Arc' to race 1. Several forage legumes were inoculated with both races of C. trifolii. Race 1 (isolate PA) and 2 (isolate NC4) became systemic in Medicago sativa and Melilotus alba; race 2 became systemic in Trifolium incarnatum. Both races defoliated Coronilla varia, T. pratense, T. repens, T. subterraneum, and Vicia villosa, whereas race 1 defoliated T. vesisulosum, T. dubium and T. incarnatum. Both races induced lesions on leaflets and petioles of Lespedeza cuneata, race 2 induced lesions on T. vesiculosum, T. hybridum, T. resupinatum, and T. dubium, and race 1 induced lesions of Lotus corniculatus. T. resupinatum and T. hybridum were nonhosts for race 1 and L. corniculatus was a nonhost for race 2. This host range of C. trifolii suggests physiological specialization to include legume species other than alfalfa.

THE EFFECT OF TRICYCLAZOLE ON FUNGAL MELANIN BIOSYNTHESIS. M.H. Wheeler, National Cotton Pathology Research Laboratory, P.O. Drawer JF, College Station, Texas 77840.

Tricyclazole [4-methyl-1,2,4-triazolo-(3,4-b)-benzothiazole] at 42 µM prevented normal brown or black melanin formation in cell walls of Verticillium spp., Thielaviopsis basicola, Macrophomina phaseoli, Diplodia natalensis, Alternaria spp., Drechslera sorokiniana, Cochliobolus carbonum, Rhizoctonia leguminicola, and Sclerotinia minor. The major site of tricyclazole inhibition in the fungi was the enzymatic reduction of 1,3,8-trihydroxynaphthalene to vermelone. Blockage of the melanin pathway at this site caused the accumulation of scytalone, flaviolin, 2-hydroxyjuglone, and other melanin metabolites. Tricyclazole at 42, 160, and 240 µM did not inhibit the biosynthesis of brown and black melanin pigments in Aspergillus niger, Rhizoctonia solani, Typhula spp., and Sclerotium rolfsii. These results show that the brown and black melanins of many fungi are formed by the same tricyclazole-sensitive biosynthetic pathway. Fungi in which melanin biosynthesis is unaffected by tricyclazole may form a different type of melanin.

IN VITRO ENZYMATIC METHYLATION OF TMV RNAS. James L. White, Dept. of Plant Pathology, Univ. of Nebraska, Lincoln, NE 68583.

Membrane preparations from TMV-infected tobacco incorporated in vitro [^{3}H]methyl-label from S-adenosyl(methyl-[^{3}H])methionine into RNase-sensitive products. Analysis of [^{3}H]methyl RNA on polyacrylamide gels revealed labeled regions that migrated with replicative intermediate and replicative form. Methylation depended on Mg^{++} ions and the 4 nucleotides and was inhibited by S-adenosyl homocysteine. Labeled RNA was hydrolyzed by RNase, phosphatase, and venom diesterase and the hydrolysate analyzed by thin layer chromatography. [^{3}H]methyl-label comigrated with authentic 7-methyl guanosine. Labeled RNA was shown to be virus specific by hybridization to denatured TMV double-stranded RNA. Whether TMV methyl transferase is virus-coded remains to be resolved. This research was supported by the SEA of the USDA under grant 7801062 from the Competitive Research Grants Office to M.K. Brakke and NSF Grant PCM 76-15867 to W.O. Dawson.

EFFECTS OF SELECTED NODULE-COLONIZING FUNGI ON GROWTH AND NITROGEN FIXATION OF SOYBEAN CULTIVAR HODGSON. K.D. Widin and B.W. Kennedy. Department of Plant Pathology, University of Minnesota, St. Paul, MN 55108.

Five fungi isolated from field grown soybean nodules and roots (Gliocladium roseum, Myrothecium verrucaria, Cylindrocarpon olidum, Corynespora cassiicola and Fusarium moniliforme) were grown on a cornmeal-sand substrate and added in a ratio of 1:5 to steamed soil prior to planting Hodgson soybean seeds previously inoculated with Rhizobium japonicum. Plants were grown in a 25° C greenhouse with a 14-hr daylength and harvested after 8 weeks. Corynespora and Cylindrocarpon caused the greatest decrease in plant growth and nitrogen fixation efficiency, followed by Myrothecium, Gliocladium and Fusarium. Treatment differences were significant for acetylene reduction, nodule number and weight but not plant dry weight. Gliocladium and Fusarium caused an increase in plant dry weight over controls. Spore suspensions of Myrothecium and Corynespora sprayed on Hodgson foliage also caused foliar injury.

FUNGI ASSOCIATED WITH RHIZOBIUM NODULES OF SOYBEANS GROWN IN SOIL OF DIFFERENT CROPPING HISTORIES. K.D. Widin and B.W. Kennedy. Department of Plant Pathology, University of Minnesota, St. Paul, MN 55108.

Soybean cultivar Hodgson, inoculated with Rhizobium japonicum, was grown in 1978 and 1979 in field plots having different cropping histories varying from continuous soybeans to no prior soybean cultivation. Nodules and roots were collected during the season, surface-sterilized and plated on 0.2% PDA. Percentage roots and nodules colonized increased over the 1978 season and values were not significantly different between treatments. In 1979, percentage colonization was similar throughout the season but plants in soil with no prior soybean cultivation had significantly fewer nodules and roots colonized than did those originating where soybeans were grown previously. Gliocladium, Myrothecium, Fusarium and Trichoderma were predominant nodule colonizers in both years. Corynespora and Phoma appeared to be more prevalent in 1979. Fungi colonizing roots were similar to those on nodules but some showed a preference for nodules.

BIOLOGICAL SEED TREATMENT IN SWEET CORN AND WHEAT AS A COMPONENT OF CROP MANAGEMENT. H.B. Wiley and Thor Kommedahl, Department of Plant Pathology, University of Minnesota, St. Paul, MN 55108.

Sweet corn (Golden Cross) and wheat (Era) grains were coated with Trichoderma harzianum conidia, captan, or both, and planted at three planting dates in field plots along with foliar or soil applications of dicamba, turbofos, and fertilizer (N:P:K, 12:12:12). Plants responded well (based on stand) to soil treatment with turbofos plus any seed treatment, singly or combined, in the early planting of wheat and the middle planting date of corn. Combinations of treatments were effective but any single treatment was not. Treatments were not effective in any late planting. When selection of planting date resulted in conditions less favorable for plant growth, several treatments resulted in stands less than those in controls. Thus seed treatment with T. harzianum appears to be an effective component of a crop management system with appropriate selection of other management practices.

EFFECTS OF SPECIFIC IONS ON GROWTH AND REPRODUCTION OF PHYTOPHTHORA MEGASPERMA VAR. MEGASPERMA. Henry T. Wilkinson and R. L. Millar, Department of Plant Pathology, Cornell University, Ithaca, NY 14853.

The effects of boron, calcium, copper, magnesium, and zinc on the formation of oospores, sporangia, and zoospores and on the rate of radial growth were determined. In three assay systems, P. megasperma grown on a Noble Agar synthetic medium amended with 4 mg/ml stigmasterol was used. In a fourth system, colonized alfalfa seedlings were treated to determine the effects of ions on zoosporogenesis. Magnesium was required for zoosporogenesis, oospore production, and for radial growth. Boron, calcium, zinc, and copper were not required for reproduction or vegetative growth. Calcium enhanced the rate and quantity of sporangium and zoospore formation. Boron was inhibitory to reproduction at concentrations greater than 50 ppm; zinc and copper were inhibitory at ca. 1-4 ppm. The effects of individual ions and their concentrations varied with the assay system and apparently were related to their concentration as contaminants in Noble Agar and to differences in the washing procedures used for each test.

REPRODUCTION AND GROWTH OF PHYTOPHTHORA MEGASPERMA VAR. MEGASPERMA ON A DEFINED MEDIUM. Henry T. Wilkinson and R. L. Millar, Department of Plant Pathology, Cornell Univ., Ithaca, NY 14853.

A synthetic, defined medium was sought that would support reproduction by P. megasperma. Media containing basal salts and a carbohydrate supported vegetative growth; none supported reproduction. Zoosporogenesis was achieved by washing cultures grown on a synthetic medium amended with stigmasterol or ergosterol or β-sitosterol. Campesterol and β-cholestanol supported the formation of sporangium-like structures which subsequently aborted. Cholesterol, cholesterol-succinate or lanosterol did not support zoosporogenesis. Sterols were also required for oospore production on synthetic media, but stigmasterol was the only one that consistently supported the formation of oospores. β-Sitosterol, cholesterol, and cholesterol-succinate supported the formation of oogonium-like structures. These results indicate different nutritional requirements for the growth of and reproduction of P. megasperma. Sterols were obligatory for reproduction and there appeared to be some sterol specificity. Furthermore, the formation of oogonia and oospores or sporangia and zoospores may be individually affected by the medium.

THE EFFECT OF SIZE AND CONCENTRATION OF INOCULUM ON THE INFECTION OF WHEAT BY GAEUMANNOMYCES GRAMINIS VAR. TRITICI IN DIFFERENT SOILS. Henry T. Wilkinson and R. James Cook, Washington State University, Pullman, WA 99164.

Wheat seedlings were grown for 4 wks in take-all conducive or suppressive soil infested with the pathogen as one of six sizes of inoculum (1.0-0.106 mm in diam.) in all combinations with ten concentrations (10-0.01 mg/g soil). Inoculum consisted of infested oat kernels (artificial) or fragments of infected wheat crowns (natural). In conducive soil (i.e. soil previously uncropped [virgin] or fumigated [methyl bromide]) the minimum-size inoculum required to produce an average of one lesion per seedling was <106 μm. The minimum concentration was 10 mg/g soil. In suppressive soil (i.e. soil from a field cropped 21 consecutive years to wheat) no lesions developed with inoculum <106 μm in diameter. Moreover, ca. 10 and 3 times the concentration of inoculum was needed with particles <150 μm and <250 μm, respectively, to produce an average of one lesion per plant in suppressive compared with conducive soil. Inoculum <250 μm was equally effective in conducive and suppressive soils. The results were similar with artificial or natural inoculum.

THE EFFECT OF SEPTORIA GLYCINES ON SOYBEAN YIELD UNDER ROTATION AND CONTINUOUS CROPPING. D. J. Williams, Diagnostic and Survey Plant Pathologist, USDA, APHIS-PPQ, Wallace State Office Building, Des Moines, IA 50319

Of 22 soybean varieties grown both in soils under rotated corn-soybean and under continuous soybean cropping practices, 17 varieties representing maturity groups I, II and III under continuous cropping had mean yields significantly reduced 16.5%, 21.3% and 14.8%, respectively. Closely associated with yield loss and defoliation during pod development and seed fill of varieties under continuous cropping was the level of brown spot caused by Septoria glycines. Mean brown spot severity ratings increased 173, 167 and 177% and defoliation increased 5, 121 and 150%, respectively, over the same varieties in rotation. This suggests a relationship between these two factors and yield reduction.

GROWTH OF PENICILLIUM OXALICUM, A BIOLOGICAL SEED TREATMENT, ON PEA SEEDS AND ROOTS IN SOIL. Carol E. Windels, Department of Plant Pathology, University of Minnesota, St. Paul, MN 55108.

Pea seeds (Pisum sativum 'Little Marvel') were dusted with spores of Penicillium oxalicum and planted in soil collected from a pea disease nursery and in autoclaved soil. Seedlings were removed from soil every 2-3 days until 14 days after planting. Seed coats and roots were examined by light- and scanning electron microscopy. In both field and autoclaved soil P. oxalicum spores germinated, formed a network of hyphae on the seed surface, and sporulated on the third day after seeds were planted. Spores of P. oxalicum were found in abundance, either singly or in groups, on tap and secondary roots and root hairs in field and autoclaved soil. In field soil, no germinated spores of P. oxalicum were seen on roots, but in autoclaved soil, spores germinated and hyphae of P. oxalicum grew between root hairs and on the root surface. Thus, spores of P. oxalicum applied to seeds appear to be active there and serve as seed protectants, but spores on root surfaces in field soil are inactive.

THE EFFECT OF PENICILLIUM OXALICUM, A BIOLOGICAL SEED TREATMENT OF PEA, ON RHIZOSPHERE ORGANISMS. Carol E. Windels and Thor Kommedahl, Department of Plant Pathology, University of Minnesota, St. Paul, MN 55108.

Pea (Pisum sativum) seeds of 5 cultivars were coated with spores of Penicillium oxalicum, captan, or not treated, and planted in a pea disease nursery. At 2, 4 and 6 wk after planting in two seasons, the population of fungi in the rhizosphere was statistically greater when P. oxalicum was applied to seeds than in controls. When applied to seeds, P. oxalicum was recovered from the rhizosphere of all cultivars in both seasons, and there was usually a greater population of other Penicillium spp. than in controls. When P. oxalicum and Penicillium spp. were subtracted from the total number of fungi, the population of rhizosphere fungi of P. oxalicum--treated seeds was not statistically different from controls. Seed treatment had no effect on Fusarium, actinomycetes or bacteria. Thus, P. oxalicum applied to seeds enhanced populations of other Penicillium spp. but did not affect other rhizosphere organisms.

POTENTIAL VECTORS OF BLACK STAIN ROOT DISEASE. J. Witcosky, J. Rudinsky, and E. Hansen, Oregon State University, Corvallis, Oregon 97331.

The role of insects in the Douglas-fir black stain root disease (Verticicladiella wagenerii) association is being evaluated. Trees (12-24 years old) were divided into 6 symptom classes by crown color and growth of the terminal shoot. Single trees from each class were excavated in September, November, March and May at 3 widely separated sites in western Oregon. Root systems were dissected and insects tallied and preserved. The beetles, Pissodes fasciatus, Steremnius carinatus, (Curculionidae) and Hylastes nigrinus (Scolytidae) are frequently associated with diseased trees. Larvae are found in black stained roots. Conidiophores of V. wagenerii, bearing viable spores, were found in galleries of H. nigrinus and in the larval galleries and pupal cells of P. fasciatus and S. carinatus. Preliminary results indicate that some of these beetles are contaminated with spores of V. wagenerii. Diseased root systems provide suitable host material for 2-4 years and may give rise to several generations of beetles.

DISTRIBUTION OF BLACK SIGATOKA DISEASE OF BANANAS AND PLANTAINS IN CENTRAL AMERICA. T. L. Woods, L. Jacome, and R. H. Stover, Tropical Research, United Fruit Company, La Lima, Honduras.

Black Sigatoka, caused by Mycosphaerella fijiensis var. difformis, is the most devastating leaf spot disease of bananas and plantains. The fungus is dispersed primarily by wind blown ascospores, infected planting material, and trash banana leaves used by truckers for padding and shade. The disease was first reported in Honduras in 1972. By the end of 1974, the pathogen had become established throughout the Ulua Valley, effectively replacing the Sigatoka pathogen, Mycosphaerella musicola, as the dominant leaf spotting organism. In 1975, the disease was observed in Belize. In 1977 it was detected in the Motagua Valley of Guatemala, with the resultant loss of 2.5 million boxes of bananas by the end of the year. In 1979 the disease was discovered in 3000 ha of plantains in the San Carlos region of Costa Rica, 500 km distant from the original focus in Honduras. The disease is now threatening extensive plantain and banana plantations on the coasts of Costa Rica and Panama.

CHARACTERISTICS OF WETWOOD IN WHITE FIR [ABIES CONCOLOR (GORD. & GLEND.) LINDL.]. J. J. Worrall, R. W. Schneider, and J. R. Parmeter, Jr., Department of Plant Pathology, University of California, Berkeley, California 94720.

Wetwood in white fir is the usual condition of the heartwood. It is characterized by a moisture content generally equal to or greater than that of sapwood, a slightly lower pH, and a brown color. Ray parenchyma is alive and starch-filled in the dry-appearing transition zone, but at the wetwood border nuclei disintegrate, starch disappears, and colored deposits accumulate. Evidence from histochemistry, UV absorption, and indicator reagents suggest phenol accumulation. Osmotic potentials ($\Psi\pi$) are consistently (often 6-8 times) lower than sapwood. Analyses of K, Na, and Ca indicate a selective accumulation of K in wetwood with concentrations of Na and Ca similar in the two tissues. Assuming a monovalent anion, the elevated levels of K are enough to account for much of the observed decrease in $\Psi\pi$. The data suggest an osmotic hypothesis to account for accumulation of water in wetwood.

MOVEMENT OF VIRUS WITHIN COWPEAS RESISTANT TO COWPEA CHLOROTIC MOTTLE VIRUS. S. D. Wyatt and T. C. Wilkinson. Dept. of Plant Pathology, Washington State University, Pullman, WA 99164.

The resistance of cowpea plant introduction (PI) 186465 to infection by cowpea chlorotic mottle virus, strain T, involves reduced virus replication and restricted virus movement. Within inoculated leaves, which are always symptomless, it is difficult to distinguish between uniformly reduced virus replication at the cellular level and a high virus-replicating capacity in only a few cells. Therefore, protoplasts were isolated at intervals from inoculated leaves and stained with virus-specific fluorescent antibody (FA). With the resistant reaction, the percent of protoplasts isolated at 4, 7, 11, 16, and 21 days which stained specifically for virus were respectively 1.2, 5.7, 9.9, 14.7, and 19.0. Strain R which causes a typical systemic infection gave a maximum of 33.6% FA- positives by 7 days. It is concluded that in the resistant reaction the initial number of replication sites is small but slowly increases at a constant rate. In both reactions the increase in infected protoplasts correlated directly with virus accumulation in leaves.

DRUG RESISTANCE PLASMIDS AS GENETIC TOOLS IN ERWINIA AMYLOVORA. J.G. Wyman, A.J. Trainer, and A.K. Chatterjee. Dept. of Plant Pathology, Kansas State University, Manhattan, KS 66506.

The plasmid R68.45, coding for ampicillin (Ap), kanamycin (Km), and tetracycline (Tc) resistance, was transferred to E. amylovora (EA225) from E. coli at a frequency of ca. 4×10^{-7}. In EA225 R68.45 the plasmid was stable, was transferred at high frequency (10^{-3}- 10^{-2}) but had limited chromosome mobilization ability of arg, his, thr, ilv, ser or rbs. Agarose gel electrophoresis of crude DNA extracts isolated from EA225 R68.45 revealed a plasmid of mobility identical to that of R68.45 from the E. coli donor as well as two resident plasmids of the EA225 parent. The plasmid RP_4:Tn7, conferring resistance to Ap, Km : streptomycin (Sm), trimethoprim (Tp), was transferred from E. coli to EA225 at a frequency of 1.5×10^{-3}. Nonselective subcultures of EA225 RP_4:Tn7 strains yielded spontaneous, presumptive Tn7 transpositional mutants that were virulent, prototrophic and Km sensitive but resistant to Sm, Tp and the RP_4-specific phage PRDI. The transposon Tn7 may be useful for genetic studies of E. amylovora.

EFFECTS OF OZONE AND SULFUR DIOXIDE ON THE APPARENT CARBON DIOXIDE EXCHANGE RATE OF EASTERN WHITE PINE (Pinus strobus L.). Yaw-Shing Yang, and John M. Skelly. Dept. of Plant Pathology and Physiology, VPI&SU, Blacksburg, VA 24061.

Three clones of eastern white pine with predetermined sensitivity to air pollution (sensitive, intermediate and tolerant respectively) were fumigated with 10 pphm ozone (O_3) and 10 pphm sulfur dioxide (SO_2) for 4 hr/day for 6 consecutive days. The carbon dioxide exchange rate (CO_2ER) of a single branchlet from each grafted scion was measured with an infrared gas analyzer hourly during, and 1 hr prior to and after the daily fumigation. O_3 and SO_2 decreased apparent CO_2 ER in all 3 clones during the fumigation periods. CO_2ER recovered after the termination of each day's fumigation. The magnitudes of CO_2 ER decrease and the rates of reduction or subsequent recovery varied among clones and pollutant treatments. There was a trend towards continuous decrease in relative CO_2 ER over the 6 day period in the sensitive clone while the tolerant clone exhibited a continuous increase. The measurement of CO_2 ER is a reliable indicator of clonal sensitivity to air pollution.

UNFORTUNATE NAMES OF DISEASES AND PATHOGENS. C.E. Yarwood, Dept. of Plant Pathology, University of California, Berkeley, CA 94720.

Late blight of potato caused by Phytophthora infestans usually appears earlier than early blight caused by Alternaria solani. Powdery mildews (Erysiphaceae) are not powdery (dry); their conidia contain more water than most airborne spores. Erysiphe is derived from the Greek erythros (red) and its application to the white powdery mildews is unfortunate. White mildews as used by Halsted (1884) would be a better common name for the Erysiphaceae. Erwinia amylovora does not dissolve starch. Pierce's disease virus and beet latent virus are now considered to be bacteria. Aster yellows virus and corn stunt virus are now considered to be mycoplasmas. Tobacco necrosis virus was named such because it caused necrotic lesions on tobacco leaves in greenhouses. But it may never have been found on tobacco in nature and is much more common in nature as a symptomless virus in roots of Lobelia, Cleome, and many other plants. Black root rot of bean is ascribed to Thielaviopsis basicola, but T. basicola produces a purple root rot of bean and cowpea and a red root condition of Cyperus.

VIRUS-LIKE INFECTIONS FROM PSEUDOPERONOSPORA, SPHAEROTHECA, THIELAVIOPSIS, AND UROMYCES. C. E. Yarwood, Dept. of Plant Pathology, University of California, Berkeley, CA. 94720.

When tobacco necrosis virus (TNV), tomato bushy stunt virus (BSV), Pseudoperonospora cubensis, Sphaerotheca fuliginea, Thielaviopsis basicola, or Uromyces phaseoli were inoculated to cucumber cotyledons (Cucumis sativus var. Ashley) systemic mosaic symptoms commonly but not consistently resulted in new growth, especially if zinc nitrate, manganese sulfate, zinc phosphate, and/or calcium glycerophosphate were added to the soil in which the indicator cucumber plants were growing. In at least 5 of the 6 above cases, this new growth was resistant to Sphaerotheca fuliginea. Most attempts to transmit an infection from this new growth beyond the cotyledons, including plants inoculated with TNV and BSV, were unsuccessful, but the few successes seemed to be favored by finger-grind inoculation, by bentonite and phosphate in the inoculum, by Chenopodium amaranticolor as an indicator host, and by quick drying of the inoculated leaves. The similarity of behavior of the four fungus infections and two viruses in cucumber is impressive.

ASSAY METHODS FOR RECOVERING CERCOSPORA SOJINA, C. KIKUCHII AND PHOMOPSIS SPP. FROM SOYBEAN SEEDS. J. T. Yorinori and J. B. Sinclair, Plant Path. Dept., Univ. of Ill., Urbana, 61801.

Seed plating on filter paper (FP) and PDA, surface disinfection and nondisinfection were compared for recovery of C. sojina (Cs), C. kikuchii (Ck) and Phomopsis spp. (Ph) from a mixture of Flambeau, Grant, Hawkeye and Norchief seeds collected from field plots inoculated with Cs. Treatments were: i - control, plated on FP; ii - 95% ethanol dip (2 sec) + wash with distilled water (FP); iii - ethanol dip + wash + 10% Clorox (4 min) + wash (FP); iv - Clorox + wash (FP); v - as iii on PDA; and vi as iv on PDA. Four samples of 100 seeds/treatment were plated at 15 seeds/plate on FP and 10 seeds/plate on PDA; and incubated for 5 days in 12 hr light (25 C) + 12 hr dark (22 C). Highest recovery of the 3 fungi was obtained with no surface disinfection, with lowest for treatments iii and v. Germination was highest when recovery of Ph was lowest. Generally, Cs and Ck did not affect germination. Surface disinfection can underestimate rate of transmission of seedborne fungi in soybeans.

IDENTIFICATION OF THREE DISTINCT BARLEY YELLOW DWARF VIRUS STRAINS IN MONTANA BY APHID TRANSMISSION AND ENZYME IMMUNOSORBENT ASSAY. D.J. Yount and T.W. Carroll, Dept. of Plant Pathology, Montana State Univ., Bozeman, MT. 59717.

Vector relationships of barley yellow dwarf virus (BYDV) were determined by aphid transmission using N.Y. biotypes of four aphid species maintained in Bozeman, MT. Two virus strains identified by aphid transmission were further confirmed by enzyme immunosorbent assay (EIA). A vector-specific strain transmitted efficiently by Macrosiphum avenae was obtained from cultivated oats in northcentral MT. A non-specific strain transmitted by M. avenae, Rhopalosiphum padi, and occasionally by Schizaphis graminum, was obtained from a barley field and greenhouse grown barley in Bozeman, MT. A second vector-specific strain transmitted efficently by Rhopalosiphum maidis was isolated from barley and barnyard grass in southcentral MT. In EIA, the M. avenae-specific and the non-specific isolates reacted strongly with the MAV and PAV immunoglobulins respectively. These two Montana variants of BYDV showed a strong similarity to the MAV and PAV strains of BYDV found in New York.

EFFECT OF ROOT ROT FUNGI AND VESICULAR-ARBUSCULAR MYCORRHIZAE ON THE ESTABLISHMENT OF RHIZOBIUM JAPONICUM ON NODULATED AND NON-NODULATED 'HARDEE' SOYBEANS. L. Zambolim and N. C. Schenck. Plant Path. Dept. Univ. of Fla. Gainesville, Florida 32611.

The effect of Glomus mosseae (Gm) at 500 chlamydospores/pot on Rhizobium japonicum (Rj) at 0.5% of seed weight, in the presence of Macrophomina phaseolina (Mp) at 40 sclerotia, Rhizoctonia solani (Rs) at 1 sclerotium and Fusarium solani (Fs) at 3,000 chlamydospores/g of soil, respectively, was studied in autoclaved soil (91.6 ppm P and pH 6.8) in a greenhouse. Root weight was significantly reduced by Mp, Rs and Fs. When Gm was added root, shoot weight and plant height were increased. The number and weight of nodules were greatly reduced by Mp, Rs and Fs but increased considerably in the presence of Gm. The percentage of roots colonized by Gm was reduced by Mp, Rs and Fs but Gm did not affect the severity of the disease. Total nutrients absorbed by shoots were reduced by Mp and significantly increased by Gm. Growth response to Gm was the same on nodulated and non-nodulated plants indicating that Rj did not have a significant effect.

INTERACTIONS BETWEEN A VESICULAR-ARBUSCULAR MYCORRHIZA AND ROOT-INFECTING FUNGI ON SOYBEAN. L. Zambolim and N. C. Schenck Plant Path. Dept. Univ. of Florida. Gainesville, Florida 32611.

Soybean growth responses in a greenhouse to Glomus mosseae (Gm) at 500 chlamydospores/pot in combination with Macrophomina phaseolina (Mp) at 40 sclerotia/g of soil, Rhizoctonia solani (Rs) at 1 sclerotium/g of soil or Fusarium solani (Fs) at 3,000 chlamydospores/g of soil were studied using autoclaved or field soil (91 ppm P and pH 6.7). Root, shoot weight and plant height were greatly reduced at 25 and 45 days in soil containing Mp, Rs or Fs; but these pathogens in combination with Gm resulted in growth responses similar to the non-inoculated control. Plant growth responses by Gm alone were significantly increased. Populations and disease severity of Mp, Rs and Fs were not significantly reduced by Gm but Mp, Rs and Fs reduced considerably the percentage of roots colonized by Gm. Soybean seed yield was reduced by Mp, Rs and Fs 20-30% in autoclaved soil and 10-16% in field soil, respectively. The results indicated that mycorrhizal plants could withstand more infection by the pathogens than non-mycorrhizal plants.

OIL THERMOTHERAPY OF SOYBEAN SEEDS. Tom Zinnen and J. B. Sinclair. Dept. of Plant Pathology, University of Illinois, Urbana, 61801.

Wells soybean seeds at 5% moisture were immersed in refined soybean oil at 90 C for 5 to 30 minutes in 5-minute increments. After immersion, all seeds were washed twice in 95% ethanol to remove the excess oil. Seeds were assayed on potato-dextrose agar after 5 days in the dark at 25 C. Germination was greatest (60%) in the nontreated control, intermediate (45%) in the 5 minute treatment, and least (30%) in the 30 minute treatment. Recovery of Phomopsis spp. was 9% in the control and less than 1% in all the other treatments. In a second study, seeds immersed for 5 weeks in soybean oil at room temperature (30 ± 2C) had the same germination as nonimmersed seeds. Heated soybean oil potentially may be used as a thermotherapeutant to control seedborne fungi.

THE EFFECT OF PYTHIUM ARRHENOMANES INFECTION AND CULTURAL FILTRATES ON WHEAT SEEDLING GROWTH. Oded Ziv and L. L. Singleton; Department of field crops, ARO. The Volcani Center. ISRAEL; and Department of Plant Pathology, Oklahoma State University, Stillwater, OK. 74078; respectively.

Pythium arrhenomanes isolates were grown in a glucose-glutamic acid liquid medium at pH 6.0. Pythium cell-free extracts were obtained through bacterial filters from isolates grown for 6 days at 21±1 C. Surface sterilized wheat seeds (cultivar TAM-101) were pregerminated (48h) in sterile water. After 24h one group was removed and exposed to infection by P. arrhenomanes. After 48h, the seedlings were subjected to the following treatments: uninfected growth in sterile medium, Pythium-infected growth in sterile medium, and uninfected growth in cell-free extract. After eight days, root and leaf lengths and fresh and dry plant weights were significantly reduced by the Pythium infection and the cell-free extract. The cell-free extract affect was slightly less than that of the Pythium infection. Measurement of increased ion conductivity of root segments in pure water indicated cell-free extracts inhibit water uptake.