

ABSTRACTS OF PAPERS

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ABSTRACTS

EFFECT OF CULTIVAR, TEMPERATURE, AND DENSITY OF MELOIDOGYNE INCOGNITA ON ROOT NECROSIS AND FUSARIUM WILT OF TOMATOES. G. S. Abawi and K. R. Barker, Depts. of Plant Pathology, Cornell Univ., Geneva, NY 14456 and N.C. State Univ., Raleigh 27650.

In greenhouse tests, 3- to 4-wk-old tomato seedlings (cv. Florida-Mhl, Manapal, Floradel, Nematex, Rutgers and Bonny Best) were inoculated with 0, 1, 5, 25, or 50 thousand eggs of *M. incognita* (MI)/15-cm pot. After 3 wk, 30 million washed conidia of *Fusarium oxysporum* f. sp. *lycopersici* (FOL; Race 1) were added per pot. Incubation temperature was 16±5, 30±5, 25, 30, or 35 C. Manapal and Florida-Mhl were also transplanted into field microplots (50x50 cm) and simultaneously inoculated with FOL and MI. Factorial analysis of the data showed no significant interaction between MI and FOL. However, numbers of MI were correlated with root necrosis ($r = 0.95^{**}$) and general wilting ($r = 0.83^{**}$). MI-infected plants showed greatest wilt and root necrosis symptoms at 30 C. At 35 C, Nematex became susceptible to MI but not to FOL in the presence of both organisms. Increase in disease severity appears additive and may involve saprophytic soilborne organisms.

INTERACTION OF SOUTHERN BEAN MOSAIC AND TOBACCO MOSAIC VIRUSES WITH LIPOSOMES. Aly M. Abdel-Salam, J.A. White and O.P. Sehgal. Dept. of Plant Pathology, University of Missouri, Columbia, 65211

Interaction of 125 I-labeled virions of southern bean mosaic virus (SBMV) and tobacco mosaic virus (TMV) with liposomes composed of phosphatidyl choline:cholesterol:stearyl amine was examined with sucrose gradient sedimentation and electron microscopy. Optimal virion:liposome interaction occurs at pH 7.5. Virion associated with liposomes are resistant to infectivity neutralization with antisera. The virion:liposome complex remained stable between pH 3 to 9, treatment with 0.1 M NaCl, or heating (60 C, 10 min). Exposure to 1% sodium dodecyl sulfate causes a release of intact and infectious virions from the liposomes. Electron microscopic examination revealed an intimate surface association of SBMV or TMV virions with liposomes, and in some cases particle engulfment. These observations indicate that in addition to electrostatic forces, hydrophobic interactions may be involved in virion binding to the liposomes.

DIFFERENTIATION OF TWO RHIZOCTONIA ISOLATES FROM WHEAT WITH SHARP EYESPOT. Musa A. Abdelshife and J. P. Jones. Dept. of Plant Pathology, University of Arkansas, Fayetteville, AR 72701.

A *Rhizoctonia* with binucleate hyphal cells (BNR) was compared with a multinucleate *Rhizoctonia* (MNR) as to growth rate in culture and pathogenicity to wheat. BNR was representative of isolates taken from sharp eyespot lesions on wheat culms and MNR of isolates from diseased roots. Radial growth on PDA showed BNR to grow most rapidly at 16-20, and MNR at 24-28 C. BNR showed negligible growth at 32 and MNR at 12 C. At comparable temperatures, MNR grew more rapidly than BNR. Seeds were planted in sand above a layer of inoculum in pots in growth chambers at 16 and 24 C. Significantly more pre- and post-emergent damping-off occurred with BNR inoculum at 16 than at 24 C but more sharp eyespot lesions developed at 24 C. More disease occurred with MNR at 24 than at 16 C but no eyespots were noted at either temperature. BNR attacked only the seedling coleoptile and MNR only the seed and root. BNR fits the description of *R. cerealis* and MNR *R. solani*.

BIOLOGICAL CONTROL OF CHONDRILLA JUNCEA (RUSH SKELETON WEED) WITH PUCCINIA CHONDRILLINA IN WASHINGTON. E.B. Adams and R.F. Line, Department of Plant Pathology, Washington State University, Pullman, WA 99164.

Puccinia chondrillina, an autoecious, macrocyclic rust, was introduced into Washington as a biological control agent of *Chondrilla juncea* (Rush Skeleton Weed) in 1978. By 1980 the rust spread 2 miles from the original release site. All spore forms have been observed in Washington. The rust has overwintered in Washington as teliospores. Teliospores developed in stem lesions on plants in the field beginning in July and were capable of germinating as early as November. However, pycnia and aecia are only observed in the field in the early spring. During the unusually mild winter of 1980-1981 the rust also

overwintered as uredia. Urediospores can infect all above ground plant parts. In 1980 the rust increased until an average of 5% of the leaf and stem surfaces were covered by uredia. An infection intensity of 5% on the stems reduced the number of flowers by 50%, viability of the seed by 40%, plant height by 2% and total plant size by 21%.

HETEROHALLISM AND HOMOTHALLISM IN THANATEPHORUS CUCUMERIS (FRANK) DONK THE SEXUAL STATE OF RHIZOCTONIA SOLANI KUEHN. Gerard C. Adams Jr. and Edward E. Butler. Department of Plant Pathology, University of California, Davis, CA 95616.

Thanatephorus cucumeris is generally considered to be homothallic. Early research examined sexuality in anastomosis groups (AG) 1 and 2. It is now possible to precisely control fruiting of AG-4 and AG-1 in vitro. Controlling the nitrogen concentration in the growth medium, providing a nutrient transition to a basal medium without nitrogen or carbon, preventing buildup of respiratory CO₂, and controlling drying of the medium induced fruiting. Ten isolates of AG-4 and four of AG-1 obtained from diverse localities were chosen; from these, single spore cultures were tested for homothallism. Single spore isolates were determined to be homokaryotic and uninucleate by H-factor analysis and nuclear staining. New heterokaryons, synthesized from self sterile single spore cultures, were induced to fruit. The majority of AG-4 isolates induced to fruit on agar medium were heterothallic; the AG-1 isolates examined were homothallic.

DETECTION OF PIERCE'S DISEASE BACTERIUM IN WILD PLANTS IN FLORIDA. W. C. Adlerz and D. L. Hopkins. University of Florida, IFAS, ARC Leesburg, FL 32748.

Fluorescence microscopy, culture on JD-3 agar medium, and ELISA assay techniques were used to determine natural infection in various weeds and wild plants with the bacterium of Pierce's disease (PD) of grapevines. Typical PD symptoms developed in grapevines inoculated with bacteria cultured from the vitaceous plants *Ampelopsis arborea* (pepper vine) and *Parthenocissus quinquefolia* (Virginia creeper) and from *Sambucus canadensis* (American elder). Symptom expression in the wild plants was especially marked in Virginia creeper and American elder. Tissue extracts from *Callitriche americana* (American beautyberry), *Baccharis halimifolia* (eastern baccharis), *Solidago fistulosa* (goldenrod), and *Rhus* sp. (sumac) gave positive ELISA reactions, but we were able to culture bacteria only from American beautyberry.

TRANSMISSION OF SPIROPLASMA CITRI BY TWO LEAFHOPPER VECTORS IN ARIZONA. R.M. Allen and C.R. Donndelinger, Dept. of Plant Pathology, University of Arizona, Tucson, Arizona 85721

Naturally infective beet leafhoppers (*Circulifer tenellus*), collected from Russian thistle (*Salsola kali*) in the vicinity of Tucson, Arizona, transmitted *Spiroplasma citri* to 10 of 18 species of healthy seedlings including sweet orange, periwinkle, zinnia, marigold, Italian Squash, onion, radish, turnip, Swiss chard and celery. Symptoms on the first six were like those noted on naturally infected, field-grown plants yielding spiroplasmas in culture. Italian squash, Swiss chard, and possibly celery are new additions to the host range of *Spiroplasma citri*. Serological and nutritional tests showed that isolates from all plant species were identical to those obtained directly from the leafhoppers. A second known vector, *Scaphytopius nitridus*, collected from *Cassia didymobotrya*, also appeared to be naturally infective. As few as five, fifth-stage nymphs of this species transmitted spiroplasmas from periwinkle to periwinkle.

ULTRASTRUCTURE OF INCOMPATIBLE REACTIONS IN COTYLEDONS OF COTTON LINES: WITH EMPHASIS ON RECOGNITION. Almousawi, A.I., Richardson, P., and Essenberg, M. OSU, Stillwater, OK 74078. Johnson, W. Langston Univ., Langston, OK 73050 and OSU, Stillwater, OK 74078

A susceptible cotton line (Ac44) and an immune line (Im216)

were inoculated with live and with heat-killed cells of the cotton pathogen *Xanthomonas malvacearum*. Live incompatible bacteria of *X. campestris*, a cabbage pathogen, were used in separate studies with the above cotton lines. The above inoculations were with or without latex beads of 0.5 μ m diameter. Envelopes formed around heat-killed *X. malvacearum* cells in Ac44 and Im216, around live *X. malvacearum* in Im216 and live *X. campestris* in Ac44, but not around live *X. malvacearum* or latex beads in Ac44. These observations suggest that all incompatible bacteria are recognized in cotton cotyledons and enveloped, while compatible pathogenic bacteria and inert latex beads of similar size are not recognized and enveloped.

INFLUENCE OF TRIFLURALIN AND EPTAM ON FUSARIUM INFECTION AND RHIZOBIUM NODULATION IN PINTO BEANS. Jack Altman. Colorado State University, Fort Collins, CO 80523.

Hypocotyl lesion size and root rot symptoms caused by *Fusarium solani* f. *phaseoli* were increased on several pinto bean varieties when infested soil was pretreated with 1 or 2 ppm Trifluralin (a,a,a-trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine) or 1.5 and 3 ppm Eptam (s-ethyl-dipropylthiocarbamate). A 50 to 75% increase in lesion size occurred in soil pretreated with Eptam or Trifluralin on the varieties San Juan Select and Olathe. However, a 30% reduction in lesion size occurred on NW 410, a variety known to have some field resistance to *Fusarium*. Root rot symptoms increased in all varieties grown in the herbicide treated soil. Plant height and number of nodules were reduced in San Juan Select, Olathe and UI 114 when seed was treated with a *Rhizobium* sp. inoculum (NITRAGIN Company) and grown in 1 ppm Trifluralin, 3 ppm Eptam and a combined Trifluralin + Eptam treated soil. (NW 410 was not included in this latter test.)

A SIMPLE TECHNIQUE FOR INFUSING TETRACYCLINE INTO PALM TREES. Jose Amador, Randolph E. McCoy, Marvin Miller. 2401 E. Highway 83, Westlaco, Texas 78596; 3205 S.W. College Avenue, Fort Lauderdale, Florida 33314

Tetracycline infusion has proven an efficient treatment for the control of lethal decline or lethal yellowing of palm trees, caused by mycoplasma-like organisms. However, to be effective, treatment must be repeated indefinitely every 3 - 4 months. A simple technique for treatment is currently being tested, using a short piece of approximately 3/4" internal diameter plastic pipe. The pipe was cut in lengths of 6 - 7" and inserted permanently into a hole drilled at a downward angle in the tree trunk. The pipe was inserted approximately 3" deep in coconut palms and approximately 6" deep in ornamental date palms. A solution containing 3 grams a.i. of tetracycline in 70 - 100 ml. of water was poured into the pipe in each tree and the pipe was corked. Some trees absorbed the solution readily, sometimes within minutes. Leaf analyses are currently being conducted to check the movement of tetracycline inside the tree and the efficacy of treatments is being evaluated by observing remission of symptoms in infected trees.

MICROFLORA ASSOCIATED WITH CHEMICAL INJECTION TO CONTROL DUTCH ELM DISEASE. J. L. Andersen and R. J. Campana, Dept. of Botany and Plant Pathology, University of Maine, Orono, ME 04469.

Wounds made to inject fungicides for control of Dutch elm disease are infection courts for microorganisms. To determine the microflora in wounded tissue, a study was made involving 60 trees and 180 injection wounds. The trees were injected with thiabendazole (TBZ) plus solvent, solvent alone, or water; and were removed and dissected over a 3-year period. Isolations of microflora were made from or around, wound-initiated, discolored wood. Sensitivity of the most dominant microflora to TBZ was tested *in vitro*. By frequency of isolation, bacteria were dominant over other microflora; Basidiomycetes dominated the fungi isolated from TBZ-treated trees. Bacteria isolated most frequently were species of *Enterobacter* and *Klebsiella*. *Flammulina velutipes* was the most common Basidiomycete. The data show that tissue killed by TBZ was colonized extensively by bacteria and fungi, that this decreased the living sapwood able to resist infection, and that bacteria and wood decay fungi in wounded elm tissue were favored by the fungicide.

ANTAGONISM OF APPLE PHYLLOPLANE MICROBES TO VENTURIA INAEQUALIS. J. H. ANDREWS and F. M. BERBEE, Dept. of Plant Pathology, Univ. of Wisconsin, Madison, WI 53706

Antagonism of apple phylloplane microbes to two strains of *V. inaequalis* was evaluated by growth inhibition on potato agar; reduction in germination and germ tube length on leaves and on agarose-coated slides; and lesion size, number, and conidial production. The best antagonists inhibited the pathogen in most assays, although their relative effectiveness varied between *in vitro* and *in vivo* trials and against *Venturia* strains. Promising antagonists were *Chaetomium globosum*, *Aureobasidium pullulans*, *Trichoderma viride* and an actinomycete. On agar these reduced *Venturia* total growth indices from 5 to 0.9, 2.4, 1.6 and 0.4, respectively. *Chaetomium* and *Aureobasidium* reduced germination 78% and 15% and germ tube lengths 91% and 46%, respectively; they consistently reduced lesion size and number, and conidial numbers, apparently by nutrient competition and antibiosis.

INTERNAL INJURY ASSOCIATED WITH SYSTEMIC INJECTIONS OF ELMS FOR THE CONTROL OF DUTCH ELM DISEASE. M.W. Andrews, R.A. Blanchette and D.W. French, Department of Plant Pathology, University of Minnesota, St. Paul, MN 55108.

Sixteen healthy American elms, mean dbh 28.6 cm, were treated with injections of Arbotect 20-S (3g/l, 1.86 l/cm dbh), Lignasan BLP (0.825 g/l, 1.86 l/cm dbh), water (1.86 l/cm dbh) and non-injected control wounds. Trees were felled 6 and 9 months after treatment to determine volume of discolored wood and successions of microorganisms associated with each treatment. The Arbotect treatment caused a significantly greater lateral extent of discoloration and volume of discolored wood as compared with non-injected, water and Lignasan treatments. Bacteria and hyphomycetes were the predominant microorganisms isolated from the non-injected and water-injected wounds. Basidiomycetes, although low in numbers, were found to be associated with the Arbotect treatment. Injection of elms with Arbotect alters the normal defense response of the tree and the successional patterns of microorganisms in a manner similar to that of paraformaldehyde pills in sugar maple tapoles.

SCREENING PHASEOLUS VULGARIS LINES IN THE SEEDLING STAGE FOR RESISTANCE TO BACTERIAL BROWN SPOT CAUSED BY PSEUDOMONAS SYRINGAE. S. H. Antonius and D. J. Hagedorn, Dept. of Plant Pathology, University of Wisconsin-Madison, Madison, WI 53706.

A method of inoculation and evaluation has been developed which allows differentiation in the seedling stage of snap bean lines Wis 17, 28, and 130, which are resistant as adult plants, from the susceptible cvs 'Eagle' and 'Tenderwhite'. Hypocotyls of 8-day-old seedlings are injected with 1 μ l of a bacterial cell suspension (10^6 - 10^{10} cfu/ml) using a Hamilton repeating dispenser with attached 50- μ l syringe. Inoculated seedlings are incubated at 22-25 C and 3 k lux with a 15-hr photoperiod. Four to 6 days after inoculation, seedlings are rated (1-5) for disease severity. Analysis may be based on mean severity rating, the ratio of estimated LD₅₀'s (log-dosage required to kill 50% of the population), or estimated RT₅₀'s (log-response time at which 50% of the host population is killed). The technique may be applied to breeding programs, as the survivors of the test can be rescued and used in crossing schemes.

RESISTANCE IN WINTER WHEAT TO MELOIDOGYNE INCOGNITA.

Louis Anzalone, Jr. and W. Birchfield, Dept. of Plant Pathology and Crop Physiology, and USDA, SEA, Louisiana State Univ., Agric. Exp. Sta., Baton Rouge, La. 70803.

Since winter wheat is used to double crop with soybeans, cotton, and vegetables in Louisiana the reaction of six cultivars Arthur 71, Coker 747, Coker 58-15, McNair 1003, McNair 1813, and Delta Queen to root-knot nematodes was determined. The wheat cultivars were planted in 20 cm clay pots of steam-sterilized soil. In four pots of each cultivar nematodes were introduced at a rate of 500 larvae per pint of soil. Four pots of each cultivar without nematodes added to the soil were planted as controls. Four pots of root-knot susceptible tomatoes with nematodes added to the soil were also planted as controls. The design was a randomized complete block, replicated four times. At maturity the plants were removed and the roots indexed for galling and egg-masses. The Horsfall-Barnett index system was used for making ratings. Ratings for the six cultivars ranged from 0 to 0.5 indicating that all of the cultivars tested were highly resistant to root-knot nematode, *Meloidogyne incognita* group.

TEMPORAL DISTRIBUTION OF ERWINIA CAROTOVORA VAR. ATROSEPTICA AND ERWINIA CAROTOVORA VAR. CAROTOVORA IN FIELDS OLD AND NEW TO POTATO PRODUCTION. J.D. Apple and M.L. Rowelson, Dept. of Bot. & Pl. Path., OSU, Corvallis, OR 97331.

The temporal distribution of *Erwinia carotovora* var. *atroseptica* (Eca) and *Erwinia carotovora* var. *carotovora* (Ecc) was studied during the 1980 growing season. Three sets of field plots, planted with one seed lot each of Norgold Russet and Russet Burbank, were located in the Klamath Basin and the Columbia Basin of Oregon. Of the two fields located in the Columbia Basin, one was new to potato production, while the other two fields had a history of potato production. Percent plant infection by Eca was greater at the beginning of the season for all plots and both varieties when compared to the percent plant infection later in the season. The variation in percent plant infection by Eca was greater in Norgold Russet than in Russet Burbank both between old and new plots and over time. In both older plots of Norgold Russet, the percent of Eca recovered at the second sampling date (18% and 32%) was much greater than that recovered at the end of the season (12% and 3%). In the newer field and for all sampling dates, less Eca was recovered in both Russet Burbank (0%) and Norgold Russet (11%). Percent plant infection with Ecc increased over time in the older fields, and during the first two sampling dates in the new field. Recovery of Ecc in Norgold Russet in the new field appeared delayed in time (ca. 20 days) when compared to both older fields.

CYTOLOGICAL ALTERATIONS INDUCED BY PERICONIA CIRGINATA TOXIN IN THE OUTER ROOT CAP OF SORGHUM. J.A. Arias, C.E. Bracker, and L.D. Dunkle*. Dept. of Botany and Plant Pathology, USDA-SEA*, Purdue University, W. Lafayette, IN 47907.
Roots of seedlings susceptible (S) and resistant (R) to

Periconia circinata were exposed to 500 ng/ml of the host-specific toxin from P. circinata (treated) or to water (control) for 0.25, 2, 4, 8, and 12 hr. Cytologically, treated R-seedlings were similar to controls. In outer root cap cells of S-seedlings treated for 2 hr, hypersecretory activity was lost, vacuolation increased, and starch grains were diminished. Longer treatments resulted in further vacuolation, loss of starch, smaller plastids, pleomorphic dictyosomes with fewer cisternae, regularly stacked ER cisternae, and cellular autolysis. Before autolysis no lesions were observed in plasma membrane or tonoplast, and mitochondrial morphology was normal. Root cap size remained constant until autolysis, after which there was some shrinkage. Mitosis was inhibited in the apical meristem of S-seedling roots after treatments of 2 or more hr. Many of the alterations are similar to those observed by Mollenhauer (pers. comm.) in outer root cap cells of maize treated with KCN.

INFLUENCE OF METHYL GLUCOSE ON DEVELOPMENT OF INFECTION CUSHIONS OF RHIZOCTONIA SOLANI. V.N. Armentrout and D.L. Grasmick, California State Polytechnic University, Pomona, CA 91768.

3-O-methyl glucose (MEG) has previously been shown to inhibit or retard infection of plants by Rhizoctonia solani. This study was to investigate this effect of MEG on infection of cotton seedlings by R. solani (AG 4). Under control conditions, infection cushions were fully formed at 24 h postinoculation (DSI = 4), whereas on MEG-treated seedlings, hyphae had merely grown along the hypocotyl without the extensive branching which precedes infection cushion formation (DSI = 1.76). There was no difference in linear growth of hyphae along the hypocotyl. A factorial analysis of MEG and glucose at different concentrations indicated no interaction between them; the DSI decreased with increasing concentration of MEG while increased glucose concentration had no effect. Addition of MEG at 2 h intervals postinoculation resulted in decreased DSI's when MEG was added before 16 h postinoculation but not after 16 h. A description by scanning electron microscopy of infection cushion development as affected by MEG will be presented.

VIRULENCE PATTERNS IN USTILAGO AVENAE ON OATS. D. C. ARNY, D. T. CAINE and F. B. DIEZ. Dept. of Plant Pathology, Univ. of Wisconsin, Madison, WI 53706

Pathotypes of U. avenae with virulence on several previously resistant oat cultivars have evolved in recent years. Tests with a number of Wisconsin collections have shown a complete range of reactions among commonly grown cultivars. Ajax, Froker, Garry, and Lodi were susceptible to most collections. Dal, Goodland, Lyon, Marathon, and Moore were resistant to most. Only Jaycee and three advanced selections were highly resistant to all collections. There was a wide range of virulence patterns on the 13 oat smut differentials. All collections were virulent on Anthony, Black Diamond, Black Mesdag, and Victory, and none was virulent on Camas of Markton. Two collections fit the previously described race 4. Fourteen other virulence patterns were obtained and all were different from described races. Although the genetic makeup of the differentials for smut reaction is not known, virulence formulae should be useful in characterizing smut collections.

BUD ROT OF WASHINGTONIA PALMS. R. A. Atilano, University of Florida, AREC, 3205 SW 70th Ave., Ft. Lauderdale, FL. 33314.

A disease previously unreported in Florida was found to be responsible for the death of 2-5 year-old Washingtonia robusta Wendl. palms in a field nursery. The symptoms were wilt of the youngest leaves which showed a dull green color that progressed to a green-brown and eventually light brown as the leaves died and desiccated. The oldest mature leaves were unaffected. Internal symptoms were a soft, gray, odoriferous rot of the bud and adjacent tissue. A Phytophthora sp. was consistently isolated from both diseased trees and surrounding field soil. The fungus grew best on PDA at 27-30 C. Symptoms identical to those observed in the field nursery developed in 1-2 year-old palms following artificial inoculation of petiole bases with tree and soil isolates applied as 1-cm diam discs of 2-week old, V-8 juice agar cultures. Evidence suggests that wounds on petiole bases made during pruning are entry ports for the fungus.

ENZYME-LINKED IMMUNOSORBENT ASSAY versus TRANSMISSION ASSAY FOR DETECTION OF OAT BLUE DWARF VIRUS IN ASTER LEAFHOPPERS. M. Azar and E.E. Bantari, Department of Plant Pathology, University of Minnesota, St. Paul, MN 55108.

In two comparisons of enzyme-linked immunosorbent assay (EIA) and 1 wk transmission assays for detection of oat blue dwarf virus (OBDV) in aster leafhoppers, 27 of 145 (19%) were positive by both assays. In three additional experiments leafhoppers caged continuously on infected oats were transferred individually to seedling oats for three successive weekly changes (transmission assay = TA). The leafhoppers were then triturated; one part was used for EIA and the remainder was used to inoculate virus free leafhoppers (inoculation assay = IA). Of 46 leafhoppers assayed by the three methods, 28 (61%) were positive

by TA, EIA and IA. Six (13%) leafhoppers were negative by TA but positive by EIA and IA. Three leafhoppers (7%) were negative by TA and EIA but positive by IA. Nine (19%) leafhoppers were negative by all assay methods. These results suggest that a high percent of aster leafhoppers (81%) may be infected with OBDV after acquisition access feeding on infected oats and some of these may be only carriers of the virus.

A MICROCOMPUTER BASED SYSTEM FOR EVALUATION OF DWARF MISTLETOE IMPACT IN BLACK SPRUCE STANDS. F.A. Baker and P.J. Scherman, Department of Plant Pathology, University of Minnesota, St. Paul, MN 55108.

DMLOSS, a simulator of mortality and spread in Arceuthobium pusillum infested black spruce stands (Picea mariana), was modified for use on an Apple II microcomputer. Stand boundaries and infection center location and size are digitized from aerial photographs. Site index, stand age, and stand density are entered from the keyboard. Areas of infection, stand value and control costs, projected for 10-year intervals to a predetermined rotation age, are printed for each stand. If desired, they can be compiled to provide estimates for larger areas. This system provides a relatively inexpensive method for dwarf mistletoe loss assessment over large, inaccessible areas of black spruce.

EVIDENCE FOR NON-PATHOGENICITY OF THE MYCOPHAGOUS NEMATODE APHELENCHUS AVENAE. G. L. Barnes, C. C. Russell and W. D. Foster. Department of Plant Pathology, Oklahoma State University, Stillwater, OK 74078.

Because Aphelenchus avenae has a demonstrated potential for biological control of soilborne fungal pathogens, a determination of its potential for pathogenicity to various agronomic and vegetable crops was made. Twenty two crops (19 genera and 7 families) were grown individually in triplicated 6 inch pots of non-sterile soil for 4 weeks in the presence of 1 million A. avenae per pot. Roots were harvested, washed free of soil, incubated in water and the water was examined microscopically for presence of A. avenae. Determination of soil populations of A. avenae were also made. Though populations of A. avenae persisted, no evidence of nematode reproduction was found and all plants were healthy. Genera tested were: Arachis, Avena, Brassica, Citrullus, Cucumis, Glycine, Gossypium, Hibiscus, Hordeum, Lycopersicon, Medicago, Phaseolus, Pisum, Raphanus, Secale, Sorghum, Triticum, Vigna, and Zea.

HISTOPATHOLOGY OF FUSARIUM MONILIFORME VAR. SUBGLUTINANS IN SLASH AND LOBLOLLY PINE SEEDLINGS. Jane B. Barrows-Broadus, USDA For. Serv., Southeast. For. Expt. Sta., Athens, Ga. 30602

Two-year-old slash (Pinus elliottii var. elliottii) and loblolly (P. taeda) pines were inoculated with isolates of Fusarium moniliforme var. subglutinans (FMS), the causal agent of pitch canker. Inoculations were made by needle puncture of the shoot epidermis through a droplet of conidial suspension. Samples were collected at regular intervals after inoculation and processed using standard histological techniques. FMS rapidly grew intercellularly from the cortex through the xylem rays to the pith. The parenchyma cell walls collapsed causing the cortex to disintegrate and producing gaps in the rays and pith. Affected cells were filled with globules of unknown composition. Traumatic resin ducts in the xylem were clustered at the boundaries of infected tissues. The epithelial cells lining the ducts and the ray parenchyma associated with them became hypertrophied before they were degraded by FMS. Although xylem tracheids also became plugged, the fungus did not appear to attack these cell walls.

EFFECTS OF HOST-SPECIFIC TOXIN FROM ALTERNARIA ALTERNATA F. SP. LYCOPERSICI ON TOMATO SUSPENSION CULTURES. S. Barsel, Department of Botany and Plant Pathology, Michigan State University, East Lansing, MI 48824.

Host-specific toxin from A. alternata f. lycopersici was tested for effects in cell cultures of Lycopersicon esculentum. In leaflet bioassays, resistant cvs tolerated 1000-fold higher concn of partially purified toxin than did susceptible. Toxin was added to suspension cultures of resistant and susceptible cvs at 0.2 - 4000 µg/ml. Resistant (cvs Walter, Ace) and susceptible (cvs Earlypak-7, VFN-Bush) genotypes, plus Nicotiana tabacum Wisc 38 were examined. Medium-induced alterations of phenotype were ruled out. Toxin effects on culture growth (dry wt, settled cell volume) and mortality (bromphenol blue stain) were assayed. Susceptible genotypes were affected more than were resistant genotypes, as indicated by growth inhibition, cell death, and discoloration. Growth inhibition and cell death were not strictly correlated. Cell culture selections for toxin and disease resistance are feasible, because genotype differences are maintained in suspension culture.

REDUCED SURFACE TENSION OF SUSPENSIONS OF *ERWINIA CAROTOVORA* SUBSP. *CAROTOVORA* INCREASES THE POTENTIAL FOR INFILTRATION OF IMMERSED TOMATOES. J. A. Bartz, U. of Florida, 1419 HSP, Gainesville, FL 32611.

Tomatoes immersed in suspensions of *Erwinia carotovora* subsp. *carotovora* (Ecc) in water may absorb water and Ecc through the stem scar tissues. In storage, such fruits rapidly decayed. Submersed fruit were immediately subjected to fluid or water-head forces, but infiltration usually did not occur instantaneously with immersion even to depths as great as 122 cm. The hydrophobic stem scar tissues resisted the intrusion of water. However, if the surface tension of a suspension was reduced by increased temperatures or surfactants, the potential for infiltration was increased. Fruit at 37 C immersed to 1 cm for 10 min in suspensions of Ecc at 20 C with or without 0.01% v/v Tergitol-7 gained an average of 0.5 or 1.3 g/fruit, respectively. Tomatoes immersed in suspensions of Ecc with depths, temperatures and times similar to those observed in commercial packinghouse flume systems were infiltrated only if surfactants were added to the suspensions.

EPIDEMIOLOGICAL STUDY OF *ERWINIA TRACHEIPHILA* WITH IMMUNOFLOURESCENCE TECHNIQUE. A. Bassi, Jr., Dept. of Plant Pathology, Univ. of Ark., Fayetteville, AR 72701.

Erwinia tracheiphila (ET) was detected from cultures, 12-spotted cucumber beetles, striped cucumber beetles, cucurbit plants, and several perennial non-cucurbit weed species using the fluorescent antibody stain technique. Antisera against sonicated cell fragments and glutaraldehyde-fixed whole cells were produced in rabbits by weekly subcutaneous nape zone injections. Specificity of the antisera to ET was evaluated in Ouchterlony double gel diffusion, microagglutination, and indirect fluorescent antibody stain tests. No cross reactivity was observed with any of the three tests in comparisons with other phytopathogenic bacteria including several *Erwinia* species. Thirty weed species and cultivated plants collected in the vicinity of a cucumber breeding nursery in which bacterial wilt occurred annually were screened for ET. Eggs, feces, intestines, mouth parts and esophagi of striped and 12-spotted cucumber beetles collected in the vicinity of the nursery were also screened for ET.

TOLERANCE TO RHIZOCTONIA SOIL ROT OF TOMATO. W. E. Batson, Jr. and E. L. Moore. Department of Plant Pathology and Weed Science and Department of Horticulture (deceased) respectively, Mississippi State University, Mississippi State, MS 39762.

Soil rot of tomato caused by *Rhizoctonia solani* is a serious fruit disease of nonstaked tomatoes in the Southeastern United States. Favorable conditions for disease development and the ubiquitous nature of *R. solani* combine to make soil rot a limiting factor in production of tomatoes for processing. Chemical control, effective in years of low rainfall, provides an unacceptable level of control during years of excessive rainfall. Consequently, the development of varieties with resistance to soil rot offers a preferred method of control. Breeding lines from crosses of PI 193407 and selected susceptible varieties offer high levels of tolerance to *Rhizoctonia* soil rot. These F₇ generation lines, in screening tests, exhibit less than 50% of the soil rot exhibited by the susceptible parent. The development of processing varieties with resistance to soil rot would open the Southeast to production of processor tomatoes.

PEPTIDE MAP ANALYSIS OF CYANOGEN BROMIDE CLEAVED CAPSID PROTEINS OF CLOVER YELLOW VEIN AND BEAN YELLOW MOSAIC VIRUSES. R. H. Baum and O. W. Barnett., Dept. of Plant Pathology & Physiology, Clemson University, Clemson, S. C. 29631

Single lesion and field isolates of bean yellow mosaic virus (BYMV) [Pratt, B4-3 strains] and clover yellow vein virus (CVV) [Pratt, C-81, BYMV-S strains] were homogenized in 1g/2ml 0.5M potassium phosphate, pH7, -1M urea (PU) containing 0.5% thioglycolic acid, 0.01M NaDIECA and 5g/8ml chloroform, precipitated with 0.25M NaCl and 4% PEG 8000, resuspended for 2 hr in PU with 1% Triton X-100, centrifuged 9,000g 20 min, reprecipitated with PEG, resuspended in PU + 0.3g Cs₂SO₄ per ml, subjected to equilibrium density centrifugation and freeze dried in 0.02M Tris pH7. Purified viruses were infective and gave only one protein band (35,000 daltons) on SDS-PAGE gels. CNBr cleaved capsid proteins were analyzed by DISC-PAGE and on isoelectric focusing gels. Peptide maps were reproducible from purification to purification for each strain whether field or single lesion isolate. Distinctive peptide patterns allowed strain differentiation.

DIFFERENTIATION OF PEANUT MOTTLE VIRUS STRAINS BY REACTION OF SOYBEAN CULTIVARS. D.C. Bays and S.A. Tolin, Department of Plant Pathology & Physiology, Virginia Polytechnic Institute & State University, Blacksburg, Virginia 24061.

Strains of peanut mottle virus (PMV) were isolated from soybean (*Glycine max* (L.) Merr.) or recovered as variants from a single

1974 soybean field isolate. Most strain cultures were initiated from single necrotic lesions on bean (*Phaseolus vulgaris* L. cv. 'Top Crop'). Classification into strain groups was based on reaction of two susceptible soybean cultivars (Essex and Lee) and three resistant cultivars (Peking, Virginia and York). None of the strains infected Peking. Four strain groups were recognized by differential reactions of Virginia and York. Virulent strains induced systemic mottle and occasionally local necrosis but no systemic necrosis. Although all strains infected Essex and Lee, there was variation in symptom severity between and among strain groups. This preliminary work establishes a basis for a soybean cultivar differential series to classify naturally occurring PMV strains.

CONTAMINATION OF SRI LANKAN FOODS WITH AFLATOXINS. G. A. Bean and S. Bandara, Dept. of Botany, University of Maryland, College Park, MD 20742 and Dept. of Agricultural Biology, University of Peradeniya, Peradeniya, Sri Lanka.

In 1980 a survey of Sri Lankan foods for aflatoxins was begun to determine if the consumption of aflatoxins may be responsible in part for the reported increase in liver disorders in this tropical country. One kg samples of various food staples were collected from 2 locations and then analyzed for aflatoxins using a minicolumn method with thin layer chromatography. The commodities most frequently contaminated with aflatoxins were rice, the major staple in this country, and groundnuts (peanuts). Rice that was parboiled before being sold contained higher levels of aflatoxin than non-processed rice. All but 2 of 10 groundnut samples were contaminated with aflatoxins B₁ and B₂; the levels ranged from 40 µg/kg to over 300 µg/kg. However, aflatoxin producing strains of *Aspergillus* spp. were isolated from all groundnut samples. Steps in the harvesting and processing of Sri Lankan foods and their influence on aflatoxin development will be discussed.

PROGRESSION DYNAMICS OF GRAY LEAF SPOT INDUCED BY *CERCOSPORA ZEA MAYDIS* ON CORN. Beckman, P. M., G. A. Payne, and C. L. Campbell. Dept. of Plant Pathology, N. C. State University, Raleigh, NC 27650.

Gray leaf spot (GLS) severity was assessed 4 times between 20 July and 17 August, 1980, on 10 corn hybrids using the Horsfall-Barratt rating system. Four leaves on each of 8 plants were assessed in 3 replicate plots for each hybrid. Temperature, RH, and rainfall were recorded. The logistic model was more appropriate than the monomolecular model for describing disease increase. Disease severity on the second leaf below the ear leaf and on the whole plant (4 leaves) were significantly correlated. Final disease severity ranged from 5.5 to 71.9% and the apparent infection rates ranged from 0.05 to 0.54. Results indicate high temperature and low rainfall are not range limiting factors for GLS; however, occurrence of severe disease after full canopy development and localization of GLS within a field or among fields suggest other microclimatic factors, e.g. RH, are important in disease development.

TOWARDS BIOLOGICAL CONTROL OF FIRE BLIGHT

S. V. Beer, Department of Plant Pathology, Cornell University, Ithaca, NY 14853

Bacteria that are not pathogenic to apple and pear are being studied for use as potential biological agents for the control of fire blight. Strains of *Erwinia herbicola* and other non-pathogens have been evaluated for their influence on the incidence of fire blight infection of apple blossoms and immature pear fruit. A bacteriocin produced by a strain of *E. herbicola* that inhibits *E. amylovora* in vitro has been tested too. In pear fruit in the laboratory, strains of nonpathogens differ in their ability to suppress *E. amylovora*. In the orchard, two strains of *E. herbicola* provided control of blossom infection that was equivalent to that achieved with 100 mg/l of streptomycin. One strain produces a bacteriocin (MW=800) in vitro, that inhibits *E. amylovora*; the other strain does not. The degree of fire blight control obtained by treating apple blossoms with living bacteria was related directly to the bacterial concentration used. Bacteriocin preparations from *E. herbicola* also reduced the incidence of infection.

HOT-WATER CURE FOR SUGARCANE MOSAIC AND RATOON STUNTING DISEASE IN SUGARCANE. G. T. A. Benda, USDA-SEA-AR Sugarcane Field Lab., Houma, LA 70361.

The two major systemic diseases of sugarcane in Louisiana are sugarcane mosaic (strains H and I) and ratoon stunting disease. Ratoon stunting disease is controlled by a single heat treatment which does not control sugarcane mosaic. Sugarcane mosaic alone or the two diseases together can be controlled in seed cane of most commercial cultivars if the stalks are treated before planting by immersing them in hot water on three successive days. The treatment sequence consists of 5 minutes at 57.3 C on the first day, 40 minutes at 55.0 C on the second day, and 35 minutes at 57.3 C on the third day. Disease control is improved if the most immature end of the stalk is removed. Survival of treated seed cane is increased if stubble

cane is used, if it is harvested at least 3 days before the beginning of heat treatment, and if the cane is treated between August 15 and September 15 when day and night temperatures are still above 20 C.

IDENTIFICATION OF TWO BIOTYPES OF *SPHAEROTHECA PANNOSA* VAR. *ROSAE* ON FOUR ROSE CULTIVARS. G. L. Bender and D. L. Coyier, Dept. of Botany and Plant Pathology and USDA-SEA-AR, Corvallis, OR 97331.

A seedling rose, descended from cv. Tropicana, showed a high degree of field resistance to *Sphaerotheca pannosa* var. *rosae* during 8 years of cultivation. Plants propagated from the original seedling became severely infected during the 1980 growing season. Two single-spore isolates of this fungus were compared with two isolates collected from cv. Dr. Huey. Each of the four isolates was used to inoculate the seedling rose and cvs. Samantha, Mary Devor, and Pink Parfait. Compatibility was compared after 48 hr incubation by determining the frequency of elongating secondary hyphae and by the occurrence of a hypersensitive reaction of the host cells. The seedling rose isolates were most compatible on seedling rose leaf tissue and least compatible on cv. Pink Parfait. Isolates from cv. Dr. Huey were most compatible with tissue from the seedling rose. These preliminary results suggest that *S. pannosa* var. *rosae* biotypes can be identified by their reactions on differential rose cultivars.

NATURE OF AND FACTORS INFLUENCING CONSUMER LOSSES IN FRUITS AND VEGETABLES ON THE CHICAGO MARKET. L. Beraha, W. P. Kwolek, R. E. Apple, USDA-SEA-AR-Market Path. Lab., Chicago, IL 60605 and Northern Regional Research Ctr., Peoria, IL 61604

Fresh fruits and vegetables purchased in 1978 and 1979 at retail in a major midwestern market included substantial proportions that had to be trimmed or discarded because they showed defects of parasitic (PA), physiological (PL), and physical (PY) origins. Of the commodities studied, the losses measured in the portions discarded or trimmed and the major factors responsible were as follows: Western apples, 9.4% (PL and PY); pears, 4.8% (PL and PY); cherries, 15.8% (PL); grapefruit, 0.3% (PL and PY); Florida oranges 13.5% (PL); Navel oranges, 7.2% (PL); peaches, 17.4% (PL and PA); strawberries, 39.8% (PY and PA); cantaloupe, 13.4% (PL); cucumber, 3.4% (PY); lettuce 10.8% (PY); sweet pepper 7.4% (PY); and tomatoes 8.7% (PA and PY). Significant influences on the type and total amount of the disorder were the retail store management, the socioeconomic neighborhood, the month purchases were made, & the packaging type applied either at or after harvest.

QUANTITATIVE IMMUNOELECTROPHORESIS OF PANICUM MOSAIC VIRUS AND ST. AUGUSTINE DECLINE STRAINS. P. H. BERGER AND R. W. TOLER, DEPT. OF PLANT SCIENCES, TEXAS A&M UNIVERSITY, COLLEGE STATION, TEXAS 77843.

"Rocket" quantitative immunoelectrophoresis (QIEP) was carried out on panicum mosaic virus (PMV) including seven strains of St. Augustine Decline (SAD). Antisera against a strain of SAD was raised in rabbits. Using this antisera and a common host, QIEP of serial dilutions of extracts from plants infected with each strain provided a standard curve. Its linear regression provided an indication of the serological relationship between these strains as well as the relative titer in the host. This method can be used to compare titer in different hosts or cultivars infected with the same virus strain. QIEP provides a rapid, accurate, inexpensive, and relatively sensitive method to measure and characterize virus infected plants.

GENERALIZED PROGRESS FOR SIMPLE INTEREST DISEASE BASED ON THE ERWINIA-LYCOPERSICON PATHOSYSTEM. R. D. BERGER AND J. A. BARTZ, Department of Plant Pathology, University of Florida, Gainesville 32611.

Disease progress after single inoculations with *Erwinia carotovora* subsp. *carotovora* into harvested tomato fruit was typical of simple interest disease (SID); i.e., monomolecular. The progress curves were also fit to the Weibull model, and the curve shapes were near the idealistic shape parameter (c=1) for SID. Latent periods were shortened, rates of disease development were accelerated, and levels of maximum disease were raised by increases in concentration of initial inoculum, decreases in varietal resistance, increases in fruit maturity, warmer storage temperatures after inoculation, and predisposition by chilling the fruit or preharvest application of Ethrel to plants. A generalized model of the development of SID is proposed in which the time of epidemic onset, epidemic rate, and maximum asymptote are determined by the tripartite components of the pathosystems.

ROLE OF INSECT INJURY AND POWDERY MILDEW IN THE EPIDEMIOLOGY OF GUMMY STEM BLIGHT DISEASE OF CUCURBITS. G. C. BERGSTROM, D. KNAVEL, and J. KUĆ. Departments of Plant Pathology and

Horticulture, Univ. of Kentucky, Lexington, KY. 40546. Observation of recent epidemics of gummy stem blight, caused by *Mycosphaerella melonis*, on cucurbits indicated a positive correlation with high incidence of either cucumber beetle injury or powdery mildew. In 2 field experiments gummy stem blight was significantly reduced in plots which were caged to exclude insects. In addition to predisposing plants to infection, the striped cucumber beetle (*Acalymma vittatum*) served as a vector of the causal fungus. In laboratory experiments both powdery mildew and melon aphids markedly predisposed cucumber leaves to *M. melonis*. Filtered, aqueous washings of mildewed leaves and aphid-infested leaves provided the same level of disease stimulation as the organisms themselves. Uninjured cucumber leaves were virtually immune to unamended *M. melonis*, but were susceptible when inoculum was amended with sucrose and amino acids. Late summer foliar necrosis in Kentucky may be caused by the interaction of powdery mildew, insects, and *M. melonis*.

INDUCED SYSTEMIC RESISTANCE TO CUCUMBER MOSAIC VIRUS IN CUCUMBER. G. C. BERGSTROM, M. C. JOHNSON, and J. KUĆ. Department of Plant Pathology, University of Kentucky, Lexington, Kentucky 40546.

Inoculation of leaf 1 and leaf 2 of cucumber cv. Marketeer with *Colletotrichum lagenarium*, *Pseudomonas lachrymans*, or tobacco necrosis virus induced systemic resistance to challenge with cucumber mosaic virus (CMV) rubbed onto leaf 3. Induced resistance was expressed as a decrease in the number of chlorotic, primary lesions on CMV-inoculated leaves and as a delay in the time of appearance of systemic mosaic symptoms in induced as compared to control plants. Differences between induced and control plants were most pronounced with dilute CMV inocula. Induced resistance also occurred when plants were challenged with CMV transmitted by melon aphids, natural vectors of CMV.

NEMATODE POPULATION DYNAMICS IN AN INTEGRATED PEST MANAGEMENT PROGRAM WITH INTENSIVE CROPPING SEQUENCES. D. E. BERTRAND, A. W. JOHNSON, C. C. DOWLER, N. C. GLAZE, R. B. CHAIFANT, D. R. SUMNER, S. C. PHATAK and J. E. EPPERSON. USDA, SEA-AR, University of Georgia, Coastal Plain Experiment Station, Tifton, GA 31793.

Nematode populations were studied in an integrated pest management program under irrigation with three intensive multi-cropping systems and four nematocidal treatments. Root-knot and ring nematodes were suppressed significantly in a two-year sequence of sweet corn-soybean-wheat-soybean-spinach, but increased rapidly on peanuts in a two-year sequence of turnip-peanuts-cucumber-turnip-soybean. Population densities of both root-knot and ring nematodes increased rapidly on field corn and southern pea in a one-year sequence of turnip-field corn-southern pea. An annual application of DD-MENCs (327 liter/ha) or methyl bromide (358.4 kg/ha) suppressed populations of nematodes on susceptible crops to very low levels throughout the year. Ethoprop (8.96 kg a.i./ha) applied preplant did not effectively reduce the population of nematodes. Preplant application of phenamiphos (8.96 kg a.i./ha), however, suppressed nematode populations near or below detectable levels.

BARK WATER RELATIONS AND THE ENLARGEMENT OF HYBRID POPLAR CYTOSPORA CANKERS. A. R. BIGGS AND D. D. DAVIS, Dept. of Plant Pathology, The Pennsylvania State University, University Park, PA 16802.

P. maximowizii X *P. trichocarpa* cuttings and intact plants were inoculated with agar discs containing mycelium of *Cytospora chrysosperma*. Cuttings were inoculated at weekly intervals during rooting in April-May, and intact plants were inoculated at weekly intervals in November-December during dormancy. In each experiment, a randomly selected set of 10 plants was pre-conditioned for 18 hr in a growth chamber before inoculation. Excised bark discs were used to determine water potential and relative turgidity at the time of inoculation. Canker size measured 1 wk after inoculation correlated positively with relative turgidity and negatively with water potential. The water relations parameters of cuttings were associated with cankers larger than those of intact plants, but only when bark moisture exceeded that of intact plants.

EFFECTS OF SULFUR DIOXIDE ON GROWTH, SULFUR CONTENT, AND WATER RELATIONS OF HYBRID POPLAR. A. R. BIGGS AND D. D. DAVIS, Dept. of Plant Pathology, The Pennsylvania State University, University Park, PA 16802.

P. maximowizii X *P. trichocarpa* plants were exposed to 0.25 ppm SO₂ for 72 hr/wk for 14 wks in 1979, or 0.12 ppm SO₂ for 72 hr/wk for 6 wks in 1980. Height growth, sulfur content of bark and foliage, and stomatal conductance rate were measured in both years. In 1980, foliage and bark water potential and osmotic potential were determined during and following SO₂ exposure. Height growth was reduced 8% and 3% by exposure in 1979 and 1980, respectively. Sulfur content of bark increased 20%, sulfur content of abscised foliage increased 300-740%. Stomatal conductance was inhibited initially then stimulated during the 72-hr exposures to 0.25 ppm, but was not affected by 0.12 ppm

SO₂. Six exposures to 0.12 ppm SO₂ induced changes in foliar water potential and osmotic potential. Both parameters tended toward increased negativity after SO₂ exposure.

POPULATION LEVELS OF *CORYNEBACTERIUM SEPEDONICUM* AND SYMPTOM DEVELOPMENT OF RING ROT IN POTATO PLANTS. A. Bishop and S. A. Slack, Dept. of Plant Pathology, University of Wisconsin-Madison, Madison, WI 53706.

Sixty single-eye potato (cv. Katahdin) seed pieces were inoculated by placing a 10 µl droplet containing 10⁶ cfu *C. sepedonicum* in the eye depression and wounding with a needle. Seed pieces were planted May 2, 1980, and bacterial populations in stem bases, roots, and tubers were assayed periodically by dilution plating of tissue extracts produced by a procedure similar to that of Lelliott and Sellar (EPPO Bull. 6:101). This procedure recovered 20-25% of the viable cells present. In roots and stems, up to 10⁶ cfu/g fresh weight were obtained June 30 and 10⁹ cfu/g on July 21, August 9, and September 3. In tubers, populations reached 10⁷ on the later three dates, but were more variable than in roots and stems. Although high pathogen populations were present by midseason, foliar symptoms were not observed until September 3. The data suggest that potato plants can support large populations of *C. sepedonicum* in the absence of wilt symptoms.

RESPONSE OF TWELVE *CYLINDROCLADIUM CROTALARIAE* ISOLATES TO SELECTION PRESSURE FROM SUSCEPTIBLE AND RESISTANT PEANUT CULTIVARS. M. C. Black and M. K. Beute, Department of Plant Pathology, North Carolina State University, Raleigh, NC 27650.

One hundred sixty isolates of *Cylindrocladium crotalariae* were screened on greenhouse seedlings for specificity indicated by differences in root rot severity (0-5 index) between susceptible peanut 'Florigiant' and resistant 'NC3033'. Six isolates with small differences (specificity for 'NC3033'), six with large differences (specificity for 'Florigiant') and three types of composites (either or both types of isolates) were selected. Field microplots were infested with equal inoculum densities (proportionately for composites) and planted with 'Florigiant' or 'NC3033'. Field response of isolates was not related to response in greenhouse screening. After two cropping seasons overall mean difference in root rot between cultivars was 1.8 (range 0.4 to 3.0). Two isolates with differences of 0.4 and 0.5 had specificity for 'NC3033'. There was a broad range among treatments in general virulence (virulence on both cultivars). Composites had higher general virulence than the average of isolate components.

THE DEODAR WEEVIL, A VECTOR AND WOUNDING AGENT ASSOCIATED WITH PITCH CANKER OF SLASH PINE. G.M. Blakeslee, J.L. Foltz, Univ. of Florida, Gainesville, FL, and S.W. Oak, U.S. Forest Service, Asheville, NC.

The relationship between the deodar weevil, *Pissodes nemorensis* (PN), and outbreaks of pitch canker on slash pine in Florida has been investigated. The known aspects of the biology of the weevil are compatible both in time and space with the known infection biology of the pitch canker fungus, *Fusarium moniliforme* var. *subglutinans* (FMS). Studies in pitch canker-infected plantations have identified a relationship between FMS and immature and newly-emerging weevils, actively feeding and/or reproducing adult weevils, and fresh PN feeding wounds on slash pine. Greenhouse and field studies have shown that characteristic pitch canker infections develop on slash pines following the feeding activity of FMS-infested adult weevils. Feeding wounds made by FMS-free weevils remained disease-free. Artificial inoculation of such wounds with conidia of FMS demonstrated that they are suitable infection courts for at least 48 hr following termination of feeding.

CULTURAL CHARACTERISTICS OF *NECTRIA COCCINEA* VAR. *FAGINATA* IN RESPONSE TO GROWTH MEDIUM, LIGHT, AND TEMPERATURE. Robert O. Blanchard and H. Van T. Cotter, Botany and Plant Pathology, University of New Hampshire, Durham, 03824.

The causal agent of beech bark disease, *Nectria coccinea* var. *faginata*, has been shown to produce perithecia in culture, but only after an incubation period of 9-17 weeks. This incubation period was reduced to 4-5 weeks by manipulation of growth medium, light, and temperature. Elm sawdust malt yeast agar (50 g elm sawdust, 10 g malt extract, 2 g yeast extract, 20 g agar, to 1 liter water) produced the most perithecia per plate of all media tested. A light requirement for production of macroconidia and perithecia was also established. Abundant mycelial tufts grew in plates treated with light, but not in those kept in darkness. Temperature, tested in 5 C increments from 5-35 C, did not affect linear hyphal growth or production of conidia, but did affect hyphal density. The optimum temperature for perithecial production was 18-25 C.

A NEW TECHNIQUE TO ACCURATELY QUANTIFY DISCOLORATION AND DECAY IN TREES. R.A. Blanchette, Department of Plant Pathology, University of Minnesota, St. Paul, MN 55108.

Defects in living trees resulting from wood-destroying microorganisms are difficult to quantify. The patterns of degradation by some of the most important decay-causing fungi are not uniform circular zones [e.g. *Phellinus* (*Fomes*) *pini* on conifers, *Inonotus* (*Polyporus*) *obliquus* on birch]. A VP-8 image analyzer, commonly used in remote sensing laboratories, provided a simple, rapid and accurate method to distinguish among sound, discolored and decayed wood. A highly significant correlation (r>0.99) was found when this new technique was compared to hand measurements from tracings of the discolored and decayed columns.

DISPLACEMENT OF *GAEUMANNOMYCES GRAMINIS* VAR. *TRITICI* BY *MICRODOCHIUM BOLLEYI* IN WHEAT TISSUES. W.W. Bockus and B.A. Daniels, Dept. of Plant Path., Kansas State Univ., Manhattan, KS 66506.

Gaeumannomyces graminis (Sacc.) Arx & Olivier var. *tritici* Walker (GGT) causes take-all disease on winter wheat (*Triticum aestivum* L.). *Microdochium bolleyi* (Sprague) Dehoog & Hermanides (MB), a common soil-borne fungus, parasitizes the roots of over 120 different graminaceous species but causes little damage to winter wheat. When wheat plants grown in a growth chamber were inoculated with both fungi, there was a slight reduction in take-all disease compared to plants inoculated with only GGT. When both treatments were recropped to wheat, take-all markedly decreased where both fungi were present. A third consecutive wheat cropping produced only slight take-all where both fungi were introduced but severe take-all continued where only GGT had been introduced. As take-all severity declined, a corresponding increase in the number of characteristic structures produced by MG in wheat roots was observed. Numbers of MG structures observed in field-collected wheat roots also correlated with years of consecutive wheat plantings.

INTERACTION OF SOIL PHOSPHORUS AND MYCORRHIZAL INFECTION AND REPRODUCTION. N.C. Bolgiano, C.E. Nelsen and G.R. Safir, Department of Botany and Plant Pathology, Michigan State University, East Lansing, MI 48824.

Soil and root samples were obtained from specific areas of the root profile of commercial onions grown on muck soils in 1979 and 1980. VA mycorrhizal infection and numbers of *Glomus* chlamydospores were determined. Infection decreased exponentially with increasing phosphorus (P), implying a P threshold above which mycorrhizal infection remained low throughout the season. Chlamydospore populations initially were low and rose slightly by the end of the season. Results of field infestation with *Glomus etunicatus* chlamydospores showed a similar threshold response of infection to soil P. Spore numbers were positively related to root infection levels. Plant weight increased slightly with inoculum in low P soil but not in high P soil. Amounts of P fertilizer presently added commercially to onions may negate potential yield responses from mycorrhizae.

A SURVEY OF JUGLONE LEVELS AMONG WALNUTS AND HICKORIES. A. Borazjani, G. H. Graves, Jr., and P. A. Hedin, Dept. of Plant Path. and Weed Sci., Miss. State Univ., and Boll Weevil Research Laboratory USDA-SEA-AR, Mississippi State, MS 39762.

Juglone (5 hydroxy-1, 4, naphthoquinone), a known fungitoxic constituent of walnuts and hickories may influence resistance to scab (*Fusicladium effusum*) in pecan. Interspecific crosses may improve resistance in pecan. A 2-yr survey of juglone levels in leaves and nuts of walnuts and hickories (including 14 pecan cultivars) was conducted. Walnuts (*Juglans regia* and *J. nigra*) consistently had higher levels than hickories. Hickories in descending order of average juglone levels in leaves were southern shagbark (*Carya caroliniana-septentrionalis*), water (*C. aquatica*), shagbark (*C. ovata*), a hican (an interspecific hybrid of unknown parentage), pecan (*C. illinoensis*), red (*C. ovalis*), pignut (*C. glabra*), bitternut (*C. cordiformis*), sand (*C. pallida*), mockernut (*C. tomentosa*), and nutmeg (*C. myristicifera*) and in nuts were shagbark, red, pecan, hican, water, pignut, nutmeg, bitternut, and mockernut. Significant seasonal variation in juglone concentration was observed in most species.

ENHANCED ELICITOR ACTIVITY OF EICOSAPENTAENOIC AND ARACHIDONIC ACIDS BY FACTORS IN THE MYCELIUM OF *PHYTOPHTHORA INFESTANS*. R. M. Bostock, R. A. Laine and J. A. Kuć. Departments of Plant Pathology and of Biochemistry, University of Kentucky, Lexington, KY 40546.

Eicosapentaenoic and arachidonic acids were isolated from the mycelium of *Phytophthora infestans* and identified as the elicitors of sesquiterpenoid phytoalexin accumulation in potato tuber. These fatty acids were found free or esterified in all active fractions, including cell wall preparations. Upon acid hydrolysis of lyophilized mycelium, elicitor activity was obtained only from the fatty acid fraction. However, the fatty acids accounted for 21% of the activity of the unhydrolyzed mycelium and the residue did not enhance their activity. Hydrolysis of lyophilized mycelium in 2N NaOH-1M NaBH₄ at 100°C and removal of the fatty acids yielded material with little or no activity. Addition of this material to the fatty acids restored the activity to that which was present in the unhydrolyzed mycelium. The results suggest that the elicitor activity of the fatty acids can be enhanced by heat and base stable factors in the mycelium.

BACTERIAL LEAF STREAK OF WILD RICE CAUSED BY *XANTHOMONAS CAMPESTRIS* AND *PSEUDOMONAS SYRINGAE*. 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*) was reported previously to be caused solely by *Pseudomonas syringae* (Phytopathology 71:204). A total of 162 isolations were made from plants with BLS symptoms collected throughout Minnesota in 1980. *Pseudomonas syringae* and *Xanthomonas campestris* were identified from 141 and 21 isolations, respectively. In pathogenicity tests in the field and in the greenhouse both species produced water-soaked, narrow streaks on wild rice leaves. Thus, BLS appears to be caused by at least two different bacteria.

INTERPLOT INTERFERENCE IN FIELD EXPERIMENTS WITH WHEAT LEAF RUST RESISTANCE. K.L. Bowen, P.S. Teng, A.P. Roelofs, and J.S. Baumer, Department of Plant Pathology, University of Minnesota, St. Paul, MN 55108.

In experimental field plots, treatment results are affected by the disease that develops in adjacent plots (interplot interference). Negative interference (NI) results in an underestimation of the resistance of a cultivar if a neighboring plot has less disease. Wheat plots infected with leaf rust (*Puccinia recondita* f. sp. *tritici*) were used to measure NI by comparing disease progress in two pairs of isolated plots—one pair of plots each consisting of Thatcher wheat (a relatively susceptible cultivar), and the other pair with one plot of Chris wheat (relatively resistant) and one of Thatcher wheat. In 1980, effects of plot size, guard area size between plots and type of guard area, on NI were investigated. Smaller guard areas (2 m vs 4 m) lead to increased interference (7% lower disease in Thatcher adjacent to Chris). Large plots had more disease than the smaller plots (4 m x 4 m vs 2 m x 2 m) and a guard area of corn resulted in lower disease than a guard area of Chris wheat.

SOYBEAN SEED QUALITY AFFECTED BY PREPLANT-INCORPORATED HERBICIDES. J. E. Bowman, J. B. Sinclair, and L. M. Wax (USDA-SEA), Depts. of Plant Pathology and Agronomy, Univ. of Illinois, 1102 S. Goodwin, Urbana, IL 61801.

The effect of 18 preplant-incorporated herbicides or herbicide combinations on Wells soybean seed quality was studied. Compared to nonherbicide-treated plots, seeds from treated plots gave significant ($P \leq 0.05$) differences in germination and recovery of seedborne fungi on PDA. Alachlor and 5 herbicide combinations were associated with significant ($P \leq 0.05$) increases in total seedborne fungi. A combination of pendimethalin, metribuzin and chloramben was associated with significant ($P \leq 0.01$) increases in *Phomopsis* spp., whereas fluchloralin + metribuzin gave significantly ($P \leq 0.05$) lower levels. A significant ($P \leq 0.01$) increase in *Cercospora kikuchii* was associated with seeds from plots with alachlor + bifenoxy or alachlor alone. Significant ($P \leq 0.05$) increases and decreases in germination were recorded on PDA, but no treatment affected germination or seedling vigor on blotters.

EVALUATION OF A *FUSARIUM SOLANI* STRAIN FOR BIOLOGICAL CONTROL OF TEXAS GOURD. C. D. Boyette, and G. E. Templeton, Dept. of Plant Pathology, Univ. of Arkansas, Fayetteville, AR 72701.

Texas gourd (*Cucurbita texana*) is a weed in sandy loam soybean fields of southwestern Arkansas. It is affected by a collar-rot disease which may have biocontrol potential. The pathogen was verified to be *F. solani* f. sp. *cucurbitae* by mating with known strains and by virulence on cucurbits. Soybeans and several other crop and weed species were immune in greenhouse tests. Pathogenesis and weed kill were dependent on inoculum level in the greenhouse and field. Optimal temperatures for weed kill in controlled environments were 24–32°C, and ranged from 16–40°C. After 8 wks, 95–99% of Texas gourd had been killed in field plots receiving pre-emerge treatments of fungus-infested oats or sand-cornmeal at 2×10^7 propagules/g soil. Soil dilution on Nash's PCNB agar was used to monitor pathogen decline for 12 months. A 30% reduction occurred after 1 month, and declined to undetectable levels after 10 months in a fine sandy loam. No evidence was found that would preclude use of this pathogen as a bioherbicide.

HISTOLOGY OF RESISTANCE TO COTTONWOOD LEAF RUST. Francis H. Brach and Louis Shain, Department of Plant Pathology, University of Kentucky, Lexington, Kentucky 40546.

Leaf discs of eastern cottonwood resistant and susceptible to leaf rust were examined histologically with increasing time after artificial inoculation with urediospores of two physiological races of *Melampsora medusae*. Two methods were developed for the study. Discs were fixed and cleared with hot chloral hydrate followed by lactophenol, stained with a Congo Red - Na lactophenol (pH 6) solution, and destained in lactophenol (pH 3). Fresh tissue was frozen in water, sectioned with a cryostat microtome, and stained with aqueous

Trypan Blue. Incompatibility was evident as early as the substomatal vesicle stage but more frequently within 1–3 days of inoculation when yellow-colored cells were observed in association with infection hyphae. Yellow-colored cells were found later and less frequently in compatible interactions. These cells also were found in bruised tissue, suggesting that they were necrotic. These results suggest that a hypersensitive death of a few cells may be associated with resistance.

BIOMASS AND STEROL CONTENT OF TWO TOMATO RACE 0 CULTURES OF *PHYTOPHTHORA INFESTANS*. B. Bradford, L. D. Moore and D. M. Orcutt. Dept. of Plant Path. & Phys., VPI & SU, Blacksburg, VA 24061.

The effects of free sterols on the growth of two tomato race 0 cultures of *Phytophthora infestans*, RK and ORB2, were determined. The cultures were grown in serial subculture, in a chemically defined liquid medium supplemented with individual free sterols. For RK, addition of sitosterol, cholesterol, campesterol, or stigmaterol to the first subculture resulted in 98, 70, 68, and 31% increases, respectively, in biomass with respect to the control. For ORB2, addition of campesterol, cholesterol, sitosterol, or stigmaterol resulted in 43, 41, 40, and 19% increases, respectively. Free and conjugated sterols were found in the mycelial mats of all cultures in both the sterol-supplemented and the controls of all three subcultures. By the third subculture, controls contained up to 73% less total sterol than subcultures receiving the individual free sterols. The amount of free sterol, steryl ester, and steryl glycoside present was primarily dependent on the individual sterol added to the medium.

EFFECTS OF ALTERED STEROL CONTENT ON THE SUSCEPTIBILITY OF *LYCOPERSICON ESCULENTUM* TO *PHYTOPHTHORA INFESTANS*. B. Bradford, L. D. Moore and D. M. Orcutt. Dept. of Plant Path. & Phys., VPI & SU, Blacksburg, VA 24061.

The sterol content of a late blight resistant ('Nova') and susceptible ('Beefsteak') cultivar of tomato was altered by growing the plants under high and low lighting regimes of 95 and 61 microeinsteins/m² sec⁻¹, respectively. At flowering, half the plants were harvested and half were inoculated with sporangia of *Phytophthora infestans*. Leaves of harvested plants were extracted and the sterol content identified and quantified. Under low light, both cultivars were higher in free sterol and steryl ester, but lower in steryl glycoside and total sterol content compared to plants grown under high light. The disease incidence and severity were significantly ($P \leq 0.05$) higher for 'Beefsteak' plants grown under low light intensity. Disease incidence and severity were not significantly different between high and low light grown 'Nova' plants. The increase in disease development in the susceptible cultivar was positively correlated with the increase in leaf sterols.

STEROL CONTENT OF SIX TOMATO CULTIVARS RESISTANT OR SUSCEPTIBLE TO *PHYTOPHTHORA INFESTANS*. B. Bradford, L. D. Moore and D. M. Orcutt. Dept. of Plant Path. & Phys., VPI & SU, Blacksburg, VA 24061.

Free and conjugated sterols were extracted from leaves of late blight resistant ('Nova', 'New Yorker', and 'West Virginia 63') and susceptible ('Beefsteak', 'Jubilee', and 'San Marzano') cultivars of *Lycopersicon esculentum* Mill. There were no significant differences ($P \leq 0.05$) in free sterol, steryl ester, or steryl glycoside content between the three resistant and three susceptible cultivars. The only significant difference among the six cultivars was that the steryl glycoside fraction of 'San Marzano' was higher than that of other five cultivars. The total sterol content of the six cultivars averaged 3.2 mg/g dry wt, and was composed of 67, 28, and 5% steryl glycoside, free sterol, and steryl ester, respectively. The total sterol fraction consisted of 37, 35, 24 and 4% stigmaterol, sitosterol, cholesterol, and campesterol, respectively. The susceptibility of tomato cultivars to *P. infestans* is apparently not related to the sterol content of the plants.

GENETIC FUNCTION OF RNA COMPONENTS OF SOIL-BORNE WHEAT MOSAIC VIRUS. Yukio Shirako and M.K. Brakke, Dept. of Plant Pathology, Univ. of Nebraska, Lincoln and Agricultural Research, SEA, U.S. Dept. of Agriculture, Lincoln, NE 68583.

Soil-borne wheat mosaic virus is rod-shaped with virion I 281 nm long and virion II varying from 92–138 nm, designated here as 0.31L to 0.50L, respectively. Infectivity experiments with re-assorted RNAI and RNAII separated by three cycles of density-gradient centrifugation showed that both RNAs were genomic. Analysis of progeny virus showed that RNAII (0.31L) in the inoculum always begat RNAII (0.31L), but RNAII (0.50L) begat a mixture of RNAIs varying from 0.28L to 0.5L, of which three, 0.50L, 0.40L, and 0.31L, have been shown to be infectious in combination with RNAI. RNAII shorter than 0.5L was also found in plants several months after inoculation with unpurified, unfractinated virus having RNAII (0.5L). Plants infected with virion I plus virion II (0.5L) differed from plants infected with shorter RNAIs in having milder symptoms and a 90,000 dalton protein. RNAII (0.5L) appeared to be unstable and produced shorter variants, thereby losing information needed for the 90,000 dalton protein.

INOCULUM DISTRIBUTION OF *SCLEROTIUM ROLFSSII* AND INCIDENCE PATTERN OF SOUTHERN STEM ROT ON PEANUT IN NORTH CAROLINA. B. J. Brewer, C. L. Campbell, and M. K. Beute. Department of Plant Pathology, North Carolina State University, Raleigh 27650.

Frequency distribution of sclerotia of *Sclerotium rolfsii* and of stem rot incidence on peanut were analyzed for goodness-of-fit to Poisson, Poisson-with-zeros, negative binomial, Thomas double Poisson, and Neyman A distributions. In each of 98 6 x 6 m quadrats 40 soil samples (20 at 7.5 cm and 20 at 15 cm depth) were taken by sampling in two paths on opposite diagonals. Samples from each depth per quadrat were pooled, air dried, and assayed for sclerotia using the aqueous-methanol technique. Zero or one sclerotium was detected in a majority of quadrats sampled. Number of stem rot lesions per quadrat were determined on 21 Oct 1980. Frequency of lesions/quadrat best fit the negative binomial (χ^2 -square = 26.91, 17 df) and Neyman A (χ^2 -square = 37.33, 16 df) distributions. Stem rot occurred in many plots where sclerotia were not detected.

LOSS OF TURGOR SUPPRESSES SENSITIVITY OF OATS TO *HELMINTHOSPORIUM VICTORIAE* TOXIN. S.P. Briggs, R.P. Scheffer, and A.R. Haug*, Department of Botany & Plant Pathology and *Department of Biophysics, Michigan State University, East Lansing, MI 48824.

Free protoplasts from leaves and coleoptiles were not obviously affected by toxin in short-term experiments. Insensitivity of protoplasts probably was not due to loss of receptor sites in cell walls because isolated walls did not bind toxin nor release electrolytes when exposed to toxin. The possibility that plasmolysis decreased sensitivity was investigated. The turgor of healthy leaves (6.7 bars) was eliminated by 0.23 M sorbitol. The rate of toxin-induced electrolyte leakage from leaf tissue was 50% less in 0.2 M sorbitol or mannitol than in water; lower concs gave little suppression and higher concs gave no increase in suppression (the rate of leakage could be lessened 50% by using 95% less toxin). This suggests that toxin causes electrolytes to leak from the cytoplasm into the apoplast, causing water to move into the vacuole which swells and leaks. Swelling is prevented by hypertonic solns, explaining the suppression of tissue and protoplast sensitivity to toxin.

MEMBRANE FLUIDITY MODULATES SENSITIVITY OF OATS TO *HELMINTHOSPORIUM VICTORIAE* TOXIN. S.P. Briggs, R.P. Scheffer, and A.R. Haug*, Department of Botany & Plant Pathology and *Department of Biophysics, Michigan State University, East Lansing, MI 48824.

Arrhenius plots of both spin label motion (i.e., membrane fluidity) and toxin-induced electrolyte leakage from leaf tissue were discontinuous at 10-12 C. These coincidences suggest that a membrane-diffusible carrier mediates leakage. Leakage from tissue which had been cooled to 0 C, treated with toxin for 1 hr, and then washed was at the same rate as that from untreated tissue at 0 C. When these cooled samples were placed at 23 C, toxin-treated tissue leaked the same as toxin-treated tissue which had been held constantly at 23 C. Leakage was 4 times faster from tissue treated with toxin, washed at 23 C, and cooled to 0 C than from tissue treated and held at 0 C throughout, but was only 20% of the rate for tissue treated and held at 23 C. This suggests that toxin is still able to bind to its receptor at 0 C but requires a more fluid membrane to transform the receptor into a carrier; the transformation is not reversed by low temperature.

ETIOLOGY OF PEACH TREE GUMMOSIS. Kerry O. Britton and F. F. Hendrix, Jr. Dept. of Plant Path., Univ. of Ga., Athens, GA 30602.

Botryosphaeria dothidea has been reported as the causal agent of peach tree gummosis. However, in Middle Georgia, *B. obtusa* was isolated ten times more frequently than *B. dothidea* from active cankers. *Botryosphaeria rhodina* was also occasionally isolated. Possible infection sites such as buds, pruning wounds and lenticels are being investigated. Cankers frequently form in association with pruning wounds, especially stub cuts, implicating these as the most common infection court. Such infections may cause extensive damage to the trunk and scaffold limbs. The incidence of *B. obtusa* isolated from buds greatly increased in January and February, prior to bud swell. Buds inoculated in February were infected as they opened in the spring. Further systemic movement of the fungus may result in killing of fruiting wood.

DETECTION OF PLANT RICKETTSIALIKE BACTERIA IN SITU USING IMMUNO-FLUORESCENCE. R. H. Brlansky, R. F. Lee, and L. W. Timmer, Univ. Fla., IPAS, AREC, 700 Expt. Stn. Rd., Lake Alfred, FL 33850.

Xylem-limited, rickettsialike bacteria (RLB) were detected *in situ* in sectioned material by immunofluorescence using immunoglobulins specific to Pierce's disease bacterium conjugated to tetramethylrhodamine isothiocyanate (TRITC). Cryostat-cut sections of RLB infected tissue were prepared from plants of grape affected by Pierce's disease, of periwinkle affected by periwinkle wilt, of plum affected by leaf scald, and of ragweed affected by an unnamed disease. Longitudinal and transverse sections about 30-40 μ m thick were immersed in TRITC-labeled

antisera for 1 hr at room temperature, mounted, and viewed with a fluorescent microscope at 560-590 nm. Orange-red fluorescing bacteria were readily observed in and adhering to the xylem vessels of diseased plants but were not present in healthy plants. No bacteria were observed when sections were immersed in TRITC-labeled normal serum or in labeled antisera to unrelated bacteria. Fluorescein isothiocyanate labeled antiserum was not useful due to autofluorescence of the xylem.

FACTORS ASSOCIATED WITH RESISTANCE OF INJURED CITRUS EPICARP TO PENETRATION BY *PENICILLIUM DIGITATUM*. G. E. Brown, Florida Department of Citrus, and C. R. Barmore, Univ. of Florida, AREC, 700 Experiment Station Rd., Lake Alfred, FL 33850

Valencia oranges, injured abrasively with #60 grit sandpaper, were highly susceptible to infection by *P. digitatum* if inoculated immediately after injury, but 50 to 100% of the fruit were resistant to infection if the injured fruit were held at 30C near 100% relative humidity for 24 hr before inoculation. Resistance was not caused by lack of spore germination due to inadequate nutrients or moisture, or by inability of pectolytic enzymes produced by *P. digitatum* to degrade pectin of the injured tissue. Histological studies showed that phenolic materials were present in injured cells within 16 hr. Lignin-like material was detected within 30 hr with 3 stains, but use of 2 additional procedures indicated that if the material in injured tissue was lignin, it was different from the type found in the vessel elements of the vascular bundles of the fruit peel. Strength of the epicarp was significantly greater at 30 hr than immediately after injury.

THERMOSENSITIVE-REPLICATION-MUTANT OF A BROAD-HOST-RANGE IncP-1 R PLASMID (pUT 13): A TOOL IN GENETICS OF *ERWINIA CHRYSANTHEMI*. Mary Ann Brown, Janet S. Ziegler and Arun K. Chatterjee, Dept. of Plant Pathology, Kansas State University, Manhattan, KS 66506.

A mutant plasmid, pUT 13 *ts-1* (Cb^r, Tn 406; Tp^r, Tn 402) thermo-sensitive in replication was tested for its ability to mobilize chromosomal markers and generate transpositional mutants in *E. chrysanthemi* EC183. Segregation of the mutant plasmid, but not of the parent, occurred at 35°C or higher. Both the mutant and parent plasmids mobilized *ser^r* and *trp^r* markers; the frequency of transfer per input donor cell was 5×10^{-4} and 2×10^{-2} , respectively. By selecting at 35°C for clones of EC183 (pUT 13 *ts-1*) resistant to carbenicillin (Cb^r; Tn 406) strains were obtained in the following classes: (a) Cb^r, Tp^r, auxotrophic; (b) Cb^r, Tp^r, prototrophic; (c) Cb^r, Tp^s, auxotrophic; and (d) Cb^r, Tp^s, prototrophic. These phenotypic classes could have resulted from transposition of Tn element(s), integration of the plasmid into the host chromosome, or reversion of the *ts* mutation.

CORN AS AN OVERSUMMERING HOST OF BARLEY YELLOW DWARF VIRUS AND APHID VECTOR IN EASTERN WASHINGTON. J. K. Brown and S. D. Wyatt, Dept. of Plant Pathology, Wash., State Univ., Pullman, WA 99164.

Barley yellow dwarf (BYD) is an economically important virus disease of winter wheat in irrigated areas of the Columbia Basin and drylands of Eastern Washington. Surveys conducted during the summer, 1980, indicate that corn (*Zea mays*) may be the major summer reservoir of the virus and its aphid vector. The Bird-cherry oat aphid (*Rhopalosiphum padi*), the most efficient vector in Washington, colonized corn in 90% of fields surveyed. Sixty-one percent of the aphids and 63% of the corn samples collected in the basin harbored BYDV. Infection levels in individual fields ranged from 4% to 64%. Naturally infected corn plants exhibited no detectable symptoms. Most cultivars tested in the greenhouse exhibited some symptom, usually a red discoloration of leaves. Slight stunting was the predominant symptom when those same cultivars were grown in field plots. Development of leaf symptoms may depend on post-infection exposure to cool temperatures. The hypothesis that corn may be an overwintering reservoir for the virus and its vector could be an important aspect in the disease cycle of BYD.

INCIDENCE OF VIRUS DISEASES OF GRAPES IN BOLIVIA. Austin Goheen, William M. Brown, Jr., and Fabian Crespo. Dept. of Plant Pathology, Univ. of Calif., Davis, CA 95616, Dept. of Botany and Plant Pathology, Colorado State Univ., Fort Collins, CO 80523, and Min. of Agric., Cochabamba, Bolivia.

A grape virus disease survey was carried out by the authors in Bolivia during 1979. The grape virus diseases found were leaf roll, fan leaf, and corky bark. In almost all instances the diseased plants were associated with propagating material imported from South Africa and Argentina. The one exception was propagating material originally imported from Fresno, CA in the 1960s before effective certification began. Improved plant quarantine and local production of virus free planting material were recommended. Virus free indexing plant material was introduced and is now established at the San Benito Exp. Sta. in Cochabamba, Bolivia.

FUSARIUM HYPOCOTYL ROT OF SUGAR PINE IN CALIFORNIA FOREST NURSERIES. K. H. Brownell and R. W. Schneider, Department of Plant Pathology, University of California, Berkeley, CA 94720.

A seedling hypocotyl rot of sugar pine causes seedling losses in some California forest nurseries. Isolations and pathogenicity tests have shown *Fusarium oxysporum* to be the causal organism. Sunken lesions form below the soil line which expand to girdle the hypocotyl killing the seedlings. Test plots at one nursery showed losses in 1979 and 1980 of 84% and 70%, respectively. Greenhouse experiments showed that susceptibility of hypocotyl tissue decreased rapidly from 1 week after emergence to near complete resistance at 2 weeks. However, once infected, lesions developed past this period and seedling deaths continued up to 10 weeks after emergence. Although the fungus was recovered to a depth of 7cm, lesions were confined to depths between 1 and 3cm. The cause of this lesion depth limitation was found to be related to interactions of soil temperature, water potential, and plant heat stress.

EFFECT OF METALAXYL ON PHYTOPHTHORA ROOT ROT OF FRASER FIR. Robert I. Bruck and Charles M. Kenerley. Dept. of Plant Pathology, North Carolina State University, Raleigh, NC 27650.

Losses of Fraser fir (*Abies fraseri*), the premium Christmas tree species grown in N.C., due to root rot caused by *Phytophthora cinnamomi* (P.c.) have exceeded 30% in nursery beds. Experiments were initiated in Spring 1980 to determine the efficacy of metalaxyl (Ridomil^R) against P.c. Twenty-six permanent plots (1 m²) each containing 50, 3/2 transplants were sampled for P.c. incidence and then treated with metalaxyl (Ridomil^R 15G) at rates of 2.7 kg/ha, 1.0 kg/ha and no fungicide (control), on 5/1, and again on 9/2, 1980. Each plot was sampled bi-monthly (5/1 through 9/2) and then again on 3/17 (1981). During the ten 1980 sampling periods, and one 1981 sample, P.c. was not isolated from roots in any of the metalaxyl treated plots. Successful P.c. isolations were accomplished on an average of 27% of all untreated plants. *Pythium* spp. was frequently isolated from roots in metalaxyl treated and untreated plants in 1980, however they were not isolated during the 1981 sample from plants treated with either rate of fungicide.

EFFECTS OF SIMULATED ACID RAIN ON THE DEVELOPMENT OF FUSIFORM RUST ON LOBLOLLY PINE. R. I. Bruck, S. R. Shafer, and A. S. Heagle, Dept. of Plant Pathology, N. C. State University, Raleigh, NC 27650.

Two half-sib families of loblolly pine (*Pinus taeda*) were exposed to simulated rain at four pH levels for 1 hr on each of two days twice before and after inoculation with basidiospores of *Cronartium quercuum* f. sp. *fusiforme*. Needles of the rust resistant family were injured more by the 'rain' treatments than were needles of the rust susceptible family. Mean injury for the two families was 0, 5, 27 and 60% at pH levels of 5.2, 4.0, 3.2 and 2.4, respectively. Six months after inoculation a mean of 2.6, 1.6, 1.2 and 0.8 galls/20 trees was observed on pine previously exposed to pH 5.6, 4.0, 3.2 and 2.4, respectively. Significantly more galls were present on the rust susceptible family than on the rust resistant family. However, the effect of pH on gall formation was the same for both families; significantly fewer galls formed on trees treated with 'rain' at pH 4.0 or less than on trees treated with 'rain' at pH 5.6.

A POTATO LATE BLIGHT FORECAST GENERATED BY A SIMULATION MODEL. J. A. Bruhn and W. E. Fry, Department of Plant Pathology, Cornell University, Ithaca, NY 14853.

A computer simulation model was used to develop a forecasting system for potato late blight. The effects of temperature, relative humidity, and rate-reducing resistance on epidemics were quantified as blight units, fungicide units were defined to describe decline in fungicide residue as a function of time and rainfall and simulated epidemic development was used to indicate when fungicide applications are required as a function of accumulated blight units and fungicide units since the last application. Our forecasting system was compared to Blitecast during 1980. Both systems recommended similar spray schedules for a susceptible cultivar, but our forecast recommended 40% fewer sprays than Blitecast for a moderately-resistant cultivar. Comparable levels of disease control were achieved with our forecast and Blitecast for both cultivars.

CHRONOLOGY OF PHYTOALEXIN PRODUCTION AND HISTOLOGICAL CHANGES IN TOBACCO CALLUS INFECTED WITH *PHYTOPHTHORA PARASITICA* VAR *NICOTIANAE*. A. D. Budde and J. P. Helgeson. AR, SEA, USDA, Dept. of Plant Pathology, UW-Madison, Madison, WI 53706.

Histological changes and phytoalexin production were examined as a function of time in tobacco callus tissues inoculated with *P. parasitica* var *nicotianae* (Ppn). Fungal infection was determined by cotton blue staining. Tissues up to 1 mm below the infection droplet and adjacent to the stained sections were analyzed for capsidiol, rishitin, and related sesquiterpenes by quantitative GLC. The compounds built up to maxima of 200µg/g fr wt at 3 days in the compatible interaction and 60µg/g fr wt at 5 days in the incompatible situation. In the compatible interaction there was

a rapid decline of phytoalexins which appeared to be associated with cell death. The decline of phytoalexins in the resistant tissue was less pronounced. These results, along with prior studies which indicate that resistance is established within 24 hr, suggest that tobacco phytoalexins are produced in response to cell stress and may not be closely correlated with primary resistance to Ppn.

LOCATION AND INVERTASE ACTIVITY OF MICROORGANISMS WITHIN SUGARBEET ROOTS. W. M. Bugbee. USDA, SEA-AR, Walster Hall, North Dakota State University, Fargo, ND 58105.

Invertase producing bacteria were found within and between xylem and live parenchyma cells of healthy sugarbeet roots. Invertase activity was not detected in recently harvested roots, but there was activity in roots stored at 4-6 C, 20-23 C, or in artificially aged root tissue. Comparison of molecular weight (MW) of invertases separated on gel columns showed two acid invertases from stored roots were similar to those of yeast (205,000 Daltons) and bacteria (158,000 Daltons). Acid invertase from microbe-free aged root tissue had an estimated MW of 33,000 Daltons. Extracts from roots kept at 20-23 C for 21 days also had a neutral invertase, MW 18,200 Daltons, that was similar to invertase found in extracts of bacteria isolated from sugarbeet roots. Enzymatic destruction of sucrose and accumulation of invert sugars in stored sugarbeet roots is due to at least three forms of microbial invertase and not to an acid invertase of host origin.

SURVIVAL OF PSEUDOMONAS SYRINGAE PV. PAPULANS AND PV. SYRINGAE IN DORMANT APPLE BUDS. T. J. Burr and B. Katz, Dept. of Plant Pathology, N.Y. State Agric. Expt. Sta., Geneva 14456.

Pseudomonas syringae pv. *papulans* (PSP) and pv. *syringae* (PSS) were detected in dormant apple buds of cultivars Mutsu, Golden Delicious (GD), Empire and Delicious. Bud samples were either washed in sterile, distilled water or macerated prior to plating on a previously described medium (KBS). PSP was rarely detected from nonmacerated buds (1 in 500) but was detected in 18, 32, 38, and 40% of macerated, 50-bud samples collected from four commercial orchards. Dissection of buds and subsequent plating of bud scale and internal tissue washes, demonstrated that the highest populations of PSP and PSS survive near the bud center, on young shoot and leaf tissues. PSP was also isolated from necrotic internal bud tissues of Mutsu and GD. Such necrotic tissue was observed in 2-14% of Mutsu buds from four orchards and in 4% of buds from one GD orchard. PSS was not associated with internal bud necrosis.

AN ENRICHMENT TECHNIQUE, USING ASPARAGINE, FOR THE ISOLATION OF PECTOLYTIC ERWINIA SPP. FROM SOIL. L.D. Butler and M.E. Stanghellini. Department of Plant Pathology, Univ. of Arizona, Tucson, Arizona 85721

An enrichment technique was used to isolate low populations of soft-rot *Erwinia* spp. from fallow soils and the rhizospheres of healthy cucumber and tomato plants. Twenty-five g samples of soil were placed in 125 ml flasks, flooded with 40 ml of 0.5% asparagine, stirred, and incubated for 24-48 hr at 28C. Then, 0.1 ml aliquots were dispensed on either sodium polypectate or crystal violet pectate (CVP) plates and incubated for 24 hr at 28C. Colonies of soft-rot *Erwinia* spp. formed characteristic depressions on pectate or CVP. In comparative studies, asparagine enrichment was more efficient than pectate enrichment (Meneley and Stanghellini, *Phytopathology* 66: 367-370) in isolating *Erwinia* from naturally infested soils, less time consuming, and did not require anaerobic incubation.

Effect of Formulation on Efficacy and Tenacity to Rainfall of Thiabendazole Deposits on Soybean Leaves. E. J. Butterfield, R. J. Pocchiarri and W. R. Landis. Boyce Thompson Institute for Plant Research, Tower Road, Cornell University, Ithaca, New York 14853 and Merck & Co., P.O. Box 2000, Rahway, New Jersey 07065.

Seven flowable or solubilized formulations of Thiabendazole were evaluated in greenhouse and laboratory tests for efficacy and tenacity to rainfall. Efficacy was evaluated in both pre-infection and post-infection applications against anthracnose of cucumber and soybean. Tenacity to rainfall was evaluated by subjecting treated soybean plants to simulated rainfall. Thiabendazole residues were determined by both bioassay and UV absorption. The pre-infection activity of Thiabendazole was not significantly affected by the formulations evaluated. The post-infection activity of Thiabendazole was significantly improved by some formulations with the greatest increase in activity observed with a solubilized formulation. Some improvement in tenacity, associated with reduced particle size or solubilization, was also observed.

CHARACTERIZATION OF SWEET POTATO FEATHERY MOTTLE VIRUS RNA. B. B. Cali and J. W. Moyer. Department of Plant Pathology, North Carolina State University, Raleigh 27650.

The nucleic acid of two strains (C and SRC) of sweet potato

feathery mottle virus (FMV) was isolated from sucrose gradients after incubating purified virus in an ammonium carbonate-SDS-EDTA buffer, pH9, containing proteinase K and bentonite. Digestion with RNase, DNase and S₁ nuclease and chemical analysis indicated that the nucleic acid was single stranded RNA. Thermal denaturation profile, T_m of 51C and 29% hyperchromicity, was also characteristic of a single stranded RNA. The RNA was infectious on both *Chenopodium amaranticolor* and *Ipomoea nil* at 100-200 µg/ml. Agarose gel electrophoresis using methyl mercury denatured RNA estimated molecular weight at 3.65 X 10⁶, which is consistent with values predicted from the particle length. Biological and biochemical properties of these strains previously suggested that FMV is a member of the potyvirus group. Virion size and genome molecular weight make it one of the largest members of the potyvirus group.

ROOT ROT OF LADINO CLOVER INDUCED BY *CODINAEA FERTILIS* AND *FUSARIUM* SP. ALONE AND IN COMBINATION. C. L. Campbell, Department of Plant Pathology, North Carolina State University, Raleigh, NC 27650.

Codinaea fertilis (NC 3 and NC 45), *Fusarium roseum* (PA 813), *F. roseum avenaceum* (PA 959), and *F. oxysporum* (PA 807) were grown on 5% cornmeal-sand medium and incorporated singly or in combination into a pasteurized soil-sand mix in greenhouse studies. Ladino clover (*Trifolium repens*) 'Tillman' seedlings were transplanted into infested and non-infested soil and 2-wk later one-half of the plants in each treatment were stressed by spraying to run-off with maleic hydrazide (MH) (3750 ppm a.i.). After 10-14 wk root disease was evaluated. Plant weight was reduced in all treatments and disease severity increased in infested soil with MH application. Root rot was not present in MH-treated or check plants in non-infested soil. Root rot severity was generally greater with the combination of *C. fertilis* and each *Fusarium* isolate than with either one alone. The combination of *C. fertilis* and *F. roseum* gave the greatest amount of disease.

ANALYSIS OF TOBACCO BLACK SHANK EPIDEMICS IN NORTH CAROLINA. C. L. Campbell, B. Jacobi, N. T. Powell, and C. E. Main, Department of Plant Pathology, North Carolina State University, Raleigh, NC 27650.

Logistic, Gompertz, monomolecular, and Bertalanffy (N=2) growth models were tested for goodness-of-fit to disease incidence data from 50 epidemics of tobacco black shank. Epidemics occurred in small plot tests from 1974-1980 on a total of 26 varieties or lines and disease was assessed at 2-wk intervals from 2 through 14 wk after transplanting. Final disease incidence ranged from 27 to 99%. Based on evaluation of R² values and residual plots, 44 epidemics could be described by the logistic model (apparent infection rate 0.009 to 0.129), 25 by Gompertz, 9 by the monomolecular, and 17 by the Bertalanffy; 27 epidemics were described by more than one model. Runs analyses on pattern of diseased plants in 315-16 or 20 plant rows from 3 separate locations in 1980 indicated a nonrandom pattern of disease in only 20 rows. A nonrandom pattern or spread of disease would usually be expected to accompany logistic disease increase.

A COMPARISON OF METHODS FOR ASSESSING GRAIN MOLD IN SORGHUM. Victor M. Canez, Jr. and Stanley B. King, Department of Plant Pathology and Weed Science and USDA-SEA-AR, Mississippi State University, Mississippi State, MS 39762.

Six varieties of grain sorghum (*Sorghum bicolor*) were field grown with and without aerial misting during seed development. At physiological maturity and harvest maturity, fungal invasion of seed was assessed by plating surface-sterilized seed on potato dextrose agar and by determining ergosterol content. *Fusarium moniliforme*, *F. roseum* 'Semitectum', *Curvularia* spp. and *Alternaria* spp. were the predominant fungi isolated. The greatest number of fungal colonies and highest ergosterol content were associated with misted seed at harvest maturity. Greater differences in fungal invasion among varieties were found with ergosterol analysis than with the plating technique. Visual assessment of grain mold was more closely correlated with ergosterol levels than with total fungal colonies.

ENVIRONMENTAL CONDITIONS FOR INFECTION AND CONTROL OF ANODA CRISTATA WITH ALTERNARIA MACROSPORA. Capo, B.T., and D.O. TeBeest. Department of Plant Pathology, University of Arkansas. Fayetteville, Arkansas 72701.

Alternaria macrospora incites leaf spots and stem cankers on spurred anoda, *Anoda cristata*, and is considered a possible biocontrol agent for this weed. Dew periods of at least 8 hr at 24C, the optimum temperature for spore germination, were required for infection of all seedlings while incubation at 20, 28, or 32C during the dew period increased the time required for equivalent disease development. Dew periods < 8 hr resulted in few lesions. In controlled environments, lesions developed rapidly between 20 and 36C with an apparent optimum of 32C. Incubation of seedlings in a programmed day/night temperature regime of 31 to 20C reduced the rate of lesion development compared to constant 32C. Incubation temperatures < 20C or > 36C inhibited spore germination and disease development. In greenhouse studies, 90% of 18 to 20-day-old seedlings were killed within 3 wk. These studies suggest optimum temperatures and dew periods for biocontrol in the field.

NEWLY IDENTIFIED NON-PINUS HOSTS OF THE PINEWOOD NEMATODE. D.E. Carling, A.P. Elliott and R.C. Lambe. Virginia Truck and Ornamentals Research Station, Virginia Beach, VA 23455 and Dept. of Plant Path. and Physiol., VPI & SU, Blacksburg, VA 24061

Recent surveys for pinewood nematode disease (pine wilt disease) in eastern Virginia have revealed that species of *Cedrus* (*C. atlantica* Manetti and *C. deodara* Loud) and *Picea* (*P. glauca* Voss) harbor populations of the pinewood nematode, *Bursaphelenchus lignicolus* Mamiya and Kiyohara. Initial observations indicate symptom development is more deliberate and restricted in *Cedrus* spp. than the more rapid and systemic pattern of symptom development commonly observed in *Pinus* spp. Selected branches may wilt and die while the majority of the crown remains symptom free. It is suspected that *Cedrus* trees infected by *B. lignicolus* may survive for many years, perhaps serving as an inoculum reservoir during that period of time. *P. glauca*, on the other hand, develops symptoms more rapidly and may die within a single season.

GROWTH REQUIREMENTS AND NUTRITION OF *CORYNEBACTERIUM NEBRASKENSE*. Randall R. Carlson and Anne K. Vidaver, Department of Plant Pathology, University of Nebraska-Lincoln, Lincoln, NE 68583.

Corynebacterium nebraskense grew on a defined medium which contained inorganic salts, glucose, seventeen amino acids, three vitamins, and agar. The growth rate of *C. nebraskense* on this medium, as measured by the appearance of single colonies, was equivalent to its growth rate on NBV, an undefined medium containing inorganic salts, nutrient broth, yeast extract, and glucose. The addition of yeast extract to the defined medium enhanced the growth rate. *C. nebraskense* had no specific amino acid requirement, since each one could be deleted in turn from the medium without affecting growth; deletion of the vitamins or all the amino acids from the medium markedly reduced growth.

ULTRASTRUCTURE OF A MIXED PLANT VIRUS INFECTION. R. J. Carr and K. S. Kim. Department of Plant Pathology, University of Arkansas, Fayetteville, Arkansas 72701

Bean plants (*Phaseolus vulgaris* L. cv. 'Cherokee Wax') infected with bean yellow mosaic virus (BYMV) and cowpea severe mosaic virus (CSMV) were utilized in evaluating ultrastructural changes resulting from mixed infection. The cytopathology of doubly-infected bean leaves was characterized by the close association of both viruses in the same cell. Most commonly CSMV particles were aligned in rows along the long axes of the BYMV rods. In addition, paracrystalline arrays of intranuclear isometric particles, approximately the same size as CSMV virions, were observed in doubly-infected cells. These had the appearance of "empty" virus shells and were usually in close proximity to the nucleolus. They were also noted to be occasionally associated with intranuclear membranes and/or filaments. Ferritin-labelled antibody, specific for CSMV, did not preferentially tag intranuclear particles but did tag cytoplasmic CSMV virions. Double infection by BYMV and CSMV induced the formation of inclusions typical of potyviruses and comoviruses.

DEVELOPMENT OF A BARLEY GERM PLASM RESISTANT TO THE SEED TRANSMISSION OF BARLEY STRIPE MOSAIC VIRUS. T.W. Carroll, S.K. Zaske and E.A. Hockett. Dept. of Plant Pathology, and Dept. of Plant and Soil Science, USDA,SEA,AR, Montana State University, Bozeman, MT. 59717.

A barley germ plasm line with acceptable agronomic characteristics was developed for its resistance to the seed transmission of three Montana isolates of barley stripe mosaic virus (BSMV). The line was derived from a 'Modjo' x 'Betzes' cross followed by six backcrosses to 'Betzes' and subsequent self-pollination 11 times. 'Modjo', a barley of poor agronomic quality, was the source of the single recessive gene now known to condition resistance to seed transmission. F₁₁ plants in the field were blast-inoculated first as seedlings, then later while tillering, with a mixture of the three Montana isolates of BSMV in partially clarified leaf sap of barley. When the F₁₂ seed from these inoculated plants was sown in the greenhouse, only three of 2610 (0.11%) of the F₁₂ seedlings expressed virus-induced symptoms and tested positive for BSMV by double immunodiffusion serology.

HISTOLOGICAL ASPECTS OF APPLE TREE ROOTS AFFECTED BY REPLANT DISEASE. F.L. Caruso and M.D. Begin, Department of Botany and Plant Pathology, University of Maine, Orono, ME 04469.

Little is known about the microscopic symptoms of roots associated with the specific apple replant disease. Roots were sampled at monthly intervals from 5 healthy and 5 declined trees in 8 orchards with replant problems. Root segments (0.5 cm) were excised and processed: (1) cleared in hot KOH and stained with 0.05% trypan blue in lactophenol; (2) fixed in Craff II; or (3) fixed in formalin acetic acid. The latter two batches were dehydrated, embedded in paraffin, sectioned at 10 µm, and stained in safranin-fast green. Fungal hyphae and vesicles of endomycorrhizal fungi were frequently observed in the cortical cells. Cortical cells surrounding endoparasitic nematodes were

sometimes completely dissolved. Epidermal, hypodermal, and cortical cells contained much densely-stained material (possibly tannins) and some nuclei appeared abnormal. The stele of infected roots appeared unaltered although hyphae were sometimes visible in the vascular elements.

INFECTION OF SWEETGUM COPPICE SPROUTS BY BOTRYOSPHAERIA DOTHIDEA. N. L. Cashion, Dept. of Plant Pathology, University of Georgia, Athens, GA 30602.

Stem cankers, from which *Botryosphaeria dothidea* (Moug. ex Fr.) Ces. et de Not. was isolated, were found on sweetgum seedlings (*Liquidambar styraciflua* L.) from a Georgia nursery in March, 1980. These trees were potted individually, pruned to 2-4 cm above the soil surface to allow coppice sprouting, and placed outside. Although none of the sprouts showed symptoms in November, *B. dothidea* was isolated from 35 of 36 sprouts sampled. Isolations from bark and wood in sequence from the base to the apex of the sprouts revealed that the infections were localized and did not form a consistent pattern indicative of spread from the infected stumps. Brown discoloration in the stumps extended downward into the wood from the dead stump surface, but was not found around actively growing sprouts. The sprouts were probably infected by conidia which were produced in the dead bark of the stumps. Inoculum produced on stump surfaces after infected trees are harvested may be a problem in the coppice production of sweetgum.

THE PROTECTION OF SOYBEAN PLANTS AGAINST PHYTOPHTHORA MEGASPERMA VAR. SOJAE (PMS) BY PHYTOALEXIN ELICITORS. B. Castanho, J. T. Bass, D. R. Lundry, and T. L. Graham. Monsanto Agricultural Products Co., St. Louis, MO 63166

Biotic (e.g. PMS walls, yeast glucan, PMS-mycolaminaran) and abiotic (e.g. detergents, polyphenolic substances) elicitors of the soybean phytoalexin glyceollin were identified on intact soybean plants using a new cotyledon-injection assay. As well, disease evaluation assays using PMS-race 3 were developed for the inoculation of specific soybean tissues (roots, leaves, hypocotyls) on whole plants using zoospores of this pathogen. Using methods which allowed the application of glyceollin elicitors to whole plants, levels of phytoalexins and corresponding protection against PMS were evaluated. Several new molecular elicitors of glyceollin were identified from this work. As well, these elicitors were responsible for high levels of glyceollin accumulation and PMS-protection in all tissues which were treated. However, we did observe weak systemic protection which did not correlate to specific elicitation of glyceollin. As such, glyceollin appears to be a major component in localized, but not systemically, induced protection.

DEVELOPMENT OF A CHEMICALLY DEFINED MEDIUM FOR THE GROWTH AND NUTRITIONAL STUDY OF SPIROPLASMA CITRI. C. J. Chang and T. A. Chen. Dept. of Plant Pathology, Rutgers University, New Brunswick, NJ 08903.

A chemically defined medium CC-922 was developed and used to investigate the nutritional requirements of *Spiroplasma citri*. Of 12 tested carbohydrates, *S. citri* is able to utilize glucose, fructose, mannose, sorbitol, sucrose, and trehalose. *S. citri* is unable to metabolize arginine as an energy source. Asparagine, cysteine, and glutamine are essential. Supplementation with at least one purine and one pyrimidine base is needed as a nucleic acid precursor. Besides palmitic acid, oleic acid, and cholesterol, *S. citri* requires phosphatidylcholine (PC) derivatives, such as PC-Dimyristoyl, PC-Dipalmitoyl, PC-Dioleoyl, and phosphatidylethanolamine for growth.

NUTRITIONAL REQUIREMENTS OF THREE FLOWER SPIROPLASMAS AND HONEYBEE SPIROPLASMA. C. J. Chang and T. A. Chen. Dept. of Plant Pathology, Rutgers University, New Brunswick, NJ 08903.

A chemically defined medium CC-494 was used to investigate the nutritional requirements of three flower spiroplasmas (FS) and honeybee spiroplasma (HBS) (23-6, SR-3, BREV1, and AS-576 respectively). Of 12 tested carbohydrates, glucose, fructose, and mannose are utilized by all four spiroplasmas. In addition, FS (23-6), and HBS (AS-576) ferment trehalose; FS (23-6) and FS (SR-3) ferment sucrose; and FS (23-6) can also use raffinose. The three flower spiroplasmas require much simpler amino acid supplementation than HBS. For example, flower spiroplasmas grow when only aspartic acid and glutamic acid are added. FS (23-6) is the only spiroplasma that can use arginine as an energy source. Either one purine or one pyrimidine base is sufficient as a nucleic acid precursor for the flower spiroplasmas, whereas HBS requires at least one purine and one pyrimidine base. Oleic acid, cholesterol, and bovine serum albumin are essential for all four spiroplasmas. Palmitic acid, a non-essential fatty acid, promotes their growth significantly.

STEM AND CUTTING ROT OF DIEFFENBACHIA MACULATA 'PERFECTION' INCITED BY FUSARIUM SOLANI. A. R. CHASE. University of Florida, ARC-Apopka, FL 32703.

'Perfection' dieffenbachias showing cutting rot, lesions along petiole and leaf edges, and a mushy, sunken stem rot were collected

from several commercial greenhouses. *Fusarium solani* was isolated from each of the affected areas. Pathogen-free dieffenbachias produced in tissue culture were inoculated with either mycelial disks or spores of the fungus grown on potato-dextrose agar medium. Mycelial disks (5mm in diameter) were placed in longitudinal cuts in the stems and sealed with parafilm. Spore suspensions (1×10^6 spores/ml) were sprayed on the surface of horizontal cuts where a stem was removed. Control plants were treated in the same manner using sterile culture medium or water, respectively. Both methods induced typical disease symptoms (mushy, sunken lesions) ten days after inoculation and was readily reisolated. Control plants did not develop symptoms and *F. solani* could not be isolated from them. *Erwinia* spp. were not recovered from either naturally or artificially infected plants. To distinguish symptoms incited by *Erwinia* spp. and *F. solani*, accurate diagnosis through culture of the causal organism is mandatory.

ISOLATION AND CHARACTERIZATION OF A TEMPERATURE-SENSITIVE (ts) MUTANT OF A BROAD-HOST-RANGE IncP-1 R PLASMID pUT 13. Arun K. Chatterjee, Mary Ann Brown, and Janet S. Ziegler, Dept. of Plant Pathology, Kansas State University, Manhattan, KS 66506.

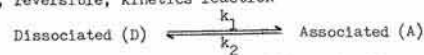
Mutant plasmids, thermosensitive in replication, are useful tools in the isolation of Hfr strains, transpositional mutagenesis, and in vivo construction of plasmid cointegrates. Those possibilities have seldom been realized with phytopathogenic bacteria since they either are non-receptive to the available ts plasmid vehicles or are unable to grow at a temperature at which the vehicles are unstable. By nitrosoguanidine mutagenesis we have obtained a mutant (pUT 13 ts-1) which apparently does not replicate at 35°C or higher. The plasmids confer resistance to carbenicillin (Tn 406) and trimethoprim (Tn 402). The host-range of plasmids includes *E. amylovora*, *E. carotovora*, *E. chrysanthemi*, *E. coli*, *P. syringae*, and *S. typhimurium*. A temperature-dependent segregation of the mutant plasmid, but not of the parent plasmid, occurred in several bacterial species. Thus, the manifestation of the Ts phenotype was independent of the genetic background of the host.

PROTECTION OF TOBACCO SEEDLINGS FROM GRANVILLE WILT WITH AVIRULENT BACTERIOCIN-PRODUCING STRAINS OF PSEUDOMONAS SOLANACEARUM. Wen-Yen Chen and Eddie Echandi. Dept. of Plant Pathology, N. C. State University, Raleigh, N. C. 27650.

A significantly high % of tobacco seedlings were protected from Granville wilt caused by *P. solanacearum* by soaking root systems in suspensions of avirulent bacteriocin-producing strains of *P. solanacearum* (ABPS) in greenhouse experiments. Root systems soaked in 10^9 colony forming units/ml (CFU/ml) of ABPS and assayed shortly after planting in pasteurized soil had 7×10^6 CFU/root system of ABPS and 30 days later 5×10^5 CFU/root system of ABPS. When roots of seedlings were dipped in a suspension of 10^9 CFU/ml of ABPS before planting, ABPS greatly reduced root colonization by the virulent strain added to pasteurized soil at a concentration of 2×10^6 CFU/g of dry soil. In pasteurized soil containing a 1:1 mixture (5×10^5 CFU/g of dry soil) of ABPS and the virulent strain, ABPS reduced multiplication of the virulent strain in soil and seedling rhizosphere.

SEMI-PERSISTENT, NONCIRCULATIVE TRANSMISSION OF PLANT VIRUSES: A COLLOIDAL KINETICS MODEL OF VIRUS-VECTOR INTERACTIONS. S.A. Childress, Department of Entomology, Texas A&M University, College Station, TX 77843.

Virions, due to their size and the physicochemical makeup of the coat protein, react as colloids in aqueous solutions relative to substrate interactions. Analysis of data dealing with aphid- and leafhopper-borne, semipersistently transmitted viruses and transmission electron microscopy of maize chlorotic dwarf virus implicate association-dissociation interactions between virions and retention sites (substrate) in the foregut of homopterous vectors. The rate of association (k_1) and dissociation (k_2) of virions from lumen to retention sites are correlated with vector retention time and inoculativity. These data indicate a first order, reversible, kinetics reaction



and are consistent with both acquisition-retention and inoculativity over time (T): $\ln A = A_0 k_1 T$ and $\ln D = D_0 k_2 T$.

REOVIRUSLIKE PARTICLES IN THE BLACK-FACED LEAFHOPPER, GRAMINELLA NIGRIFRONS. S. A. Childress and Kerry F. Harris, Department of Entomology, Texas A&M University, College Station, TX 77843

Electron microscopic examination of leafhopper tissues revealed reoviruslike particles of unknown origin. The presumed virus particles (ca. 56-nm diam) were observed in virtually every organ and tissue examined, as well as free in the hemocoel of affected leafhoppers. However, virus was notably absent from gut lumina and gut epithelial cells. Cytological changes in affected insects are similar to those associated with both leafhopper and plant-hopper infection by plant reoviruses. Extensive paracrystalline and crystalline arrays of particles, viroplasmlike areas, and other cytopathological changes confirm the presumed viral nature of the particles and suggest propagation of virus in the insect.

The apparent absence of virus in the gut suggests that virus is maintained in the leafhopper population solely via transovarial passage of virus from parent to progeny. Furthermore, attempts to detect similar particles in apparently healthy plants on which affected leafhoppers are reared have proved negative.

EXPRESSION OF FUSARIUM SEMITECTUM IN COTTONSEED. A. Ciegler, L. Lee, M. Klich, T. Jacks, and T. Hensarling, Southern Regional Research Center, USDA, P.O. Box 19687, New Orleans, LA 70179.

We found that developing cotton bolls varying in age from fertilization to dehiscence appeared to be free of internal fungal activity. However, 48 hours after dehiscence 100% infection of seed by *Fusarium semitectum* was found. Fortuitous contamination was ruled out. Immature seeds gave no fungal growth, whereas, all mature seeds showed contamination. Plating sections of the boll onto agar seeded with *F. semitectum* revealed fungal inhibition primarily about the intercarpellary membrane with slight inhibition about the carpellary membrane. *Penicillium oxalicum* and *Aspergillus flavus* were not inhibited. Extraction of bolls with a variety of solvents indicated no constitutive antibiotic was present. Gossypol and gossypol derivatives were not responsible for the inhibition. It is theorized that *F. semitectum* is present very early in seed development and that inhibition results from either presence of a phytoalexin or tannin precursors and that the fungal inhibitory factor is lost on seed maturation.

ANALYSIS OF CONIDIA AND GERMINATION MEDIA FOR HOST-SPECIFIC TOXIN PRODUCED BY HELMINTHOSPORIUM CARBONUM. L.M. Cluffetti and L.D. Dunkle. USDA-SEA. Dept. of Botany and Plant Pathology, Purdue University, W. Lafayette, IN 47907.

Helmintosporium carbonum Race 1 produces a host-specific toxin and causes a leaf spot of corn lines that are sensitive to the toxin. Susceptible and resistant disease reactions of near-isogenic lines are distinguishable by 24 hr after inoculation with conidia, suggesting that the determinant of pathogenicity is produced prior to that time. Attempts to relate toxin synthesis during conidial germination to pathogenesis were limited by the relative insensitivity of biological and chemical assays. Therefore, high-pressure liquid chromatographic procedures for quantifying toxin were developed with purified preparations. Although the method is ca. 30-fold more sensitive than root growth inhibition bioassays, no toxin was detected in homogenates of ungerminated conidia nor in the media that did not support germination. The procedure is now being used to determine whether germinating conidia synthesize toxin and, if so, to establish the temporal relationship between toxin synthesis and penetration and colonization of the host.

AERIAL INFRARED PHOTOGRAPHY FOR DISEASE DETECTION IN FIELD PLOTS OF BARLEY OATS AND WHEAT.

R.V. Clark, D.A. Galway and Y.C. Paliwal - Research Station and Chemistry and Biology Research Institute, Agriculture Canada, Ottawa, Ontario, Canada K1A 0G6

The use of aerial photography as a means of detecting and estimating disease damage to cereals was explored in field plots of Vanier barley, Elgin and Victory oats and Neepawa wheat after inoculation with various fungal pathogens. Half of the plot area was treated with maneb fungicide at regular intervals, starting mid June, while the other half was left untreated. In addition, paired rows in some plots of Elgin oats were inoculated with barley yellow dwarf virus (BYDV) and the plots sprayed at intervals with insecticide. Severe infection of spot blotch (*Bipolaris sorokiniana*) on barley, crown rust (*Puccinia coronata*) on Victory oats, BYDV and crown rust on Elgin oats and powdery mildew (*Prysinthe graminis*) on wheat developed on inoculated plants. Effective control of spot blotch and crown rust but not of mildew was obtained with maneb and no BYDV developed on uninoculated plants. Sequential infrared photographs, starting in mid June showed little difference between fungal diseased and healthy plants but BYDV infected rows could be distinguished. Yield losses amounted to 49% for spot blotch, 62% for BYDV and 47% for crown rust. By maturity, considerable lodging was present, particularly in the plots not treated with fungicide.

THE IMPACT OF AMBIENT OXIDANT ON FOLIAR SYMPTOMS AND TUBER YIELD AND QUALITY OF FIELD-GROWN POTATO CULTIVARS IN NEW JERSEY.

B. B. Clarke and E. Brennan, Department Plant Pathology, Cook College, P.O. Box 231, New Brunswick, N.J. 08903.

Green mountain (GM), Norchip (NC) and Norland (NL) potato cultivars were grown for four years under standard commercial practices to determine their relative susceptibility to oxidant and to evaluate the effectiveness of an antioxidant, EDU, applied as a soil drench. The order of foliar susceptibility to oxidant was NL > NC > GM, and symptom severity directly correlated with the ambient oxidant dosage. EDU significantly reduced foliar symptoms. When compared to the EDU treatment, untreated NC plants sustained a 31% loss in tuber yield (1980) and NL a 25% reduction (1979 and 1980). Specific gravity and tuber number were significantly reduced in 1980 for untreated NL plants. The timing and dosage of an oxidant episode, in relation to tuber development, determines its effect on tuber yield and quality.

CHARACTERIZATION OF KIEVITONE HYDRATASE FROM FUSARIUM SOLANI f. sp. PHASEOLI CULTURE FILTRATES. T. E. Cleveland and D. A. Smith, Plant Pathology Department, University of Kentucky, Lexington, Ky, 40546.

Characterization of kievitone hydratase, an enzyme which catalyzes detoxification of the phytoalexin kievitone (Physiol. Pl. Pathol. 14:179) is reported. The enzyme was isolated from *Fusarium solani* f. sp. *phaseoli* culture filtrates by centrifugation and filtration, and concentrated by lyophilization. Purification was achieved by anion exchange chromatography, gel filtration (Sephadex G-200) and isoelectric focusing. Kievitone hydratase (MW = 173,000 ± 15,000) is an acidic protein with an isoelectric point of 5.73 ± 0.34. It has a temperature optimum of 55 C, but denatures rapidly at temperatures exceeding 65 C. Kievitone hydratase has a pH optimum of 5.5 at 27 C with an apparent Km of 1.745 x 10⁻⁵ M under these conditions. Preliminary findings indicated that it also occurs in *Fusarium*-infected bean tissues.

SCLEROTINIA SCLEROTIUM WHITE MOLD OF SOYBEANS. Molly Niedbalski Cline and Barry Jacobsen. Dept. of Plant Pathology, University of IL, N-533 Turner Hall, 1102 S. Goodwin Ave., Urbana, IL 61801

In several areas of Illinois, *Sclerotinia sclerotiorum* white mold has become an occasional problem in soybean (*Glycine max*) fields previously cropped to beans (*Phaseolus vulgaris*). The disease reaction of 17 soybean cultivars from maturity groups II, III, IV, was evaluated using two inoculation methods. Plants in full bloom (R5) were inoculated by spraying with an ascospore suspension (1-5 x 10⁵ ascospores/ml) or plants in the V3 growth stage were inoculated by placing macerated carrot tissue colonized by the fungus directly onto the leaf surface. Following inoculation, plants were placed in a mist chamber at 20-25°C for 7-12 days. Disease incidence and symptom development showed all cultivars tested by both inoculation methods to be highly susceptible. Ascospores readily infected blossoms in the R5 stage and only infected plants in the V3 stage when an exogenous energy source was added or when tissues were injured.

PENETRATION, INFECTION AND DEVELOPMENT OF MARSSONINA JUGLANDIS IN LEAVES OF BLACK WALNUT. Steven Cline and Dan Neely, Department of Plant Pathology, University of Illinois and Illinois Natural History Survey, Urbana, IL 61801.

Penetration, infection and development of walnut anthracnose in black walnut (*Juglans nigra* L.) leaves were observed. A conidial suspension was atomized onto mature leaves. Leaf samples were taken at 24 hr intervals up to 240 hr after, and examined by paraffin sections, whole leaf mounts, and scanning electron microscopy. Conidia germinated within 48 hr and formed appressoria either from short germ tubes or directly from conidia at the point of contact. Penetration was direct through host epidermal cells and appeared to combine both chemical and mechanical modes of entry. Intercellular hyphae were observed at 72 hr while intracellular spread through epidermal cells was not prominent until 144 hr. Hyphal movement occurred laterally through simple pit connections in secondary leaf veins. At 168 hr, mycelium had entered the mesophyll and host cell necrosis could be seen microscopically.

USE OF VITAL AND FLUORESCENT-ANTIBODY STAINS TO DETECT PROPAGULES OF P. MEGASPERMA F. SP. GLYCINEA RACE 1 IN SOIL. S.D. Cohen, Department of Botany and Plant Pathology, Michigan State University, East Lansing, MI 48824.

Seven different fluorescent and non-fluorescent stains were evaluated as vital stains for mycelia and oospores of *Phytophthora megasperma* f. sp. *glycinea* race 1 (ATCC 44032). Viable mycelia in Capac loam soil were best observed with fluorescein diacetate and 6-carboxy-fluorescein diacetate. Tetrazolium bromide consistently stained viable oospores in soil. Mycelia and oospores were also stained by an indirect fluorescent-antibody method. Antiserum (supplied by Dr. J. MacDonald, U.C. Davis) was tested with propagules of *P. megasperma* f. sp. *glycinea*, *P. cactorum*, *Pythium ultimum*, *Aphanomyces euteiches* and *Fusarium solani*. All five fungi reacted with the antiserum. Specificity of the antiserum to *P. megasperma* f. sp. *glycinea* was not enhanced by dilution or by repeated adsorption by *Pythium ultimum* mycelia.

PATHOGENICITY OF PYTHIUM APHANIDERMATUM ON DUCKWEED AND WATER-MEAL. P. F. Colbaugh, Texas Agricultural Experiment Station, Texas A&M University Research and Extension Center at Dallas, Dallas, Texas 75252

A foliar blight of the floating aquatic weed duckweed (*Lemna* sp.) caused by *Pythium aphanidermatum* was observed in commercial hydroculture beds used for production of tropical foliage plants. The pathogen was isolated from blighted areas of duckweed ranging from 5 cm to 30 cm in diameter and used successfully to inoculate healthy duckweed fronds. Laboratory studies demonstrated pathogenicity of the fungus on *L. valdiviana*, *L. gibba*, *L. perpusilla*, *L. obscura* and one species of water-meal (*Wolffia* sp.). Foliar blighting caused by the pathogen resulted in complete death of infected duckweed and water-meal plants following inoculation of fronds with a 0.5 cm diameter mycelial plug on V/8 agar. Micro-

scopic observation of diseased duckweed fronds demonstrated mycelial colonization by the fungus from diseased to adjacent healthy plants. Inoculation studies at 3 C temperature intervals from 18 to 30 C demonstrated greatest foliar blighting activity on four *Lemma* spp. at 24 and 27 C.

IDENTIFICATION OF A VIRULENCE GENE IN PSEUDOMONAS SAVASTANOI. L. Comai, and T. Kosuge. Department of Plant Pathology, University of California, Davis, CA. 95616.

P. savastanoi induces galls on oleander and olive plants. Production of indoleacetic acid (IAA) by the bacterium is associated with the capacity for inducing galls. In strain 2009, the gene for tryptophan (Trp) monooxygenase (*iaaM*), which converts L-Trp into indoleacetamide, and the gene for indoleacetamide hydrolase (*iaaH*), which converts indoleacetamide to IAA, are borne on plasmid pIAA1. Reintroduction of pIAA1 into IAA-negative, pIAA1-less strains, restores IAA synthesis and capacity to stimulate gall formation, a virulence trait. To prove that the IAA genes are determinants of virulence and not merely associated with an unknown tumorigenic function, a segment of pIAA1, 2.7 kilobase pairs was cloned in *E. coli* and shown to bear the *iaaM* locus. The recombinant plasmid pLUC1, carrying that region of DNA, was reintroduced in pIAA1-less *P. savastanoi*, fully restoring virulence.

CONTROL OF SUGARCANE SMUT BY VANGARD TM J. C. Comstock and S. A. Ferreira, Dept of Genetics & Pathology, Hawaiian Sugar Planters' Association, P. O. Box 1057, Aiea, Hawaii 96701.

Vanguard TM, a Ciba-Geigy fungicide, has activity against the sugarcane smut pathogen, *Ustilago scitaminea*. Systemically infected seedpieces of variety H50-7209 given a 20-min preplant dip in 0, 100, 500, and 1000 ppm Vanguard developed 16, 13, 6, and 5% infected stalks with terminal sori at 4-1/2 months after planting. The level of smut at the 500 and the 1000 ppm treatments was significantly lower than that of the untreated control. A preplant dip of healthy seedpieces for 20 min at 52°C in 1000 ppm Vanguard reduced smut development in the first and second ratoon crops that were exposed to high levels of smut inocula. The plant and ratoon crops were ratooned at 4-month intervals. In the first ratoon, varieties H59-3775, H62-4671, and H57-5174 developed 19, 2, and 2% smut-infected stalks with a 1000 ppm Vanguard preplant treatment compared to 43, 8, and 9% with no pretreatment. In the second ratoon, varieties H62-4671 and H57-5174 had 41 and 23% infected stalks with a Vanguard preplant treatment and 60 and 28% infected stalks with no treatment. With the most susceptible variety, H59-3775, both treatments had 80% infection.

TOLERANCE TO PAPAYA RINGSPOT VIRUS IN PAPAYA. R. A. Conover and R. E. Litz. University of Florida Agricultural Research and Education Center, Homestead, FL 33031.

All papayas are susceptible to papaya ringspot virus (PRV) but symptoms vary widely on different plants. A subjective measure of field response to PRV was developed to evaluate progeny in a breeding program to develop PRV-tolerant cultivars. Categories were 1) tolerant: plants nearly symptomless; 2) mild: slightly mottled, little reduction in leaf area or plant vigor; 3) severe: prominently mottled and/or leaf distortion, sharply reduced leaf area, shortened petioles, slow growth; 4) very severe: severe mottle and leaf distortion, greatly reduced leaf area, very short petioles, poor vigor. Plants grown from a papaya line from Colombia showing PRV-tolerance were rated 4% tolerant, 11% mild, 80% severe and 5% very severe. After 3 generations of sib mating PRV-tolerant selections, ratings were 55% tolerant, 37% mild, 8% severe, 0% very severe. Tolerant plants develop more prominent symptoms during the winter or when exposed to other environmental stress. The % soluble solids (sugars) were 11.1, 10.3, 9.5 and 7.0 for plants rated tolerant, mild, severe and very severe.

HOST RANGE OF UROMYCES VICIAE-FABAE. R.L. Conner and C.C. Bernier, Department of Plant Science, University of Manitoba, Winnipeg, Manitoba, Canada R3T 2N2.

Isolates of *Uromyces viciae-fabae* collected from native and cultivated species of *Vicia*, *Lathyrus* and *Pisum* at different locations throughout Southern Manitoba were used in cross-inoculation studies of this rust. A total of 20 *Vicia* spp., 10 *Lathyrus* spp., 1 *Lens* sp. and 1 *Pisum* sp. were included in tests against each isolate. Pathogenicity was determined on the basis of the presence or absence of sporulation two weeks after inoculation. The isolates were found to have much larger host ranges than previous work had indicated. Many host species did not react uniformly to specific isolates. Rust isolates shared so many hosts in common, that it was not possible to divide them into discrete biological forms. Rust found on native species of *Vicia* and *Lathyrus* could infect one or more of the crop species, *Vicia faba*, *Pisum sativum* and *Lens culinaris*, so could play an important role in the epidemiology of this disease.

A SELECTIVE MEDIUM FOR PYTHIUM SPP. FOR ROUTINE DIAGNOSTIC LABORATORY ISOLATION. Kenneth E. Conway. Department of Plant Pathology. Oklahoma State University, Stillwater, OK 74078.

The operation of a Plant Disease Diagnostic Laboratory requires

the use of selective agar media for certain groups of pathogens. A medium containing 2% agar, 300 µg/ml sodium Ampicillin and various concentrations of the fungicide CGA-64251 (Ciba Geigy) was evaluated. *Rhizoctonia solani* from Geranium, *Pythium arhenomanes* from wheat, *Rhizoctonia solani* mating groups AG1 and AG2, *Sclerotium rolfsii* from peanuts, *Trichoderma harzianum* from soil, *Fusarium epispheeria* from boxwood, *Phytophthora* sp., and *Pythium* sp. from tomatoes, were cultured on combinations of this medium in petri dishes. Measurements of colony diameters were recorded every three days for two weeks. Concentrations of CGA-64251 at 100 ppm and 1000 ppm allowed most rapid growth of *Pythium* spp. and restricted other tested fungi. This medium is inexpensive, easy to prepare and has been used successfully in the diagnostic laboratory for isolating *Pythium* spp. from plants and soil.

EFFECT OF POSTHARVEST CALCIUM TREATMENTS ON DECAY OF STORED 'DELICIOUS' APPLES. William S. Conway, Horticultural Crops Quality Laboratory, HSI, SEA-AR, U.S. Department of Agriculture, Beltsville, MD 20705

'Delicious' apples harvested from commercial orchards in Maryland and Virginia were used in a storage test to determine the effect of calcium chloride treatments on decay. The fruit were treated with 0, 2, 4, 6 or 8% solutions of calcium chloride by dipping, vacuum infiltration (250 mm Hg) and pressure infiltration (15 psi). The apples were then placed in storage (0 C). After 3 months, the fruit were removed from storage, wounded on 2 sides and inoculated with a conidial suspension of *Penicillium expansum*. Following additional storage at 20 C for 7 days, the apples were rated for decay severity by measuring the diameter of the decayed area at the inoculation sites. Fruit tissue was also analyzed for calcium content after storage. Least decay and greatest increase in tissue calcium content occurred in those apples pressure infiltrated with calcium chloride. Effectiveness in decay control increased as calcium concentration of the infiltrated solution increased.

RELATIONSHIP OF CULTURAL PRACTICES, AIR TEMPERATURES, AND DURATION OF LEAF WETNESS TO THE DEVELOPMENT OF RHIZOCTONIA LEAF SPOT AND BLIGHT OF TALL FESCUE. H. B. Couch. Dept. of Plant Path. & Physiol., VPI & SU, Blacksburg, VA 24061.

Rhizoctonia solani-incited leaf spot and blight is a major disease of tall fescue (*Festuca arundinacea*) in the sections of the North American continent characterized by warm, humid summer months. In greenhouse-based studies, tall fescue plants grown under nutritional regimes of either high imbalanced N or high balanced N, P, and K were more susceptible to the disease than those grown under either low imbalanced N or low balanced N, P, and K. Plants grown at soil moisture regimes of continuous 1/3 atm, and cyclic 1/3 atm + 15 atm + 1/3 atm, respectively, were not altered in their apparent susceptibility to the disease. In environment control chamber-based studies, it was determined that the optimum conditions for infection were 48 hr continuous free moisture on the leaf surface and an air temperature of 32 C, while the optimum temperature for colonization was 26 C.

MUTANTS OF XANTHOMONAS MALVACEARUM WITH RESISTANCE TO 2,7-DIHYDROXYCADALENE, AN INHIBITOR FROM COTTON. E. C. Cover and M. Essenberg, Dept. of Biochemistry, Oklahoma State University, Stillwater, OK 74078.

2,7-Dihydroxycadalene (DHC) is produced in leaves and cotyledons of bacterial blight-immune lines of upland cotton after inoculation with *Xanthomonas malvacearum* E. F. Sm. (Dows.), the causal agent of bacterial blight. DHC is inhibitory to *X. malvacearum* (ED₅₀ = 0.4 mM). Spontaneous and ethyl methane-sulfonate-induced mutants of *X. malvacearum* with ability to grow in the presence of DHC were selected in liquid cultures containing 0.4-0.7 mM DHC. Three classes of DHC-resistant mutants were obtained. Class 1 had lost virulence to Ac44, a cotton line susceptible to all known races of *X. malvacearum*. Class 2 was virulent to Ac44, but when reisolated after growth in Ac44, was no longer DHC-resistant. Class 3 was virulent to Ac44 and retained DHC-resistance during growth in Ac44. Population trends of class 3 and of the parent strain in resistant plants were compared to determine whether DHC-resistance increases ability to multiply in plants that produce DHC.

CONTROL OF PHYTOPHTHORA ULICIS ON ENGLISH HOLLY WITH SPRAYS OR SOIL DRENCHES. D. L. Coyer, USDA-SEA-AR, Corvallis, OR 97330.

Field-grown English holly (*Ilex aquifolium* L.) was sprayed with CGA 48988 (Ridomil®; 0.599 g/L), SN 66752 (Previcur-N; 0.94 g/L) or Kocide 101 (1.198 g/L) in November, 1979. Treated trees were sampled 23 da later and half the samples were inoculated with a spore suspension of *P. ulicis* before packaging. The samples were incubated 22 da at 45(±5) C. Leaf infection and/or defoliation were significantly reduced in inoculated and uninoculated samples due to spraying with CGA 48988. Kocide 101 caused leaf injury and increased defoliation. Drench treatments using CGA 48988 (5.35 g/m²) and two rates of LS 74-783 (Alifette®; 4 g and 8 g/m²) were applied to field-grown holly trees in late October, 1980. Samples were cut 20 and 35 da after treatment and stored at 45(±5) C. Percent infected leaves was reduced from 10.74 to 0.26 (20 da cut) and from 9.90 to 0.45 (35 da cut) due to treatment with CGA 48988. Defoliation was reduced from 81.5 to 30.9 percent. LS 74-783 was less effective than CGA 48988.

IDENTIFICATION OF THE SOURCES OF HIGH LEVEL RESISTANCE TO FUSARIUM WILT IN WATERMELON. J. M. Crall, University of Florida, ARC Leesburg, P. O. Box 388, Leesburg, FL 32748.

Several workers have reported on a high level resistance in watermelon (*Citrullus lanatus* [Thunb.] Matsum. & Nakai) to wilt caused by *Fusarium oxysporum* (Schlecht.) f. sp. *niveum* (E.F.S.) Snyd. & Hans. Some of them have described this resistance as deriving from Florida seedling 124. Search of our records and correspondence indicates that this selection arose from a cross of Leesburg x Hawkesbury made here in 1936. Recent studies on resistance to wilt in seedlings showed that neither Kleckley Sweet (from which the Leesburg variety was selected) or Hawkesbury have the high level resistance to *Fusarium* wilt that is typical of Calhoun Gray and several other varieties. Apparently the high level resistance derives from a fortuitous combination of factors from each of the parents followed by a selection process that enabled its identification. It is not present in the variety Blacklee, which was developed from the same cross.

CONTROL OF PHOMOPSIS CANE AND LEAF SPOT DISEASE OF GRAPEVINE. J. D. Cucuzza and M. A. Sall. Department of Plant Pathology, University of California, Davis, CA 95616.

Three chemicals were used to control *Phomopsis* cane and leaf spot disease of grapevine for two seasons in a commercial vineyard (*Vitis vinifera* cv. Tokay) near Lodi, CA. The effects of these chemicals on pycnidial activity were monitored by periodically examining the number of cirrhi present on bark strips following hydration for one hour and incubation at high humidity. Dinoseb and sodium arsenite were found to suppress pycnidial activity (85-100%) whereas captan did not. A quantitative method of evaluating disease severity in the field was developed using a weighted average of both leaf and cane symptoms. The three chemicals reduced disease severity to different degrees. When severe, disease caused a significant reduction ($p < .05$) in the number of clusters as well as the weight of the fruit/vine ($p < .10$).

GRAZING PATTERNS OF MYCOPHAGOUS COLLEMBOLA AND ASSESSMENT OF BIOCONTROL POTENTIAL. E. A. Curl and Joni M. Snell. Department of Botany, Plant Pathology, and Microbiology, Auburn University, AL 36849.

Studies in Alabama have shown that mycophagous microarthropods of the Order Collembola are prevalent in the rhizosphere of cotton, and provided significant control of *Rhizoctonia* damping-off of seedlings in greenhouse tests. Collembola generally are unspecialized feeders; however, laboratory tests have shown, among 15 pathogens tested, measurable "preferences" by species of *proisotoma* and *Onychiurus* for mycelia of specific root-infecting fungi. Grazing patterns on a water agar base showed a high preference for *Rhizoctonia solani*, but aversion to *Sclerotium rolfsii* and to sporulating cultures of *Trichoderma harzianum*. Field sampling indicated a parallel coexistence for Collembola and *Rhizoctonia*, except between June and September when the animal population was low and *Rhizoctonia* infestation was high. In a controlled environment, populations of Collembola varied according to the rhizosphere effect of different crop plants commonly used in a cotton rotation system.

SEPTORIA SP. ON BARLEY AND HORDEUM PUSILLUM. Barry M. Cunfer, Department of Plant Pathology, Georgia Station, University of Georgia, Experiment, GA 30212.

Septoria sp. was recovered from distinctly oval leafspots on barley (*Hordeum vulgare*). The lesions had a buff center containing numerous scattered pycnidia. *Septoria* isolates were also recovered from irregular necrotic areas on leaves of *H. pusillum* (little barley). Conidia from lesions on both *Hordeum* species were indistinguishable from those of *S. nodorum* from wheat. On oatmeal, wheat meal and other agar media isolates from *H. pusillum* were similar to *S. nodorum* but most isolates from barley differed. In cross inoculations barley isolates were virulent to barley and *H. pusillum* whereas *S. nodorum* from wheat was highly virulent to wheat and *H. pusillum*, but only weakly virulent to barley. Isolates from *H. pusillum* were pathogenic to all three species. *Septoria* sp. was reisolated from sporulating pycnidia on the glumes of field-harvested barley seed and from all floral parts including seed of *H. pusillum* inoculated in the greenhouse.

ANALYSES OF PLASMIDS IN PSEUDOMONAS SYRINGAE. T. C. Currier and M. K. Morgan, Dept. of Plant Pathology, Kansas State University, Manhattan, KS 66506.

The DNA from 25 syringomycin (SR) producing strains and 14 syringotoxin (ST) producing strains of *P. syringae* was analyzed for the presence of plasmids by agarose gel electrophoresis. Thirteen SR-producing strains and all ST-producing strains contained at least one plasmid. The sizes of the plasmids ranged from about 3×10^6 to about 120×10^6 daltons. Strains Ps 955 and Ps 229 contained one plasmid and Ps 179 contained three plasmids. These plasmids have been eliminated from their respective hosts. The properties of the cured and parent strains have been compared for the following: 1) bacteriophage and bacteriocin production and sensitivity, 2) sensitivity to antibiotics, heavy metals and ultraviolet light, 3) utilization of a wide range of compounds as sole carbon source, and 4) toxin production and pathogenicity. Only subtle differences

between the cured and the parent strains have not been observed. Two of the plasmids in Ps 179 have been shown to be self-transmissible.

CHROMOSOME MOBILIZATION ABILITY (Cma) IN PSEUDOMONAS SYRINGAE MEDIATED BY THE PLASMID R68.45. T. C. Currier and M. K. Morgan, Dept. of Plant Pathology, Kansas State University, Manhattan, KS 66506.

The plasmid R68.45 has Cma in bacteria of many genera including some phytopathogenic species. It has recently been shown that this plasmid contains a direct DNA duplication which is essential for Cma. We have found that this duplicated region is unstable under certain conditions in certain bacteria. The duplicated region contains two PstI and one HpaI, PvuII and SmaI restriction endonuclease sites. R68.45 has been introduced into two syringomycin-producing strains of *P. syringae*, and the integrity of the duplicated region has been confirmed by restriction endonuclease analyses. Both of these strains can now donate chromosomal markers at about 5×10^{-7} per donor cell.

PHYTOPHTHORA PARASITICA, A NEW PATHOGEN OF SAND PINE. W.E. Dahm, R.S. Webb, School of Forest Resources and Conservation, Univ. of Florida, Gainesville, FL 32611 and T. Miller, USDA Forest Service, Gainesville, FL.

Phytophthora parasitica and *P. cinnamomi* were isolated from declining and dead Choctawhatchee variety sand pine (CSP) seedlings from a commercial nursery in north Florida. *Phytophthora parasitica* had not previously been associated with mortality of CSP or Ocala variety sand pine (OSP) seedlings. Soil collected from a sand pine nursery bed was fumigated and infested at 5 and 50 propagules per gram of soil with an isolate of *P. parasitica* cultured from symptomatic CSP nursery-grown seedlings. Four-week-old CSP and OSP seedlings grown from seed, were transplanted at a density of 25 per ft² (269 per m²) in flats containing infested soil. Mortality occurred at both inoculum levels among OSP but not CSP seedlings and *P. parasitica* was recovered from dead OSP seedlings. To date of this abstract, pathogenicity has not been shown for CSP seedlings.

POPULATIONS OF PLASMIDIOPHORA BRASSICAE RESTING SPORES IN IRRIGATION WATER SEDIMENTS. L.E. Datnoff, G.H. Lacy and G.J. Griffin. Dept. Plant Path. & Phys., VPI&SU, Blacksburg, VA 24061.

Populations of *Plasmidiophora brassicae* resting spores (RS) found in sediments of ponds used to irrigate cabbage, were estimated by comparing the incidence of symptoms on seedlings grown in sediments to the incidence on seedlings in steamed sediments artificially infested with various RS populations. When comparing standard curves of RS populations to symptom incidence at 95% confidence limit, populations in three sediments were estimated to be 8×10^5 - 2×10^7 , 6×10^4 - 2×10^5 and 2×10^6 - 1×10^3 RS/g. Slopes of curves in arithmetic and log₁₀-log₁₀ plots of RS density versus symptom incidence [transformed to log_e (1/(1-y)), y = symptom incidence] were similar to the slopes of curves based on the data of Colhoun (Phytopath. 61:1280-1292, 1971); however, symptom incidence occurred at a higher RS density than he observed. Since steaming soils releases nutrients, initial RS populations may be reduced by spontaneous germination. However, these results indicate high RS populations are present in some pond sediments.

DESTRUCTION OF TOBACCO CELL MEMBRANES BY THE PHOTSENSITIZING TOXIN, CERCOSPORIN. M. E. Daub. Dept. of Crop and Soil Sciences, Michigan State University, E. Lansing, MI 48824

Cercosporin, a metabolic product of *Cercospora* species, is a photosensitizing compound which rapidly kills plant cells in the light. Tobacco leaf disks which were exposed to cercosporin in the dark and then transferred to the light showed a dramatic increase in electrolyte leakage within 1-2 min. Cercosporin-treated leaf disks incubated in the dark and untreated, light-exposed disks had no increase in electrolyte leakage. All tobacco protoplasts exposed to cercosporin in the light were destroyed within 45 min. Chloroform:methanol extracts of toxin-treated suspension cultures gave positive reactions for lipid hydroperoxides in the thiobarbituric acid test. Cercosporin-treated leaf disks emitted high concentrations of ethane 12-24 hrs after incubation in the light. The data suggest that cercosporin is mediating a peroxidation of membrane lipids, which leads to the rapid destruction of cell membranes and death of the cells.

ISOLATION AND CULTURE OF THE BACTERIA ASSOCIATED WITH PHONY PEACH DISEASE AND PLUM LEAF SCALD. M. J. Davis, W. J. French, and N. W. Schaad. Departments of Plant Pathology: Rutgers University, Cook College, NJAES, New Brunswick, NJ 08903; University of Florida, IFAS, Monticello, FL 32344; University of Georgia, GES, Experiment, GA 30212

The fastidious, xylem-limited bacteria often referred to as "rickettsialike" and associated with phony peach disease (PPD) and plum leaf scald (PLS) were isolated from peach with PPD in Florida and from plum with PLS in Florida and Brazil. Xylem sap containing the bacteria was expressed from stem sections and streaked onto a modification of the PD2 medium developed for the Pierce's disease (PD) bacterium. Colonies reaching 0.05-0.10 mm in diameter developed after 2 wks at 28 C. Strains of the

PPD and PLS bacteria have been maintained for over 15 passages in both agar and broth cultures. Cells of the PLS and PPD bacteria from culture and host tissues were immunofluorescent positive against IgG to cells and membranes of the PLS bacterium extracted from host tissues and the PD bacterium grown in culture.

CONTROL OF PHYTOPHTHORA ROOT AND FOOT ROT OF CITRUS WITH TWO SYSTEMIC FUNGICIDES. R.M. Davis, Texas A&I University Citrus Center, Weslaco, TX 78596

Soil drenches of Ridomil (100 mg a.i./liter) and foliar sprays of Aliette (2,000 mg a.i./liter) reduced root rot of potted sour orange seedlings inoculated with *Phytophthora parasitica*. Ridomil at 200 mg a.i./liter was phytotoxic to potted citrus but not to field trees. Lesions on the trunks of 2-yr-old trees were controlled with foliar sprays of Aliette or treatments with Ridomil as either a soil drench or trunk paint. Ridomil as a trunk paint was the only treatment that arrested development of lesions on 5-yr-old trees. In a bioassay, systemic fungicidal activity was detected in bark disks from the trunks of 2-yr-old trees for 12, 6, and 8 wks following trunk paints of Ridomil, drenches of Ridomil, and Aliette foliar sprays, respectively. Activity in trunks of 5-yr-old trees treated with Ridomil as a bark paint was detected for at least 21 wks. Little or no activity was found in 5-yr-old trees treated with Aliette or soil drenches of Ridomil.

SEROTYPES WITHIN PSEUDOMONAS SYRINGAE PV. TOMATO. J. B. JONES, D. L. Dawe, and S. M. McCarter, Departments of Plant Pathology and Medical Microbiology, Univ. of Georgia, Athens, GA 30602.

Serological relationships among 18 isolates of *Pseudomonas syringae* pv. tomato were studied. Antisera (As) were prepared in rabbits against autoclaved cells of three isolates. Whole cell suspensions of bacteria (9×10^8 cells/ml) were tested with the three As in microagglutination, Ouchterlony double diffusion (ODD), and indirect immunofluorescence (IF) tests. Absorption of cross reacting antibodies by antigens used to prepare the three As, followed by microagglutination, confirmed the presence of at least two serotypes. One group (designated serotype I) consisted of 13 isolates and a minor group (serotype II) consisted of two isolates. Three isolates reacted with the three absorbed antigens and were not grouped. Two of the As reacted similarly with all 18 isolates when absorbed and were considered identical. ODD and IF results correlated well with microagglutination but were not as conclusive.

INOCULATION OF WOUNDED AND UNWOUNDED SUGARCANE WITH USTILAGO SCITAMINEA. Jack L. Dean, U. S. Sugarcane Field Station, Canal Point, Florida 33438.

Wounded and unwounded buds of 15 sugarcane clones were inoculated by immersion and by high pressure spray in a factorial experiment. Wounding increased infection by 53% and wound state interacted significantly with clones. High pressure spray increased infection by 78% but method of applying spores did not interact with clones. The time between inoculation and the appearance of the first smut whip in each clone correlated significantly with the amount of infection produced in wounded buds but not in unwounded buds. These results support the view that there is both a mechanical and a physiological component of resistance to smut in sugarcane and that the relative importance of the two components varies among clones.

FACTORS AFFECTING ALFALFA STAND ESTABLISHMENT. P. A. Delwiche¹, C. R. Grau², and R. C. Harvey², Departments of Plant Pathology¹ and Agronomy², University of Wisconsin, Madison, WI 53706

Repeated establishment failures of *Phytophthora megasperma* (Pm) resistant cultivars have suggested that pathogens other than or in addition to Pm may be involved. Experimental fungicides with selective activity against pythiaceous fungi have been employed to identify factors involved in seedling death. At one location in 1978, alfalfa plant densities in field plots treated with the fungicide Ortho 20615 (2.2 kg a.i./ha), the herbicide benefin (1.4 kg a.i./ha), Ortho 20615 plus benefin or not treated were, respectively, 11, 0, 86 and 0 plants/m². With Ortho 20615 alone at 4.4 kg/ha, plant densities were 151 plants/m². At the same location in 1979-80, metalaxyl and Ortho 26745 produced significant effects on number of seedlings established the first year, and winter survival and forage production the following spring. Winter survival in plots treated with 2.2 4.4 kg a.i./ha metalaxyl was 83 and 81% compared to 53% in non-treated plots, and 79 and 82% in plots treated with the same rates of Ortho 26745.

REACTION OF ALFALFA CULTIVARS AND OTHER CROPS TO WISCONSIN ISOLATES OF VERTICILLIUM ALBO-ATRUM (ALFALFA STRAIN). P. A. Delwiche, C. R. Grau, and D. P. Maxwell, Dept. of Plant Pathology, Univ. of Wisconsin, Madison, WI 53706

Verticillium wilt of alfalfa, caused by *V. albo-atrum* (Vaa), was diagnosed in 16 counties in Wisconsin in 1980. Isolates of (Vaa) were similar morphologically and in pathogenicity to those found on alfalfa in the Pacific Northwest. Root-dip inoculations of legume and non-legume crops with Wisconsin isolates demonstrated that the fungus infects the roots of and can be isolated from

above-ground parts of the following plants: alfalfa, soybean, red clover, sweet clover, hairy vetch, birdfoot trefoil, radish, snap bean, kidney bean, and pea. Sunflower, cabbage, and potato were non-hosts. Inoculation of 12 alfalfa cultivars indicated that 'Vertus' was the most resistant to Vaa, and contained ca. 50% resistant plants (based on isolation of Vaa from individual plants). The percentage of resistant plants was relatively low in Arc, Iroquois, Anchor, Saranac, WL 318, Agate, Vernal, Answer, A54, Peak and Trident.

SOME EFFECTS OF SYRINGOMYCIN AND SYRINGOTOXIN PRODUCED BY PSEUDOMONAS SYRINGAE VAN HALL ON STRUCTURE AND FUNCTION OF ISOLATED MAIZE MITOCHONDRIA. G. Surico and J. E. DeVay, Dept. of Plant Pathology, University of California, Davis, CA 95616.

The toxigenic peptides, syringomycin (SR) and syringotoxin (ST), produced by ecotypic strains of *Pseudomonas syringae*, caused changes in oxidative metabolism of mitochondria isolated from ACCO maize lines WF9 and B37 which differed in susceptibility to holcus spot disease. The effects of the toxins on mitochondrial activities were determined by measuring uncoupling of oxidative phosphorylation with malate, succinate, or NADH as substrates. Both toxins at 7 to 24 μ g/mg of mitochondrial protein caused complete uncoupling with all three substrates. No differences were observed in the effect of the two toxins on WF9 and B37 mitochondria, although pathogenicity tests indicated that leaves of WF9 were more susceptible to holcus spot than B37. SR and ST also caused decrease of membrane potential and swelling of mitochondria, but the effect of ST was greater than that of SR. Experiments with whole and sonicated mitochondria indicated that the effects of the toxins were irreversible.

SYSTEMIC WILDFIRE TOXICITY IN CUCUMBER SEEDLINGS. Stephen Diachun and G. C. Bergstrom, Department of Plant Pathology, University of Kentucky, Lexington, KY 40546.

Cotyledons of cucumber seedlings, c.v. SMR 58, were infiltrated with suspensions of *Pseudomonas tabaci*. Within 4 or 5 days wildfire spots appeared on inoculated areas; they were followed often by systemic chlorosis in the first and second leaves above the inoculated cotyledons. When roots of cucumber seedlings growing in paper "rag dolls" were atomized with suspensions of the wildfire bacteria, colonies of bacteria were visible microscopically on the roots within 48 hours, but visible necrosis did not develop. No visible systemic toxicity developed in leaves of the seedlings with bacterial colonies on their roots.

PURIFICATION OF AN EXTRACELLULAR CUTINOLYTIC ENZYME FROM COLLETOTRICHUM GLOEOSPORIOIDES ON CARICA PAPAYA. Martin B. Dickman¹, Suresh S. Patil¹, & P.E. Kolattukudy², Dept. of Plant Pathology¹, Univ. of Hawaii, Honolulu, HI 96822, Institute of Biological Chemistry, Washington State Univ., Pullman WA 99164.

The mode of penetration of *C. gloeosporioides*, the causal agent of papaya anthracnose, is unknown. Previous field data indicate that the pathogen breaches the host's cutin barrier in the orchard. *C. gloeosporioides* was grown in a still culture in mineral salts medium with purified papaya cutin as the sole source of carbon. After two weeks incubation, the enzyme from culture filtrates was purified by ammonium sulfate precipitation, gel filtration, and ion exchange chromatography. The purified enzyme, which hydrolyzes tritiated cutin, is a cationic glycoprotein (16% carbohydrate) with a MW of about 25000 d (by SDS-polyacrylamide gel electrophoresis). The enzyme hydrolyzes two model substrates, p-nitrophenol palmitate and p-nitrophenol butyrate (PNB), thus differing from previously reported cutinases which utilize only PNB. Diisopropylfluorophosphate inhibits the enzyme indicating that catalysis by cutinase involves an active serine.

THE EFFECT OF SOIL MATRIC POTENTIAL ON INFECTION OF CRUCIFERS BY PLASMIDIOPHORA BRASSICAE. Robin L. Dobson and R. L. Gabrielson, Washington State University, Western Washington Research and Extension Center, Puyallup, Wash. 98371

The infection of crucifers by *P. brassicae* is characterized by two phases: infection of root-hairs and of cortical cells. The latter is associated with the typical clubroot disease symptoms. To define soil moisture levels required for these two infection phases, a western Washington Sultan silt loam was inoculated with 10^7 resting spores/gm soil and maintained at specific matric potentials with tension plates and semipermeable membranes. Root-hair infections were counted after 7 - 10 days and visible clubs were scored after 6 weeks. Root-hair infections were observed at moisture levels close to -1,000 mbars while cortical cell infection did not occur unless matric potentials were greater than -200 mbars (field capacity is about -300 mbars and permanent wilting about -15,000 mbars). Thus, while induction of clubroot disease symptoms requires soil moisture levels above field capacity, root-hair infection can occur below this point.

DOUBLE-STRANDED RNA FROM PLANTS INFECTED WITH CLOSTEROVIRUSES. J. Allan Dodds and Moshe Bar-Joseph, Department of Plant Pathology, University of California, Riverside, CA 92521.

Double-stranded RNA has been detected by gel electrophoresis following cellulose chromatography of extracts from 7 g or less of plant tissue infected with three closteroviruses, apple chlorotic leafspot virus (ACLSV), beet yellows virus (BYV) and citrus tristeza virus (CTV). The molecular weight of the

major dsRNA segment for each virus was estimated to be 5×10^6 (ACLSV), 8×10^6 (BYV) and 12×10^6 (CTV). The values are approximately double the values known or predicted for the ssRNA genomes of the three viruses. Diagnostic patterns of multiple minor dsRNA segment (MWT $0.4 \times 10^6 - 6 \times 10^6$) were also detected for BVV and CTV. These patterns showed minor variations dependent upon the source of tissue, the leaf position analysed and the host species used. Bark was a better source of CTV dsRNA than leaves. No dsRNA was detected in healthy Citrus aurantiifolia, Citrus medica (CTV hosts), Claytonia perfoliata (BYV host), and Chenopodium quinoa (ACLSV host).

USE OF FIELD-INFECTED PLANTS FOR BARLEY YELLOW DWARF VIRUS (BYDV) PURIFICATION AND ANTISERUM PRODUCTION. B. Doupnik, Jr., G. Bryant and T. P. Pirone. Department of Plant Pathology, University of Kentucky, Lexington, KY 40546.

Naturally-infected oats with red leaf symptoms typical of BYD and free of symptoms of other viruses were collected in May 1980 and frozen until use 6-10 months later. Freeze-dried tissue was ground to pass a 60 mesh screen and virus was purified by differential and sucrose-gradient centrifugation. Yields ranged from 25-60 μg virus/100 g tissue. Electron microscopy revealed typical BYDV particles free of viruses of other morphology. Rabbits injected with the purified BYDV yielded an antiserum which gave positive reactions in ELISA tests with the homologous virus and with the RPV and PAV isolates, but not with the MAV and RMV isolates, of BYDV. Use of naturally infected leaves eliminated the need for rearing specific vectors and yielded amounts of virus comparable to those reported from greenhouse-grown tissue. The antiserum is being tested with suspected BYDV-infected samples from throughout Kentucky to assess its usefulness for diagnostic purposes.

A NEW STRAIN OF BEAN YELLOW MOSAIC VIRUS (BYMV) IN RED CLOVER IN KENTUCKY. Ben Doupnik, Jr., S. A. Chabrial, and N. L. Taylor. Plant Pathology Department, University of Kentucky, Lexington, KY 40546.

Virus isolates, collected from red clover plants in experimental plots in Lexington, Ky, were identified as BYMV based on an ELISA test using an antiserum to strain 204-1 of BYMV. The latter strain is the predominant one in susceptible red clovers in Kentucky. The detection of BYMV was somewhat surprising since the samples were from plants representing several generations of backcrosses which incorporate resistance to strain 204-1. The reaction of diagnostic host plants including several cultivars of pea, bean, and soybean to the new isolates of BYMV indicated that they were similar to each other but clearly distinct from strain 204-1. The new isolates from red clover were collectively designated as the red clover (RC) strain of BYMV. The RC strain appears to be similar in its biological properties to previously described BYMV isolates from soybean in Kentucky. The serological relationship among these 3 strains of BYMV is being studied.

EFFECT OF TEMPERATURE ON SCLEROTINIA MINOR MYCELIOTIC SCLEROTIAL GERMINATION, MYCELIAL GROWTH, INFECTION, AND COLONIZATION OF 'FLORIGIANT' PEANUTS. R.L. Dow, D.M. Porter, and N.L. Powell. Dept. of Plant Pathol. & Physiol., VPI; USDA-SEA-AR, Suffolk, VA 23437; Dept. of Agron., VPI, Blacksburg, VA 24061.

Mycelial germination of artificially produced sclerotia of several isolates of Sclerotinia minor on potato-dextrose agar(PDA) was higher after 24 hr at 20 C than at 10, 15, 25, or 30 C. After 3 days, little difference was found in percentage germination among isolates grown at 15, 20, and 25 C. Germination was greater than 70% at each of the temperatures except 30 C. Sclerotia germinated better at 20 and 25 C on both moist filter paper and peanut leaflets. Eruptive germination was common at 15 and 20 C while hyphal germination (single or few strands) was more characteristic at 10, 25, and 30 C. Mycelial growth on PDA was better at 20 and 25 C. Infection and colonization of dehiscent peanut leaflets, intact peanut plant mainstems or lateral stems were greatest at 20 C. Under laboratory conditions 20-25 C is optimum for S. minor germination, growth, infection, and colonization.

EFFECT OF SUSCEPTIBILITY AND ADULT PLANT RESISTANCE ON PRIMARY PENETRATION OF OATS BY ERYSIPE GRAMINIS F. SP. AVENAE. S. M. Douglas, R. T. Sherwood* and F. L. Lukezic. Dept. of Plant Pathology, The Pennsylvania State University and *U.S. Regional Pasture Research Laboratory, USDA, SEA-AR, University Park, PA 16802

The percent germination of conidia in 24 h was similar on leaves of Mariner (susceptible), Maldwyn (adult plant resistant-APR), and Dal (reportedly APR). However, germination was significantly higher on the 2nd-formed than the 4th-formed leaves. Mariner showed no significant change in the ratio of papillae to germinated conidia (P/G) from leaf 2 to leaf 4. Maldwyn had the same P/G ratio as Mariner in leaf 2, but a significantly higher P/G ratio in leaf 4. Dal had high P/G ratios in leaf 2 and 4, and was significantly higher than Maldwyn in leaf 2 but not in leaf 4. Papilla formation which limits primary penetration was implicated as a component of APR. Differential susceptibility of epidermal long cells and subsidiary cells as measured by percent germination and P/G ratio was not evident in any cultivar examined.

THE IMPACT OF PHOTOCHEMICAL OXIDANT AIR POLLUTION ON BIOMASS PRODUCTION OF VEGETATION NATIVE TO THE BLUE RIDGE MOUNTAINS.

S. F. Duchelle and J. M. Skelly. Dept. of Plant Path. & Phys., VPI & SU, Blacksburg, VA 24061.

The effect of ambient ozone (O_3) on biomass production of vegetation native to the Shenandoah National Park was examined in six 10-ft diameter plots during the 1980 growing season. Within each plot, 15 circular microplots $1/4 \text{ M}^2$ were randomly established. Vegetation within these microplots was harvested at 3 different times using a paired plot technique for comparisons of biomass production between 2 specific time periods. The biomass produced between June 23 and August 4 averaged 679, 335, 321 gm^{-2} for the filtered, non-filtered, and open plots, respectively. The biomass produced between August 4 and September 16 averaged 78, 150, 125 mg^{-2} for the filtered, non-filtered, and open plots, respectively. The highest monthly average and the peak 1 hr conc. of O_3 were 0.056 and 0.100 ppm, respectively. Low ozone doses may reduce biomass production of vegetation native to the Shenandoah National Park and this effect is manifested early in the growing season.

ULTRASTRUCTURAL STUDIES OF PHYTOPHTHORA ROOT ROT OF RESISTANT AND SUSCEPTIBLE SPECIES OF PERSEA. L. Dugger, and G. A. Zentmyer. Department of Plant Pathology, University of California, Riverside, CA 92521.

Ultrastructural examinations of early stages of infection of Phytophthora root rot of resistant Persea seedlings showed disease development to be slower and somewhat restricted as compared to susceptible seedlings. In resistant species necrotic cells with coagulated protoplasm were found in advance of the fungus and cell wall lesions were observed adjacent to intercellular hyphae. The earliest effects in the susceptible species were a swelling of the endoplasmic reticulum, characteristic shrinkage of the protoplast and formation of cell wall appositions. In cortical cells of severely infected roots of both resistant and susceptible species most internal cell membranes were fragmented and diffuse cell wall digestion was apparent. The high inoculum density used may in part be responsible for the eventual breakdown of resistance.

AFFECT OF AMMONIUM SULFATE ON VERTICILLIUM DAHLIAE GROWTH. D. R. Duncan and E. B. Himelick, Department of Plant Pathology, University of Illinois and Illinois Natural History Survey, Urbana, IL 61801.

Tree fertilization with $(\text{NH}_4)_2\text{SO}_4$ has been reported to suppress disease development in plants infected with Verticillium dahliae. When this fungus was grown for 15 days on Czapeks-Dox agar (CDA) in which the nitrogen source was 3 g/L $(\text{NH}_4)_2\text{SO}_4$, NaNO_3 , or asparagine, growth measured as dry weight was 9-10 mg, 38-40 mg, and 50-55 mg, respectively. Furthermore, on a CDA medium containing 1.5 g/L asparagine plus 1.5 g/L $(\text{NH}_4)_2\text{SO}_4$, fungal growth was equal to that produced on the NaNO_3 medium. This level of growth was maintained even with $(\text{NH}_4)_2\text{SO}_4$ concentrations as high as 6 times that of the asparagine. Asparagine is often the most plentiful amino acid in tree sap. Thus, these results indicate that if $(\text{NH}_4)_2\text{SO}_4$ effectively suppresses development of Verticillium wilt of trees, the effect cannot be attributed to a direct effect of the salt on the fungus in the vascular system.

THE IMPROVEMENT OF FLUID UPTAKE IN TREE INJECTIONS. D. R. Duncan and E. B. Himelick, Department of Plant Pathology, University of Illinois and Illinois Natural History Survey, Urbana, IL 61801.

The injection of therapeutic solutions into tree trunks is a potentially useful technique for controlling many diseases. When using gravity as a source of injection pressure, fluid uptake is limited by occlusions that form within the xylem and causes a 90-99% loss of solution uptake within 24 hr. This occluding process has been reduced by 35-81% in 20 cm diameter pin oak and sycamore trees by treating the injection site with a 5 ml solution of propylene glycol adjusted to pH 3.0 with glacial acetic acid. Such a reduction is equivalent to increasing water uptake 3-5 times. By using 0.25% ascorbic acid in the injection solution, a similar prevention of vascular blockage occurred in red-bud and resulted in a 20-fold increase in water uptake over a 24 hr period. The results obtained suggest that uptake of chemotherapeutics may be improved by the use of supplementary chemicals such as propylene glycol and ascorbic acid.

GLOBAL OCCURRENCE OF SORGHUMS SENSITIVE TO TOXIN PRODUCED BY PERICONIA CIRCINATA. L.D. Dunkle, USDA-SEA-AR, Dept. of Botany and Plant Pathology, Purdue Univ., W. Lafayette, IN 47907. Milo disease, a root rot of certain genotypes of sorghum, is unique to the sorghum-growing regions of the US. Pathogenic isolates of the causal agent, Periconia circinata, which produce a host-specific toxin (PC toxin), have been found only in those regions. Seedlings of sorghums (primarily durra and milo groups) from the world collection were tested for sensitivity to PC toxin, a response directly related to susceptibility to the pathogen and an indirect assay for the semi-dominant Pc gene which conditions susceptibility. The majority (90%) of the international sorghum lines tested were insensitive to PC toxin as were related or wild species. However, susceptible genotypes were found in accessions of sorghums from India, Sudan, Nigeria, and China in addition to the original milo cultivars from the US that were susceptible to P. circinata during the 1930's. Thus, the Pc gene has persisted in sorghums near the center of origin of the crop where the pathogen is not known to exist. Selection pressure of pathogenic, toxin-producing strains of P. circinata in the US apparently favored resistant mutants.

BINDING OF *PSEUDOMONAS SOLANACEARUM* TO TOBACCO AND POTATO SUSPENSION CULTURE CELLS. Jonathan P. Duvick and Luis Sequeira, Department of Plant Pathology, University of Wisconsin-Madison, Madison, WI 53706.

Attachment of avirulent bacteria to the plant cell wall has been considered to be an initial step in the recognition phenomenon that leads to the hypersensitive response in tobacco. As a model system for the study of attachment we investigated the interaction of radiolabelled *Pseudomonas solanacearum* strains with suspension culture cells (SCC) from tobacco and potato. Bacteria labelled with ^{14}C glucose or ^3H thymidine were incubated with washed SCC and then filtered through Miracloth discs. Counts retained on the Miracloth discs provided a measure of the number of bacteria bound to SCC. A high proportion (up to 70%) of cells of the avirulent strain B1 were bound by SCC, whereas cells of the parental strain (K60) were bound less efficiently (10-30%). Kinetics of binding, pH optima and effects of various ions and macromolecules indicate that nonspecific electrostatic forces are involved in this attachment.

GENETIC ANALYSIS OF CUCUMBER MOSAIC VIRUS. M. C. Edwards, D. Gonsalves, and R. Provident, Dept. of Plant Pathology, Cornell Univ., N.Y.S. Agric. Exp. Sta., Geneva, N.Y. 14856

In New York, cucumber mosaic virus (CMV) strains B, C, and LsS are used in an intensive program of breeding vegetable crops for resistance. CMV-B, but not CMV-C, infects *Phaseolus vulgaris* systemically. CMV-LsS differs from CMV-B and CMV-C by its ability to infect *Lactuca sativa*. None of these, however, can be distinguished from the other two serologically. To determine the RNA component responsible for pathogenicity to these hosts, pseudorecombinants were constructed using purified RNAs and inoculated onto appropriate test plants. Sufficient purity of RNA species was demonstrated by enhancement tests. Results from some experiments indicate that RNA 1 and/or 2 is responsible for pathogenicity of CMV-B to bean. Preliminary evidence indicates that pseudorecombinants containing only one CMV-LsS RNA species are not capable of infecting *L. sativa*. There is also some indication that certain pseudorecombinants comprised of CMV-B and CMV-LsS are less virulent than their parental types.

EFFECTS OF LEAF AGE AND INOCULUM CONCENTRATION ON INFECTION OF SOUR CHERRY BY *COCCOMYCES HEMIALIS*. S. P. Eisensmith, T. M. Sjulín and A. L. Jones. Department of Botany and Plant Pathology, Michigan State University, East Lansing, MI 48824.

Cherry leaves inoculated soon after unfolding developed the highest number of lesions/cm² of leaf area 11 days after inoculation. Log₁₀ of lesion frequency decreased linearly with leaf age from 5 to 36 days at 10⁵ and 10⁶ spores/ml, but at 10⁴ spores/ml no change was observed. Log₁₀ of lesion frequency decreased with increasing leaf age from 35 to 70 days only at 10⁶ spores/ml, while no changes in lesion frequency were observed in 103- to 126-day-old leaves. With 1- to 32-day-old leaves, infection with 10² to 10⁴ spores/ml was uniformly low. At 10⁵ spores/ml, lesion frequency declined with leaf age starting with the first unfolded leaf, while at 10⁶ spores/ml lesion frequency did not decline until the leaves were fully expanded suggesting low levels of resistance can be overcome by high inoculum levels. This information can be used to modify disease forecasts which are currently based solely on weather and to evaluate the susceptibility of new cherry cultivars in breeding programs.

CORRELATION BETWEEN DEGREE OF AGGLUTINATION OF *PSEUDOMONAS PHASEOLICOLA* CELLS BY RAW LECTIN PREPARATIONS FROM 15 BUSH BEAN CULTIVARS AND DEGREE OF RESISTANCE TO BACTERIAL INFECTION: F.E. El-Banoby and K. Rudolph, Inst. Pflanzenpathologie, Univ. Göttingen, West-Germany

In earlier experiments agglutination of *Pseudomonas phaseolicola* by lectin containing extracts from halo blight resistant bush bean leaves (*Phaseolus vulgaris*) was reported, whereas extracts from a susceptible cultivar did not cause agglutination. Similar experiments were now done with leaf extracts from 15 different bean cultivars (susceptible cvs.: Mistral, Jolli, Rote Pariser, Benarys Riesen, Valgreen, Heg; resistant cvs.: Tara, 553/78, Ladoska, Ryco, Warox, Bertil, 02, Valja). In general, strong agglutination of bacteria was only observed with extracts from resistant cultivars, but not with extracts from susceptible cvs.

EPIDEMIOLOGY OF MULTILINE CULTIVARS: SELECTION OF CULTIVARS FOR CONVERSION TO MULTILINES. Vern J. Elliott, D.R. MacKenzie, and R.R. Nelson. Dept. Plant Pathology, The Pennsylvania State Univ. Univ. Park, PA 16802.

Selection of cultivars for conversion to multilines is not guided by defined criteria. Some postulate the complementation of multiline action by rate-limiting resistance while others ignore the possibility. To test for complementary effects in the wheat powdery mildew system, three series of multilines were made by mixing varying amounts of a vertically resistant line with either Chancellor, Knox, or Redcoat. These mixtures represented a 1,10,25, or 50 component multiline of each cultivar. By our cri-

teria, Knox performed best in complementing multiline action. Although Redcoat was most effective in suppressing disease, this cultivar appeared to interfere with multiline action. Chancellor complemented multiline action but less than Knox.

UPTAKE AND TRANSLOCATION OF RIDOMIL IN APPLE TREES. M. A. Ellis, G. G. Grove, and D. C. Ferree. The Ohio Agricultural Research and Development Center, Wooster, OH 44691 and The Ohio State University, Columbus 43210.

Five year old Delicious apple trees on MM-111 rootstock were grown in plastic pots in the greenhouse. Pots were drenched with 500 ml of either a 50, 100, 500 or 1,000 ug/ml solution of Ridomil in water. Drenches were slowly applied to soil, taking care not to put fungicide in contact with the crown or trunk of the tree. At 72 hr after drenching, plugs (approx. 7 mm long and 5 mm wide) were cut from the trunk at 5, 10 and 15 cm above the soil line. Plugs were placed bark-side-down on PBNC media in petri dishes. Agar plugs were cut from 5 day-old cultures of *Phytophthora cactorum* and placed on top of the apple plugs so that they were in contact with xylem. After 5 days, *P. cactorum* had grown from agar plugs, colonized the apple wood, and on to the PBNC media. No growth was observed on agar plugs from trees drenched with any concentration of Ridomil. The data suggests that Ridomil was taken up by apple roots and translocated upward in sufficient concentration to inhibit growth of *P. cactorum*.

THE SOIL DEGRADATION OF DICHLORAN, IPRIDIONE, AND VINCLOZOLIN IN LODI LOAM AND WOODSTOWN LOAMY SAND SOILS. W.H. Elmer and R. J. Stipes. Dept Plant Pathol. and Physiol., Virginia Tech, Blacksburg, VA 24061

Soil degradation of dichloran (D), ipridione (I), and vinclozolin (V) was studied in Lodi loam (LL) and Woodstown loamy sand (WLS) soils. Breakdown was monitored in fungicide-amended soils incubated at 21 and 28 C. Residues were solvent-extracted at time intervals, and detected by bioassays; utilizing radial growth measurements of *Scierotinia minor* on soil extract-amended agar plates. All fungicides incorporated in LL at 3 ug/g soil (X) disappeared after 8 wks when incubated at 28 C. Only I was detected in LL after 17 wks when incubated at 21 C. All fungicides at the 2X rate disappeared in LL after 17 wks incubation at both temperatures, with increased degradation at 28 C. Disappearance was generally slower in the WLS for I and V, but faster for the 2X rate of D. Fungicides degraded at the X and 2X rates similarly in the WLS. The potential for soil and water contamination by these compounds appears to be minimal.

EFFECT OF CROP MANAGEMENT ON VERTICILLIUM WILT AND COTTON YIELD. K. M. El-Zik and H. Yamada, Department of Plant Sciences, Texas A&M University, College Station, Texas 77843.

The effects of row spacing, irrigation, nitrogen rate and plant population on % Verticillium wilt and yield of Acala SJ-2 and SJ-5 cultivars were studied in four experiments during 1977-80. Field inoculum density ranged from 5.6 to 10.2 microsclerotia/g soil. Both foliar and vascular wilt symptoms increased significantly as the amounts and frequency of post-plant irrigations were increased from 25.9 to 57.7cm. Generally, cotton grown on narrow rows (51 & 76.5cm) had fewer plants showing foliar symptoms than the conventional 102cm rows. Nitrogen rate (112 & 224 kg/ha) and plant population (64,246 & 128,492 plants/ha) did not influence % wilt. Acala SJ-5 had significantly less plants with foliar symptoms than SJ-2, however, results of % vascular necrosis were inconsistent. Foliar symptoms are better indicators of adverse yield effects than vascular discoloration. The highly significant correlation of yield with % Verticillium wilt symptoms was negative, as increased severity of the disease is associated with decreased yield.

A SEEDLING INOCULATION TECHNIQUE TO SCREEN FOR BACTERIAL SPECK RESISTANCE OF TOMATOES. D. A. Emmatty, B. F. George and M. D. Schott. Heinz U.S.A., Bowling Green, OH, 43402.

Ten day old tomato seedlings of bacterial speck susceptible cultivars, H2653, Chico III and C-28 were inoculated by dipping the cotyledons in a suspension of *Pseudomonas tomato* adjusted to 7 x 10⁶ cells/ml. When they were incubated at 17.6 C (day and night average temperature), all the inoculated seedlings were killed within 12 days with severe infection of the cotyledons, the terminal bud and the hypocotyl. The roots were free of any symptoms. The resistant breeding line, Ont. 7710, under the same inoculation procedures, exhibited only cotyledonary lesions within 12 days. These lesions were small in size and limited in number and did not result in any necrosis of the seedlings. Twelve percent of these plants with the cotyledonary lesions were slightly stunted 18 days after inoculation. The rest of the seedlings of Ont. 7710 were all healthy.

REGENERATION OF HEAD LETTUCE FROM ISOLATED LEAF MESOPHYLL PROTOPLASTS. Dean E. Engler and R. G. Grogan, Department of Plant Pathology, University of California, Davis, CA. 95616.

An efficient method for the isolation, division, and growth into calli of Iceburg lettuce leaf mesophyll protoplasts and the subsequent regeneration of these calli into entire plants has been devised. Surface sterilized leaves are sliced into narrow strips, preconditioned in the cold overnight, and exposed to a mixture of .3% Macerozyme, 1.4% Cellulysin and 2% PVP in a suitable osmoticum. Exposure of the source plants to

low light dose prior to protoplast isolation allowed the osmotic level during isolation and subsequent steps to be maintained at a low level (0.35 M sucrose). The plating and growth of these protoplasts were done in a manner similar to Shepard (Plant Physiol. 60:313). Growth at 20 C with 18 hr photoperiods for 3-4 weeks resulted in calli of 1-2 mm which could then be differentiated by plating on a medium with appropriate ingredients. Regenerates will be tested for potentially useful variation including disease resistance.

COMPARISON OF SPORE CONCENTRATIONS MEASURED BY SINGLE AND MULTIPLE SAMPLERS. M. G. Eversmeyer and C. L. Kramer, USDA-SEA-AR, Dept. of Plant Pathology and Division of Biology, Kansas State University, Manhattan, Kansas, respectively.

Use of fungal samplers in epidemiological studies has raised a question of whether a single spore sampler is an adequate measure of spore concentration in the air mass being sampled. Fifteen rotorod samplers were operated in a 1 x 2 M grid in several ecological niches to obtain spore concentration data on a cross section of an air mass. There were no significant differences in spore concentrations measured by samplers in a 1 x 2 M grid when a source of spores was not within 15 M of the samplers. In another experiment 20 rotorod samplers were operated at 1, 2, and 3 M above ground level within a 31 x 46 M grid downwind of a wheat plot to determine the effect of a source of spores on homogeneity of downwind spore concentrations. The source area significantly influenced the vertical spore concentrations, but not the horizontal spore concentrations measured by samplers located an equal distance downwind. There were no significant differences in spore concentrations measured by the samplers located the same distance downwind of the source plot.

SOME PROPERTIES OF TWO BACTERIOPHAGES OF *XANTHOMONAS CITRI*. Frances F. Fan (USDA, SEA, HSI, Fruit Lab, Beltsville, MD 20705), and M. K. Corbett (Univ. MD, Botany Dept., College Park, MD 20742).

Citri phages Cpl and Cp2 have 60 nm polyhedral heads with tails 168 nm and 16 nm long, respectively. Adsorption rate constants were 8.52×10^{-11} ml/min for Cpl and 2.3×10^{-11} ml/min for Cp2 in nutrient broth plus .5% NaCl (NSB) and 5 mM MgCl₂. In one step growth experiments Cpl and Cp2 have latent periods of 40 & 130 min; rise periods of 35 and 60 min; and burst sizes of 24 and 37 particles/infected cell, respectively. Their densities are 1.517 g/cc (Cpl) and 1.497 (Cp2) in equilibrium CsCl₂ gradients. Phages purified by rate zonal CsCl₂ centrifugation had specific infectivity of 10^{11} - 10^{12} PFU/A₂₆₀ unit. The infectivity of Cpl was stabilized by 4 mM CaCl₂ in 0.01M tris buffer pH 7.0, and the yield was increased 3-5 times in NSB + 0.2% Glucose. Infectivity of Cpl was reduced >99.5% in 0.05% SDS while Cp2 was unaffected. Both phages were >95% inactivated after 5 min at 60C and at pH 3 or pH 11 after 1 hr; but were stable in .005-1.5 M NaCl for 3 days.

SELECTION OF BEANS (*PHASEOLUS VULGARIS* L.) FOR MULTIPLE DISEASE RESISTANCE. J. C. Faria, and D. J. Hagedorn, Dept. of Plant Pathology, University of Wisconsin-Madison, Madison, WI 53706.

A technique was developed for selecting beans with resistance to *Uromyces phaseoli* f. sp. *typica* (Upt), *Xanthomonas campestris* pv. *phaseoli* (Xcp), and *Fusarium solani* f. sp. *phaseoli* (Fsp). Seven-day old seedlings were dipped in a suspension of 3×10^5 conidia/ml of Fsp, and transplanted to silica sand. Two to 3 days later, primary leaves were spray-inoculated with 10^8 CFU/ml of Xcp after injury with a multi-needle inoculator. Plants were then inoculated with Upt, using 2×10^4 uredospores/ml in 50 ppm Tween 80, and incubated for 20 h in a mist chamber at 20 C. Plants were returned to a 24 C greenhouse. Disease readings were taken after 12 days for Upt, 16 days for Xcp, and 20 days for Fsp. Symptom expression for each disease was unaffected by the presence of the other diseases.

MEIOSIS IN PHANEROCHAETE CHRYSOSPORIUM AND VARIATION IN WOOD DECAY ABILITY AMONG HOMOKARYOTIC CULTURES. Patrick Fenn and Margaret Mead, Department of Plant Pathology, University of Arkansas, Fayetteville, AR 72701.

The white-rot basidiomycete *Phanerochaete chrysosporium* is the subject of physiological and applied studies of lignocellulose bioconversion. Nuclear staining of a homothallic isolate, MF-446 (ATCC 35540), showed that 96% of 5635 nucleated basidiospores were binucleate. Studies of meiosis and basidiospore formation revealed that the two nuclei arise from mitosis in the developing spore, thus basidiospores are homokaryotic. Single basidiospore cultures decayed sweetgum sapwood at different rates. Among the cultures, average dry weight losses ranged from 8 to 31% after a 6 wk decay period at 36C. ME-446 consistently caused a 16% average weight loss. Homokaryons also differed in growth rates and fruiting ability; some were homothallic while others have not fruited on agar media or wood. Homokaryon selection should yield stable cultures with different cellulose, hemicellulose and lignin degrading activities.

INOCULUM PRODUCTION AND FIELD APPLICATION OF ENDOMYCORRHIZAL FUNGI. James J. Ferguson and John A. Menge, Department of Plant Pathology, University of California, Riverside, CA 92521.

Endomycorrhizal spore production was influenced by photoperiod and light intensity. When mycorrhizal sudan grass, inoculated

with *Glomus fasciculatus*, was exposed to extended photoperiods under uniform high intensity mercury vapor and metal halide lamps, significant levels of spore production (60 spores/g soil) occurred earlier than in plants grown under normal daylength conditions. Decreasing light intensities reduced infection and sporulation in mycorrhizal sudan grass grown under low soil phosphorus conditions. Mechanized field inoculation of direct seeded and transplanted citrus seedlings can be carried out, utilizing both tractor-mounted fertilizer banding equipment and tractor-drawn seeding machines. After soil inoculation soil inoculum remained consistently infective for up to 10 weeks in fumigated field soil and for up to 7 weeks in greenhouse citrus pot cultures. Under field conditions inoculum densities as low as 2,700 spores/m² stimulated citrus root infection and growth.

RESISTANCE IN DIPLOID SOLANUM PHUREJA, S. STENOTOMUM, AND S. BERTHAULTII INTERCROSSES TO POTATOVIRUS Y. E. N. Fernandez-Northcote, and C.R. Brown, Universidad Nacional Agraria La Molina - International Potato Center, and International Potato Center, Apartado 5969, LIMA-PERU, respectively.

Progenies from *Solanum phureja*, *Solanum stenotomum* and *Solanum berthaultii* intercroses were screened for resistance to a common strain (Y⁰) of potato virus Y (PVY). At 20-33 C from 3,421 seedlings, only 5 subsequently propagated as clones were resistant after spray-gun inoculation and a manual reinoculation. Three clones showed some resistance to aphid inoculation. All five could be infected by graft inoculation. In later trials at 12-22 C resistance was considerably higher to both aphid and graft inoculation. Resistance is apparently polygenically inherited and selection pressure was evidently high at the high temperatures of early screenings. After mechanical inoculation with two distinct Y⁰, one necrotic (Y^N), and one intermediate (Y^I) Peruvian PVY strains, at 10-22 C, one clone was not infected by any strain, one was infected only by Y^N strains and none were infected by the Y^I strain. Delay in infection and symptoms expression was evident in other selections with different PVY isolates not only at the low but also at higher temperatures. The level of resistance found in this diploid material would probably be useful only for areas of relatively low temperature.

A NEW INOCULATION TECHNIQUE FOR SUGARCANE SMUT, *USTILAGO SCITAMINEA*. S. A. Ferreira and J. C. Comstock, Dept. of Genetics & Pathology, Hawaiian Sugar Planters' Association, P.O. Box 1057, Aiea, Hawaii 96701.

Although satisfactory for clonal screening, the standard dip and natural infection methods of inoculation are inefficient for special studies concerning pathogenicity of smut cultural types, race identification, and elucidating the nature and genetics of sugarcane smut resistance. Consequently, a new inoculation technique was developed to assess disease reactions of specific clones using only a few seedpieces. Single bud seedpieces were hot water treated at 52 C for 20 min, dipped in 300 ppm (a.i.) Benlate for 1 min, then germinated in plastic crispers at 28 C for 7-10 days. One-half ml of a teliospore suspension, ranging from 10^5 teliospores/ml, was injected into the shoot meristem. After a 24-hr incubation period, inoculated seedlings were planted in the field. Disease reactions were assessed 4-5 months later. At an inoculum concentration of 10^3 teliospores/ml, disease reactions of 8 sugarcane clones were similar to those obtained using the standard inoculation method. Results indicated also that the injection technique could be used to differentiate smut races A and B.

CYTOLOGY OF A GENETIC ABNORMALITY IN LEAVES OF ARACHIS HYBRIDS. D.M. Ferris, P.E. Richardson, Department of Botany and Oklahoma Agricultural Experiment Station, D.J. Banks, Department of Agronomy, USDA, Oklahoma State University, Stillwater, OK 74078.

Semilethal, chlorotic leaf spots develop in peanut lines involved in disease resistance breeding. Complex hybrids produced in crosses and backcrosses with cultivated wild *Arachis* spp. are resistant to certain diseases, but enlarging chlorotic lesions progressing to necrosis are produced. Histological studies of the sunken lesions show membrane and chloroplast degeneration leading to cell death in the localized spot. Phenolase, peroxidase, and phenylammonium lyase assays were performed to determine enzyme activity in relation to disease development. Enzyme activity was correlated with light, fluorescence and electron microscopic studies.

SOIL PASTEURIZATION BY MICROWAVE OVEN TREATMENT. R. S. Ferriss, Dept. of Plant Pathology, University of Kentucky, Lexington, KY 40546.

Naturally infested silt loam soil in polyethylene bags was treated at full power in a commercial microwave oven. Populations of soil microorganisms were assayed using selective media. Treatment of 1-kg soil at 17 to 37% H₂O (wt H₂O/dry wt soil) for 150 sec reduced populations of *Pythium* spp., *Rhizoctonia* spp., and *Fusarium* spp. to below detectable levels; reduced the population of soil bacteria by a factor of approx. 20; and reduced the total population of soil fungi by a factor of approx. 500. The minimum treatment time needed to achieve these effects was positively related to soil moisture content, weight of soil treated, and rate of cooling of the soil after treatment. Microwave oven treatment released significantly less nutrients into the soil solution than did autoclaving for 2 hr or methyl bromide-chloropicrin (98:2) fumigation (1 lb/45 kg soil).

CHANGES IN SOME PHYSIOLOGICAL PARAMETERS OF SUSCEPTIBLE AND RESISTANT PEPPER FRUIT TISSUE TO BACTERIAL INFECTION. E. Fischer & A. Novacky, Dept. Plant Path., Univ. of MO, Columbia, MO 65211

The effect of infection with *Xanthomonas vesicatoria* on the cell membrane potential (Em), vacuolar K⁺ concentration, respiratory activity, and intracellular ATP content of susceptible and resistant fruit tissue of *Capsicum annuum* was studied. Inoculation with bacteria led in light and dark to an initial transient depolarization of the cell membrane which then completely or partially repolarized followed by a final decline of Em to ca. -50 mV in 40 and 60 h in compatible and incompatible combination respectively. The vacuolar K⁺ rose from 138 to 180 mM in 35 h and from 154 to 190 mM in 12 h in susceptible and resistant fruit tissues, but then declined steadily. The intracellular ATP concentration decreased rapidly after inoculation in both combinations, whereas respiration remained unchanged. Since the changes observed were similar in susceptible and resistant reaction they appeared to be nonspecific. They differed only in time when they occurred, which was faster in incompatible than compatible combination indicating a different trigger mechanism. (Supported by NSF)

SYMPTOMATOLOGY AND COLONIZATION OF CHRYSANTHEMUM INFECTED WITH FUSARIUM OXYSPORUM F. SP. CHRYSANTHEMI. N. L. Fisher and T. A. Toussoun, Fusarium Research Center, The Pennsylvania State University, University Park, PA 16802

Cultivars of *Chrysanthemum morifolium* were inoculated with *Fusarium oxysporum* f. sp. *chrysanthemi* and rated for wilt. Symptoms were observed and stems indexed for *Fusarium*. Colonization was a better variable for determining susceptibility than symptoms. Cultivars ranged from highly susceptible to resistant, and varied in symptom location. Symptoms on Yellow Delaware (YD) progressed from the top of the plant downward, and on Royal Trophy (RT) the symptoms progressed up from the base. Inoculation of cultivars related to YD and RT did not indicate two distinct symptom types, but showed much variation in symptom progression. Colonization of plants by *Fusarium* was investigated by indexing for 15 consecutive days after inoculation. Discontinuous colonization was noted in 14% of plants, perhaps due to conidia in vessels.

SPIROPLASMA CITRI IS AN ETIOLOGICAL AGENT IN BRITTLEROOT DISEASE OF HORSERADISH. J. Fletcher, G.A. Schultz, R.E. Davis, C.E. Eastman, and R.M. Goodman, Univ. of Illinois, Natural History Survey, Urbana, IL 61801; USDA, Beltsville, MD 27085.

Brittleroot (BR) disease of Illinois horseradish, which occurs in sporadic epidemics with severe crop losses, is characterized by foliar chlorosis, stunting, and discolored root pith, followed by plant death. The presence of mycoplasma-like organisms in diseased plants was shown by Dienes' staining reactions of root sections; spiroplasmas were cultured *in vitro* consistently from plants with BR symptoms, but never from symptomless plants. Spiroplasmas were also isolated from *Circulifer tenellus* reared in captivity and allowed to feed on BR plants. All spiroplasma isolates tested were indistinguishable from *Spiroplasma citri* by growth inhibition and deformation tests, and by polyacrylamide gel electrophoresis. *C. tenellus* injected with horseradish isolates of *S. citri* transmitted the spiroplasma to horseradish test plants, which later developed symptoms of BR. *S. citri* was reisolated from these plants.

THE INFLUENCE OF INFECTION TIMING, INFECTION TECHNIQUES AND SITE ON THE REACTIONS OF SORGHUM SEEDLINGS TO PYTHIUM. G.A. Forbes¹, O. Ziv², and R.A. Frederiksen¹. Dept. Plant Sciences, Texas A&M Univ., College Station 77843¹; ARO The Volcani Center, Israel².

An *in vitro* infection technique was evaluated for determining reactions of sorghum seedlings (*Sorghum bicolor*) to *Pythium graminicola*. Differential reactions of 12 sorghum cultivars were established based on the effects on root length, leaf length, fresh weight and dry weight. When the most resistant and susceptible cultivars were compared in infested soil, there was no significant difference in percent emergence. In other experiments, roots of seedlings grown *in vitro* were infected near the tip and 3cm back from the tip. Tip infection killed the seedlings. The other infection site resulted in moderate damage. In corresponding greenhouse trials, seedlings planted at different distances from inoculum showed different responses, ranging from no emergence (1cm away) to no damage (4cm away). In this case, it appears that emergence, which is often used for resistance screening, is determined more by infection timing and site than by resistance of host tissue to infection.

XIPHINEMA RIVESI, A NEW TOMATO RINGSPOT VIRUS VECTOR. Lyle B. Forer, Nancy Hill and Charles A. Powell, Pennsylvania Department of Agriculture, 2301 North Cameron Street, Harrisburg, Pennsylvania 17110.

Soil containing high populations of *Xiphinema rivesi* was collected from the rootzone of *Prunus serotina*. The nematodes were removed from the soil by a sieving-decanting technique. Aliquots of water containing ca. 1000 nematodes were added to 250 cc beakers containing two, tomato ringspot virus (TmRSV) infected or healthy cucumber, 'donor plants' growing in a sand-vermiculite (50/50 volume) mix. After two weeks the *X. rivesi* were removed from the 'donor plants' by the sieving-decanting technique, and ca. 50 were added to 100 cc plastic beaker containing one cucumber 'bait plant' growing in the sand-vermiculite mix. After ca. one month the 20 'bait plants' were assayed for TmRSV using the ELISA. TmRSV was not transmitted by *X. rivesi* when they were previously exposed to the healthy cucumber 'donor plants' but TmRSV transmission occurred in 8 of 10 pots that received *X. rivesi* previously exposed to TmRSV infected 'donor plants'.

GERMINATION OF OOSPORES OF PHYTOPHTHORA MEGASPERMA F.SP. MEDICAGINIS. Helga Forster, O. K. Ribeiro, and D. C. Erwin. Dept. of Plant Pathology, University of California, Riverside, CA 92521.

Up to 85% of the oospores from a carrot broth medium of several isolates of *P. megasperma* f.sp. *medicaginis* germinated. The oospores were separated from the mycelium by incubating oospore suspensions in solutions of β -glucuronidase and aryl sulfatase. The experiments were carried out in aqueous solutions under blue light. Germination rates increased with increasing age (from 2 weeks to 7 weeks) of the cultures from which the oospores were harvested. Alfalfa root extracts and exudates, certain soil extracts, and diluted nutrient media stimulated germination. No single factor was responsible for the increase in germination, but the ratio between certain individual compounds was important. Storage for 3 months in a sterile soil extract greatly enhanced germination. RNA and protein synthesis, and respiration are involved in the germination process because known inhibitors of these processes inhibited germination.

CONTROL OF WHITE MOLD OF BEANS WITH BENLATE FUNGICIDE VIA SPRINKLER IRRIGATION. R. L. Forster, University of Idaho Research and Extension Center, Kimberly, ID 83341.

Efficacy of single applications of Benlate 50W (2 lb/A) via sprinkler irrigation for the control of white mold (*Sclerotinia sclerotiorum*) of dry beans was determined in two tests conducted in 1979 and 1980. In 1979 Benlate was applied through lateral-roll wheel-mounted sprinkler lines to two different areas of a field of "Upland" small white beans on July 20 and 31. Approximately 30% of the plants had at least one open blossom on July 20, and by July 31 all plants had pods ranging to 4 in long. At harvest, white mold control was 61 and 75%, respectively, for the July 20 and 31 treatment dates compared to the untreated checks. Seed yields were increased 15 and 25%, respectively, for the July 20 and 31 Benlate applications. In 1980 Benlate was applied to a field of "Viva" pink beans via a center pivot sprinkler in 6750 GPA on July 31 when all plants had pods ranging to 1 in long. At harvest, an 85% reduction in white mold incidence and a 7% yield increase were noted in the Benlate-treated area.

EFFECT OF MOISTURE AND MECHANICAL INJURY ON AFLATOXIN PRODUCTION. B. Fortnum and A. Manwiller. Department of Plant Pathology and Physiology and Department of Agronomy and Soils, respectively. Pee Dee Exp. Sta., Clemson Univ., Florence, S. C. 29503.

Hybrids appearing resistant or susceptible to aflatoxin formation were selected on the basis of toxin production in yield trials. Hybrids received the following treatments (28 days post mid silk) in all possible combinations: mechanical injury to kernels plus inoculation with *A. flavus* (NRRL3357), inoculation with *A. flavus* without mechanical injury to kernels, both treatments with and without irrigation. Mechanical injury to kernels inoculated with *A. flavus* dramatically increased toxin production on all hybrids. Husk removal and inoculation of non-damaged kernels with *A. flavus* resulted in elevated levels of aflatoxin in all hybrids. Values ranged from 86 ppb for non-injured kernels to as high as 35,000 ppb (ug/kg aflatoxin B₁) for injured kernels. Toxin production was reduced to below 20 ppb under irrigation only in fields relying on natural populations of *A. flavus*. The data suggest drought enhances aflatoxin production through means other than altered kernel physiology.

SCREENING CORN KERNELS FROM MISSOURI FOR INTERNAL FUNGI. A.S. Foudin, O.H. Calvert, H.C. Minor. USDA, APHIS, PPQ; Dept. of Plant Pathology and Dept. of Agronomy, University of Missouri-Columbia, Columbia, MO 65211, respectively.

A survey of the internal fungi of corn was undertaken to define what internal fungal species are present in commercial corn hybrids grown under farm-field conditions. The corn hybrid/variety trial plots from the University of Missouri at Novelty, MO were the source of the hybrids screened. Following surface sterilization, 100 intact kernels from each of triplicate samples from 144 hybrids were plated on potato-sucrose-agar. Plates with 5 kernels each were incubated in the dark at 28 C for 5 days. The identification of the fungi associated with each individual kernel and the magnitude of growth were recorded. Partial analysis of the corn hybrids in this test has revealed a low population of fungi in the *Aspergillus flavus* group and high populations of *Fusarium moniliforme*, *A. niger* and three species of *Penicillium*. Unusual and infrequently encountered genera were *Alternaria*, *Chaetomium*, *Dreschlera*, *Nigrospora*, and *Trichoderma*. This survey provides a foundation for assessment of seed quality and aflatoxin potential in some corn hybrids.

QUANTITATIVE STUDY OF COLONIZATION OF CONIDIA OF HELMINTHOSPORIUM SATIVUM BY SOIL BACTERIA AND THEIR EFFECT ON SPORE GERMINATION. A. Fradkin and Z.A. Patrick, Dept. of Botany, University of Toronto, Toronto, Canada, M5S 1A1.

The colonization of conidia of *H. sativum* by soil bacteria was studied quantitatively by means of epifluorescence microscopy. Conidia were recovered from soil after 1 to 10 weeks incubation and stained either with acridine orange, or europium chelate to observe the occurrence of microbial cells on their surfaces. The significance of the colonizing microflora on germinability of the conidia was examined by using Nuclepore polycarbonate filter membranes. The ability of conidia recovered from soil to germinate in sterilized distilled water, and in cleared V8 juice broth was compared to numbers of bacteria colonizing them, and to morphological changes observed microscopically. The results showed that colonization of the fungus by bacteria in soil resulted in increased dependence of conidia on exogenous sources of nutrient for their germination. After 6 weeks in soil, most of

the colonized conidia were devoid of septa. Effect of soil pH, temperature and moisture level on bacterial colonization of spores was also studied.

SMALL CIRCLES OF DOUBLE-STRAND RNA ARE PRESENT IN EXTRACTS OF PSTV-INFECTED TOMATO AND TO A LESSER DEGREE IN EXTRACTS OF HEALTHY TOMATO. R. C. French, M. A. Price, and K. S. Derrick, Dept. Plant Path. & Crop Physiol., La. State Univ. Agric. Expt. Sta., Baton Rouge, LA 70803.

Extracts of healthy and potato spindle tuber viroid (PSTV) infected tomato (*Lycopersicon esculentum* Mill var. Rutgers) were assayed by serologically specific electron microscopy (SSEM), using antiserum to double-strand RNA. Low but consistent amounts of a small circular form (CF) of presumably double-strand RNA were detected in extracts of PSTV-infected tomato made by freezing tissue in liquid N₂ and grinding with 0.05 M tris, pH 7.2 (1 ml/g). The contour length of CF was ca. 110 nm, which corresponds to the expected length of a double-strand intermediate of PSTV. CF of similar circumference, but in much lower concentration, were seen in extracts of healthy tissue. Attachment of CF to SSEM grids was increased ca. 15-fold in the presence of 10 mM Na₂EDTA.

GROWTH OF SLASH PINE SEEDLINGS AND SAPLINGS AFTER INFECTION WITH THE FUSIFORM RUST FUNGUS. R. C. Froelich, W. L. Nance, and G. A. Snow. Southern Forest Experiment Station, Gulfport, Miss. 39503

About 3,000 trees from nine plantings of 6-year-old slash pines were used to study effects of fusiform rust on height growth. Trees were sorted into 22 health classes according to year of first infection, type of infection (branch, stem, or none), and degree of stem girdling (< or > 50%). The effects of disease on growth were assessed as changes in relative ranking. Early stem infection was more serious than late infection except when girdling was < 50%. Regardless of initial ranking, trees with stem galls fell to very low relative ranking before death. Branch infections did not seem to affect height growth unless the fungus stimulated growth of the infected branch. Apparently increased branch size was at the expense of main stem growth. The fungus tended to attack larger trees and most stem infected trees can be expected to die before they reach merchantable size. What effect this will have on the final yield of the forest is not known.

WHEAT CV. CHANCELLOR IS A MIXTURE OF GENOTYPES. D. W. Gabriel and A. H. Ellingboe, Department of Botany and Plant Pathology, Michigan State University, East Lansing, MI 48824 and International Plant Research Institute, 853 Industrial Road, San Carlos, CA 94070, respectively.

Chancellor is the common background parent cultivar for highly isogenic wheat lines differing by single genes for resistance to powdery mildew (*Pm* lines). High resolution, two-dimensional electrophoresis revealed a peptide variant in some Chancellor seedlings, but not in others. The peptide was not present in any of the *Pm* lines tested. The variant peptide appears to reflect a change in molecular weight from about 63,000 to about 68,000, with a very slight change in charge (pI of about 4). The variant peptide is among the 300 most visible peptides in seedling extracts that were subjected to electrophoresis and stained with silver. Thus, the variant peptide appears to be made in a large number of copies. Chancellor appears to be a mixture of the original type and a variant type which appeared subsequent to the breeding of the *Pm* lines.

EFFECT OF MULCHING ON INCIDENCE AND SEVERITY OF WEB BLIGHT OF BEANS IN COSTA RICA. J.J. Galindo¹, G.S. Abawi¹, H.D. Thurston², and G. Gálvez³; Plant Pathology Depts., Cornell Univ., Geneva, NY 14456¹ and Ithaca, NY 14853², and CIAT, Apdo 55, 2200 Coronado, San José, Costa Rica³.

Soilborne sclerotia and colonized debris are the main sources of inoculum for web blight (WB) caused by *Thanatephorus cucumeris*. Inoculation of beans occurs mainly by splashing rain. Plots were established in a field with a history of severe WB. Mulching with rice husks (2.5 cm thick) greatly reduced splashing of inoculum and lowered disease incidence. At harvest, incidence of WB in cv Porrillo 70 was 100 and 13%, and seed yield was 0 and 655 kg/ha for the nontreated and mulched plots, respectively. Similar results were obtained with cv Mexico 27. Mulching with rice husks was superior to PCNB applied at 10, 20 or 40 kg/ha. The local production practice "frijol tapado" (seeds broadcast in vegetation that is later cut and left as mulch) was as effective as rice husks in reducing the incidence of WB, but yield appears to be lower.

SOUTHERN CORN LEAF BLIGHT: A PLANT DISEASE SYSTEM FOR DEFINITIVE EPIDEMIOLOGICAL RESEARCH. R. C. Garber, W. E. Fry, O. C. Yoder and A. E. Apple, Department of Plant Pathology, Cornell University, Ithaca, NY 14853

Southern Corn Leaf Blight was selected to investigate the roles of specific genes and gene products in epidemic development. Favorable features of the system include a pathogen sexual stage that is readily manipulated *in vitro* and the ability to produce controlled epidemics in small field plots. Thus, pathogen mutants can be made nearly isogenic to wild type isolates, and the effect of a single allele can then be tested in the field with all other variables in the system normalized. Near-isogenic isolates of *Helminthosporium maydis* developed to date have shown that its epidemic-inducing potential is abolished by albinism, reduced by cycloheximide resistance, and slightly influenced by alleles for mating type. Other genes thought to

be important in epidemic development (such as that controlling toxin production) will be used to test the theory of stabilizing selection, which predicts that such genes impose a cost on the pathogen under conditions where they are superfluous.

RELATIONSHIP OF TOXIN AND FUNGUS IN THE ZEA MAYS-ASPERGILLUS FLAVUS HOST PATHOGEN SYSTEM. C.A.C. Gardner and J.R. Wallin, University of Missouri-Columbia, Columbia, MO 65211.

Four inbred maize lines were subjected to five aqueous solution treatments: toxin-producing culture spores (*A. flavus*), non-toxin-producing culture spores, toxin alone, non-toxin-producing culture spores + toxin, and a control (H₂O). Treated seeds remained in moist petri dishes at 27C for three days, then were planted in four-inch pots in the greenhouse. Emergence, plant height, plant symptoms, and recovery of *A. flavus* by aseptic plating of plant pieces on Aspergillus Differential Medium were observed. Height differences were significant only for lines; emergence was significant for lines and treatments. *A. flavus* was recovered from plant parts for two treatments, toxin-producing culture and toxin + non-toxin-producing culture. Toxin may be necessary for establishment of fungal infection; this resembles a true host-parasite system. Implications of these results for future research and a resistance breeding program will be discussed.

Paper has been withdrawn.

RESISTANCE TO CITRUS TRISTEZA VIRUS IN CITRUS HYBRIDS AS DETERMINED BY ENZYME-LINKED IMMUNOSORBENT ASSAY. S. M. Garnsey, H. C. Barrett, and D. J. Hutchison, U.S. Horticultural Research Laboratory, AR, SEA, USDA, Orlando, FL 32803.

Enzyme-linked immunosorbent assay (ELISA) provides a convenient quantitative measure of citrus tristeza virus (CTV) titer in citrus hosts and it was used to detect resistant progeny from crosses with *Poncirus trifoliata* (L.) Raf., a citrus relative resistant to CTV, and with other *P. trifoliata* hybrids. Selected first generation hybrids of *P. trifoliata* and hybrids of pummelo (*Citrus grandis* (L.) Osb.) X Carrizo citrange (*C. sinensis* (L.) Osb. X *P. trifoliata*) and hybrids of an unnamed citrumelo (*C. paradisi* Macf. X *P. trifoliata*) X sweet orange were propagated in duplicate on CTV-infected rootstocks. The titer of CTV in new flush tissue was assayed 4 times in 9 months by ELISA. Some CTV-resistant first and second generation hybrids were identified, and apparent differences in titer were noted among CTV-susceptible hybrids. Development of CTV-resistant scion varieties appears feasible from selected breeding lines.

RATE ZONAL GRADIENT CENTRIFUGATION OF CITRUS TRISTEZA VIRUS. S. M. Garnsey, R. F. Lee, and R. H. Bransky. U.S. Horticultural Research Laboratory, AR, SEA, USDA, Orlando, FL 32803 and University of Florida, AREC, Lake Alfred, FL 33850.

Citrus tristeza virus (CTV) has been difficult to band in sucrose rate zonal gradients because it shears easily during purification. To reduce particle shearing, we gently extracted infected young citrus bark tissue in 0.05 M Tris buffer, pH 8.0 containing 100 mg/ml sucrose and 0.5% 2-mercaptoethanol. Extracts were partially clarified by low-speed centrifugation and treatment with 1% Triton X-100, and were concentrated on sucrose step gradients. Virus-containing fractions were identified by ELISA and analyzed for particle integrity by SSEM. When concentrated extracts were centrifuged in 200-500 mg/ml linear sucrose gradients, a concise zone of CTV particles was detectable by light scattering and UV absorption. The CTV particles migrated slightly ahead of the NP-1 component of citrus leaf rugose virus (S₂₀ ≈ 106). The CTV band contained numerous flexuous 2000 nm-long particles; was infectious to slash-cut-inoculated Etrog citrons; and contained a large RNA.

EFFECT OF THE CONCENTRATION OF NON-CARBOHYDRATE CONSTITUENTS ON GROWTH, SPORULATION AND XYLANASE PRODUCTION BY BIOPOLARIS MAYDIS RACE T. M. O. Garraway and T. J. Harrison. Dept. of Plant Pathology, The Ohio State University, Columbus, OH 43210, and Ohio Agr. Res. and Dev. Cen., Wooster, OH 44691.

Sporulation and growth of *B. maydis* race T (BMT) on a standard medium (SM) containing 5 g of glucose (G), amylopectin (A), xylose (X) or xylan (Xn), 4.0 g L-asparagine, 1.5 g KH₂PO₄, 0.75 g MgSO₄ · 7H₂O, 0.1 mg each of CuSO₄, ZnSO₄, Fe₂(SO₄)₃ · 5H₂O, and 20 g agar per liter of distilled water, were compared

with that on a medium with the same carbohydrate concentrations but with the non-carbohydrate ingredients diluted 20-fold (DM). With G, A and X as carbon sources growth (mg dry wt/thallus) was 20% less on DM than on SM. But with Xn as the carbon source growth on DM was 50% less than on SM. Also sporulation declined on DM but the trends were less consistent than those for growth. Low growth on DM containing Xn was related to low xylanase levels in the fungus. These data suggest a unique role of non-carbohydrate constituents in the utilization of cell wall carbohydrates for growth of BMT *in vivo*.

FUNGICIDAL CONTROL OF EUTYPA ARMENIACA IN MICHIGAN VINEYARDS. E. H. Gendloff and D. C. Ramsdell, Dept. of Botany and Plant Pathology, Michigan State University, East Lansing, MI 48824.

Field trials were conducted in winter and early spring of 1979-80 in a vineyard at Lawton, MI. Mature 'Concord' grapevines were pruned such that 20 pruning wounds per vine were made on 2-year-old wood. Vines were then sprayed with a 0.5 liter suspension of either Benlate® 50% W.P. at the rate of 1.2 or 4.8 g/L (1 or 4 lb./100 gal.), Difolatan® 4F at the rate of 10 or 20 ml/L (4 or 8 qt./100 gal.), or water as a control. Pruning sites were then inoculated with 500 ascospores of *E. armeniacae* on the day of spraying or 2 wk later. These trials were conducted on four separate dates. In two of the trials, an added treatment of 500 macroconidia of *Fusarium lateritium* per pruning site was tested as a biocontrol. Tissue isolations were made from pruning stubs onto PDA about one year later. Benlate at 4.8 g/L (4 lb./100 gal.) gave statistically significant control of the disease at both inoculation times. Where inoculations were made on the day of spraying, reduction of infection ranged from 76.8 to 86.2%. The other treatments gave marginal or no control.

USE OF FLUORESCENT LABELED ANTIBODY FOR THE DETECTION OF EUTYPA ARMENIACA IN 'CONCORD' GRAPEVINES. E. H. Gendloff and D. C. Ramsdell, Department of Botany and Plant Pathology, Michigan State University, East Lansing, MI 48824.

Antisera were made by intramuscular injection of rabbits with both whole cell or cell wall preparations of *E. armeniacae*. Titers of 1/64 and 1/128 were obtained with the cell wall and whole cell preparations, respectively. Antisera were conjugated with the fluorescent dye rhodamine isothiocyanate (RITC) and tested for selectivity against the mycelium of various fungi on glass slides. The fungi varied in their reactivity to the stain. *E. armeniacae* and *Phomopsis viticola* reacted with the antiserum made to cell walls, whereas *Guignardia bidwellii* and *Alternaria* sp. did not. Hyphae in cross sections from fresh cane stubs that had previously been inoculated with *E. armeniacae* fluoresced only when treated with the stain. 'Indirect' staining of cane sections, using goat anti-rabbit labeled RITC and anti-*Eutypa* serum, gave much greater hyphal fluorescence than the 'direct' method described above. Some fungal saprophytes present in the cane section did fluoresce with the indirect method.

COLONIZATION OF YOUNG COTTON ROOTS BY SOIL FUNGI. J. S. Gerik and O. C. Huisman, Department of Plant Pathology, University of California, Berkeley, California 94720.

Colonization of cotton roots by *Verticillium dahliae* and a saprophytic strain of *Fusarium oxysporum* was studied on root tips obtained from greenhouse-grown plants, growing in naturally infested soil. The frequency of rhizoplane colonies of *V. dahliae* per cm root increased as a function of distance from root tip, over the first cm., then stabilized to a constant value. Colonization by *F. oxysporum* was found to be similar to *V. dahliae*, but the point at which colonization frequency stabilizes was closer to the root tip than it was for *V. dahliae*. This suggests that *F. oxysporum* is able to respond to host stimuli quicker, and hence able to colonize the root faster than *V. dahliae*. The fact that colonization frequency stabilizes suggests that colonization only occurs near the root tip, and not continually along the root.

BACTERIAL BLIGHT OF COWPEA: VARIETAL EFFECTS ON DISEASE INTENSITY. R. D. Gitaitis and D. A. Smittle. Department of Plant Pathology and Department of Horticulture, University of Georgia, Coastal Plain Station, Tifton, GA 31793.

Severity and incidence of bacterial blight of cowpea caused by *Xanthomonas campestris* pv *vignicola* were evaluated in four cultivars of cowpea in a replicated field trial in southern Georgia. Apparent infection rates (r) of an induced epidemic were calculated for a 22-day period. Average r values were determined to be 0.19 with White Acre, 0.29 with Pinkeye Purplehull, 0.31 with Mississippi Silver, and 0.35 with Coronet. The amount of lesion expansion and total leaf area per plant were major factors determining levels of disease that occurred among the four cultivars. However, the influx of new lesions that developed from either primary or secondary inoculum could not account for the different r values observed.

REDUCED GROWTH, ASOCARP PRODUCTION, AND INFECTION OF WHEAT BY PYRENOPOHORA TRICHOSTOMA CAUSED BY MICROORGANISMS. J. Ghazanfari and F. J. Cough. Plant Path. Dept., Oklahoma State University, Stillwater, OK 74078.

Microorganisms isolated from soil and wheat straw inhibited mycelial growth on agar medium and ascocarp production on straw by *Pyrenopeziza trichostoma*. The most inhibitory organisms were identified as *Bacillus licheniformis*, *Bipolaris sorokiniana*, *Stachybotrys oenanthes*, and *Alternaria tenuis*. *B. licheniformis* and *B. sorokiniana* significantly reduced mycelial

growth of *P. trichostoma* on V-8 agar when compared to *S. oenanthes* or *A. tenuis*. Significantly more pseudothecia developed on sterile straw inoculated with *P. trichostoma* than on non-sterile straw, or on straw inoculated with the inhibitory organisms. Infection of wheat seedling leaves inoculated with *P. trichostoma* followed by a spray suspension of *B. licheniformis* cells resulted in only 5% coverage with tan spot lesions. Leaves not treated with *B. licheniformis* were killed.

IDENTIFICATION OF BEET WESTERN YELLOWS VIRUS ASSOCIATED WITH ACCESSORY SALIVARY GLANDS OF THE APHID VECTOR. F. E. Gildow and J. E. Duffus, Department of Plant Pathology, University of California, Berkeley, CA 94720; and SEA, U.S.D.A., Agricultural Research Station, Salinas, CA 95915

Isometric particles, 25 nm in diameter, were observed by transmission electron microscopy in sections of accessory salivary gland from 6 of 6 aphids (*Myzus persicae*) reared 10 days on shepherd's purse infected with a severe isolate of beet western yellows virus (BWYV). The particles were identified as BWYV by indirect labelling of dissected accessory glands with ferritin-conjugated antibody. In 5 of 5 aphids reared on BWYV-infected radish, particles were observed in basal lamina, in plasmatemna invaginations, in microvilli-lined canals, and in coated pits fused to canal membranes. Virus particles were never observed in basal lamina surrounding principal salivary glands, nerve ganglia, or muscle tissue, in any of 15 aphids examined. Results show a specific association between accessory gland basal lamina and BWYV, and suggest movement of virus through the accessory gland is a mechanism for BWYV transmission.

COMPOSITION OF DOUBLE-STRANDED RNA CONTAINING PARTICLES FROM HYPOVIRULENT ENDOETHIA PARASITICA STRAIN 113. K. Gillies and N. K. Van Alfen, Department of Biology, UMC 45, Utah State University, Logan, Utah 84322.

A double-stranded RNA containing particulate fraction can be purified from extracts of hypovirulent *Endothia parasitica* strain 113. The composition of these particles and their similarity to virus-like particles found in other fungal genera have not been reported. We have studied the composition of purified double-stranded RNA containing particles by colorimetric assays for nucleic acids and protein, and by electrophoresis techniques. The RNA component was confirmed to be double-stranded by formamide-gel electrophoresis and RNase-DNase digestion experiments. Our experiments indicate that purified particles contain less than 0.1% protein (by mass) while approximately 12% of the particle is chloroform-methanol extractable. The remainder of the mass is RNA. These results suggest that these particles are not virions composed of nucleic acid incapsidated with protein but resemble more closely RNA replication structures found in some higher plant viruses.

EFFECT OF TEMPERATURE ON THE SPORULATION AND CONIDIAL GERMINATION OF CERCOSPORA ARACHIDICOLA. S. M. Gobina and H. A. Melouk, Department of Plant Pathology, and USDA, SEA, AR, Oklahoma State University, Stillwater, OK 74078.

Sporulation of *Cercospora arachidicola* (the number of conidia/mm² of necrotic area produced at 100% RH) was determined on detached leaflets of the peanut cv. Tamnut 74 at 16, 20, 25, 30, and 35 C after 96 hr of incubation in darkness. Sporulation was significantly highest at 30 C and lowest at 35 C. Sporulation at 30 C was higher than at 25 C which in turn was significantly higher than the other treatments. Furthermore, conidia produced at 35 C were significantly shorter than those produced at other temperatures. Conidial suspensions of *C. arachidicola* were incubated at 15, 20, 25, 30, and 35 C. Percent germination was recorded every 12 hr for 48 hr. Conidial germination after 12 hr of incubation at 15 and 35 C was less than 1% and 84%, respectively. However, after 48 hr of incubation, there was no significant difference in germination between all temperatures.

EFFECT OF PLANT AGE ON WEED HOST SUSCEPTIBILITY TO X-DISEASE. K. Conot and A. H. Purcell. Department of Entomological Sciences, University of California, Berkeley, CA 94720

Filaree (*Erodium cicutarium*) and *Amsinckia intermedia*, two weeds found in California cherry and peach orchards, were less susceptible to X-disease (XD) with increasing plant age. Leafhoppers (*Colladonus montanus*) infective with either Peach Yellow Leaf Roll (PYLR) or Green Valley (GV) types of XD were given a one wk inoculation access period on filaree, *Amsinckia*, or celery test plants. Rates of transmission to filaree of various ages were as follows: 3-12 days, 43%; 2-3 wk, 18%; and 4 wk or older, 0%. Symptom differences were not observed between PYLR- or GV-infected filaree plants; however, the GV type of XD was more virulent in celery.

TOMATO WHITE LEAF, A DISEASE INDUCED BY CUCUMBER MOSAIC VIRUS IN ASSOCIATION WITH A LOW MOLECULAR WEIGHT RNA. D. Gonsalves, R. Provvidenti, and M. C. Edwards. Dept. of Plant Pathology, Cornell University, N.Y.S. Agr. Exp. Station, Geneva, NY 14456

Since 1970, an apparently new disease of tomato has occurred near Geneva, New York. Affected plants have a striking white-green mottle of leaves, petioles, stems, flowers, and fruits. Plants are severely stunted but fruits reach full maturity. The causal agent was experimentally transmitted by aphids and mechanically to several cultivars of *Lycopersicon esculentum* and other *Lycopersicon* spp. Cucumber mosaic virus (CMV-WL) has

been consistently recovered from affected plants. Purified preparations of CMV-WL contain six RNA components, designated RNA-1, RNA-2, RNA-3, RNA-4, RNA-5 in order of decreasing molecular weight. Tomato plants inoculated with RNAs 1+2+3 failed to develop white leaf symptoms, but did exhibit green mottle accompanied by a downward leaf curling along the main vein and great reduction of the leaf lamina. Conversely, the 'white leaf' syndrome was only expressed in plants inoculated with RNAs 1+2+3+5.

THE NATURE AND ORIGIN OF THE APPLE AGGLUTININ OF *ERWINIA AMYLOVORA* IN PETIOLE XYLEM VESSELS. R.N. Goodman, Dept. of Plant Pathology, University of Missouri, Columbia, MO 65211.

The avirulent, unencapsulated isolate E₈ of *Erwinia amylovora* was originally observed to be agglutinated *in vivo* by Huang et al., (1975), *Physiol. Plant Path.* 6:283. The current ultrastructural study details the development of the agglutinin over a time course of 6, 12, 24, and 48 hrs after petiole inoculation with isolate E₈ and the agglutination of E₈ in the lumen of xylem vessels. The size of the agglutinin granules are clearly depicted as ≈ 100 nm in diam. They originate in adjacent xylem parenchyma cells as the granules are apparent either side of the plasmamembrane. Electron micrographs suggest an exocytotic extrusion phenomenon at the plasmamembrane parenchyma wall interface and subsequent movement of the granules through xylem pit pores into vessel lumens. The relationship of the bacteria-agglutinating granules to a highly active protein agglutinin, isolated from apple seed, stem and leaf tissue will be discussed.

STOMATAL BEHAVIOR AND WATER RELATIONS IN SUGAR BEET LEAVES INFECTED WITH POWDERY MILDEW. T. R. Gordon and J. M. Dunaway, Department of Plant Pathology, Univ. of Calif., Davis, CA 95616

Sugar beet leaves (*Beta vulgaris*) were inoculated with powdery mildew (*Erysiphe polygoni*) on their adaxial surfaces; the abaxial surfaces remained uninfected. In the light, stomatal conductance to water vapor loss (L_1) was reduced on both surfaces of infected leaves as the disease progressed. In darkness both diffusive and viscous flow conductance of mildewed leaves were considerably higher than comparable healthy leaves. The effect of water stress on L_1 was examined by withholding water from the soil in which plants were grown. Healthy leaves showed a substantial decrease in L_1 as leaf water potential (Ψ) dropped, whereas for adaxial surfaces of mildewed leaves, L_1 was not significantly altered by leaf Ψ values as low as -39 bars. As a result mildewed leaves transpired more than healthy leaves at low Ψ values and at soil $\Psi < -6$ bars the Ψ values of mildewed leaves were much lower than uninfected leaves. The relationship between turgor pressure and leaf Ψ was not altered in mildewed leaves.

ANTAGONISM OF RHIZOCTONIA SOLANI BY TRICHODERMA HARZIANUM IN TWO SOILS. G. R. Goss, M. M. Joshi, and S. N. Hillebrenner, Kalo Laboratories, Inc., 525 Kentucky Street, Quincy, IL 62301.

A granular inoculum of *Trichoderma harzianum* at 1.9×10^5 propagules/gram of soil destroyed the mycelial squares (MS) and sclerotia (SC) of *Rhizoctonia solani* in autoclaved and unautoclaved Wakeland sand (WS) and Seaton-Urban silt loam (SSL) soils. The survival of MS and SC in WS and SSL was monitored over a 5-week period at 30C and -0.3 bars water potential. The effect of soil moisture on the survival was determined by burying MS and SC for three weeks in the two soils adjusted to -0.3, -1.0, and -5.0 bars at 30C. The survival was determined by placing MS and SC on PDA amended with Dexon and chloramphenicol. Disintegration of both MS and SC began in both soils within one week; SC survived better than MS. Survival of both MS and SC was poorer in SSL than in WS; no *R. solani* propagules survived the 5-week period in either autoclaved or in unautoclaved SSL. Destruction of *R. solani* by *T. harzianum* at -0.3 and -1.0 bars was not significantly different but was significantly greater than at -5.0 bars water potential.

DIURNAL AND SEASONAL DISCHARGE PATTERNS OF CONIDIA OF THE PECAN SCAB FUNGUS *FUSICLIADIUM EFFUSEUM*. T. R. Gottwald, USDA-SEA-AR Byron, GA 31008 and P. F. Bertrand, Rural Development Center, Tifton, GA 31793.

Release of conidia of *Fusicladium effusum*, was monitored in 1980 with a Burkard 7-day recording spore trap. Rain water dispersal was measured using 21 funnel traps baited with sporulating scab lesions on various plant parts. Rainfall favored sporulation but reduced hourly spore catches. Conidia discharge was also inhibited by prolonged periods of drought. Aerial dispersal accounted for most of the inoculum recorded. Spore release peaked at mid-day and usually followed a diurnal periodicity, suggesting that sporulation occurred during the night. Appreciable conidia release was recorded from April through Nov. with maximum spore release occurring between June and Oct. Maximum spore release correlated well with decreasing vegetative wetness and decreasing relative humidity during drying periods following dew or rainfall. Conidia release was inhibited by temperatures above 30°C and below 5°C. Symptoms were expressed ca. 21 days following infection periods consisting of several successive days with 10-16 hours vegetative wetness.

INFLUENCE OF VESICULAR-ARBUSCULAR MYCORRHIZAE AND SOIL PHOSPHORUS ON TAKE-ALL DISEASE OF WHEAT. J. H. Graham, Dept. of Plant Pathology, Univ. of Calif. Riverside, CA 92521.

The influence of soil P and vesicular-arbuscular mycorrhizae (VAM) on take-all disease of wheat appears to be the same

in P-deficient soil (0.5 ppm P, pH 8.2), i.e., these factors increase root P content leading to a decrease in root exudation which reduces pathogen activity. For plants grown in P-deficient soil, the formation of high levels of VAM (>70%) by *Glomus fasciculatus* increased root P content nearly to the level of P-treated plants, whereas 50 ppm soil P severely inhibited VAM formation (<10%). Root exudation of amino acids and reducing sugars, which was lower in heavily mycorrhizal and P-treated plants than untreated controls, was correlated with root P content. When plants of each P-VAM treatment combination were inoculated with *Gaeumannomyces graminis* var. *tritici*, the P-treated plants and mycorrhizal plants grown in P-deficient soil developed less take-all than the untreated controls.

SURVIVAL OF *PSEUDOMONAS SOLANACEARUM* IN THE SOIL, RHIZOSPHERE, AND PLANT ROOTS. G. A. Granada and L. Sequeira, Dept. of Plant Pathology, University of Wisconsin-Madison, Madison, WI 53706.

The survival of *P. solanacearum* (Races 1, 2, and 3) in the soil and in the rhizosphere of plants grown in the greenhouse was studied with the use of a selective medium (*Phytopathology* 71: 220). When hosts (pepper, castor bean, and tomato) and presumed nonhosts (bean and corn) were grown in infested soil or inoculated by dipping the roots in a bacterial suspension, there was no apparent long-term survival in soil or rhizospheres. Survival appeared to depend on localized or systemic root infection of all plants tested. Commonly, no vascular discoloration of infected root tissues occurred and no wilting symptoms were observed. In general, the presence of large populations of *P. solanacearum* in the rhizosphere was associated with the apparent release of bacteria from infected roots. Long-term survival of different strains of the bacterium was correlated with their ability to infect the roots of a given cultivar.

A SYSTEM FOR EXPOSING PLANTS FOR SHORT PERIODS TO LARGE CONCENTRATIONS OF HYDROGEN FLUORIDE (HF) GAS. A. L. Granett, E. A. Allingham, and E. C. Smith, Statewide Air Pollution Research Center, University of California, Riverside, CA 92521

Vegetation downwind of rocket launching facilities may be exposed to HF clouds. To test plant sensitivity to HF doses, a system was developed to deliver stable levels of HF for short periods. Aqueous HF was volatilized by injecting solns at 0.2 ml min⁻¹ into dry 100 C air flowing at 12 L min⁻¹. During each 20-min fumigation, five 15-L samples of chamber atmosphere were bubbled through 20 ml of 0.01 N NaOH and the F⁻ content of the samples was measured with a F⁻-specific electrode. When 1.6, 3.3, 6.5, 13, and 20% aqueous HF was injected, chamber air contained 0.85±0.26, 1.35±0.14, 3.60±0.46, 7.65±0.04, and 10.5±0.37 mg HF m⁻³ respectively. Negative pressure and a modified door on 1.1-m³ continuous-stirred tank reactor chambers allowed safe, rapid removal of treated plants. Symptoms on exposed plants ranged from rapid bleaching to abaxial glazing and necrosis of leaves. Our work provides a contrast to studies of plant response to long-term, small doses of HF.

PHYTOTOXICITY OF VAPORS, SPRAYS, AND SOIL DRENCHES OF JP4 JET FUEL. A. L. Granett, A. B. Baudoin, and H. E. Stone, Statewide Air Pollution Research Center, University of California, Riverside, CA 92521.

Over 800,000 L of jet fuel are jettisoned from military aircraft monthly and additional fuel is released into the environment by leaks and spills during transport, transfer, or storage. We investigated the effects of JP4 vapors and sprays on foliage and of soil drenches on seedlings. Injury resulting from vapor or fine spray applications was of the acute type and similar to that reported for other oils. Water-soaked lesions appeared on leaves within minutes after either treatment and became necrotic and bleached 1-3 days later. Some species such as corn had distinct chlorotic areas. Symptoms and sensitivity ranking of the nine species tested were the same whether vapors or sprays were used. Bean, pea, and radish, the most sensitive species, were injured by vapors of 5 g m⁻³ for 1 hr or by foliar spray deposits of 0.1-0.2 mg cm⁻². Germination of seeds and seedling growth was inhibited in soil drenched with 25 mg JP4 cm⁻². Inhibition was reduced if treated soil was allowed to air for a week.

A POSSIBLE POTATO SPINDLE TUBER VIROID (PSTV) INHIBITOR IN TRUE POTATO SEEDLINGS. M. E. Grasmick and S. A. Slack, Dept. of Plant Pathology, Univ. of Wisconsin-Madison, Madison, WI 53706.

The bioassay host 'Rutgers' tomato (*Lycopersicon esculentum* Mill.) is used to detect PSTV in potato plants. We have routinely inoculated 'Rutgers' plants by mechanical abrasion with a 1:5 tissue-buffer (0.1 M phosphate, pH 7.0-7.3) extract. This method has been efficient for bioassays in which mature PSTV-infected potato or tomato plants are indexed (*Phytopathology* 70: 922). Recently, we have attempted to index true potato seedlings generated from PSTV-infected parents. The 'Rutgers' plants in these assays did not develop disease symptoms when inoculated by our routine procedure. However, serial dilutions of extracts resulted in disease development with symptom severity increasing with dilution. Symptomless plants inoculated with the concentrated extracts were shown to be PSTV-infected by polyacrylamide gel electrophoresis assays. Data suggest the presence of an inhibitor in potato seedling extracts.

INTERACTION OF MELOIDOGYNE HAPLA AND DITYLENCHUS DIPSACI ON SEVERAL PLANT CULTIVARS. G. D. Griffin, Crops Research Lab., USDA, SEA, AR; Utah State University, Logan, UT 84322

Seed of Stone Improved tomato, U.S. 33 sugarbeet, Wasatch wheat, Ranger alfalfa, Yellow sweet clover, and Tender crop bean were germinated and inoculated with *Ditylenchus dipsaci*

and *Meloidogyne hapla* larvae singly and in combination. Stunting of all plants occurred from *D. dipsaci* parasitism; alfalfa was the most susceptible while bean and wheat showed the least amount of stunting. Alfalfa and sweet clover were the most susceptible plants to *M. hapla*, while there was a top growth response in wheat, a nonhost to *M. hapla*. A combination of *D. dipsaci* and *M. hapla* had little or no effect on the top growth of wheat or bean, while growth of all other plants was significantly reduced ($P = 0.05$). There was little or no mortality in wheat, bean, and sugarbeet to a combination of *D. dipsaci* and *M. hapla*, while alfalfa and sweet clover had the greatest number of plants succumbing to the combination inoculation.

INOCULUM PATTERN AND INOCULUM DENSITY-DISEASE INCIDENCE RELATIONSHIPS OF CYLINDROCLADIUM CROTALARIAE IN PEANUT FIELD SOIL. G. J. Griffin, J. D. Taylor and K. H. Garren. VPI & SU, Blacksburg, VA 24061 and USDA, Suffolk, VA 23437.

The horizontal pattern (distribution) of *Cylindrocladium crotalariae* microsclerotial inoculum in soil was determined in a 1975 field plot established to study inoculum density-disease relationships, and the influence of crop rotation on pathogen populations from 1975 to 1978. The microsclerotial inoculum pattern fitted the negative binomial distribution, indicating that the microsclerotial inoculum pattern was not random, but was clumped or clustered. First-order regression equations gave the best fit in arithmetic plots of inoculum density versus disease incidence [transformed to $\log_e(1/(1-y))$]. \log_{10} - \log_{10} regression line slopes of the same variables were low for both a corn-peanut sequence ($b=0.45$) and a peanut-peanut sequence ($b=0.30$). Inoculum clumping appeared to contribute to the low slope values. Low winter soil temperature and low soil water potential had a greater influence on the quantity of microsclerotia in soil than did crop sequence.

CYTOPLASMIC MALE STERILITY IN VICIA FABA: ASSOCIATION WITH DOUBLE-STRANDED RNA VIRUS-LIKE PARTICLES. L.K. Grill and S.J. Garger, Department of Molecular Biology, Zeecon Corporation, 925 California Avenue, Palo Alto, California 94304.

High molecular weight double-stranded RNA virus-like particles appear to be responsible for the male sterility trait in *Vicia faba* L. plants. Subcellular fractions of the leaf tissue from cytoplasmic male sterile (CMS) and fertile plants were analyzed in an attempt to locate, identify and characterize the genetic material involved with the sterility trait. The only significant difference appears to reside in the cytosol of the male sterile plant cells, from which the virus-like particles can be isolated. The CMS-associated RNA species cannot be isolated from *V. faba* lines which have been restored or have reverted from the sterile phenotype. Evidence will be presented implicating these virus-like particles as the agents responsible for the male sterile phenotype.

GEL ELECTROPHORESIS TO DETECT DEHYDROGENASE ISOZYMES IN BEAN RUST UREDOSPORES. J.V. Groch and C.P. Vance, University of Minnesota, St. Paul, MN 55108.

Isozymes are valuable genetic markers to detect gene frequency and heterozygosity in populations. Six dehydrogenase enzymes were evaluated in uredospores of two single-pustule isolates of *Uromyces phaseoli* var. *typica* having differences in virulence on many bean cultivars. About 0.20 g of ungerminated, uredospores were fractured with a Braun homogenizer and centrifuged to remove cell walls. Isozymes were separated on both polyacrylamide disc gels and starch slab gels. Slabs were each stained in a 0.05 M Tris buffer adjusted to pH 7.0. Six dehydrogenase enzymes had sufficient activity on discs to result in unambiguous banding: malic, succinic, glucose-6-phosphate, 6-phosphogluconic, glutamic and β -glycerophosphate. The first four enzymes showed two or more distinct bands. On slabs, results were similar for the first five enzymes. Differences in band number between the two isolates were observed for some of the enzymes. Genetic interpretation of banding patterns will require examination of banding patterns of progeny isolates.

FACTORS ASSOCIATED WITH THE MEASLES DISORDER OF HONEYDEW MELON IN CALIFORNIA. W. D. Gubler and R. G. Grogan. Department of Plant Pathology, University of California, Davis, CA 95616.

Measles is an abiotic disorder of the smooth-skinned cultivars of *Cucumis melo* as well as *C. sativa* and *Cucurbita pepo*. Symptoms are superficial green or brown spots on the fruit surface, stems or leaves, and are more prevalent on melons planted for fall harvest, although slight fruit measles also has occurred on summer harvested fruit following periods of unusually cool night temperatures ($<17^\circ\text{C}$). Symptoms were reproduced in the greenhouse on leaves and fruit of honeydew melons grown at constant soil temperatures of $24-27^\circ\text{C}$ and at ambient day temperatures of $30-33^\circ\text{C}$ followed by a sudden shift to night temperatures of $13-15^\circ\text{C}$ and 95-100% RH. These conditions were conducive to guttation. Measles severity was increased when these plants also were fertilized with 25 meq NH_4SO_4 . Diseased tissue showed significant differences in chemical constituents as compared with healthy tissue. Partial control of measles has been achieved with reduced irrigation and/or a preplant incorporation of Dolomite at 4484 kg/ha.

PURIFICATION OF CITRUS TRISTEZA VIRUS (CTV) ON SUCROSE-CESIUM SULPHATE CUSHION GRADIENTS AND ESTIMATION OF ITS RNA SIZE. D. J. Gumpf, M. Bar-Joseph and J. Allan Dodds. Department of Plant

Pathology, University of California, Riverside, CA 92521.

The CTV purification procedure of Bar-Joseph et al. (1972) (Virology 50: 821) was modified to include a short Cs_2SO_4 -sucrose cushion step gradient for virus concentration and purification. Polyethylene glycol concentrated virus suspensions were loaded on step gradients prepared by layering one ml fractions of 0, 15, 22.5 and 30 percent Cs_2SO_4 (w/w) dissolved in 0.04 M sodium phosphate, pH 8.2, containing 10 percent (w/w) sucrose. Tubes were centrifuged in a Beckman SW41 rotor for 2 1/2 hr at 38,500 rpm and 8°C . The virus band was located immediately below a green membranous zone. This method was found effective for the rapid concentration of other CI-sensitive virus particles including beet yellows virus (BYV). Electrophoretic mobility in agarose gels of the SS RNA from purified CTV was slower than SS RNA isolated from BYV, watermelon mosaic virus and tobacco mosaic virus. The molecular weight of CTV SS RNA was estimated to be $6.5-7.0 \times 10^6$ daltons.

TRANSMISSION AND EPIDEMIOLOGY OF XANTHOMONAS TRANSLUCENS. Valerie N. Hall, Hee Kyu Kim, David C. Sands, Dept. of Plant Pathology, 520 Johnson Hall, Montana State University, Bozeman, MT 59717.

Xanthomonas translucens has recently become prevalent in irrigated cereal fields of Montana. Isolates from barley, wheat and rye were classified into form species based on their virulence on barley, wheat, oats, and rye: f. sp. *cerealis*, *hordei-avenae*, *hordei* and *undulosa*. All isolates were shown to be pathogenic on barley. Seed transmission rate of *X. translucens* f. sp. *hordei* was dependent on the infection level of the seedlot, which ranged from 0-95%. Actual transmission occurred from only a small percentage of infested seed (less than 2%). Seed treatment with copper hydroxides or with antibiotics reduced seedling infection rates. Field epidemiology studies using an antibiotic resistant strain of *X. translucens* f. sp. *hordei* showed it capable of spreading 28 sq. meters from a single infection locus within 39 days. Infection cycles as short as ten days were noted.

DIFFERENTIAL RESPONSE OF PEACH MESOPHYLL CELL MEMBRANES TO CULTURE FILTRATES OF XANTHOMONAS PRUNI AND X. PELARGONII. F. Hammerschlag, USDA, SEA, AR, Beltsville, MD 20705.

A bioassay system using peach mesophyll cells stained with merocyanine 540 was developed to detect toxin activity in culture filtrates (CF) of *X. pruni*. Fluorescence data revealed that maximum changes in membrane potential (PD) occurred when peach cells from susceptible cultivar Sunhigh were exposed to CF of virulent isolates of *X. pruni* and to valinomycin. Slight PD changes occurred when Sunhigh cells were exposed to CF of avirulent isolates of *X. pruni* and to nutrient broth and when cells from resistant cultivar Compact Redhaven were exposed to CF of a virulent isolate of *X. pruni*. Transient PD changes occurred when Sunhigh cells were exposed to CF from nonpathogen *X. pelargonii*. These results suggest that a toxin present in culture filtrates of *X. pruni* may play a role in bacterial leaf spot of peach and may be an effective screening agent in a cell selection program. This bioassay may be useful in determining whether toxins produced in CF of virulent isolates can be used to screen germplasm for resistance to *X. pruni*.

DEPOSITION OF A LIGNIN-LIKE MATERIAL IN POTATO TUBER DISCS IN RESPONSE TO NON-PATHOGENIC FUNGI. R. Hammerschmidt, Department of Botany and Plant Pathology, Michigan State University, East Lansing, MI 48824.

Inoculation of freshly cut potato tuber discs with conidia of *Cladosporium cucumerinum*, *Colletotrichum lagenarium* or *Fusarium solani* f. sp. *phaseoli* resulted in the deposition of a lignin-like material in host cell walls. Histochemical staining revealed that lignification occurred near germinating spores. Based on histochemical and chemical tests, lignification occurred within 12 hours after inoculation. Little or no cell browning (hypersensitive-like response) occurred in response to these fungi. Uninoculated controls exhibited little or no lignification until 36 hours after cutting. An increase in insoluble esters of phenolic acids and suppression of wound induced chlorogenic acid accumulation was associated with the non-pathogen induced lignification.

ALFALFA SEEDLING LOSSES IN THE CENTRAL VALLEY OF CALIFORNIA. J. G. Hancock, Department of Plant Pathology, University of California, Berkeley, California 94720.

Emergence of alfalfa in broadcast seeded plantings in the Central Valley of California during early autumn was 50 to 60%, whereas it was 30 to 40% during the winter or early spring months. In the autumn plantings, about 30% of the seedlings had stem or root lesions and a significant number of seedlings (5%) had lost their tap root and had conspicuous adventitious lateral branching. Seedling diseases were not as common in the winter plantings and the degrees of emergence were similar in fumigated and nonfumigated plots. The most common pathogens associated with root and stem lesions in seedlings from the field or greenhouse plantings were *Pythium ultimum* and *Rhizoctonia solani*. In greenhouse tests fungicides selective against pythiaceae and basidiomycetous fungi (ethazole and PCNB) improved emergence percentages significantly above those in untreated soils.

RESISTANCE TO RUST (PUCCINIA SUBSTRIATA VAR. INDICA) IN PEARL MILLET. Wayne Hanna, Homer D. Wells, and Glenn W. Burton.

Rust, *Puccinia substriata* var. *indica* is the most serious disease on pearl millet *Pennisetum americanum* (L.) Leeke in the U.S. In 1975, a plant highly resistant to rust was observed in a late maturing introduction (cultivar - 'Se Fa') from Senegal. This resistant plant was crossed with inbred 'Tift 23DB' which is susceptible to the rust. Observations on F_1 , F_2 , F_3 and backcross progenies involving both natural infection under field conditions and controlled inoculations in the greenhouse indicate that resistance is dominant and controlled by at least two gene loci where a dominant allele is required at each locus for resistance. Resistance is expressed as small flecks appearing ca. eight days after infection and only a low percentage of flecks develop small sporulating pustules after 12 to 14 days.

INFRA-SPECIFIC VARIANTS OF *VERTICILLADIELLA WAGENERI*. T. C. Harrington and F. W. Cobb, Jr., Department of Plant Pathology, University of California, Berkeley, California 94720.

Three distinct groups within *Verticilladiella wagneri* (cause of black stain root disease) were apparent when 67 isolates from western North America were grown on PDA. Isolates from Douglas-fir had olive pigmentation, a hyaline mycelial margin, and were generally intermediate in their sensitivity to temperatures above 25°C. Isolates from pinyons (*Pinus edulis* and *P. monophylla*) had similar pigmentation, but had a narrower hyaline margin, a denser mycelial mat, sporulated more readily and generally survived better at 26°C. Hard pine (*P. ponderosa* and *P. contorta*) isolates had brown pigmentation, a pigmented mycelial margin, sporulated poorly, and were usually killed at 26°C. These observations suggest that distinct variants of *V. wagneri* exist, each with a relatively narrow host range and unique distribution. Differences among the groups were also reflected in results of pathogenicity tests involving inoculations of Douglas-fir and ponderosa pine seedlings.

SUCROSE STIMULATION OF LEAFHOPPER PROBING AND FEEDING: THE SENSORY TRANSDUCTION MECHANISM. Kerry F. Harris, Department of Entomology, Texas A&M University, College Station, TX 77843

Sucrose applied to the vector's (*Graminella nigrifrons*) side of a parafilm membrane markedly stimulates probing and feeding. The phagostimulatory effect is long-lived and, in sharp contrast to control insects, most leafhoppers on sucrose-treated membranes can be observed probing and actively ingesting feeding mixture at any given time. Preliminary studies suggest that the sucrose stimulator is detected via the labium. Applying wax "boots" or oil to the tarsi, or amputating them, does not inhibit the response, whereas applying oil to the tip of the labium does. Furthermore, electron microscopy has revealed the presence of two pores, one on either side of the bilobed, apical pad formed by the labial groove. Each pore opens into a cavity that is highly innervated by dendrites. It is hypothesized that these pores are contact chemoreceptors and that their stimulation by phytochemical-saliva mix formed at the start of a probe represents the first direct chemical communication between plant and insect in the host-selection process.

CYTOPATHOLOGY OF MAIZE CHLOROTIC DWARF VIRUS (MCDV)-INFECTED CORN. Kerry F. Harris and S. A. Childress, Department of Entomology, Texas A&M University, College Station, TX 77843

Healthy and MCDV-infected corn leaves, *Zea mays* L. hybrid WF9 X OH51, were examined by transmission electron microscopy. Accumulations of MCDV virions were observed within electron-dense, granular inclusions in the cytoplasm of sieve cells, phloem parenchyma cells and, less frequently, mesophyll parenchyma cells. Individual MCDV virions were rarely observed free in the central vacuole and interspersed in the cytoplasm of phloem parenchyma and sieve cells. Phloem cells of MCDV-infected leaves contained cytopathological structures such as differentially electron-dense particulate aggregates, curved fibriform material, vesicle accumulations, and laminate inclusions. Additionally, numerous hexagonal crystalline inclusions were observed in the cytoplasm of mesophyll parenchyma cells in infected plants. An analysis of these data indicates that the cytopathological effects of MCDV infection in corn are more extensive and varied than formerly realized.

PRELIMINARY OBSERVATIONS ON THE MORPHOLOGY OF APICAL SENSORY PEGS ON APHID LABIA. Kerry F. Harris and S. A. Childress, Department of Entomology, Texas A&M University, College Station, TX 77843

The distal peg receptors of 10 species of aphids were examined by scanning electron microscopy: *Acyrtosiphon pisum*, *Amphorophora agathonica*, *Aphis craccivora*, *A. nasturtii*, *Aulacorthum solani*, *Macrosiphum euphorbiae*, *Myzus persicae*, *Rhopalosiphum maidis*, *R. padi*, and *Schizaphis graminum*. The number and arrangement (bilaterally symmetrical, but eccentric groupings of eight on either side of the labial groove) of the pegs were similar for all species examined. Additionally, a pore was localized at the base of each peg. These pores superficially resemble ecdysial pores and are located above the peg socket on the side opposite the point membrane. This pore positioning, as well as the eccentric positioning of the pegs on either side of the labial groove, would result in maximal stimulation when a peg is deflected towards its pore side. The aforementioned characteristics confirm the theory that these pegs are mechanoreceptors that enable aphids to discern host plant-contact (pressure) and topography (e.g., antinatal grooves and vein contours).

DISTRIBUTION OF AND SAMPLING METHODS FOR *CYLINDROCLADIUM CROTALARIAE* IN A PEANUT FIELD. F. C. Hau, C. Lee Campbell and

M. K. Beute. Department of Plant Pathology, North Carolina State University, Raleigh, NC 27650.

Inoculum density (ID) of *Cylindrocladium crotalariae* was determined by elutriation of soil samples from 288 quadrats (three 96-sample replicates) in a 723 m² peanut field in June 1980. Five frequency distributions (Poisson, negative binomial, Thomas double Poisson, Neyman's Type A, and Poisson with zeroes) were tested for goodness-of-fit to ID frequency class data. The negative binomial distribution model best described the ID data. Values of the 'k' parameter - an index of aggregation - were 2.21, 2.77, and 2.09 for the 3 replicate samples and 2.31 for the combined 288 samples, which indicated a clumping or clustering of inoculum in soil. Nine simulated sampling methods differing in area covered and shape of path were used to draw samples from the field. Two methods utilizing diagonal paths (sample size=16 or 32) had sample means within 5% of the population means. Random samples did not give accurate population estimates.

TEMPERATURE EFFECT ON VICTORIN-INDUCED ROOT CAP CELL DEATH. Martha C. Hawes, Dept. of Plant Pathology, University of Kentucky, Lexington, KY 40546.

Victorin induces false plasmolysis and death in root cap cells from oat cultivars that are susceptible to Victoria blight, caused by *Helminthosporium victoriae*. The rate of cell death caused by victorin was found to be highly temperature-dependent. Death of isolated root cap cells was measured by a loss in the ability to fluoresce when stained with fluorescein diacetate. Over 95% of the cells remained alive for up to 4 weeks when incubated at temperatures ranging from 10°C to 35°C in water alone, in inactivated victorin, or in culture filtrates of a nonpathogenic strain of the fungus. When incubated in 0.01 to 50 units per ml of partially refined victorin, cell death was proportional to toxin concentration and to temperature. The majority of cells maintained in up to 50 units per ml of toxin at 10°C remained alive for over 4 weeks, whereas at 35°C nearly all cells in 50 units/ml of toxin were killed within 2 hours. Root cap cells from a resistant cultivar were unaffected by all concentrations of toxin tested, even at 35°C.

SURVIVAL OF *ERWINIA CHRYSANTHEMI* IN ASSOCIATION WITH PHILODENDRON SELLOUM, OTHER GREENHOUSE ORNAMENTALS, AND IN POTTING MEDIA. R. A. Haygood, D. L. Strider, and E. Echandi, Department of Plant Pathology, North Carolina State University, Raleigh, NC 27650.

A rifampin-resistant *Erwinia chrysanthemi* strain (R_1), similar to the wild type, was detected by an enrichment technique for 11 mo from detached artificially infected *Philodendron selloum* (Ps) leaves placed on a greenhouse bench, in potted media, and in the laboratory. R_1 was recovered for 13 mo from artificially infested potted media and Ps seed. R_1 was capable of surviving in association with leaves of 23 host and nonhost greenhouse ornamentals for 5-6 mo. Epiphytic populations of R_1 decreased markedly after nonwounded Ps leaves were inoculated with 1×10^7 colony forming units/ml and maintained at 100% RH.

A CARLAVIRUS FROM KALANCHOE BLOSSFELDIANA. S. S. HEARON USDA, SEA, AR, Florist & Nursery Crops, Beltsville, MD 20705

A flexuous rod-shaped virus (Kalanchoe latent virus, KLV) from *K. blossfeldiana* 'Rotkappchen' was purified from the local lesion host *Chenopodium quinoa*. Additional hosts of KLV were *Chenopodium* spp. that formed local lesions and *Tetragonia expansa* that developed local lesions and limited symptomless systemic infection. The normal length of particles in KPTA negatively stained leaf dip and purified preparations was 600-640 nm; thermal inactivation point was 65-70°C; longevity in phosphate buffered crude sap was 3-5 days. Virus was purified by chloroform-carbon tetrachloride clarification of leaf extracts in 0.1 M K₂HPO₄ buffer, pH 9.3, with 1% Triton X-100 and 5mM EDTA, 2X precipitation with 4% PEG 6000 and passage through a controlled pore glass bead (70 nm pore size) column. In microprecipitin and immunoelectron microscopy using antiserum to KLV and eight carlaviruses, KLV was related to, but distinct from, lily symptomless, carnation latent, potato S and chrysanthemum B viruses. Infected 'Rotkappchen' and *C. quinoa* leaves contained fusiform virus aggregates typical of a carlavirus. KLV is proposed as a new carlavirus.

ULTRASTRUCTURE OF SORGHUM BICOLOR 'Rio' INFECTED WITH STRAINS OF SUGARCANE MOSAIC VIRUS (SCMV). S.S. Hearon, A.G. Gillaspie, Jr., and R.G. Mock. USDA, BARC-West, Beltsville, MD 20705

Each of seven SQMV strains (A,B,D,E,H,I, and K) was mechanically inoculated to the second leaf of 10 *Sorghum bicolor* 'Rio' seedlings. Plants were grown on a 16 hr photoperiod under 1600 ± 200 ft-c of cool white fluorescent light at 27±2°C. Samples from inoculated and systemically infected leaves and comparable samples from uninoculated control plants were excised, fixed and embedded at 5-7 and 12-14 days after inoculation in three experiments. All strains induced pinwheel inclusions that appeared at the cell walls first and in cytoplasmic masses later. Membrane-bound bundles of fibrous strands and/or cytoplasmic inclusions with a densely stained matrix were induced by infection with some strains. Based on the morphology of the pinwheels, the strains were divided into three groups: those that formed 1) predominantly or only sheet laminations (SCMV-A,B,D,K); 2) circular laminations (SCMV-H, I); and 3) both circular and sheet laminations (SCMV-E).

RELATIONSHIP OF LESION DEVELOPMENT TO DISEASE PROGRESS, A MORE GENERAL MODEL FOR COMPOUND-INTEREST DISEASE. F.V. Hebard, Dept of Plant Path & Physiol, VPI&SU, Blacksburg, VA, 24061.

The effect on disease progress of changes in sporulation intensity per lesion with lesion age has not been specified in simple models of compound-interest disease. Expressing disease progress with a difference equation, epidemic speed from time t_0 to t_1 is proportional to initial inoculum at time t_0 , $I(t_0)$, times tissue available for infection, $[1-y(t_0)]: (y(t_1)-y(t_0))/(t_1-t_0)=R_{ac} \cdot I(t_0)[1-y(t_0)]$. R_{ac} is the infection rate corrected for latent period, removals, and variation in intensity of sporulation. y is incidence, the number of lesions over maximum potential number of lesions. From time t_1 to t_2 , speed is: $(y(t_2)-y(t_1))/(t_2-t_1)=R_{ac}[I(t_1)+A(t_1)[y(t_1)-y(t_0)]] [1-y(t_1)]$. $A(t_1)[y(t_1)-y(t_0)]$ is the inoculum for lesions of age t_1 . $A(t_1)$ is the rate of sporulation of lesions of age t_1 , and $[y(t_1)-y(t_0)]$ is the incidence of lesions of age t_1 , formed at time t_0 . Generalizing: $(y(t_{n+1})-y(t_n))/(t_{n+1}-t_n)=R_{ac} [I(t_n)+\sum_{i=0}^n A(t_{n-i}) [y(t_i)-y(t_{i-1})]] [1-y(t_n)]$. This equation should be useful in studying the effect of lesion sporulation on disease progress.

IMPROVED INJECTOR DESIGN FOR PRESSURE INJECTING CITRUS TREES WITH TETRACYCLINE. S. L. Hedden¹, R. F. Lee², L. W. Timmer², and L.G. Albrigo², USDA, SEA-AR¹, and University of Florida², Agricultural Research and Education Center, Lake Alfred, FL 33850

Force-fit injectors, 6.35 mm dia., were compared with lag-screw type injectors, 9.53 mm dia., for placement of tetracycline in the outer, active xylem layer of citrus tree tissue. The force-fit stainless steel tubes had plugged ends and six 0.16 mm dia. peripheral holes on flat recessed sides of the injectors. The lag-screw injectors had 2 V-slots along the sides for solution delivery. Force-fit injectors were driven into 5.9 mm drilled holes and lag-screws were turned into pretapped holes. A rubber washer on the injector formed a seal at the bark surface which prevented leakage around the injector at pressures up to 1723 KPa. Tetracycline activity in injected trees was bioassayed using *Bacillus cereus*. Trees treated with force-fit injectors had significantly higher percentages of twigs with activity and larger zones of inhibition than those injected with the lag-screw type injectors at the same conc. of tetracycline. Activity in twigs persisted longer where force-fit injectors were used.

LIPOLYSACCHARIDE-DEFECTIVE MUTANTS OF PSEUDOMONAS SOLANACEARUM. Carol A. Hendrick and Luis Sequeira, Dept. of Plant Pathology, Univ. of Wisconsin-Madison, Madison, WI 53706.

Mutants of a fluidal strain of *Pseudomonas solanacearum* (K60) were selected for resistance to bacteriophages specific for strains with smooth (complete) LPS. Discontinuous SDS-polyacrylamide gel electrophoresis of LPS on 7.5% and 10% gels resolves many bands of varying mobility, suggesting that LPS from all strains is heterogeneous with respect to size. Most mutant strains lose part or all of the slow-moving bands that correspond to smooth LPS; many retain only the fast-moving bands that correspond to rough (incomplete) LPS. Carbohydrate analysis of the LPS of rough mutants indicates a significant reduction in xylose, rhamnose, and N-acetylglucosamine, suggesting that these strains lack part or all of the O-polysaccharide. These LPS-defective mutants do not cause the hypersensitive response in tobacco leaves typical of certain spontaneous rough mutants of *P. solanacearum*, nor do they produce the spreading necrosis typical of the parental strain.

EFFECTS OF MEDIA AND SOIL ENRICHMENT ON ISOLATION OF RHIZOCTONIA SOLANI FROM SOIL. L. J. Herr, Department of Plant Pathology, Ohio Agric. Res. and Dev. Ctr., Wooster, OH 44691.

To facilitate investigations of *R. solani* populations in soils with low propagule densities, six plating media [2% water agar (WA), WA+antibiotics (WA+ab), nitrite-gallic acid, low sucrose-nitrate (L-SN), medium-SN and high-SN] and soil enrichment [soil amended with 0.5% w/w sugarbeet pulp (BPA), incubation 1 wk, debris plated on WA+ab] were compared using the soil debris isolation method. Two sandy loam soils of low *R. solani* propagule densities and one of high propagule density were assayed. Among media no differences (P<.05) were found in numbers of *R. solani* colonies isolated. Soil enrichment resulted in isolation of 3.7-16.9 times as many colonies of *R. solani* as were found in unamended soils plated on the same medium. Because colony counts of unamended soils did not increase with increased nutrient content of media, it appears all isolated propagules capable of growth do so, even on WA. Apparently BPA caused a saprophytic increase in *R. solani* propagules in soil prior to assay.

OCCURRENCE OF ALTERNARIA HELIANTHI ON SUNFLOWER IN OHIO. L. J. Herr and P. E. Lipps, Department of Plant Pathology, Ohio Agricultural Research and Development Center, Wooster, OH 44691

A new leaf and stem spot disease of sunflower, caused by *Alternaria helianthi* (Hansf.) Tub. and Nish., was found in Ohio during 1980. Severely affected sunflower were defoliated and frequently exhibited lodging. Leaf spots have dark brown margins with grey centers, ranging from several mm to 1.5 cm in diam. Stem lesions start as black flecks or streaks, enlarging later to cover large areas of the stem. Isolations were made directly from sporulating lesions by transferring the characteristic spores to 2% water agar. *A. helianthi* conidia are cylindrical, non-beaked and borne singly (av. size 100 X 25 μ m). *A. helianthi* was highly virulent, killing plants at high spore concentrations (15,000/ml). Seeds of three of 11 cultivars tested were infested with *A. helianthi*. Apparently, infested

seed was the source of inoculum for the disease outbreak in Ohio.

PURIFICATION OF BEET WESTERN YELLOWS VIRUS. Adrianna D. Hewings and Cleora J. D'Arcy, Department of Plant Pathology, University of Illinois, Urbana, IL 61801

To maximize yields of beet western yellows virus (BWV) different host plants and purification methods were studied. Purifications from *Crambe abyssinica* and an IL biotype of *Capsella bursa-pastoris* gave low yields. No clean BWV was obtained from endive, lettuce or Chinese cabbage. *Thlaspi arvense* and a CA biotype of *C. bursa-pastoris* yielded clean BWV; the latter was selected for further investigation. Seeds sown in flats were induced to germinate with .2M KNO₃. Three week old seedlings were inoculated for 3 days in a growth chamber and returned to the greenhouse for symptom development. Time of harvest trials indicated that yields in excess of 1.3 mg/kg could be obtained from tissue harvested 14-25 days post-inoculation. BWV was extracted by grinding fresh or frozen tissue to a fine powder in excess liquid N₂. Triton and chloroform clarification was more effective than PEG. *Myzus persicae* transmitted BWV after being fed purified virus through a Parafilm membrane.

LIGNIN AND CARBOHYDRATE REMOVAL FROM WOOD BY HEARTROT AND SAPROT FUNGI AFFECTED BY OXYGEN. J. L. Highley, S. Bar-Lev, and T. K. Kirk. Forest Products Laboratory, P.O. Box 5130, Madison, Wisconsin 53705.

The rate of lignin and carbohydrate removal in wood by heartrot and saprot fungi under low and high O₂ concentrations was studied to determine whether heartrot fungi possess ligninolytic and cellulolytic systems tolerant of low O₂ levels. Lignin and carbohydrate removal from wood by both saprot and heartrot fungi was decreased by subatmospheric O₂ levels. Thus, although heartrot fungi decay heartwood in living trees at O₂ levels considerably less than atmospheric, they do not possess a unique ability to decompose wood at the low levels. Differences, however, in carbohydrate/lignin (C/L) ratios between the two types of decay fungi indicate that their lignin- and/or polysaccharide-degrading systems respond differently to low O₂. The saprot fungi were more selective in lignin removal than the heartrot fungi, and their C/L ratios increased with increasing O₂ concentrations; C/L ratios of the heartrots remained rather constant with increasing O₂.

INITIAL RELEASE OF PERONOSPORA DESTRUCTOR SPORES IN ONION FIELD PLOTS. P.D. Hildebrand and J.C. Sutton, Dept. of Environmental Biology, University of Guelph, Guelph, Ontario, N1G 2W1, Canada.

Weather variables were monitored in onion plots inoculated with *P. destructor*. Atmospheric water potentials (ψ) and temperature were measured with aspirated wet and dry thermistors, irradiance with an Eppley Pyranometer, wind speed with a cup anemometer, and leaf wetness with electrical impedance grids. Airborne spores were quantified with a Kramer-Collins 7 day sampler. When spore counts were high (789-2082 spores/day), initial spores (5-230 spores/hr) were trapped at 0600-0700 hours E.S.T. Initial release did not coincide with changes in wind speeds, which remained low (≤ 0.64 m/sec) or with ψ which remained at or near saturation (0 to -15 bars). However, initial release did coincide with increasing irradiance in the range of 15 to 333 W/m². Initial release possibly was related to spore maturity and to infra-red (IR) radiation at sunrise (Leach, C. M. Phytopathology 70: 192-196). Massive release (101-626 spores/hr) occurred between 0700-0900 hours when ψ first increased from near saturation.

MICROFLORA OF FIELD CORN. R. A. Hill, D. M. Wilson, N. W. Widstrom and W. W. McMillan. University of Georgia and USDA Coastal Plain Experiment Station, Tifton, GA 31793.

Numbers and kinds of microfungi that colonize ears of corn grown in southern Georgia from silking to harvest and associations among species were determined with emphasis on aspergilli and penicillia. Microorganisms isolated included *Aspergillus* spp., predominantly the *A. flavus* group; *Penicillium* spp., most often *P. funiculosum*; *Fusarium* spp., primarily *F. moniliforme*; species of *Alternaria*, *Aureobasidium*, *Cladosporium*, *Epicoccum*, *Helminthosporium*, *Paeclomyces*, yeasts, actinomycetes and bacteria. *A. flavus* incidence in 1978 increased from < 1% of kernels colonized at full silk to between 50 and 90%, 60 days after full silk. Colonization was not influenced by planting date, treatment with insecticide spray, or insect infestation. The pattern of colonization by *A. flavus* in 1979 was similar to 1978 but the incidence of *A. flavus* was less, especially for early planted corn, with < 30% kernels colonized 60 days after full silk. Aflatoxin production was not affected by treatment or planting date in 1978 or 1979.

COMPARISON OF CHRONIC BEE PARALYSIS VIRUS TO SEVERAL MULTI-COMPONENT PLANT VIRUSES. B. Hillman and T.J. Morris, Plant Pathology Department, U.C. Berkeley, Berkeley, Ca. 94720. Chronic bee paralysis virus (CBPV) is a single stranded RNA virus which attacks the honeybee (*Apis mellifera*) causing paralysis and often death. Superficial similarities between CBPV and heterocapsidic multicomponent plant viruses such as alfalfa mosaic virus (AMV) have been noted by several authors, but direct comparisons have not been carried out. We report such a comparison of sedimentation coefficients, electrophoretic mobilities, buoyant densities, capsid proteins, virion RNAs, and replicative form RNAs with AMV, tobacco streak virus (TSV),

and raspberry bushy dwarf virus (RBDV). CBPV is strikingly similar to these plant viruses; of particular note is the finding of at least three and possibly four virion RNAs as well as three and possibly four replicative form RNAs. Each of the plant viruses chosen for comparison is known to be pollen transmitted and CBPV infected colonies show high virus titers in their pollen, suggesting a possible epidemiological link to these systems.

SURVIVAL, ESTABLISHMENT, AND DISPERSAL OF PSEUDOMONAS SYRINGAE ON SNAP BEANS (PHASEOLUS VULGARIS L.). S. S. Hirano, S. J. Demars and C. E. Morris, Department of Plant Pathology, University of Wisconsin, Madison, WI 53706

A rifampicin-resistant mutant (R10) of a pathogenic *P. syringae* strain (bacterial brown spot) was applied to 4 plots (400, 200, 100 and 50 m²) of snap beans 3 wk after planting. Each plot was centered in a quadrant of a bean field 90 m x 90 m. From an initial population of $\approx 10^7$ cfu/gm fr wt, R10 decreased 10-fold by 6 hr after application, 100-fold by 24 hr (to the approximate level of total populations on unsprayed plants), and 1000-fold by 2 wk. At 2 wk, R10 ranged from 0.4 to 100% (mean of 16%) of the total bacterial population on each of 25 leaflets. After 3 wk, populations of R10 stopped declining and increased. At 5 wk, the mean log R10 population was 6.5 cfu/gm fr wt, with R10 comprising, on the average, 10% of the total population on individual leaflets. From 6 to 10 wk after application, R10 was detected on 99 of 100 leaflets and 29 of 30 mature pods, usually at levels much less than 1% of the total epiphytic population. R10 was found on imprints of leaves and pods taken from all parts of the field.

EPIPHYTIC ICE NUCLEATION ACTIVE (INA) BACTERIAL POPULATIONS IN RELATION TO HALO BLIGHT INCIDENCE IN OATS. S. S. Hirano, D. I. Rouse, D. C. Army, E. V. Nordheim*, and C. D. Upper#, Depts. of Plant Pathology, *Forestry and Statistics, and #AR, SEA, USDA, University of Wisconsin, Madison, WI 53706.

The ice nucleation activity of *Pseudomonas syringae* pv. *corona-faciens* was used to estimate the frequency with which high populations of the pathogen occurred on individual leaves of 5 varieties of oats planted in experimental plots. At weekly intervals starting on May 20, 25 days after planting (DAP), 90 leaves per variety were sequentially subjected to -2.5, -3.0, and -4.0 C. Leaves that froze at relatively high nucleation temperatures (NT \geq -2.5 C) generally had higher populations of INA bacteria than did leaves with lower nucleation temperatures, as determined by washing and dilution plating. The frequency with which INA bacterial populations exceeded 10^4 cfu on individual leaves was 70% for leaves with NT \geq -2.5 C, but only 5% for leaves with -2.5 C > NT \geq -3.0 C. At 42 DAP, the frequency with which leaves froze at -2.5 C for each of the 5 varieties was highly predictive of the amount of halo blight 11 days later ($r^2=0.94$, $r=0.97$, $p<.01$).

SPRING DORMANCY OF TILLETIA CONTROVERSA TELIOSPORES. J. A. Hoffmann and B. J. Goates, USDA-SEA-AR, Logan, UT 84322.

Dwarf bunt, caused by *Tilletia controversa*, has not been observed in spring-sown wheat even though weather conditions in spring occasionally are favorable for teliospore germination and infection. Teliospores from bunted wheat heads on soil in the field were collected monthly for 1-3 years and tested for germinability in the laboratory. Teliospores collected in July through January germinated in maximal amounts (75-95%). Those collected in February, May, and June germinated in moderate amounts (35-65%), whereas those collected in March and April germinated in amounts ranging from a trace to <10%. Teliospores kept in the laboratory germinated in near-maximal amounts throughout the year. These results indicate that teliospores in nature become dormant in spring which may account for the lack of infection in spring-sown wheat. Preliminary studies suggest that teliospore dormancy is induced by protracted cool (<5 C), moist conditions and is broken by a period of warm, dry conditions.

THE ROLE OF PHYTOALEXINS IN RESISTANCE OF SOYBEAN TO BACTERIA AND FUNGI--INHIBITION OF GLYCEOLLIN SYNTHESIS BY GLYPHOSATE. M. J. Holliday and N. T. Keen, Dept. of Plant Pathology, University of California, Riverside, CA 92521.

The herbicide glyphosate inhibited glyceollin synthesis in soybean leaves inoculated with *Pseudomonas syringae* pv. *glycinea* (Psg) or hypocotyls inoculated with *Phytophthora megasperma* f.sp. *glycinea* (Pmg). Glyphosate has recently been shown to inhibit the synthesis of chorisamate. Cell populations of Psg in incompatible leaves treated with glyphosate were two-fold higher than in untreated leaves, but not 10-fold higher as in compatible-reacting leaves. Thus, inhibition of glyceollin only partially prevented resistance to Psg. In contrast, glyphosate inhibition of glyceollin completely prevented resistance expression in hypocotyls to Pmg. Pretreatment with phenylalanine restored glyceollin synthesis ability in glyphosate treated plants, resulting in complete expression of resistance to Psg or Pmg. The results suggest that glyceollin accumulation is the major mechanism of resistance to Pmg and is a component, but not the only determinant of resistance to Psg.

EFFECT OF TEMPERATURE AND RELATIVE HUMIDITY ON GERMINABILITY AND INFECTIVITY OF PUCCINIA POLYSORA UREDOSPORES. C. A. Hollier and S. B. King, Dept. Plant Path. and Weed Sci. and USDA-SEA-AR, respectively, Miss. State Univ., Mississippi State, MS 39762.

Uredospores of *P. polysora* were maintained at temperatures from 4 to 36C at 4° increments and at 4 relative humidities (15,35,

65,95%) for 1,3,7,28 and 56 days after which germinability and infectivity were evaluated. After treatment, germination was determined following 24 hr incubation on water agar. Optimum temperature for germination generally ranged from 12-20C throughout the testing period, regardless of relative humidity (RH). Germination was always drastically reduced at 4 and 8C. As time increased, germinability decreased most rapidly at high temperatures and high RH. Germinability was generally best maintained at 15 and 35% RH, regardless of temperature. Germination decreased from 78-86% at all RH's at day 1 to 35% at 15% RH, 27% at 35% RH and 0% at 65 and 95% RH by day 56. Infectivity, determined by inoculation of excised corn leaf tissue floated on a kinetin/sucrose solution, followed a pattern similar to that of germinability.

NEMATODE-COMPUTER COMPARISONS. J. P. Hollis, Dept. Plant Path. & Crop Physiol., La. State Univ. Agric. Expt. Sta., Baton Rouge, LA 70803.

Small nematodes offer a unique miniaturization model on basis of 1024 cells (entelous condition) and $\approx 10^9$ functions (genes) per cell compared with theoretical (10^9) bits of information on 4 mm diameter (megabit) silicon chips. Nematodes are essentials which feature integrated ultra-miniaturized memory (central genome), power supply (respiratory system) and central processing unit (nervous system) distributed among 1024 cells; memory controlled by billions of years of cumulative programming, responding actively (output) to input and electron transmission supplemented by ions, neurotransmitters and chemical messengers. Nematode output is both tropistic (behavior and movement) and endogenous (ingestion, digestion, cellular activities, respiration and defecation). Computers are cultural existents which feature exogenous power supply, separate or detachable input, memory, central processing and output devices; all are controlled by a separate existent and feature passive input, output, both retention and destruction of individual cell memory contents by new input and circuits transmitting electrons only.

NEMATODES--BIODETECTORS OF CHEMICAL POLLUTION AND EXTRATERRESTRIAL LIFE. J. P. Hollis, Dept. Plant Path. & Crop Physiol., La. State Univ. Agric. Expt. Sta., Baton Rouge, LA 70803.

Both environmental closure (realization that earth is a delicate, closed ecological system) and environmental opening (realization that earth is infinitesimal part of cosmos) focus attention on nematodes with their unique characteristics of morphological complexity, eutely, resistance to radiation, dormancy, extremely diverse affinities with microbial ecosystems and the ease with which they can be extracted and quantified wherever water occurs. The position of free-living forms just above microorganisms in the food chain (Phytopath. 47: 468-473, 1957) provides means for concentration, quantification and determination from nematode samples of pollutant chemicals intercepted by bacteria, fungi, algae and protozoa, in comparison with ambient soil and water pollution. Likewise, plant parasitic nematodes can be analyzed for substances removed from higher plants (Phytopath. 58: 725, 1968). Finally, nematodes can be used in space probe landings in search for extraterrestrial microorganisms, and nematodes, by comparing movement signals supplied by introduced and indigenous forms.

NEMATODES IN COMPUTER DESIGN. J. P. Hollis, Dept. Plant Path. & Crop Physiol., La. State Univ. Agric. Expt. Sta., Baton Rouge, LA 70803.

Computer-programming has developed through improvement of input software devices such as compilers which translate programming languages into the machine language of numbers that the computer understands. The Mead-Conway principle provides that a designer write a computer program that sets out what a central processing unit circuit is supposed to do. The computer then draws the circuit blueprint for design of a new computer (hardware). The use of nematode behavior summarized by Croll (Chap. 12, p. 343-363 in "The organization of nematodes," N. A. Croll, ed., Acad. Press, 1976) in circuit design on the Mead-Conway principle is indicated with respect to attraction/repulsion to specific chemical concentration gradients (Proc. Helminthol. Soc. Wash. 39: 5-6, 1972); thus loops and alternate decision algorithms will have natural (unprogrammed) terminals based on numbers understood by both nematodes and computers. The use of nematodes in simulation experiments for writing programs is seen as a way to design computers with more flexible capacity to interpret high level languages.

A STANDARDIZED METHOD OF RATING THE REACTION OF BARLEY TO PYRENOPHORA TERES. M. G. Holtmeyer and R. K. Webster, Department of Plant Pathology, University of California, Davis, CA 95616.

Pyrenophora teres (Drechslera teres) causes net blotch of barley. Previous workers have evaluated the seedling reaction of barley to *D. teres* by a number of rating scales. Comparison of data from these is often difficult because of varying criteria. In the course of evaluating numerous single spore isolates for reaction on differential barley varieties, several infection types were seen which could not be satisfactorily classified using existing rating scales. A new system, including categories for 13 infection types, is proposed. This system considers size of lesions, extent of netting, degree of chlorosis and necrosis, and collapse of leaf. Categories are as specific as possible to ensure accuracy and repeatability and to enable comparison with results of other studies when used with a standardized inoculation technique. The use of this system will hopefully lead to a standardization of future work with *D. teres*.

EFFECT OF FUNGICIDES AND TEMPERATURE ON IN VITRO GROWTH OF GEOTRICHUM CANDIDUM, PENICILLIUM DIGITATUM AND P. ITALICUM. L. G. Houck, USDA, SEA/AR, P.O. Box 8143, Fresno, CA 93747

Growth of *G. candidum*, incitant of lemon sour rot, was prevented at 5 C and averaged 0.36, 0.69, 1.04 and 1.25 mm/hr at 10, 15, 20 and 25 C, respectively, during 7 days on PDA. Citrus post-harvest fungicides thiabendazole (TBZ), benomyl, 2-aminobutane (ZAB), borax-boric acid and soda ash incorporated into media at 5 to 500 ppm, or biphenyl in the atmosphere, did not effectively restrict growth of *G. candidum*. Sodium o-phenylphenate (SOPP) and imazalil were not effective at 10 ppm but reduced growth by one-half at 100 ppm and stopped it at 500 ppm. Imazalil, TBZ and benomyl prevented growth, ZAB, SOPP and biphenyl reduced it, and soda ash and borax-boric acid had only a slight effect on growth of *P. digitatum* (green mold) and *P. italicum* (blue mold) in vitro. Low temperature reduced growth of these *Penicillia* as effectively as that of *G. candidum*. No interaction was noted between cold temperatures and fungicides.

ANTHER AND PISTIL BLIGHT OF STRAWBERRY BLOSSOMS CAUSED BY A RHIZOCTONIA SP. C. M. Howard and E. E. Albrechts, University of Florida, Agr. Research Center, Rt. 2, Box 157, Dover, FL 33527.

For several years we have encountered a condition of potted strawberry plants in the greenhouse, and occasionally of plants in the field, in which the anthers of some flowers are black and the pistils are abnormal or totally destroyed. Isolations from these blossoms failed to consistently yield any specific microorganism. Observations revealed that affected flowers could usually be detected by the presence of a pink color or brown necrotic spot on the petals of buds several days before they opened. Isolations from anthers or pistils of these buds yielded a *Rhizoctonia* sp. Flower buds were inoculated with the *Rhizoctonia* sp. by placing 2 mm squares of potato dextrose agar on which the mycelium was growing under the sepals. The plants were enclosed in plastic bags for 3 days. As these flowers opened, all had brown necrotic spots where the inoculum was in contact with the petals, all but one had black anthers, and 50% had pistil destruction. *Rhizoctonia* was reisolated from the affected flowers.

INFLUENCE OF IRRIGATION SEQUENCES ON INFECTION OF GREEN TOMATO FRUIT BY PHYTOPHTHORA PARASITICA. M.W. HOY, J.M. Ogawa, and J.M. Duniway, Dept. of Pl. Path., Univ. of Calif., Davis 95616.

Infested field soil was sampled from the surface of furrows 3 and 28 days after irrigation. Samples were flooded and release of *P. parasitica* zoospores was detected by infections of green cherry tomatoes floated as a trap over the soils. Zoospores were released 15 minutes after flooding the moister soil, which averaged -1.9 bars soil water potential (Ψ), but were not released until 2 hrs after flooding the drier soil, which averaged -219 bars Ψ . Incidence of fruit infection increased rapidly in the moist soil, reaching 100% after 16 hrs, but never exceeded 10% after flooding the drier soil. In the field, tomatoes lying in recently irrigated furrows were infected within 2 hrs after the onset of irrigation, and the incidence of disease increased rapidly to 91%. In furrows not irrigated for 25 days, there were no infections until 7 hrs after an irrigation began and the incidence of disease never exceeded 25%. Apparently more zoospores are released promptly if the soil has not dried extensively.

A NEWLY RECOGNIZED VIRUS IN 'TENDERGREEN' MUSTARD (BRASSICA CAPESTRIS). II. CHARACTERIZATION. H. T. Hsu, ATCC, Rockville, MD 20852; E. L. Civerolo, and R. H. Lawson, USDA, SEA, AR, Beltsville, MD 20705.

The virus from apparently healthy 'Tendergreen' mustard was characterized by density gradient and analytical centrifugation, polyacrylamide gel electrophoresis and electron microscopy. Following rate zonal sedimentation in linear and linear-log sucrose and equilibrium density gradient centrifugation in CsCl, the distribution of the virus was polydisperse. However, one major, slower-sedimenting and one minor, faster-sedimenting zone were apparent. Virions from both zones ranged from 28 to 39.2 nm in diameter. However, most of the virions measured 33.6 nm in the slower sedimenting zone and 33.6 to 36.4 nm in the more rapidly sedimenting zone. The sedimentation coefficient of the major component was 83 S. Approximately 16 components of intact virus were resolved in 3% polyacrylamide gels. Infectious nucleic acid preparations were resolved into multiple electrophoretic components. The virus contains a major polypeptide of about 28,000 d.

A NEWLY RECOGNIZED VIRUS IN 'TENDERGREEN' MUSTARD (BRASSICA CAPESTRIS). I. DETECTION, HOST RANGE, TRANSMISSION, PURIFICATION, AND SEROLOGY. H. T. Hsu, ATCC, Rockville, MD 20852; R. H. Lawson, E. L. Civerolo, USDA, SEA, AR, Beltsville, MD 20705; and H. E. Waterworth, USDA, SEA, AR, Glen Dale, MD 20769.

A virus was detected in apparently healthy 'Tendergreen' mustard (*B. campestris*). The virus was purified from inoculated *B. campestris* leaves in 0.1 M phosphate, pH 7.0, followed by clarification with 8% butanol, precipitation with 10% PEG and 0.05 M NaCl, and sucrose density gradient centrifugation. Among 62 genera in 28 families, only *B. campestris* and *B. pekinensis* were infected by mechanical inoculation. No apparent symptoms developed in either species. Seed transmission rate was 40-90% in experimental and 1% in commercial *B. campestris* seed. Antiserum of 1/512 to 1/1024 titer was prepared. Viral antigen was readily detected by immune

electron microscopy and Ouchterlony double diffusion (ODD) tests in infected plants or seeds collected from infected plants. In ODD tests the virus did not react with antisera to 30 described polyhedral viruses.

COMPARATIVE VIRUS CONTENT OF SOYBEAN CULTIVARS INOCULATED WITH SOYBEAN MOSAIC VIRUS. C. H. Huang, R. M. Lister, T. S. Abney, and G. Shaner, Purdue University and USDA, SEA, W. Lafayette, Indiana 47907.

Leaf samples were systematically collected at weekly intervals during July, August, and September from field-grown plants of several soybean cultivars hand-inoculated with soybean mosaic virus (SMV - "Midwest" strain). Comparison of the virus content of samples by ELISA indicated statistically significant differences, by which the cultivars could be ranked with respect to virus accumulation. These rankings were confirmed in similar experiments with plants grown in the greenhouse or in a growth chamber for only three weeks. In these experiments, there was substantial agreement between the results from the inoculated (primary) leaves and systemically infected (compound) leaves. This suggests that the selection of cultivars resistant to SMV accumulation in the field could be based simply on short-term greenhouse or growth chamber experiments. However, experiments with another strain of SMV indicated a different ranking of cultivars with respect to virus accumulation.

SUPPRESSION OF BINDING OF RHIZOBIUM JAPONICUM ON SOYBEAN ROOTS BY HETERODERA GLYCINES. J. S. Huang and K. R. Barker, Department of Plant Pathology, North Carolina State University, Raleigh, NC 27650.

Soybean seeds 'Ransom' were germinated in vermiculite for 5 days, and the seedlings were transplanted to Styrofoam cups containing 150 cm³ of 65-mesh silica sand and 0, 500, 2,500 or 12,500 juveniles of race 1 of the soybean cyst nematode, *Heterodera glycines*. Soybean roots were harvested 3 days later and incubated with a suspension of *Rhizobium japonicum* strain 61A76 prepared from a 4-day old culture grown in a synthetic medium containing D-³H-glucose. After washing, the roots were digested, and the radioactivity was measured. Roots from cyst nematode-inoculated seedlings had lower radioactivity as compared to those from controls on a per root or per unit root weight basis. Binding of *R. japonicum* to control soybean roots also was inhibited by pretreatment of roots with D-galactose or N-acetyl-D-galactosamine, the haptens of soybean lectin (SBL). These results suggest that SBL is involved in binding *R. japonicum* to soybean roots, and that the soybean cyst nematode infection suppresses the binding between these roots and *R. japonicum*.

MANAGING ORGANIC FERTILIZERS TO MINIMIZE PREDISPOSITION TO SOIL-BORNE DISEASE. Huber, D.M., H.L. Warren, R.A. McCormick, D.W. Nelson, and C.Y. Tsai. Purdue Univ., W. Lafayette, IN. 47907.

This research evaluated the effect of inhibiting nitrification of liquid swine manure at 31 and 62 mt/ha applied in the fall or spring on corn stalk rot caused by *Gibberella zeae*. Corn yields were increased 62% by inhibiting nitrification of fall-applied manure and 7% with spring-applied manure. Stalk rot was more severe on plants receiving spring (64% stalk rot) than fall-applied manure (45%). Unfertilized, N-deficient plants had 32% stalk rot. Inhibiting nitrification of fall and spring-applied manure with nitrapyrin markedly reduced stalk rot (20%). Stalk rot increased as the rate of manure increased unless nitrification was inhibited. Soil and tissue analyses indicate the pre-disposition of corn to stalk rot by organic fertilizers is the result of stimulated nitrification and plant uptake of a preponderance of nitrate nitrogen. Use of a nitrification inhibitor with organic fertilizers improves their nutrient value and reduces predisposition to disease.

SELECTING FIELD RESISTANT SLASH PINE FAMILIES THROUGH GREENHOUSE INOCULATION. S. D. Hubbard, C. H. Walkinshaw, and R. L. Anderson, USDA Forest Service, Forest Pest Management, Asheville, NC 28813 (SDH & RLA), and Southern Forest Experiment Station, Gulfport, MS 39503.

Results from greenhouse inoculation tests can be used to indirectly select slash pine families with field resistance to fusiform rust caused by *Cronartium quercuum* f. *fusiforme*. This is currently done at the Resistance Screening Center in Asheville, NC. Reduction of disease in field plantings of selected families is directly proportional to the correlation between greenhouse and field progeny tests. Eight symptom types expressed by greenhouse inoculated seedlings were correlated with a measure of field resistance for 30 slash pine families. The "best" combination of symptom types chosen using regression techniques ($r=.80$) was better than the currently used symptom type, percent galled ($r=.44$). Four forms of a selection index were evaluated for use in predicting relative field resistance. One index ($r=.79$) is recommended for immediate application at the Resistance Screening Center.

USE OF HEMICELLULOSE WASTE AND UREA FOR CONTROL OF PLANT PARASITIC NEMATODES. A. Huebner and R. Rodriguez-Kabana. Dept. of Botany, Plant Pathology, and Microbiology, Auburn University, 36849.

The effect of the addition of hemicellulosic paper-mill waste (HW) and urea on plant parasitic nematodes was studied in greenhouse experiments with Ransom soybeans in a silt loam. Addition of urea alone to the soil in the range of 0-1.0g N/kg soil resulted in declines in numbers of plant parasitic nematodes; however, the plants either died or showed marked phytotoxicity. When HW (32 g/kg soil) was mixed with urea, nematode numbers

declined as with urea alone but the plants in soil with up to 0.6g N showed good growth. The addition of HW alone had little effect on nematodes. Values for pH, urease activity, and $\text{NH}_4\text{-N}$ in soil samples 2 wk after initiation of the experiment increased directly in response to urea concentration. When HW was added, a similar trend was evident but values for the variables were generally higher. $\text{NO}_3\text{-N}$ was highest in soil that received 0.2g urea N/kg. Results show that the addition of HW provides an oxidizable carbon source for removal of excess N in the soil by microorganisms.

ULTRASTRUCTURAL COMPARISON OF FOUR SOYBEAN MOSAIC VIRUS STRAINS. P. L. Hunsat and S. A. Tolin, Department of Plant Pathology & Physiology, Virginia Polytechnic Institute & State University, Blacksburg, Virginia 24061.

Two Virginia isolates of soybean mosaic virus (SMV), VA and OCM, were classified as G1 and G3 strains, respectively, according to the soybean differential cultivar system of Cho & Goodman (Phytopath. 69: 467-470). These strains were compared ultra-structurally to two Illinois cultures, a G1 strain (Isolate 019-2) and a G3 strain (Isolate 83-2), obtained from R.M. Goodman (Univ. Ill.). G1/VA induced numerous scroll-type pinwheels within the cytoplasm of infected cells whereas G1/Il-019-2 induced scroll-type pinwheels and cytoplasmic strands. G3/OCM and G3/Il-83-2 both induced few scroll-type pinwheels and numerous cytoplasmic strands within infected cells. G3/OCM, G1/Il-019-2 and G3/Il-83-2 induced mild macroscopic symptoms and G1/VA induced more severe symptoms on susceptible soybean cultivars. Cytoplasmic strand development is believed to be correlated with severity of symptoms induced.

THE EFFECT OF PLASMID pCG131 ON THE OUTER MEMBRANE PROTEIN COMPOSITION OF PSEUDOMONAS SYRINGAE HS191. R. H. Hurlbert and D. C. Gross, Dept. of Bacteriology & Public Health and Dept. of Plant Pathology, Washington State University, Pullman, WA 99164.

Outer membrane (OM) was isolated from *Pseudomonas syringae* HS191, a strain causing holcous spot of corn. OM preparations were enriched in hexosamine and 2-keto-3-deoxyoctonate, and contained only 16 and 18 percent of the cytoplasmic enzymes NADH oxidase and malate dehydrogenase, respectively. Analysis of the OM protein composition by SDS-polyacrylamide gel electrophoresis and isoelectric focusing showed a minimum of 22 proteins. Seven of these proteins could be modified either by heat, 2-mercaptoethanol, or both. The OM protein composition of strain HS191, which contains plasmid pCG131, was compared to that of its plasmidless derivatives, PSG100 (virulent) and A0111 (avirulent). Only one OM protein appeared to be genetically coded by plasmid pCG131. However, pCG131 appeared to repress the synthesis of several proteins in the OM of HS191 since both plasmidless strains had additional OM proteins. No association was observed between virulence and specific changes in OM protein composition.

CELL WALL APPPOSITIONS AND PLANT DISEASE RESISTANCE: SUBCELLULAR SITES OF FUNCTIONAL PEROXIDASES ASSOCIATED WITH KOHLRABI WOUND PLUGS. H. W. Israel, J. R. Aist and S. J. Bucci, Department of Plant Pathology, Cornell University, Ithaca, New York 14853.

Mechanically induced wall appositions in kohlrabi root hairs effectively block penetrations by *Olpidium brassicae*. The nature of this resistance is unknown, but phenolic derivatives may play a role. Since peroxidases have been implicated in the metabolic generation of some of the derivatives, 3,3'-diaminobenzidine, which yields osmiophilic products upon reaction with peroxidases, was used to locate enzyme activity, by transmission electron microscopy, in host cells forming wound plugs. Reaction product was localized in cortical regions of the wound plugs as well as in the endoplasmic reticulum and the dictyosome stacks and vesicles typically abundant in adjacent cytoplasmic aggregates. Elevated, localized peroxidatic activity, coupled with appropriate substrates and the exocytosis of wound plug deposition, could accumulate lignins or fungi-toxic quinones in the appositions. Further work should indicate whether or not these provisional concepts are valid.

LENGTH OF PROTECTIVE ACTIVITY OF CGA-64251 FOR CONTROL OF BROWN ROT BLOSSOM BLIGHT IN STONE FRUIT. J. Van Geluwe, J. R. James, and W. E. Davidson, AG Division, CIBA-GEIGY Corp., Greensboro, NC

CGA-64251 (1-[2-(2,4-Dichlorophenyl)-4-ethyl-1,3 dioxolan-2-yl]methyl)-1H-1,2,4-triazole), was applied with an airblast sprayer (480 L/HA) at rates of 20 g ai/HA to 'Tilton', 'Blenheim' and 'Moorpark' apricots, 'Santa Rosa' plums, and 'Summercrest' peaches. Fungicide applications were initiated at daily intervals beginning 7 days prior to bloom. At full bloom, 4 replications of 25 blossoms for each variety were brought into the laboratory and misted with a spore suspension of *Monilinia fructicola* (10,000 spores/ml). Blossoms were incubated at 20°C for 72 hrs. and rated for percent infected blossoms. Under heavy disease pressure CGA-64251 provided effective ($P = 0.01$) disease control when applied up to 5 days prior to bloom. Mean percent infected blossoms among varieties is the 5, 6, and 7 day treatments were 17.5, 33.3 and 51.7, respectively, compared to 69.2% in the untreated check. These results indicate that CGA-64251 provides up to 5 days protective activity when applied prebloom to stone fruit.

THE POTENTIAL FOR ADAPTATION OF PHYTOPHTHORA INFESTANS ISOLATES TO POTATO CULTIVARS WITH RATE-REDUCING RESISTANCE. R. V. James and W. E. Fry, Department of Plant Pathology, Cornell University, Ithaca, NY 14853.

Long-term use of cultivars with rate-reducing resistance would be endangered if *Phytophthora infestans* isolates can adapt strongly to such cultivars. We tested whether such adaptation occurred with one isolate of *P. infestans* race 1234 on plants of two potato cultivars, Sebago (resistant) and Norchip (susceptible). Sporangia from each cultivar were reinoculated to that cultivar. After 15 passages, there was no consistent tendency for one isolate, or one isolate-host combination to show increased pathogenicity. We assayed this by measuring infection efficiency and total sporulation. The potential of natural and mutagenized populations to adapt to these and other cultivars, with different levels of rate-reducing resistance, will be studied to assess if adaptation of sufficient magnitude to endanger long-term use of such cultivars occurs.

SEPTORIA LEAFSPOT OF PROCESSING TOMATO CONTROLLED BY SPRAY SCHEMULES PRODUCED BY THE EARLY BLIGHT FORECASTING SYSTEM (FAST). S. F. Jenkins, Jr. Dept. of Plant Pathology, North Carolina State University, Raleigh, NC 27650.

A forecasting system for *Alternaria solani* on tomato (FAST) was used during early and late summer plantings both in 1979 and 1980 on the processing tomato cv. 'Dorchester' at Clinton, NC. The predominant foliar disease in all four plantings was *Septoria lycopersici*. The 1979 treatments consisted of no spray (OD), 7-day (7D) and according to FAST. In 1980, 7D was replaced by 5-day (5D) treatment. The fungicide chlorothalonil was used at the rate of 1.3 lb a.i./100 gal. In 1979, 6 sprays of chlorothalonil were applied at 1.3 lb a.i./100 gal to 7D early planting, 5 sprays to 7D late and 3 sprays each to FAST early and FAST late. In 1980, 8 sprays were applied to 5D early, 7 sprays to 5D late, 4 sprays to early FAST and 3 sprays to late FAST. In the four plantings FAST was statistically equal to 5D and superior to 7D in controlling *Septoria* leafspot. The amount of disease in OD was significantly higher ($p = 0.01$) than 5D, 7D and OD in all plantings.

USE OF CHLORINE TO SUPPRESS ROOT INFECTING PATHOGENS OF VEGETABLES GROWING IN RECIRCULATING HYDROPONIC SYSTEMS. S. F. Jenkins, Jr. Dept. of Plant Pathology, North Carolina State University, Raleigh, NC 27650.

Pseudomonas solanacearum, *Pythium aphanidermatum*, and *P. myriotylum* on tomato and *P. aphanidermatum* and *P. myriotylum* on cucumber are highly contagious destructive pathogens when introduced into greenhouse recirculating hydroponic systems. Chlorine (Cl) from NaOCl and Ca (OCl)₂ added and maintained continuously at 2.5 to 5 ppm in the nutrient solution suppressed the pathogens and the diseases in tomato and cucumber trough and nutrient film systems with no crop injury. Concentrations of less than 2 ppm were ineffective. At ≥ 10 ppm Cl there was phytotoxicity. Chlorine (100 ppm) was used successfully in recirculating water for one day to sanitize the hydroponic systems following removal of diseased crops.

ESTIMATION OF SPECIFIC RESISTANCE BY REGRESSION ANALYSIS OF DISEASE IN HOST LINES INOCULATED WITH SEVERAL PATHOGEN ISOLATES. A. E. Jenns and K. J. Leonard, Department of Plant Pathology, North Carolina State University, Raleigh, NC 27650.

Analysis of variance is often used to detect specific resistance or virulence among combinations of a series of host lines inoculated with a series of pathogen isolates. Specificity is indicated by a significant line x isolate interaction, but the analysis does not compare the levels of specific resistance in each line. Estimates of levels of specific resistance can be obtained in regressions of disease scores for each line-isolate combination vs. the virulence index of each isolate. In standard stability analyses the virulence index is based on mean disease score for the isolate over all lines. Low slopes and low deviations from the regression are expected to indicate lines with little specific resistance. Using a model of additive gene effects, we found that the amount of specific resistance is better correlated with deviations from regression if virulence indexes are based on disease scores on a single host line selected for least specific resistance.

GENETIC INTERACTIONS BETWEEN INBRED CORN LINES AND ISOLATES OF BIPOLARIS MAYDIS AND COLLETOTRICHUM GRAMINICOLA. A. E. Jenns and K. J. Leonard, Department of Plant Pathology, North Carolina State University, Raleigh, NC 27650.

Ten inbred lines from the open-pollinated corn variety Jarvis were selected from 50 randomly collected lines to represent a wide range of susceptibility to one isolate each of *Bipolaris maydis* or *Colletotrichum graminicola*. Ten isolates of each pathogen were selected for a wide range of virulence on a corn line with average resistance. Resistance and virulence ratings were based on lengths of lesions on leaves of greenhouse-grown seedlings inoculated with 5 μ l droplets of suspensions of known spore concentrations. For each disease the ten corn lines were inoculated in all possible combinations with the ten pathogen isolates. The experiment was run six times with each pathogen. Analysis of variance for individual runs indicated a significant interaction effect for corn lines and *B. maydis* isolates in all runs and for corn lines and *C. graminicola* isolates in four of six runs. For both diseases the combined analysis over all six runs revealed no significant interaction.

HISTOPATHOLOGY OF LONGLEAF PINE NEEDLES INFECTED BY SCIRRHIA ACICOLA (DEARN.) SINGERS. F. F. Jewell, Sr., School of Forestry, Louisiana Tech Univ., Ruston, LA 71272.

Longleaf pine (*Pinus palustris* Mill.) needle tissue infected with *Scirrhia acicola*, the brown-spot needle blight fungus, was examined. Tissue samples bearing typical bar-spot lesions and others having a yellow bank-type lesion were fixed, embedded in paraffin, sectioned by rotary microtome, stained by an orceillin BB-aniline blue schedule, and examined by light microscopy. The tissue damage in all needle samples was restricted, mostly, to the mesophyll cells. The major host reaction in all samples was, not the dissolution of the host cells, but a collapse of the mesophyll cells, causing the affected area to have a lattice-like appearance devoid of cellular components. Affected areas were sharply defined from unaffected. Inner extent of host reaction was the endodermis and the vascular tissues were unaffected. *S. acicola* hyphae were present in limited numbers. Frequently, a species of *Fumago* was observed on the epidermis of the samples.

FOLIAR DISEASES CAUSE INSIGNIFICANT LOSS IN LEAF AREA OF FLORIDA GROWN SOYBEANS. Steven B. Johnson and R. D. Berger, Plant Pathology Department, University of Florida, Gainesville, Florida 32611.

In 1980, measurements of leaf area and disease incidence and severity were taken weekly from soybean (*Glycine max* 'F76-8846') plants in a field experiment with benomyl, metalaxyl, benomyl plus metalaxyl, and untreated plots. The loss in photosynthetic area owing to foliar diseases was less than 1% of total area. Total plant area and total plant photosynthetic area increased linearly to a maximum at the R3 stage, then decreased linearly to zero prior to harvest. The area under the growth curve for the decreasing area was significantly larger for the benomyl plus metalaxyl treatment than for the untreated plots. Where no seed yield differences resulted from the treatments, benomyl, alone or with metalaxyl, reduced the number of fungal reproductive structures by 80% and 50% on the pods and stems, respectively. The most important pathogens affecting pod, stem, and seed quality were *Phomopsis sojae* (*Diaporthe sojae*), *Colletotrichum truncatum*, and *Fusarium* spp.

HISTOLOGICAL AND BIOCHEMICAL COMPARISONS OF PLANT INDUCED INEFFECTIVE NODULES. L.E.B. Johnson and C.P. Vance, USDA, SEA, AR and The Department of Plant Pathology, The University of Minnesota, St. Paul, MN 55108.

Nodules ineffective in N₂-fixation formed on 4 alfalfa genotypes when inoculated with effective strains of *Rhizobium meliloti*. These ineffective nodules were compared with effective N₂-fixing nodules by light and electron microscopy. Acetylene reduction, nodule soluble protein, glutamine synthetase (GS), glutamate synthase (GOGAT), glutamate dehydrogenase (GDH) and phosphoenolpyruvate carboxylase (PEP Case) were also compared. Ineffective nodules that formed on MnAg(In) and MnSa(In) were similar to effective nodules in early development. However, these nodules had smaller bacteroids and senesced more rapidly than effective nodules. In contrast, nodules that formed on MnNC 3226 and MnNC 3811 were tumor-like, had few bacteroids and were filled with starch. Ineffective nodules had low activity for GS, GOGAT, PEP Case and acetylene reduction when compared to effective nodules. Host plant nodule GS, GOGAT and PEP Case are required for N₂ assimilation in effective nodules. Ineffectiveness can occur at a number of developmental stages and is frequently manifest in responses similar to disease resistance.

COTTON LAIMOSPHERE POPULATIONS OF MICROORGANISMS AND THEIR ANTIBIOTIC EFFECT ON PYTHIUM ULTIMUM. L. F. Johnson & Nancy G. Bartley, Department of Entomology and Plant Pathology, The University of Tennessee, Knoxville, TN. 37901

With a dilution-plate procedure populations of microorganisms were determined in laimospheres (soil adjacent to hypocotyls) of 9-day-old cotton seedlings. Numbers of bacteria were 2.1 times higher in laimosphere soil than in soil 3-4 cm distant from the hypocotyl. Numbers of actinomycetes or fungi in laimosphere soil were not significantly different from those in non-laimosphere soil. Antibiotic producers were determined with a modification of the plate-dilution frequency technique of Harris and Sommers (Appl. Microb. 16:330-334, 1968). Numbers of microorganisms that inhibited growth of *Pythium ultimum* were not significantly different in laimosphere soils of 2 cotton cultivars, 'Dixie King 3' and 'Delcot 277', that differed in susceptibility to *P. ultimum*. A selective increase in non-antibiotic producers in laimosphere soil was detected; numbers of antibiotic producers were higher in soil 3-4 cm distant from hypocotyls than in laimosphere soil.

DETECTION OF *EPICHLÖE TYPHINA* IN TALL FESCUE BY MEANS OF ELISA. Mark C. Johnson, M. R. Siegel, T. P. Pirone, Dept. of Plant Pathology, University of Kentucky, Lexington, KY 40546.

Epichloe typhina, a clavicipitaceous internal colonizer of tall fescue (*Festuca arundinaceae*) is thought to be involved in the fescue toxicity syndrome of cattle. Because the infected fescue plants exhibit no external symptoms, detection of the fungus in tall fescue has been dependent on microscopic examination of culm pith tissue. An antiserum prepared to homogenates of washed *E. typhina* mycelium grown in liquid media was used in an enzyme-linked immunosorbent assay (ELISA) to detect antigens of *E. typhina* in homogenized seed and plant samples of tall fescue. The assay could detect as little as 20 ng dry weight of fungal mycelium and was able to detect *E. typhina* in individual seeds of tall fescue. The assay is extremely specific for *E. typhina*. Of 15 different fungal genera tested, including *Acremonium*, *Helminthosporium*, *Pythium*, *Rhizoctonia*, and *Sclerotium*, all showed reactivities less than 0.1% that of *E. typhina*.

POTENTIAL STORAGE HAZARD OF SOYBEANS HARVESTED WITH BLACK NIGHTSHADE. Coy W. Jones and Bill W. Kennedy, Department of Plant Pathology, University of Minnesota, St. Paul, MN 55108.

Eastern black nightshade, *Solanum pryncanthum* Dun. is a widely distributed pest in upper midwest soybean-growing areas. Combining operations frequently result in whole (green) fruits being harvested along with soybeans, or, if fruits have ripened, they invariably rupture and a bluish-brown coloration is spread over soybean seed surfaces. We have shown that fruits contain 73-82% moisture and provide loci of mold initiation during storage. Soybean seed lots that contain 4% nightshade fruits result in molding within 3 months in a seedlot at 12% but not at 6.3% moisture content. *Aspergillus* spp. sporulated on soybean seeds with pulp and juice of nightshade fruits coated on surfaces within 8 weeks at 14-16% moisture at room temperature; storage fungi were less prolific on similarly treated glass beads. Sporulation of storage molds invariably began at sites on soybean seeds where 5 µl droplets of nightshade extract was applied. Conclusions are that nightshade fruits alter moisture content as well as act as a growth medium for storage fungi.

SURVIVAL OF *PSEUDOMONAS TOMATO* IN ASSOCIATION WITH WEEDS, DISEASED TISSUE, AND SOIL IN GEORGIA. J. B. Jones and S. M. McCarter, Dept. of Plant Path., Univ. of Georgia, Athens, 30602.

Washings from leaves and roots of 25 plant species collected from fields previously cropped to tomatoes were vacuum infiltrated into foliage of Chico III tomato plants to detect epiphytic populations of *Pseudomonas tomato* (*P. syringae* pv. *tomato*). The bacterium was recovered from roots of *Secale cereale* collected from a field near Tifton, Georgia and from leaves and roots of *Stellaria media*, *Arabisopsis thaliana*, and *Lamium amplexicaule* from fields near Athens. In summer field tests at Athens and Tifton *P. tomato* survived poorly in artificially infested soil (10⁹ cfu/g) and in infected tissue on the surface or buried 20 cm deep. It was not recovered at the first sampling time (15 days at Tifton and 24 days at Athens) from soil or buried tissue. It was present at the first sampling in tissue on the surface but was not recovered at the second sampling (45 days at Tifton and 60 days at Athens). In temperature tank tests at 18 to 38 C it survived for 2 months in buried tissue at 18 C but was not recovered after 1 wk at 33 and 38 C.

MONITORING SOYBEAN FOLIAR DISEASES IN ILLINOIS IN 1980. Edward G. Jordan, USDA, APHIS, PPO, Department of Plant Pathology, University of Illinois, 1102 S. Goodwin Ave., Urbana, IL 61801

Ratings of soybean disease monitoring plots at nine locations in Illinois in 1980 showed the major foliar diseases to be brown spot (BS), bacterial pustule (BP), bacterial blight (BB), and downy mildew (DM). Leaf area infection of the cultivar Clark at the R5 growth stage due to BP ranged from 22% in the northwest and 28% in the northeast to less than 1% in the southeast and southwest. Infection of the BB-susceptible cultivar Essex at the R5 growth stage was only 2% in the southeast and southwest compared to 13% in the west and 16% in the north. BS infection of the cultivar Wells at the R6 growth stage was most severe in the northeast (33%) and east southeast (24%) and least severe in the southwest (4 to 5%). DM infection of the cultivar Williams at the R5 growth stage was 3% or less at all locations except in the southeast where infection was 17%. Variations in disease severity are attributed to differences in temperature, rainfall, humidity, crop rotation, and cultivar.

DETECTION OF DOUBLE STRANDED RNA IN AVOCADO. Ramon L. Jordan, J. Allan Dodds, and Howard D. Ohr. Dept. of Plant Pathology, Univ. of California, Riverside, CA 92521.

During investigations to determine the causal agent of the avocado blackstreak disease, three double stranded RNA (dsRNA) polyacrylamide gel band patterns were detected in tissue extracts from as little as 2.5 g of both healthy and diseased sources. Estimated molecular weights for the major dsRNA segments of the three patterns were 6.0 and 0.5 x 10⁶ d. for pattern 1, 3.0 x 10⁶ d. for pattern 2, and 2.3, 2.2, and 2.0 x 10⁶ d. for pattern 3. All of the segments were digested when gels were soaked in RNase and water, and were not digested when the gels were soaked in RNase and 0.3M NaCl. One, two, or all three dsRNA patterns could be detected per sample, depending on the avocado variety, individual, or tissue source tested. Some varieties had no detectable dsRNA. It is proposed that these dsRNAs are the replicative forms of three previously undetected avocado viruses. At present, none of these can be specifically associated with the avocado blackstreak disease.

CONTROL OF BROWN-SPOT NEEDLE BLIGHT ON LONGLEAF PINE BY BENOMYL ROOT-DIP TREATMENT. A. C. Kais, C. E. Cordell, C. E. Affeltranger. Southern Forest Experiment Station, Gulfport, Miss. 39501; Southeastern Area State & Private Forestry, Asheville, N. C. 28803 and Alexandria, La. 71360.

The root systems of longleaf (*Pinus palustris* Mill.) pine seedlings were dipped in various benomyl-clay mixtures (0, 1.0, 5.0, 10.0, and 20.0% a.i. benomyl) and then outplanted at sites in Merryville, Louisiana; Saucier, Mississippi; Brewton, Alabama; Albany, Georgia; and Tallahassee, Florida. The seedlings planted at each site were obtained from a local nursery. Survival and percent brown spot (*Scirrhia acicola* (Dearn.) Siggers) infection were evaluated after the first and second years in the field (1979 and 1980). Seedling survival and percent infection varied from site to site. Survival could not be correlated to brown spot infection but was strongly related to levels of benomyl. The 10% and 20% a.i. benomyl treatments greatly

reduced seedling survival on sites with extremely sandy soils. With the exception of the lowest dosage level (1% a.i.), all benomyl treatment levels provided good disease control.

THE NECROTIC RESPONSE INDUCED BY *XANTHOMONAS CAMPESTRIS* PV. *CAMPESTRIS* IN CABBAGE LEAF PARENCHYMA. Hisatoshi Kaku and Luis Sequeira, Dept. of Plant Pathology, University of Wisconsin-Madison, Madison, WI 53706.

Xanthomonas campestris pv. *campestris* (XCC) normally invades the vascular elements, but not the parenchyma of cabbage leaves. When intercostal panels of cabbage leaves were infiltrated with 10^9 CFU/ml of the bacterium, necrosis of the parenchyma occurred within 48 hr. Of 10 other pathovars of *X. campestris*, only *X. campestris* pv. *raphani* induced a similar response. This necrotic response was visually indistinguishable from the hypersensitive response (HR) induced by *Pseudomonas syringae* pv. *lachrymans* (PSL) in cabbage leaves. The population of PSL declined rapidly after infiltration, whereas that of XCC continued to increase even after the tissue collapsed. Electron microscopy studies showed the XCC multiplied mostly in the intercellular spaces and that no attachment to the host cell walls occurred. Thus, the necrotic response induced by XCC in cabbage leaf parenchyma probably is not a typical HR.

OVERWINTERING OF *SEPTORIA GLYCINES* IN SOYBEAN LEAVES. T. A. Kamicker and S. M. Lim, Department of Plant Pathology, University of Illinois, Urbana, IL 61801.

Survival of *Septoria glycines* in soybean leaves was measured from December of 1980 to April of 1981. Naturally infected leaves from field-grown soybeans were placed in mesh bags and positioned at 1 m above the soil surface, on the surface, buried 5-8 cm, and buried 20-23 cm. The experiment was arranged as a split plot in time with 3 replications. Monthly, ten-8 mm leaf disks from each treatment within a replication were incubated on moist filter paper in petri plates. For each disk, total pycnidia were counted on 0 (washing date), 1, 3, and 5 days. Oozing pycnidia were counted on 1, 3, 5, 6, 7, 8, 9, and 10 days. Preliminary results from the winter months indicate that more oozing pycnidia are present on buried leaves than those placed on or above the soil surface during the same sampling month.

ZONATE EYESPOT OF WILD RICE IN MINNESOTA. M.K. Kardin, R.L. Bowden, J.A. Percich and L.J. Nickelson, Department of Plant Pathology, University of Minnesota, St. Paul, MN 55108.

A new disease of wild rice (*Zizania aquatica*) caused by *Drechslera gigantea* was observed for the first time in growers' fields in August, 1979 and recorded again in August 1980. The early symptoms were small grayish green lesions, approximately 1 mm in diameter, with a well defined brown margin. In the later stages the lesions enlarged, became tan in the center, and secondary lesions formed around the primary lesions, producing typical zonate eyespot symptoms. The lesions were 0.8-1 x 1.5-2 cm in size. The disease was observed in three growers' fields and at two of the University of Minnesota Experiment Stations, but not in natural stands. The fungus was pathogenic to Netum, K-2, and Johnson cultivars of wild rice. In greenhouse tests Netum and K-2 showed zonate eyespot symptoms, while the Johnson cultivar produced typical eyespot lesions on most plants and large tan to brown lesions on the other plants.

EFFECT OF TEMPERATURE ON DISEASE REACTION OF SOYBEAN CULTIVARS USED TO IDENTIFY RACES OF *PHYTOPHTHORA MEGASPERMA* VAR. *SOJAE*. B. L. Keeling, U. S. Department of Agriculture, SEA, Stoneville, MS 38776.

Eight differential soybean [*Glycine max* (L.) Merr.] cultivars (Harosoy, Sanga, Harosoy 63, Mack, Aitona, PI 103091, PI 171442, and Tracy) used to identify physiologic races of *Phytophthora megasperma* Drechs. var. *sojae* Hildeb. (P.m.s.) were inoculated (hypocotyl puncture method) with races 1, 2, 7, 10. Inoculated plants were maintained at 21, 24, 27, or 32 C for 5 days, including a 16 hr. moist chamber treatment immediately following inoculation. The disease reaction of the differential cultivars (based on number of plants killed) indicated 24 C was the optimum temperature for classifying P.m.s. races. Resistant cultivars generally became more susceptible as the temperature increased from 24 to 32 C: Sanga, Harosoy 63, and Aitona became susceptible to race 1; Harosoy 63 became susceptible to race 2; and Sanga and PI 103091 became susceptible to race 7. The reaction of Mack to the 4 races was least affected by high temperature.

NATURAL OCCURRENCE OF OOSPORES OF "*PHYTOPHTHORA PALMIVORA* MF4" (P. CAPSICI) IN COCOA PODS IN BRAZIL. M. K. Kellam and G. A. Zentmyer, Dept. of Plant Pathology, University of California, Riverside, CA 92521.

Plerotic oospores with amphigynous antheridia were found in soft rotten cocoa pod pieces from husk piles and in mummified fruits on cocoa trees in field plots of CEPLAC in Itabuna, Brazil. These oospores were morphologically similar, with average dimensions as follows: oogonia 24.8 μ m, oospores 22.8 μ m, oospore walls 1.3 μ m, and antheridia 11.2 x 12.2 μ m. Frequently, antheridia were absent or partially disintegrated while oogonial stalks remained intact. Of 431 oospores removed from 2 pods, 63 germinated after 2 to 35 days in water under continuous light. Usually germinating oospores produced one or

more sporangia. Most of 21 single oospore isolates can be identified as "*P. palmivora* Morphological Form 4", which we feel should be designated as *P. capsici*, but they are strikingly different from each other with respect to colony morphology and to sporangium morphology, production, caducity, and stalk length. Isolates included both A¹ and A² mating types.

EFFECT OF SOIL TEMPERATURE ON SURVIVAL OF *PHYTOPHTHORA CINNAMOMI* IN *ABIES FRASERI* NURSERY BEDS. Charles M. Kenerley and Robert I. Bruck, Dept. Plant Pathology, N. C. State University, Raleigh, NC 27650.

Four plots (1.2 x 3m) were established 8 Oct. 1980 in infested nursery beds to monitor soil populations of *P. cinnamomi* during winter and spring. Soil samples were taken to a depth of 15 cm and propagule density determined by wet-sieving and plating. Maximum and minimum soil temperatures at 7.6 and 15 cm did not exceed 0 C for 60-66 and 37-58 days, respectively, between Dec. 19 and Feb. 22. Average propagule densities in the 4 plots declined from 4.26 on Oct. 8 to 0.02 propagules/g dry soil on March 9. Soil temperature and propagule density were highly correlated (P = 0.01). Chlamydospores surviving free in the soil accounted for 67 to 83% of the propagules detected. These data suggest that *P. cinnamomi* can survive in very low numbers in soils at temperatures not exceeding 0 C as free chlamydospores which may function as primary inocula the following spring.

MEASUREMENT OF SOYBEAN INJURY USING CHLOROPHYLL ASSAYS OF COTYLEDONS. B.W. Kennedy and W.L. Koukkari, Department of Plant Pathology, University of Minnesota, St. Paul, MN 55108.

Mild and severe infection resulting from inoculation with suspensions of *Pseudomonas syringae* pv. *glycinea* by pressing leaves between coarse sandpaper resulted in significantly greater amounts of chlorophyll/mg dry wt in cotyledons on infected plants than on controls. Shoot length and dry weight above cotyledons were significantly different from controls only on severely infected plants; thus cotyledon chlorophyll analysis was a more sensitive indicator of damage than height or dry weight. Further, controls subjected to severe and mild inoculation procedures with water only had significantly more chlorophyll than controls receiving no mechanical injury. The cotyledon assay was sensitive enough to detect a single mild or severe rubbing of stems or leaves between fingers. Our test is based upon the endogenous capacity of a soybean plant to alter its metabolic development in response to injury and we can then quantify the extent of stress imparted by a variety of treatments.

EPIDEMIOLOGY OF *MYCOSPHAERELLA JUGLANDIS* LEAF SPOT OF *JUGLANS NIGRA*. Kenneth J. Kessler, Jr., Forestry Sciences Lab., SIU, Carbondale, IL 62901.

Weekly spore and lesion numbers and seasonal cumulative lesions were related to temperature and precipitation regimes. Ascospores initiated primary infections in May. Lesions appear 7-10 days after leaf inoculation. *Cylindrosporium conidia* appear 10-14 days later. Optimal germination of conidia occurs at 27 C, and 34 C is unfavorable. Infection seldom occurs below 15 C. Extensive defoliation requires at least 2 or 3 secondary cycles of conidial infections. Conidial populations peak in early August. Within-tree increase in lesions can occur through conidial dissemination and germination in dew drops. A seasonal pattern of chlorotic foliage and numerous lesions by early July, defoliation during July and early August, and nearly complete defoliation before the end of August was typical.

CYTOPATHOLOGY OF MOSAIC DISEASE OF EUPHOBIA. K. S. Kim, E. M. Martin and R. J. Carr, Dept. of Plant Pathology, University of Arkansas, Fayetteville, AR. 72701.

Leaf-sap inoculation of Euphorbia mosaic virus caused chlorotic lesions on inoculated primary leaves and mosaic and/or mottling on newly developed leaves of *Datura stramonium*. Thin-section electron microscopy of such leaves revealed the following nuclear changes; nucleolar hypertrophy, segregation of granular and fibrillar portions of the nucleolus, the appearance of DNP-containing fibrillar rings and spherical virus-like particles (15-20nm in diameter), which were similar to those changes associated with known whitefly-transmitted viruses. In addition to these changes, certain phenomena not common to other whitefly-transmitted virus infections were also found. These were: 1)nuclear changes and the occurrence of virus-like particles not limited to phloem cells; 2)the appearance of "interchromatin granules" in the nucleoplasm which became incorporated into fibrillar rings; and 3) characteristic cytoplasmic inclusions found near the nuclei.

STORAGE ROT OF TOMATO TRANSPLANTS CAUSED BY *PHYTHIUM APHANIDERMATUM*. S. H. Kim and W. A. Woodward, Pennsylvania Department of Agriculture, Harrisburg, PA 17110.

Pythium aphanidermatum was occasionally associated with storage rot of symptomless transplants from GA when planting time was delayed. Tomato cultivars of different ages grown in a soil-less mix in a greenhouse, 16-29 C, were inoculated with a fragmented fungal suspension. Seven days after inoculation, these symptomless plants were freed from growth medium then subjected to simulated transport and storage conditions by packing in brown paper. After a 24 hr transport simulation at 10 C, and then 3 and 4 day storage at 23 C, the 47 and 54 day old plants died. In another study, plants packed immediately following

separation from the growth medium and stored at 28 C for 3 days resulted in 100 % mortality; whereas, plants allowed to dry after separation before packing, 35 % weight loss, resulted in 25 % mortality. This study suggests that a population of *P. aphani dermatum* which failed to produce stem rot in GA could become detrimental during storage in PA especially with a higher level of moisture in a crate.

EPIDEMIOLOGY OF PUCCINIA CORONATA F. SP. AVENAE IN SOUTH CAROLINA. Graydon C. Kingsland, Luther W. Baxter, Dept. of Plant Pathology and Physiology, Clemson University, Clemson, SC 29631.

Crown rust of oats (caused by *P. coronata* f. sp. *avenae*) developed in epidemic proportions during October 1979 on three production fields of *Avena sativa* var. Century planted in August, 2½ months prior to the recommended date. An average of three uredia per culm leaf were present on 90% of leaves two and three at the four-leaf stage. There were three uredia per leaf on 64% of leaves three and four at the five-leaf stage on 12 Dec. No new uredia were found during six surveys conducted on 24 Jan. and later. Urediospores collected on 9-cm agar plates in an Anderson spore sampler decreased from an average of 50 per plate on 16 Dec. to 9 on 24 Jan., 1 on 7 Feb., and 0 on four subsequent dates. Germination of spores averaged 70% through the last sample date. Germination of urediospores from uredia decreased progressively from 77% on 15 Nov. to 3% on 24 Jan. No infection occurred on Sumter 3 oats planted 8 Nov. in a field 50 feet from the Century oats. The disease did not reappear in the spring of 1980.

RYE DECLINE, AN ABIOTIC DISEASE IN SOUTH CAROLINA. Graydon C. Kingsland, R. Walker Miller, Department of Plant Pathology, Clemson University, Clemson, SC 29631.

Rye (*Secale cereale* var. *Wrens Abruzzi*) was stunted and chlorotic, tillered poorly, and yielded only ca 10 bu/A when seeded in untilled stubble of *Lespedeza cuneata*. *Helminthosporium sorokinianum* was isolated from diseased plants during the original diagnosis. Seed treatment and/or soil fumigation did not control the disease. The syndrome, in addition, could not be explained entirely by assuming *H. sorokinianum* to be the only causal factor. Severe decline symptoms developed on barley, oats, rye, and wheat in all plots with or without removal of organic debris. All small grains grew vigorously throughout the season after seeding into plots from which *lespedeza* roots had been removed. Seedling emergence and plant growth was poor and decline symptoms were severe when these grains were seeded into plots with *lespedeza* roots intact. This decline appears to be an abiotic disease associated with *lespedeza* roots.

RELATIONSHIPS BETWEEN CONTAMINATION OF SMALL GRAINS SEEDS BY HELMINTHOSPORIUM SOROKINIANUM AND SEED GERMINATION, SEEDLING BLIGHT, AND GRAIN YIELDS FROM TREATED AND UNTREATED SEEDS IN SC. Graydon C. Kingsland, Wesley Witcher, Dept. of Plant Pathology and Physiology, Clemson University, Clemson, SC 29631.

Samples of seeds of barley, rye, and wheat (7, 9, and 11, respectively) were collected from four counties. Differences in germination (avg of 89, 75, and 79%, respectively) among samples were statistically significant. Seed contamination with *H. sorokinianum* averaged 41, 70, and 25% for barley, rye, and wheat, respectively. The correlation coefficient between contamination and germination was significant for barley but not for rye or wheat. Seedling blight in the greenhouse averaged 40, 15, and 4% for barley, rye, and wheat, respectively. Barley seedling blight was significantly correlated with percent seed contamination. Seedling blight of rye or wheat was not correlated with seed contamination. Grain yields of barley, rye, and wheat from Arasan-treated seeds averaged 2 to 5 bu/A more than yields from adjacent plots seeded with untreated seeds. The differences, however, were not statistically significant.

THE INFLUENCE OF PATHOGEN INTERACTIONS ON APPARENT INFECTION RATES IN POTATOES WITH "EARLY DYING" DISEASE. M. L. Kirkland and M. L. Powellson, Department of Botany and Plant Pathology, Oregon State University, Corvallis, OR 97331.

Potato plant infection by *Verticillium dahliae*, *Erwinia carotovora* var. *atroseptica* (Eca), *Erwinia carotovora* var. *carotovora* (Ecc) and *Colletotrichum atramentarium* was monitored over time in a Nrgold Russet field. The previous potato crop in this field had died prematurely and 96% of the current season's crop was dead or dying 111 days from planting. Daily apparent infection rates (r) were based on isolations from 85 to 148 plants per sampling date; plants were collected at the beginning and end of the logarithmic phase of the "early dying" disease progress curve. The apparent infection rates for the various pathogen combinations were: $r = 0.0141$ (*V. dahliae* + Eca), $r = 0.0031$ (*V. dahliae* + Ecc + *C. atramentarium*) and $r = 0.0028$ (*V. dahliae* + *C. atramentarium*). The apparent infection rates for potato plants infected by only one pathogen were: $r = 0.0083$ (*V. dahliae*), $r = 0.0022$ (Ecc), and $r = 0.0012$ (Eca). Rate of disease progress was greater in plants co-infected with *V. dahliae* and Eca than in plants infected solely by either pathogen. Conversely, in plants co-infected with *V. dahliae* and Ecc and/or *C. atramentarium*, rate of disease progress was slower than in plants solely infected with *V. dahliae*.

ISOLATION OF TURNIP MOSAIC VIRUS FROM SAFFLOWER. J. M. Klisiewicz, AR, SEA, USDA, Department of Plant Pathology, University of California, Davis, CA 95616

Turnip mosaic virus (TUMV) was isolated from naturally infected safflower (*Carthamus tinctorius*) plants showing mosaic and stunting in the field. The virus was transmitted to safflower

by mechanical inoculation and by aphids (*Myzus persicae*) in a nonpersistent manner. Necrotic, local lesions formed on inoculated leaves. Inoculated plants of some cultivars showed severe systemic mosaic, stunted growth and reduced flowering, whereas other cultivars developed only mild systemic necrosis. Local lesions formed on inoculated leaves of *Gomphrena globosa*, *Chenopodium quinoa* and *C. amaranticolor*. Systemic mosaic developed in *Zinnia elegans*, *Brassica pekinensis*, *B. rapa*, *B. periviridis*, and weed hosts *B. geniculata* (short-pod mustard), *B. campestris* (common mustard), and *Raphanus sativus* (wild radish). TUMV from safflower showed a positive serological reaction with TUMV antiserum in immunodiffusion plates containing sodium dodecyl sulfate. The uniform, flexuous, rod-shaped particles measured about 788 nm.

ACQUISITION BY APHIDS OF SPIROPLASMAS FROM PLANTAGO MAJOR. J. W. Kloepper and D. G. Garrett, Department of Plant Pathology, University of California, Berkeley, California 94720.

Spiroplasmas were isolated from *Myzus persicae* fed on two *Plantago major* plants from which spiroplasmas were previously isolated. Both plants were previously inoculated via injected leafhoppers (*Macrostelus fascifrons*): one with *S. citri* isolated from stubborn-diseased orange and one with a spiroplasma (serologically indistinguishable from *S. citri*) originally isolated from *M. fascifrons* fed on *P. major* with Tulelake Aster Yellow disease (Sensu Freitag). The number of aphids from which spiroplasmas were isolated varied with aphid age. Spiroplasmas were isolated from 2 out of 3 groups of alates (10 per group) but from only 1 out of 7 groups of small young and from 0 out of 5 groups of mature, plump adults. The spiroplasmas isolated from the aphids were serologically indistinguishable from the ones isolated from the two *Plantago* plants. Results of attempts to transmit spiroplasmas using aphids will be discussed.

REDUCTIONS OF ERWINIA CAROTOVORA ON POTATO ROOTS AND IN DAUGHTER TUBERS FOLLOWING SEEDPIECE TREATMENTS WITH PLANT GROWTH-PROMOTING RHIZOBACTERIA. J. W. Kloepper, M. N. Schroth and V. Vitanza-Jack, Department of Plant Pathology, University of California, Berkeley, California 94720.

Plant growth-promoting rhizobacteria (PGPR) were examined for their effect on root colonization by *Erwinia carotovora* (either sub sp. *carotovora* or *atroseptica*). The average population of *Erwinia* on roots was significantly reduced on plants treated with PGPR strains Al, B10, E6 or BK1 in a total of 3 field plots. The reductions occurred in both sandy loam and peat soils, and ranged from 90 to 100% reductions compared to water-treated controls. PGPR strain TL3B2 did not significantly reduce *Erwinia* populations. Treatments of PGPR strains BK1, B10 and mixtures of these with TL3B1 resulted in statistically significant reductions in the percentage of daughter tubers infested with *Erwinia* in two field tests; reductions ranged from 44 to 67%, compared to water-treated controls. These results suggest that specific PGPR may be useful in reducing *Erwinia* infestations in lots of seed potatoes.

THE SPREAD OF MAIZE DWARF MOSAIC VIRUS FROM JOHNSONGRASS TO MAIZE. J. K. Knoke, R. Louie, L. V. Madden, and D. T. Gordon, USDA-SEA-AR and Departments of Entomology and Plant Pathology, Ohio Agric. Res. and Devel. Center, Wooster, OH 44691.

Spread of maize dwarf mosaic virus (MDMV) from virus-infected johnsongrass (*Sorghum halepense*) to adjacent susceptible maize (*Zea mays*) was evaluated during 1979 and 1980. The relationship between MDM incidence in maize and distance from the source was adequately described by the model $Y = a[\exp(-bd)]^c$, where Y is disease incidence at distance d from the source, b is the spread coefficient, and a is the scaling factor. In both years b was significantly greater than zero, demonstrating that MDMV spread to the maize test plants. In control plots with no virus source, b values and disease incidence were lower than in test plants. For a single planting in 1979, the steepness of the gradient of disease incidence from the source (quantified by b) decreased with time as fewer plants remained uninfected. For two successive plantings in 1980, no significant difference in the b values were observed. Virus spread also was not related to prevalent wind direction.

FACTORS AFFECTING SEXUALITY IN PHYTOPHTHORA PARASITICA. W. H. Ko, Department of Plant Pathology, University of Hawaii, Beaumont Agricultural Research Center, Hilo, HI 96720.

Both A¹ and A² mating types of *P. parasitica* were changed from self-sterile to self-fertile after being stored for two years. Similar change of sexuality occurred on A², but not A¹, mating type after *P. parasitica* isolates were grown on V-8 agar containing 5 ppm chloroneb for 14 days. Single zoospore isolates obtained from each of these self-fertile cultures contained both A¹ and A² mating types. About 1% of the zoospore population were self-fertile, but their self-inductive nature was transitory and unstable. After two transfers to V-8 agar, all became self-sterile and behaved as the original mating type. Without treatment A¹ and A² isolates gave only A¹ and A² mating types, respectively, in single zoospore cultures. Conversion of certain individuals to an opposite mating type explains the apparent change from self-sterile to self-fertile in *P. parasitica* after long-term storage or chloroneb treatment. It is suggested that the unstable self-fertile zoospores represent the transitional state in the conversion in both directions.

METHODS FOR DETECTING SUPPRESSIVE SOIL IN SMALL QUANTITY. W. H. Ko and W. C. Ho, Department of Plant Pathology, University of

Hawaii, Beaumont Agricultural Research Center, Hilo, HI 96720.

Due to its unique ability to grow on natural soil, reduced growth rate of *Rhizoctonia solani* on a soil sample was used as an indication that the soil is suppressive to the pathogen. Growth of *R. solani* on smoothed soil surface was recorded under a vertical-illumination microscope at 2-day intervals for 6 days. On 6 of 30 soil samples tested, *R. solani* grew only 12 to 35 mm in comparison with 98 mm on conducive soil. Sporangia of *Pythium splendens* coated with extract of cucumber roots were incubated on the smoothed soil surface for 6 hours at 24 C. After staining with rose bengal, germination was counted directly under the vertical-illumination microscope. On 8 of the same 30 soil samples, *P. splendens* sporangia germinated only 4 to 44% in comparison with 95% germination on conducive soil. Three soil samples suppressed both pathogens, three selectively suppressed *R. solani*, and the other five strongly suppressed *P. splendens* only.

DETERMINING BEAN ROOT ROT POTENTIAL OF FIELDS IN WISCONSIN'S CENTRAL SANDS. K. Kobriger, and D. J. Hagedorn, Dept. of Plant Pathology, University of Wisconsin-Madison, Madison, WI 53706.

The possibility of predicting field disease and yield loss due to bean root rot on the basis of a greenhouse soil assay for root rot potential was evaluated. Samples from 25 commercial fields in 1979 and 41 fields in 1980 were assayed in the greenhouse. Thirty subsamples collected from each field were bulked, air dried at 24 C and mixed thoroughly before being placed in 15 cm clay pots. Six seeds of 'Early Gallatin' were planted per pot. Pots were watered sparingly for 10-13 days and then maintained at field capacity until 30-40 days after planting. Roots and hypocotyls of greenhouse grown plants and plants grown in the sample fields for 30-40 days were rated for disease on a scale from 0 (no disease) to 4 (dead). This scale was converted to a disease index from 0 to 100%. A high correlation existed between greenhouse disease indices and field disease indices. Results indicate this technique may be a useful approach to disease "control" via omission of fields with high bean root rot potential from bean production.

EVALUATION OF FOUR SAMPLING PATTERNS FOR DETERMINING THE BEAN ROOT ROT POTENTIAL IN FIELD SOILS. K. Kobriger and D. J. Hagedorn, Dept. of Plant Pathology, Univ. of Wisconsin, Madison, WI 53706

Four different soil sampling patterns were compared to determine their applicability in evaluating bean root rot potential of commercial snap bean fields in the central sands area of Wisconsin. The four patterns were as follows: 1) a composite of ten samples taken at equal intervals along a diagonal transect across the field; 2) a composite of thirty samples taken along a square pattern covering approximately 2.5 acres in size; 3) a composite of thirty samples taken along a "W" pattern covering approximately 2.5 acres; 4) a composite of nine samples taken along a "M" pattern covering approximately 2.5 acres. Individual soil samples from each field were bulked, air dried at 24C, and mixed thoroughly before placing in 15 cm clay pots. A disease index bio-assay previously developed to determine bean root rot potential was used in the greenhouse to compare samples collected by the different methods. Highest correlation between field and greenhouse DIs was observed with pattern 2.

BACTERIAL COUNTS AND YIELDS: IDENTIFICATION OF SUGARCANE SELECTIONS HIGHLY SUSCEPTIBLE OR TOLERANT TO INJURY BY RATOON STUNTING DISEASE. H. Koike, USDA, SEA, AR, Houma, LA 70361; A. G. Gillaspie, Jr., USDA, SEA, AR, Beltsville, MD 20705; and G. T. A. Benda, USDA, SEA, AR, Houma, LA 70361.

Sugarcane cultivars are susceptible to infection by the ratoon stunting disease (RSD), but the effect of the disease on yields can vary widely among cultivars, ranging from 50% to none. As yield tests require years of effort, the breeder needs a simpler method to determine the yield response of his selections to RSD. A recent experiment relates yield effects and numbers of the RSD-bacterium in stalk juice of 20 cultivars. The four cultivars with a history of RSD tolerance had the least yield losses and the fewest bacteria, whereas the five with known high susceptibility to RSD injury had the highest yield losses and the highest average number of bacteria. Eleven cultivars with intermediate susceptibility varied widely in yield losses and bacterial number. Bacterial counts may be useful in identifying cultivars most intolerant and most tolerant to RSD.

DOWNY MILDEW EFFECT ON ONION SEED PRODUCTION IN IMPERIAL VALLEY, CALIFORNIA. Demetrios G. Kontaxis, University of California, Cooperative Extension, 960 East Street, Pittsburg, CA 94565.

An epiphytotic of downy mildew, *Peronospora destructor* (Berk.) Casp., on onion occurred in Imperial Valley of California during February 1978. Ridomil^R 50W (N (2,6-Dimethyl-phenyl)-N-(Methoxyacetyl)-alanine methyl ester), 980 grams a.i./673 liters water/hectare was applied on 15.0 meter long beds twice—8 February and 3 March 1978. Similar plots not treated with Ridomil^R served as controls. The treatments were randomized and replicated five times. There were two plant rows of onion cultivar hybrid Yellow Granex PRR per bed. The plots were harvested on 5 June, 1978. The treated & non-treated plots yielded 115.2 & 40.2 kilograms of seed per hectare, respectively. The data were statistically significant at 0.1% level. Ridomil^R was not phytotoxic, rendered the plants deep green and effectively suppressed the disease.

FIELD TECHNIQUE FOR ASSESSING ROOT GROWTH AS AFFECTED BY POTATO EARLY DYING. J. B. Kotcon, D. I. Rouse, and J. E. Mitchell, Dept. of Plant Pathology, University of Wisconsin, Madison, WI, 53706.

It has been hypothesized that various soilborne pathogens associated with early dying affect potato root growth. Potato (cv. Norgold Russet) root growth dynamics were assessed quantitatively in field plots (methyl bromide-treated and control) with 91 cm row spacings and 30 cm between plants in the row. Soil cores, 5 cm diam., from depths of 0 to 15 and 15 to 30 cm were collected at points 5, 15 and 38 cm from the plant between rows and at 15 cm from the plant within rows. Roots were screened from the cores and root lengths were estimated by the line intercept method. Quantitative determinations of root infection by *Pratylenchus*, *Verticillium*, *Colletotrichum*, *Fusarium* and *Erwinia* were made throughout the season. Average root length per plant was 14 m per plant at emergence and increased to 502 m per plant by 11 weeks after planting, but declined as plants senesced. Differences in total root length could not be related to chemical treatment or pathogen infection.

SCANNING ELECTRON MICROANALYSIS AND DETECTION OF INJURY TO HYBRID POPLAR BUDS ASSOCIATED WITH AMBIENT AIR POLLUTION Charles R. Krause, USDA, SEA, AR, Delaware, OH 43015

Hybrid poplar ramets, *Populus deltoides* x *P. trichocarpa* were grown from May, 1979 through March, 1981 under ambient field conditions either in clean air (low background levels of air pollution) at Delaware, OH or in polluted air (phyto-toxic levels of air pollution) at Cleveland, OH. In March, terminal vegetative buds of poplars grown in clean air were uninjured while those grown in polluted air were mottled. Buds from ramets grown on each site were compared with a scanning electron microscope equipped with an X-ray energy dispersive spectrometer (EDS). Epidermal cells from buds grown in clean air were turgid with uniform cuticles. Particulates, including heavy metals, were not present at significant levels. Epidermal cells from buds grown in polluted air were injured. Significant levels of Fe were present in particulates on epicuticular surfaces and in epidermal cell lesions as detected with EDS.

COLONIZATION OF RESISTANT AND SUSCEPTIBLE *RAPHANUS SATIVUS* CULTIVARS BY *PLASMODIOPHORA BRASSICAE*. T. K. Kroll, G. H. Lacy and L. D. Moore, Dept. of Plant Path. & Phys., VPI & SU, Blacksburg, VA 24061.

Colonization of crucifers roots by *P. brassicae* occurs in a primary cycle (1°) in the epidermis and a secondary cycle (2°) in the cortex. The degree and rate of colonization of a resistant, mildly susceptible, moderately susceptible and very susceptible radish cultivars were compared. Seeds were germinated in web-lite:vermiculite:peat moss (2:2:1), infested with 10⁶ resting spores/g, and grown at 25 C with continuous light. Inoculated and control plants from each cultivar were harvested at 1.5, 3, 5, and 7 days after seeding; mounted with acetocarmine in 10% gelatin and observed for 1° colonization. Other plants were harvested at 5, 10, 15, 20 and 25 days, fixed, embedded, sectioned, and observed for 2° colonization. No difference in the degree or rate of 1° colonization was detected among the cultivars. Secondary colonization along with host cell hypertrophy and hyperplasia were observed only in susceptible cultivars.

GENETIC CONTROL OF COWPEA CHLOROTIC MOTTLE VIRUS SYMPTOMS, MOVEMENT, AND ACCUMULATION. C. W. Kuhn, Dept. of Plant Path., Univ. of Georgia, Athens, GA 30602; S. D. Wyatt, Dept. of Plant Path., Wash. State Univ., Pullman, WA 99164; and B. B. Brantley, Dept. of Hort., Georgia Station, Experiment, GA 30212.

Host genotype controls symptoms, virus movement, and virus accumulation in cowpeas infected with cowpea chlorotic mottle virus. Virus movement was controlled by a dominant gene; the recessive genotype inhibited virus movement. Five levels of virus accumulation were found in various cowpea lines and in F₁, F₂, and backcross populations. Both the concentration of virus and the rate of virus replication appeared to be controlled by the action of several genes. The movement gene appeared to be closely linked with one of the genes which controls virus replication. Symptomatology was unrelated to virus accumulation. Furthermore, yield of pods and seeds was more closely related to virus accumulation than to symptom severity. When different virus strains were tested, the virus genome also was found to control the level of virus accumulation and virus movement.

INDUCTION OF SPORULATION BY *PHOMOPSIS SOJAE* ON DEAD SOYBEAN STEMS. Martin M. Kulik, Seed Research Laboratory, PGGI, SEA-USDA, Bldg. 006, BARC-W, Beltsville, MD 20705.

Sporulation by *Phomopsis sojae* did not occur on dead, overwintering soybean stems collected and placed in laboratory moist chambers each month from September, 1979 through April 1980. In an attempt to induce sporulation, stem sections collected in October of 1979 and 1980 were soaked for 30, 60, or 90 min in acetone, dimethylformamide, methylene chloride, petroleum ether, water, or xylene. Sections soaked for 60 min in methylene chloride showed the greatest amount of sporulation. Treatment for 30 or 90 min induced only a limited amount of sporulation. Stem sections were also placed on water agar plus 350 ppm of nitrogen from allantoin, ammonium sulfate, caffeine,

guanidoacetic acid, sodium nitrate, uracil, or urea, with or without pretreatment in methylene chloride for 60 min. The greatest amount of sporulation occurred on pretreated stem sections placed on water agar plus allantoin.

EFFECTS OF SIMULATED ACIDIC PRECIPITATION ON *ERWINIA HERBICOLA* AND *PSEUDOMONAS SYRINGAE* POPULATIONS. G. H. Lacy, B. I. Chevone and N. P. Cannon. Dept. of Plant Path. & Phys., VPI & SU, Blacksburg, VA 24061.

Acidic precipitation, as low as pH 3.4, occurs in southwestern Virginia. The biological effects of acidic precipitation on epiphytic bacteria is unknown. No viable colony forming units (cfu) of epiphytic strains of *Erwinia herbicola* and *Pseudomonas syringae* grown on agar were recovered after exposure for 50 min to water acidified at pH 2 and the cfu were depressed significantly at pH 3. Compared to pHs 4, 5, 6, and 7, neither species grew in minimal broth adjusted at pH 2. At pH 3, *E. herbicola* grew slowly, but *P. syringae* did not grow. For both species, uptake of O₂ in broth was reduced 30 min after exposure to pH 2, 3, and 4, but *P. syringae* was most inhibited. Populations of the bacteria on soybean leaves treated with acidified water (pH 3.4) were reduced (> 90%; P ≤ 0.025) compared to leaves treated with distilled water (pH 5.7).

TRANSFORMATION OF *ERWINIA STEWARTII* AND *E. HERBICOLA* WITH DNA OF SEVERAL PLASMIDS. G. H. Lacy and R. E. Schlesinger-Bryant. Dept. of Plant Path. & Phys., VPI & SU, Blacksburg, VA, 24061, and Biology Dept., Yale Univ., New Haven, CT, 06520.

Erwinia stewartii and *E. herbicola* strains were transformed using a CaCl₂ technique with plasmids pBR322 (2.6 megadaltons), pSC201 (5.6 md), pCR1 (8.6 md), and, probably, RP1 (36 md). Putative transformants were selected on media containing either tetracycline or kanamycin. Phenotypic confirmation of transformation of two plasmids was made by the ability of transformants to express unselected plasmid markers for resistance to ampicillin (pBR322 and RP1) and kanamycin (RP1). DNA similar to pBR322, pSC201 or pCR1, but not RP1, was detected by electrophoresis of plasmid DNA from transformants. Restriction analysis of plasmid DNA from *E. stewartii* transformants confirmed the presence of pBR322. Plasmid DNA from *E. stewartii* (pBR322) transformed *Escherichia coli*. Transformation with a wide range of plasmid sizes indicates that large segments of plasmid-cloned DNA could be introduced into *Erwinia* strains.

RELATION OF VAPOR PRESSURE DEFICIT TO RELEASE OF *BOTRYTIS SQUAMOSA* CONIDIA. M. L. Lacy and G. A. Pontius, Department of Botany and Plant Pathology, Michigan State University, East Lansing, MI 48824.

Of environmental parameters measured (air temperature, relative humidity, rainfall, leaf wetness, and wind speed and direction), vapor pressure deficit (VPD) calculated from % relative humidity (VPD = saturated - ambient water vapor pressure) in the temperature range 10-24 C was most closely correlated (r = -.67) with numbers of *Botrytis squamosa* conidia trapped with a Burkard spore trap. Large spore catches were preceded by two or more days of consistently low (0-3 millibars) vapor pressure deficits at temperatures of 10-24 C. Temperatures outside this range inhibited spore release. Most spores were caught between 0800 and 1300 hours. Spore catches could be predicted with good accuracy using a table of estimated probability indices of spore release based on mean VPD and air temperature for the preceding three day period.

COMPARISON OF TWO METHODS OF ARTIFICIAL INOCULATION OF CONTAINER GROWN SWEET GUM TREES (*LIQUIDAMBAR STYRACIFLUA* L.) WITH *DOTHIORELLA* SP. R. C. Lamb and William H. Ridings. Dept. of Plant Path. & Phys., VPI & SU, Blacksburg, VA 24061, and Plant Path. & Phys., Clemson Univ., Clemson, SC 29631.

When inoculation of sweet gum seedling trees with conidia of *Dothiorella* sp. was compared with inoculation using pycnidia on autoclaved sweet gum bark strips, only the bark strip inoculum caused trunk lesions, trunk gumming and stem die-back. After 3.5 months, trunk lesions were produced on 100% of the wounded and 66% of the non-wounded trees. After 10 mo infected trees had numerous lesions on the main trunk indicating spread of inoculum from early infections. No lesions resulted from conidia sprayed on pruned stem tips, mechanical bruises or pruned stem stubs after 2.5 mo. Under these experimental conditions conidia were not capable of infecting sweet gum stems or trunks.

METHODS FOR ISOLATING DOUBLE-STRANDED RNA FROM VIRUS INFECTED PLANTS. Leslie C. Lane and Theresa M. Curtin, Department of Plant Pathology, University of Nebraska, Lincoln, NE 68583 USA.

Most plant viruses contain RNA. Isolating and characterizing double-stranded replicative forms (RFs) of these viruses has been recognized as a general diagnostic tool. The high sensitivity of recently developed fluorescence detection methods makes this approach especially appealing. We have found cesium sulfate buoyant density centrifugation to effectively remove DNA from RFs. We have found that a mixture of Hoechst 33258 (Calbiochem) and ethidium bromide stains DNA Yellow and RNA orange. The dye mixture is useful for monitoring DNA contamination of RNA preparations.

DEVELOPMENT OF SCAB CAUSED BY *FUSICLADIUM EFFUSUM* ON PECAN SEEDLINGS. A.J. Latham, Ala. Agric. Exp. Stn., Auburn University, AL 36849.

Forecasting of fungicide applications for control of pecan scab, caused by *Fusicladium effusum*, is based on the suggested accumulation of 100 or more hr of leaf wetness or 100 to 240 hr of 90% or higher RH. Scab-free 'Schley' pecan seedlings growing in plastic bags were suspended from mature pecan trees with visible scab lesions 29 May, 1980. Seedlings were returned to the greenhouse at weekly intervals and replaced by scab-free seedlings. Scab did not develop on leaves exposed to airborne *F. effusum* conidia during wk 1, 2 and 6 when no rainfall occurred, but did occur on plants during wk 3, 4 and 5 when rainfall occurred. Wetness periods of 16, 12.75 and 12 hr were recorded by a De Wit leaf wetness meter for the first rains of weeks 3, 4 and 5, respectively. Severe infections resulting from singular free moisture periods as short as 12 hr indicated that the cumulative total approach to disease prediction may prove inadequate.

INCIDENCE OF CEPHALOSPORIUM STRIPE AS INFLUENCED BY WINTER WHEAT MANAGEMENT PRACTICES. R. X. Latin, R. W. Harder and M. V. Wiese, Department of Plant and Soil Sciences, University of Idaho, Moscow, Idaho 83843.

The incidence of *Cephalosporium* stripe was related to selected winter wheat management practices prevalent in the Palouse region of northern Idaho and eastern Washington in 1980. A study was conducted in field plots seeded in a split plot, split block experimental design. Management variables included rotation sequence, tillage method, cultivar, and the amount of nitrogen fertilizer applied. Disease incidence was measured at the early milk stage and expressed as the percentage of tillers exhibiting symptoms of *Cephalosporium* stripe. The greatest difference in stripe incidence occurred among rotation and tillage factors. The two-year, winter wheat/spring pea rotation showed higher disease incidence than the three-year rotations. Among tillage practices *Cephalosporium* stripe was most severe in no-till and progressively decreased in minimal and conventional tillage plots.

EFFECTS OF SO₂ ON LESION DEVELOPMENT BY *XANTHOMONAS PHASEOLI* IN RED KIDNEY BEAN. J. A. LAURENCE AND K. L. REYNOLDS, BOYCE THOMPSON INSTITUTE AT CORNELL UNIVERSITY, ITHACA, NY 14853.

Two cultivars of bean (*Phaseolus vulgaris* L. cv. 'California Lite Red Kidney' and 'Redcloud') were exposed in controlled environmental chambers, to 0, 260, or 520 µg m⁻³ SO₂ for 6 h on each of 5 days before and/or after inoculation with ≈ 10⁹ CFU of *Xanthomonas phaseoli* (3² factorial experiment). Exposure to SO₂ did not result in foliar injury in either cultivar. Redcloud plants were more susceptible to the pathogen than were California Lite Red Kidney beans, but there were no interactions between cultivars and SO₂ treatments. Post-inoculation exposure caused the latent period to be lengthened and resulted in smaller lesions relative to plants that were not exposed to SO₂. Pre-inoculation exposure was not effective in inhibiting lesion development, but there was a significant pre-x post-inoculation exposure interaction: 260 µg m⁻³ SO₂ before inoculation increased the effectiveness of the 520 µg m⁻³ post-inoculation exposure in inhibiting lesion development.

A LABORATORY SCREENING PROCEDURE FOR RESISTANCE IN CORN AFLATOXIN PRODUCTION. E.L. Lauer, and O.H. Calvert, Dept. of Plant Pathology, University of Missouri, Columbia, MO 65211.

A laboratory procedure to screen *Zea mays* lines for resistance to aflatoxin production was evaluated. Surface sterilized (2% chlorox for 2 min) kernels of aflatoxin-free corn lines (B73Ht, Molt7Ht, and A634Ht) that had been grown in Iowa were inoculated with conidia from *Aspergillus flavus* (NRRL 3357 and 4665) and *A. parasiticus* (NRRL 2999 and 3145). Water to bring the kernel moisture content to 25-28% was added with the inoculum and the kernels were tumbled for 24 hr for thorough mixing. The inoculated kernels then were divided into 100g lots and placed in unsealed Ziploc bags and incubated for 14 d at 32 C, dried, ground, extracted in acetone, purified by binding to a C₁₈ cartridge and analyzed for aflatoxin B₁ level by high pressure liquid chromatography (reverse phase). Also at 14 d 200 kernels were surface sterilized and plated on potato dextrose agar to determine the percentage of infected kernels. High aflatoxin production and kernel infections were consistently obtained.

ISOELECTRIC FOCUSING OF PROTEIN EXTRACTED FROM *MELOIDOGYNE* SPECIES. Edgar C. Lawson III and George E. Carter, Jr., Dept. of Plant Pathology and Physiology, Clemson University, Clemson, SC 29631.

Isoelectric focusing is a very sensitive method for separation of proteins from complex mixtures. It is an electrophoretic separation technique which separates by the migration of charged molecules to their specific isoelectric points in a continuous pH gradient. This technique is being evolved as a means for identifying *Meloidogyne* species. The total soluble proteins are extracted from nematode eggs and analyzed on the isoelectric focusing apparatus. Currently four species and several races of *Meloidogyne* are being investigated with this technique. The protein banding patterns produced by the isoelectric focusing of the nematode egg proteins demonstrate that this method can be used to differentiate between *Meloidogyne* species.

ACTIVE SPORE DISCHARGE IN DONNY MILDEWS. C. M. LEACH, Department of Botany and Plant Pathology, Oregon State University, Corvallis, Oregon, 97331.

The generally accepted explanation for violent discharge of spores (sporangia) by downy mildew postulates a hygroscopic mechanism. Rapid twisting of sporangiothecia in response to humidity changes is supposed to mechanically fling spores into the air. To assess the validity of this mechanism, spore discharge by *Peronospora destructor* on onions was observed visually and recorded photographically using special illumination. Sporangia were consistently propelled into the air along trajectories that were at right angles (approx.) to the leaf's surface irrespective of orientation to gravity. The flights of spores, whether from the same or different sporangiothecia, were always roughly parallel. These results cannot be explained on the basis of a hygroscopic mechanism. The pattern of spore discharge by *P. destructor* is essentially the same as that reported for *Drechlera turcica* and other fungi, for which an electrostatic mechanism has been proposed. Spore discharge by *P. destructor* is triggered by humidity changes, exposure to infrared radiation and vibration, similar to *D. turcica*.

RELATIONSHIP OF HUMIDITY, INFRARED RADIATION AND VIBRATION TO SPORANGIUM LIBERATION BY *PERONOSPORA DESTRUCTOR*. C. M. Leach, P. Hildebrand and J. C. Sutton. Oregon State University, Corvallis, Oregon (1st author) and University of Guelph, Guelph, Ontario, Canada.

The effects of relative humidity (RH), red-infrared radiation (IR) and vibration on sporangium discharge were analysed under controlled conditions with air flow (0.5m/sec.) and temperature (17-18C) kept constant. In darkness, any lowering of RH from saturation triggered sporangium liberation with reductions at lower humidity levels (e.g. below 59%) most effective. Raising the humidity from a lower level to a higher level, or back to saturation, also triggered sporangium discharge though it was generally much less than liberation caused by comparable decreases of RH. Brief exposures to IR (1 min.) induced sporangium discharge with greatest release for exposures at low humidities, though some discharge occurred even at saturation. Sporangia were also liberated by vibration. Numbers of sporangia liberated by vibration was directly related to humidity level and also the presence or absence of IR. Sporangiothecium development required a minimum of 6 to 8h at 17.5 C (RH 100%) before sporangia were "ripe" for discharge.

HETEROKARYON INCOMPATIBILITY IN *BIPOLARIS MAYDIS* (HELMINTHOSPORIUM MAYDIS). J. Leach and O. C. Yoder, Dept. Plant Pathology, Cornell University, Ithaca, NY 14853.

Auxotrophic mutants were crossed with field isolates from Australia, Mexico, Illinois, and New York. Five to ten auxotrophic progeny of each cross were tested for ability to form heterokaryons when paired on minimal medium with complementary auxotrophic tester isolates. In some cases, all progeny were incompatible with the tester, whereas in others, there was segregation of incompatibility and compatibility, although segregation ratios did not permit a determination of the number of loci involved. The mating type locus did not act as a heterokaryon incompatibility locus and segregated independently of heterokaryon incompatibility. After a second backcross generation there was single gene segregation for heterokaryon incompatibility in some crosses but not others. *B. maydis* apparently has several loci controlling heterokaryon incompatibility. If so, asexual recombination is probably rare in nature.

NOVEL PROTEINS IN TOBACCO LEAVES TREATED WITH BACTERIAL LIPO-POLYSACCHARIDE. J. E. Leach, J. A. Kempe and L. Sequeira. Dept. of Plant Pathology, Univ. of Wisconsin, Madison, WI 53706

The acquisition of generalized, systemic resistance in tobacco, following inoculation with viruses or fungi, has been reported to result in changes in the soluble protein composition of leaves. Generalized resistance is also induced by infiltrating tobacco leaves with bacterial lipopolysaccharide (LPS). We have investigated the soluble protein content of *Nicotiana tabacum* cv. "Bottom Special" leaves after infiltrating with LPS from *Pseudomonas solanacearum*. Proteins were extracted from leaves with 0.1 M acetate buffer (pH 3.6) and 0.25 M NaCl and then separated by polyacrylamide gel electrophoresis. Several novel proteins were found in the protected leaves, but these did not comigrate with the "b-proteins" extracted from leaves infected with tobacco necrosis virus or tobacco mosaic virus (strain 1952-D).

RESPONSE OF FIVE MAJOR SOIL-BORNE POTATO PATHOGENS TO HERBICIDES UTILIZED IN POTATO CROP MANAGEMENT SYSTEMS. S. S. Leach and C. Gordon. N.E. Plant, Soil and Water Laboratory, USDA, SEA/AR, Orono, Maine 04469

The response of five major soil-borne potato pathogens; *Rhizoctonia solani*; *Fusarium* sp.; *Helminthosporium solani*; *Verticillium albo-atrum*; and *Alternaria solani* to linuron, metribuzin, dinoseb, paraquat, EPTC, and dalapon was determined by fungal growth on herbicide amended media of herbicides alone and in all combinations. Soils to which field rates of herbicides were applied were tested for effect on fungal growth to a depth of 50mm in 5mm increments. None of the herbicides tested *in vitro* increased the growth rate of the fungi; and only dinoseb prevented growth of all fungi. Linuron reduced, and the dalapon and paraquat combination stopped growth of *R. solani* after 96 hrs. All combinations of herbicides applied at field rates except dalapon and metribuzin reduced fungal growth. Where the herbicides were applied to soil, inhibitory action was only found with dinoseb. Dinoseb acted as a soil sterilant in the top 10mm; and at depths below this a normal soil microflora was observed.

RICE SHEATH BLIGHT RESPONSE TO FOLIAR FUNGICIDE APPLICATION. F.N. Lee and M.L. Courtney. Univ. of Arkansas Rice Research and Extension Center, P.O. Box 351, Stuttgart, AR 72160

Rice sheath blight, caused by *Rhizoctonia solani*, is an impor-

tant rice disease worldwide. Response to foliar fungicide applications for sheath blight control are often erratic under apparently similar disease conditions. In inoculated field tests, average yield reductions were 2.13 mt/ha for the highly susceptible variety Lebonnet and 1.4 mt/ha for the more tolerant variety Starbonnet. In the same tests, 2 foliar applications of fentin hydroxide (0.54 kg/ha ai) resulted in a yield increase of 1.81 mt/ha for Lebonnet and 1.04 mt/ha for Starbonnet, representing 84% and 92% recovery of losses due to sheath blight, respectively. Comparable applications of benomyl (0.56 kg/ha ai) produced an increased yield of 1.02 mt/ha (47%) of Lebonnet and 0.45 mt/ha (38%) of Starbonnet. Two applications of thiabendazole (0.42 kg/ha ai) resulted in an increased yield of 0.70 mt/ha (32%) for Lebonnet and 0.13 mt/ha (9%) for Starbonnet.

SPIROPLASMA CITRI AND THE CLOVER LEAF-ASSOCIATED AGENT IN SIEVE ELEMENTS ISOLATED FROM INFECTED PLANTS OF PERIWINKLE (CATHARTUS ROSEUS). I.-M. Lee, Department of Plant Pathology, Cook College, Rutgers University, New Brunswick, NJ 08903; and R. E. Davis, Plant Virology Lab, PPI, SEA, USDA, Beltsville, MD 20705.

Sieve elements of periwinkle infected with *Spiroplasma citri* or clover club leaf (CCL) agent were isolated by differential centrifugation of cell debris resulting from partial digestion of plant tissue with macerating enzymes. From few to as many as several hundred motile helical cells, individual or in large clusters, could be seen by dark field microscopy in a single sieve element from a plant infected with *S. citri*. Cells of *S. citri* remained motile for at least 7 days in isolated sieve elements maintained at 4°C in near isotonic buffered solution. Numerous non-motile rod-shaped or short filamentous bacterial cells were observed in sieve elements isolated from plants with CCL disease. The method offers a means for studying morphology and other properties of viable cells of uncultivated as well as cultivable pathogens in sieve elements.

ARTIFICIAL INFECTION OF OPENED AND UNOPENED COTTON BOLLS BY AN AFLATOXIN-PRODUCING STRAIN OF *ASPERGILLUS FLAVUS*. L. Lee, A. Ciegler, M. Klich, T. Jacks, and T. Hensarling, Southern Regional Research Center, USDA, P.O. Box 19687, New Orleans, LA 70179.

Aspergillus flavus, a fungal infectant of field cotton, can elaborate carcinogenic aflatoxins in the seed and kojic acid in the lint of closed bolls. Kojic acid is enzymatically oxidized to a blue-green-yellow fluorescent derivative (BGYP) by peroxidase on lint in closed bolls. Boll maturity optimal for formation of BGYP and aflatoxin is not known. Field inoculations with *A. flavus* were made on unopened bolls 20, 25, and 35 days post anthesis and harvested at 3-day intervals from 2 to 40 days post inoculation. The BGYP derivative was detected on the fiber at each stage of boll development, but seed from the mature bolls proved the best substrate for aflatoxin elaboration. Laboratory inoculations of mature opened bolls showed that at 100% humidity *A. flavus* can invade the seed without formation of BGYP on the lint and with formation of toxins in a few seeds. BGYP is, therefore, formed only in closed bolls, whereas, aflatoxin may be produced in closed and opened bolls.

COMPARISON OF RADIOIMMUNOSORBENT ASSAY AND ENZYME LINKED IMMUNOSORBENT ASSAY FOR DETECTION OF RICKETTSIALIKE BACTERIA AND CITRUS TRISTEZA VIRUS. R. F. Lee, L. W. Timmer¹, D. E. Purcifull², and S. M. Garnsey³, Univ. of Florida, IFAS, AREC, Lake Alfred 33850¹, ²Univ. of Florida, Dept. of Plant Pathology, Gainesville 32611, and ³AR-SEA-USDA, Orlando, FL 32803.

A radioimmunosorbent assay (RISA) was developed for detection of rickettsialike bacteria (RLB) and citrus tristeza virus (CTV) and compared to the enzyme linked immunosorbent assay (ELISA). The double-antibody sandwich procedure was used. Purified immunoglobulins were adsorbed to polystyrene beads. The beads were washed and incubated in the test sample, washed again and incubated with either ¹²⁵I- or alkaline phosphatase-labeled immunoglobulins. The amounts of ¹²⁵I-immunoglobulin bound to the beads were proportional to the amount of RLB or CTV in the sample. The RISA was as sensitive as ELISA for detection of CTV and 10 to 100 times more sensitive for detection of RLB. Quantitative comparisons were easier with RISA as compared to ELISA.

EFFECTS OF HELMINTHOSPORIUM SACCHARI (HS) TOXIN ON NON-GREEN TISSUES AND A RE-EXAMINATION OF TOXIN BINDING. M.S. Lesney, R. S. Livingston, and R.P. Scheffer, Dept. of Botany and Plant Pathology, Michigan State University, East Lansing, MI 48824.

Green leaves, etiolated shoots and roots from susceptible clones of sugarcane were equally sensitive to toxin. Comparable tissues of resistant clones were not affected. Others have suggested that HS toxin may have tissue specificity, and that chloroplasts are required. Our results indicate no tissue specificity, and no requirement for functional chloroplasts. Equilibrium dialysis of ¹⁴C toxin against tissue homogenates and membrane preparations gave no indication of toxin binding. Membrane preparations from susceptible and resistant tissues were then mixed with ¹⁴C-toxin and fractionated on gel columns. There was no indication of toxin binding to high mol wt fractions. A non-specific chem-luminescence sometimes gave false counts which could be mistaken as evidence for binding. This occurred with incompletely oxidized samples, or with samples not held in the dark before counting. The mode of action of HS toxin is still an open question.

ETIOLOGY AND CONTROL OF RADISH SCAB. D. R. Levick, C. T. Stephens, and M. L. Lacy. Department of Botany and Plant

An isolate of *Streptomyces* sp. cultured from scabbed radishes produced typical scab lesions on radishes grown in artificially infested muck soil, and was reisolated from these lesions. Abundant white to gray aerial hyphae were produced in culture, along with variable amounts of pigment in the substrate. SEM observations revealed straight sporophores and smooth to slightly ridged spores ca. 0.6 X 1.0 μ m. None of 29 radish cultivars was highly resistant to scab, however, disease incidence was consistently lower in white cultivars. Neither acidification of soil with sulfur or $AlSO_4$, nor the addition of minor elements to soil was effective in reducing scab. A PCNB drench (28 kg a.i./ha) one week after planting significantly reduced scab. High soil moisture levels during the first half of the growing period were strongly correlated ($r=-.93$) with low scab incidence. Irrigated plots (water potential >-0.6 bars) had 50% less scab than non-irrigated plots (water potential <-1.8 bars).

CHLAMYDOSPORE FORMATION BY TRICHODERMA SPECIES. J. A. Lewis and G. C. Papavizas. USDA, SEA-AR, Beltsville, Maryland 20705.

Trichoderma spp. are known to produce chlamydo-spores, but these propagules are not used taxonomically and their role in survival of *Trichoderma* spp. in soil has not been determined. Various isolates and UV light-induced mutants of *T. harzianum* and *T. viride* readily formed terminal and intercalary chlamydo-spores in submerged cultures. Quantity, size (7-10 μ m), and location (terminal and/or intercalary) of chlamydo-spores in hyphae varied with the isolates used. Chlamydo-spores, separated from dried or frozen mycelium, germinated readily when placed on agar media. Conidia of *Trichoderma* spp. exposed to sterile soil extract (pH 4.5) for 1 wk rapidly converted to chlamydo-spores; and these were approximately 80% less in volume than those produced on mycelium grown in submerged cultures. Conidia of *T. harzianum* and *T. viride* placed in contact with nylon mesh containing hyphae of *Rhizoctonia solani* formed chlamydo-spores in association with lysis of pathogen mycelium. The importance of chlamydo-spores in ecology, survival, and applicability of *Trichoderma* as a biological control agent will be discussed.

HYPOXYLON SPP., GANODERMA LUCIDUM, AND AGRILUS BILINEATUS IN ASSOCIATION WITH DROUGHT RELATED OAK MORTALITY IN THE SOUTH. R. Lewis, Jr. South. For. Exp. Sta., P. O. Box 227, Stoneville, MS. 38776.

A high incidence of drought-related oak mortality was observed in 1978 and 1980. The principal species affected were: *Quercus nigra* and *Q. phellos* in Arkansas and Mississippi, *Q. falcata* in Texas, and *Q. laurifolia* in Florida. During the 1980 summer drought, 85% mortality was observed in a 200-ha stand in east central Arkansas. Mortality was less frequent in other stands. *Hypoxylon* spp. were observed on 95% of the dead trees and those with dieback. *Ganoderma lucidum* was found on dead and dying trees with root decay in Arkansas, Mississippi, and Florida. The borer, *Agrilus bilineatus*, made trunk girdling galleries in many affected oaks in Arkansas. Trees were not examined for borers at other locations. Oak mortality in the South is triggered by drought but borers and hypovirulent canker and root decay fungi appear to be contributing factors.

SAPROPHYTIC DEVELOPMENT OF PYTHIUM ULTIMUM IN SOIL AS A FUNCTION OF WATER MATRIC POTENTIAL AND TEMPERATURE. R. Lifshitz and J. G. Hancock, Department of Plant Pathology, University of California, Berkeley, California 94720.

Populations of *Pythium ultimum* increased in a sandy loam soil amended with fragments (ca. 1mm²) of mature (green) cotton leaves directly in relation to matric potentials (ψ_m) between -5 and -0.25 bars at 16, 21 and 27C. Saprophytic development of *P. ultimum* was not detected in water saturated soil or in soil incubated above 32C. Optimal temperatures for population development on leaf fragments were between 18 and 21C in natural soils and between 21 and 30C in radiation sterilized soils. The latter temperatures (21 to 30C) are similar to those found for optimal linear growth in culture. Evidence was obtained which suggests that antagonistic microflora play a key role in limiting the activities of *P. ultimum* in soil at temperatures between 21 and 30C, and thus shifting the optimum for growth and development to between 18 and 21C.

PROPERTIES OF COWPEA RUGOSE MOSAIC VIRUS. A.A. dos Santos, M.T. Lin, and E.W. Kitajima. Inst. of Biol. Sci., Univ. Brasilia, 70910 Brasilia, DF, Brazil.

Cowpea rugose mosaic virus infected mechanically 6 of 11 species in Leguminosae, 3 *Chenopodium* spp., and *Gomphrena globosa*, but not anyone of 15 species in Solanaceae, Compositae, Cruciferae, Euphorbiaceae, and Graminae. *Myzus persicae* and *Aphis nerii*, but not *A. coreopsidis*, *A. citricola*, *Dactynotus* sp., and *Hyperomyzus* sp., transmitted the virus in a stylet-borne manner. The virus had a particle length and *in vitro* physical properties typical of potyviruses and was capable to induce pinwheel inclusions in infected cells. A specific antiserum to this virus was produced. In SDS-immunodiffusion tests, this virus was shown to be serologically related to, but distinct from, cowpea green vein-banding virus and unrelated to blackeye cowpea mosaic, bean common mosaic, bean yellow mosaic, soybean mosaic, watermelon mosaic-I and turnip mosaic viruses.

NEW SEROTYPES OF COWPEA SEVERE MOSAIC VIRUS. M.T. Lin, E.W. Kitajima, and C.L. Costa. Inst. Biol. Sci., Univ. of Brasilia, 70910 Brasilia, DF, Brazil.

Two isolates of cowpea severe mosaic virus (CPSMV), CPSMV-Arkansas of U.S.A. and CPSMV-Bean of Brazil, were shown to be serologically distinct from the previously described serotypes I and II of the virus in Central Brazil and were designated as serotypes III and IV, respectively. Besides serological distinction, serotype III was different from the other serotypes by being able to cause chlorotic spots in *Nicotiana tabacum* 'TNN' and serotype IV was unique in not being able to induce local lesions in *Chenopodium amaranticolor*. Some cytological differences in cells infected with serotype III or IV were observed by electron microscopy. Two species of beetle, *Ceratomyza arcuata* and *Diabrotica speciosa*, transmitted serotype IV from bean to bean.

DISSEMINATION OF BACTERIA, INCLUDING PSEUDOMONAS SYRINGAE, IN A BEAN PLOT. J. Lindemann, D. C. Army, S. S. Hirano and C. D. Upper*. Department of Plant Pathology and *AR, SEA, USDA, University of Wisconsin, Madison, WI 53706.

Vertical flux, ie. upward movement, of viable bacteria was estimated from the differences between bacterial aerosol concentrations (measured with Andersen samplers) and wind speeds at two heights in a ca. 0.8 ha bean plot. A net upward movement of bacteria (ca. 250-450 CFU m⁻²s⁻¹) occurred during dry, sunny weather. At the same times, deposition onto nutrient glycerol agar in petri plates at canopy height was 10-20 CFU m⁻²s⁻¹, which is equivalent to 10²-10⁴ viable bacteria per day deposited onto an area the size of a bean leaflet. A rifampicin-resistant strain of *P. syringae* pathogenic to bean (R10) was present on the leaves, was detected in the air, and was deposited onto agar. R10 constituted up to 1% of the total CFU deposited. Light rain increased the deposition rate about 10 fold, but did not change the fraction that was R10. If the number of hours of dry weather is greater than 10 times the number of hours of rain, then dry deposition may be quantitatively important for the dissemination of *P. syringae*.

EPIPHYTIC PSEUDOMONAS SYRINGAE POPULATION SIZE GREATER THAN A THRESHOLD LEVEL IS PREDICTIVE OF BROWN SPOT INCIDENCE ON SNAP BEANS. J. Lindemann, D. C. Army and C. D. Upper*. Department of Plant Pathology and *AR, SEA, USDA, University of Wisconsin, Madison, WI 53706.

The epiphytic populations of *P. syringae* pathogenic to bean (Psb) on symptomless bean leaflets (*Phaseolus vulgaris* cv. Eagle) differed at a series of sites in central Wisconsin planted with the same seedlot. At flowering time, the apparent threshold population requisite for infection was 10⁴ Psb CFU/g fresh weight since brown spot was not observed at seven sites where epiphytic Psb populations remained below this level. At four other sites, the probability that Psb populations exceeded the threshold varied from 0.14 to 0.80; brown spot incidence varied from 3.6% to 39.5%. Incidence one week after flowering (y) was predicted from the incidence at flowering (x) and the probability that Psb exceeded the threshold (z) by $y = b \times (1 - \frac{z}{100})$. Disease incidence was significantly correlated with predicted incidence ($r^2=0.92$, $r=0.96$, $p<0.05$).

USE OF DIGITAL VIDEO IMAGE ANALYSIS IN PLANT DISEASE ASSESSMENT. S. E. Lindow and R. R. Webb, Department of Plant Pathology, University of California, Berkeley, CA 94720

The area of lesions caused by *Altereria solani* and *Phytophthora infestans* on tomato, *Septoria apii* on celery, *Ascochyta peridum* on bracken fern and total leaf area were quantitated non-destructively by means of computer controlled video digitizing hardware. Leaves were scanned with a black and white video camera equipped with a red ($\lambda > 620$ nm) filter. Basic and machine language programming in an Apple II computer equipped with a video analog to digital converter was used to address and digitize 16,232 individual pixels each into one of 64 values. Digitized picture elements were grouped according to magnitude into three categories corresponding to black background, healthy, and necrotic tissue. Algorithms utilizing a correction for background variation allowed reproducibility to $\pm 1\%$ in successive measurements. Individual measurements and statistical analysis of results required 8.6 sec. Estimated total and necrotic leaf areas differed from areas measured with a planimeter by less than 2.0% and 2.5% respectively.

RHIZOCTONIA CEREALIS CAUSING SHARP EYESPOT OF WHEAT IN OHIO. Patrick E. Lipps and Leonard J. Herr. Department of Plant Pathology, Ohio Agricultural Research and Development Center, Wooster OH 44691.

Binucleate *Rhizoctonia*-like fungi were isolated from wheat culms with typical sharp eyespot lesions. Initially, three isolates were tested for pathogenicity on Era spring wheat grown in the greenhouse. By maturity, inoculated culms developed sharp eyespot lesions and "white heads" typical of the disease. Subsequently, 25 isolates were paired with binucleate anastomosis tester isolates of groups CAG 1-7. Hyphal anastomosis occurred between CAG 1 (*Rhizoctonia cerealis*) and the 25 wheat isolates. A seedling assay was developed to test for differences in pathogenicity among isolates. Plants were grown in a growth chamber at 10 C with 10 hr light (1,500 lux) per day for 4 weeks. Pathogenicity ratings for the 25 isolates ranged from 2.0 to 4.3 (0=no symptom, 5=dead plant). Mean rating for tester CAG 1 was 4.0 and CAG 2-7 were non-pathogenic (0.05-0.2). Results confirm

that *R. cerealis* was the cause of sharp eyespot symptoms on wheat in Ohio.

INTRADERMAL AND INTRAMUSCULAR INJECTION FOR RAISING ELISA ANTISERA. R. M. Lister, J. Hammond and D. Clement, Dept. Botany and Plant Pathology, Purdue University, W. Lafayette, Indiana 47907

In two experiments with paired rabbits, intradermal injections of a "PAV-like" isolate of barley yellow dwarf virus raised antisera that were similar in precipitin titres but were distinctly superior in ELISA activity to antisera raised by intramuscular injections. However, similar experiments with cowpea mosaic virus did not indicate such differences. In all cases, tests of successive bleeds indicated that the ELISA activity of antisera continued to increase for a period of 70-90 days after the first injection, whereas titres as measured by gel-diffusion tests increased for only about one-half of this period. The results confirm the superiority of relatively late bleeds for use in ELISA, and also suggest that intradermal injection is worth investigation in preparing ELISA antisera.

FUNGAL PRODUCTS CHEMICALLY RELATED TO HELMINTHOSPORIUM SACCHARI TOXIN PROTECT SUGARCANE TISSUES FROM THE TOXIN. R. S. Livingston and R. P. Scheffer, Dept. of Botany and Plant Pathology, Michigan State University, East Lansing, MI 48824.

Five compounds were purified to near-homogeneity from culture filtrates of the fungus. One compound is the host-selective toxin which contains at least five galactose units and a sesquiterpene. The other four compounds, called noxins, were isolated by procedures similar to those used for the toxin. Each noxin contained the sesquiterpene, yet differed from the toxin and from each other by the number of galactose units. Toxin caused loss of electrolytes from susceptible but not from resistant sugarcane leaf disks; the noxins did not induce electrolyte loss. Pre-treatment of leaf disks with noxin-1 (the one most similar to toxin in structure) at 100 µg/ml reduced by > 95% the loss of electrolytes induced by toxin (2.5 µg/ml). The other noxins have fewer galactose units than does noxin-1, and were less effective in protecting tissues against toxin.

SURVEY OF COMMERCIAL CARNATION CULTIVARS FOR FOUR VIRUSES IN CARNATIONS USING INDIRECT ELISA. S. A. Lommel, A. H. McCain and T. J. Morris, Department of Plant Pathology, University of California, Berkeley, California 94720.

An indirect ELISA technique was employed to survey for carnation ringspot virus (CRSV), carnation mottle virus (CaMoV), carnation yellow fleck virus (CYFV) and carnation etched ring virus (CERV) in commercial carnations throughout California. A total of 226 samples were collected from 31 locations. The statewide incidence of CaMoV was 78%, CYFV 13%, CERV 15% and CRSV 0%. Of the samples surveyed, 21% contained a mixture of two or more of these viruses, which is the important factor for growers, because significant yield loss occurs when two or more viruses infect a sample. The statewide average of virus-free plants was 18%. The survey samples were derived from 7 propagation sources. Carnations from different propagators varied widely in the incidence of the tested viruses. This data suggests that initial infection of commercial carnations occurs at the propagator level, and only limited spread occurs in production greenhouses, with the exception of CaMoV.

EVALUATION OF INDIRECT ELISA FOR THE DETECTION OF TWO CARNATION VIRUSES. S. A. Lommel, A. H. McCain and T. J. Morris, Department of Plant Pathology, University of California, Berkeley, California 94720.

An indirect ELISA test was compared to the standard sandwich ELISA test for the detection of carnation ring spot virus (CRSV) and carnation mottle virus (CaMoV) in carnations. The indirect test proved to be more sensitive than the sandwich test for virus detection and offered the advantage of simplicity. The indirect ELISA utilizes an anti-IgG-enzyme conjugate, which is commercially available, thus avoiding the necessity of manufacturing a specific enzyme conjugate. Precoated plates are unnecessary, allowing for direct application of the sample to the wells. Antiserum for each antigen to be detected need not be purified and coupled to enzyme, thus eliminating an important lab-to-lab variable. Crude antiserum can be utilized although it should be cross-absorbed to prevent spurious host protein reactions. Interference and enhancement phenomena were observed when the indirect test was utilized for virus detection in crude plant extracts. These phenomena prevent the determination of quantitative amounts of virus antigen in crude plant extracts.

FACTORS AFFECTING ANTIBIOSIS OF PLANT-GROWTH PROMOTING RHIZO-BACTERIA. J. E. Loper and M. N. Schroth, Department of Plant Pathology, University of California, Berkeley, CA 94720.

Plant growth-promoting rhizobacteria (PGPR) were screened for siderophore and bacteriocin production *in vitro*. Addition of trypsin to overlay medium containing an indicator strain reversed bacteriocin antibiosis but not siderophore antibiosis. Addition of 10^{-4} M FeCl₃ to overlay medium reduced sensitivity of indicator to siderophores but not to bacteriocins. Several rhizobacterial strains produced both siderophores and bacteriocins. Siderophore production was temperature sensitive; growth of many strains was inhibited on low iron medium below 12°C or above 33°C. Growth inhibition at temperature extremes was reversed by addition of 10^{-6} M FeCl₃ or purified siderophore to the medium. Siderophore production by PGPR strains B10 and B4 at 33°C was only 9.2% and 13.5% respectively, of that at 28°C. Temperature range permitting siderophore production dif-

fered among rhizobacterial strains. Greenhouse experiments indicated both bacteriocins and siderophores affect plant growth-promoting capabilities of these rhizobacteria.

LESION TYPE, SURFACE AREA, AND PERCENT INFECTION OF COMMON SCAB OF POTATOES IN RELATION TO DISEASE ASSESSMENT. ROSEMARY LORIA Long Island Horticultural Research Laboratory, Cornell University, Riverhead, NY 11901.

In New York, resistance of potato (*Solanum tuberosum*) is evaluated in naturally infested field plots. Scab infection on 40 tubers from each 10-hill plot is scored according to surface area covered with lesions and lesion type. These values are used to calculate disease severity ratings for each cultivar. Every test plot is paired with a Chippewa plot, which is also rated for disease severity and used as a susceptible standard to evaluate disease pressure. Relationships between average surface area of scab lesions (SA), lesion type (LT), and percent infected tubers (PI) were evaluated for 1980 test cultivar and Chippewa plots. SA was correlated to the PI of test cultivars ($r = .79$) and Chippewa ($r = .65$). LT was also correlated with the PI of test cultivars ($r = .94$) and Chippewa ($r = .68$). SA of both Chippewa ($r = .93$) and the test cultivar ($r = .80$) was strongly related to LT.

SOLID STREAM INOCULA FOR TRANSMISSION OF MAIZE DWARF MOSAIC VIRUS. Raymond Louie and J. K. Knoke, USDA-SEA-AR, Ohio Agricultural Research and Development Center, Wooster, OH 44691.

Solid stream inocula formed by solid stream nozzle tips (SSN) was significantly more efficient than aerosol inocula formed by an artist airbrush in transmission of maize dwarf mosaic virus (MDMV). In one test, inoculum (1:20, w/v) applied from a distance of 10 cm using a SSN with a 0.7 mm diameter opening and 2.1, 4.2, 6.3, 8.5, 10.6, and 12.7 kg/cm² resulted in 65, 81, 82, 93, 96, and 96% transmission, respectively. Artist airbrush applied inoculum (4.2 kg/cm²) resulted in 23% transmission. When the same inoculum was applied with the aid of 600-mesh silicon carbide, the percentage transmission values for SSN ranged from 87 to 100 but were not significantly different ($P=0.05$) from each other or from the 88% transmission for an artist airbrush. Inoculation with an artist airbrush requires consistent digital dexterity but SSN is more tolerant of user's variation. Inoculation time with SSN is ca. 1/3-1/5 that of artist airbrush.

ULTRASTRUCTURAL EFFECTS OF TAGETITOXIN, A CHLOROSIS-INDUCING TOXIN FROM PSEUDOMONAS SYRINGAE PV. TAGETIS, ON WHEAT ETIOPLASTS. J. H. Lukens and R. D. Durbin. Dept. of Plant Pathology and AR, SEA, USDA, UW-Madison, Madison, WI 53706

Pseudomonas syringae pv. *tagetis* causes apical chlorosis in its natural Compositae hosts—marigold, sunflower and ragweed—through the action of a nonhost-specific exotoxin, called tagetitoxin. Purified toxin produces apical chlorosis in nonhosts such as zinnia, mustard, radish, cucumber and wheat. Etioplasts in the leaf apices of 5-day-old, dark-grown, toxin-treated wheat seedlings (cv. Lathrop) differ from etioplasts of control leaves in that they lack the normal extensive internal membrane development, including the paracrystalline prolamellar body and primary thylakoids. Instead, toxin-treated etioplasts contain a mass of osmiophilic plastoglobuli. Although the envelope appears intact, plastids are abnormal in shape, having irregular outlines and frequent invaginations. Mitochondria and other organelles do not appear to be affected by the toxin. Similar light-independent effects on developing plastids were observed in 4-day-old dark-grown cucumber cotyledons.

INFECTIVITY TITRATIONS OF PSEUDOMONAS SOLANACEARUM ON TOMATO. K. Y. Lum, and A. Kelman, Malaysian Agric. Res. and Dev. Inst., Serdang, Selangor, Malaysia, and Dept. of Plant Pathology, University of Wisconsin, Madison, WI 53706.

Bacterial wilt resistance of tomato lines and virulence of Race 1 isolates of *Pseudomonas solanacearum* were determined by infectivity titrations. Inoculations were made by the insertion at a leaf axil of one capillary pipette/plant with 20 plants/inoculum level; inoculum doses ranged from 10^8 to 10^1 CFU. Probit analysis of quantal responses of tomato lines to isolate FLA9 (from Florida) gave ED₅₀ values of 1.5×10^2 for susceptible Bonny Best and 7.6×10^3 for the resistant cultivar Venus. Eight isolates from diverse geographic regions differed significantly in virulence to Bonny Best and resistant FP5, BWN21 and Venus. ED₅₀ values of isolates from certain geographic locations generally were higher for lines developed at the same location than for those from other sources. Probit regression lines for the isolate with the lowest ED₅₀ value for a particular cultivar had steeper slopes than those for other isolates.

SUPPRESSION OF PATHOGENS IN SOILS FROM TRADITIONAL MEXICAN AGRICULTURAL SYSTEMS. R. D. Lumden, J. A. Lewis, R. Garcia-E., and G. A. Friás-T., USDA, SEA-AR, Beltsville, MD 20705, Colegio Postgraduados, Chapingo, MX, and C.S.A.T., Cardenas, MX.

Incidence of disease in three soils from a still-practised Aztec agricultural system [Chinampa without disease (CH/S), with disease (CH/C) and Chapin (CH)] was compared to that in soil from Chapingo (CHA) under modern agricultural practice. The soil CH/C was located near CH/S but was no longer cultivated by Aztec agricultural methods. Also, a soil from a Mayan system [Popal (POP)] was compared to a modern agricultural soil from Tabasco, Mexico (TAB). At 20 C, there was less damping-off of radish seedlings caused by natural inoculum in soils CH/S, CH, and POP than in soils CH/C, TAB, or CHA. Likewise the same

three suppressive soils repressed activity of added inoculum of *Pythium aphanidermatum* on radish and *Sclerotium rolfsii* on tomato at 32°C. Added inoculum of *Rhizoctonia solani* caused less disease of thiram-treated radish seed in soils of the traditional Aztec and Mayan agricultural systems than in comparable soil types under modern agricultural cultivation.

PEANUT WEB BLOTCH: SYMPTOMS AND FIELD PRODUCTION OF INOCULUM. E. S. Luttrell, Dept. of Plant Path., Univ. of Georgia, Athens 30602, and D. H. Smith, Texas A&M Univ., TAES, Yoakum 77995.

Tamnut 74 and Florunner peanuts were planted in alternate rows in 3 x 3-m plots. Initial inoculum was introduced by placing a 15-cm pot of infected seedlings in the center of each plot. Secondary cycles of infection occurred throughout the season from ascospores produced on dead leaves. All reported symptoms developed on both cultivars. Superficial netting and web blotch predominated. A few necrotic spots with pycnidia developed in October. Mature ascocarps developed in 2 weeks on detached infected leaflets in screen wire envelopes on the ground or suspended in the canopy. Leaflets placed in laboratory moist chambers produced only pycnidia. Fewer ascocarps and pycnidia were produced on Tamnut 74 than on Florunner. The fungus, *Didymosphaeria arachidicola* (Chochrjakov) Alcorn, Punithalingam & McCarthy, belongs in the genus *Didymella*. The conidial state belongs in the genus *Ascochyta* in the traditional sense as *A. adzamethica* Schoschiaschwili or, according to Boerema's concept, in *Phoma* as *P. arachidicola* Marasas, Pauer & Boerema.

PATHOGENS OF ICE PLANT IN CALIFORNIA. J. D. MacDonald, J. R. Hartman* and J. D. Shapiro. Department of Plant Pathology, University of California, Davis, CA 95616 and *Department of Plant Pathology, University of Kentucky, Lexington, KY 40546

Ice plant (*Carpobrotus* spp.) is commonly grown in California as a ground cover, and in many areas, plantings of all ages have shown symptoms of decline which include wilting, yellowing, or death of individual plants or large patches of plants. *Pythium* and *Phytophthora* species were isolated from plants growing in poorly drained soils and having symptoms of cortical root decay and lower stem and crown rot. On many plants with one or more wilted branches, *Phomopsis* sp. was isolated from stem cankers associated with an orange discoloration in cambial tissue. *Verticillium dahliae* was isolated from stems of severely wilted plants collected in Southern California. Greenhouse inoculations have confirmed the pathogenicity of each of these fungi to ice plant. To date, no plant pathogenic bacteria, mycoplasmas, or viruses have been associated with diseased ice plants, and work is in progress to determine whether nutrient imbalances have a role in the decline syndrome.

WEATHER MONITORING INSTRUMENTATION FOR PLANT DISEASE MANAGEMENT PROGRAMS AND EPIDEMIOLOGICAL STUDIES. W. E. MacHardy, Department of Botany and Plant Pathology, University of New Hampshire, Durham, NH 03824.

Battery-operated field instrumentation has been developed which combines a digital rain gauge, a leaf wetness indicator, and a hygrothermograph in one unit. The instrumentation has several characteristics considered essential for the programs being developed in New Hampshire: low-construction cost, low-maintenance, simplified design and technology, durability, reliability, and flexibility (adaptable to orchard and field crop conditions). An important feature is a visual record of the temperature, relative humidity, duration of leaf wetness, and rain-intensity and distribution on one chart. This allows these weather variables to be examined and assessed in the field either individually or as they interrelate. In addition, the instrumentation can be wired to activate a spore trap or other device during periods of leaf wetness.

A CABBAGE DISEASE CAUSED BY A *XANTHOMONAS* SP. AT LOW TEMPERATURES. M. Mahmud and L. L. Black, Dept. Plant Path. & Crop Physiol., La. State Univ. Agric. Expt. Sta., Baton Rouge, LA 70803.

Market Prize cabbage grown during the winter of 1977-78 in South Louisiana exhibited disease symptoms which included necrotic lesions on the leaf margin, circular necrotic lesions on the leaf lamina, and dark necrotic leaf veins. A bacterium, *Xanthomonas* sp., was isolated from the lesions and shown to be the causal agent. Cultural, morphological, and biochemical tests suggested that this bacterium is similar to *X. campestris*, the black rot pathogen. Studies in controlled environment chambers showed that this disease develops on plants held at 18°C or below following inoculation, while plants held at 23°C or above develop small, localized necrotic spots around hydathodes and stomata. Inoculation of field grown cabbage in the winter of 1980-81 showed that disease severity varies among cultivars. The disease described differs from typical black rot in that no chlorosis is associated with the lesions, this pathogen invades stomata, and disease development occurs only at low environmental temperatures.

CHARACTERIZATION OF THE HOST-SPECIFIC TOXIN PRODUCED BY HELMINTHOSPORIUM SACCHARI, THE CAUSAL ORGANISM OF EYESPOT DISEASE OF SUGARCANE. V. Macko, Boyce Thompson Institute, Tower Road, Ithaca, NY 14853; and D. Arigoni and W. Acklin, Department of Organic Chemistry, Swiss Federal Institute of Technology, Universitätsstrasse 16, CH-8006 Zürich.

Detailed investigation of the host-specific toxin complex from

H. sacchari has led to the isolation and characterization of three isomeric glycosidic components $C_{29}H_{40}O_{22}$ (mol. weight 884), each active at 2×10^{-11} moles. The three isomers are built from four β -galactofuranoside units and a bicarbo-cyclic doubly unsaturated aglycone $C_{15}H_{24}O_2$; they differ in the location of one double bond in the sesquiterpene moiety. Two minor toxins (< 1% of active complex) and some related non-toxic components are also present. These results differ considerably from those reported by Steiner and Strobel (J. Biol. Chem., 246, 4350, 1971); they are also at variance with the more recent claims by Scheffer and Livingston and Livingston and Scheffer (Phytopath., 70, 400, 1980; Phytopath., 71, 237, 1981), according to which there is only one active form of the toxin composed of galactose residues and a $C_{15}H_{24}$ fragment.

PHOMOPSIS CANKER OF RUSSIAN-OLIVE. H. Maffei, H.L. Morton and D.C. Etz. University of Michigan, Ann Arbor, MI 48109.

In SE Michigan, 53 of 100 mature Russian-olive trees (*Elaeagnus angustifolia*) were found to contain cankers. *Phomopsis elaeagni* caused 98% of these and *Tuberularia ulmea* caused 2%. Of the *P. elaeagni* isolates, 15 were randomly chosen for field and greenhouse mycelial inoculations in order to prove pathogenicity and study disease development. All 15 isolates caused typical disease symptoms and were subsequently reisolated. Of the trees inoculated during leaf-flush, 1/3 wilted above the inoculation site without producing a canker. Those inoculated during the growing season formed sunken, spreading cankers often with pycnidia around the margins. One month after inoculation, average canker length, by isolate, ranged from 24 to 100 mm. To study conidial production, three light regimes and six media were tested. In the dark, no spores were produced; in intermittent light, large stroma and conidia in tendrils were produced; and in continuous light numerous small stroma without tendrils were produced. PDA, V-8, and NA supported more fruiting than CMA, MA, or Russian-olive agar.

INFESTATION OF POTATO TUBERS BY *ERWINIA CAROTOVORA* FROM SOIL. E. A. Maher, A. Kelman, and S. H. De Boer, Department of Plant Pathology, University of Wisconsin-Madison, Madison, WI 53706, and Agriculture Canada, Vancouver, B.C. V6T 1X2.

Prior to planting, selective media and enrichment techniques were used to detect soft-rotting *Erwinia* in soil from a field planted with potatoes for eight consecutive seasons and on the Russet Burbank and Norgold Russet seed potatoes used to plant test plots. Low to moderate levels of *Erwinia carotovora* subsp. *carotovora* (Ecc) strains (serotypes V, XV, XIII, and untyped strains) were detected in three of four seedlots. Ecc serotypes III, XII, XXIX, and untyped strains were isolated from the soil. By mid-July, *Erwinia* infection of stems ranged from 16.6 to 50.0 percent, but was not correlated with infestation of seedlots. The serotype most common in isolations from soil, XXIX, was also the strain obtained most frequently in stem isolations. At harvest, isolations from daughter tubers yielded serotypes III, V, XV, XVI, XXIX, and untyped strains; however, serotype XXIX and the untyped strains were the predominant isolates obtained.

RESPONSE OF *LIRIODENDRON TULIPIFERA* L. TO LONG TERM LOW CONCENTRATION FUMIGATION WITH O_3 , SO_2 , AND NO_2 SINGLY AND IN COMBINATION. M. J. Mahoney, J. M. Skelly and B. I. Chevone. Dept. of Plant Path. & Phys., VPI & SU, Blacksburg, VA 24061.

Five week old yellow poplar seedlings were fumigated in Continuous Stirred Tank Reactors 6 hr/day for 34 consecutive days with O_3 (.07 ppm), SO_2 (.06 ppm) and NO_2 (.10 ppm). Treatments included O_3 , SO_2 , O_3+SO_2 , $O_3+SO_2+NO_2$ and charcoal filtered air. Trees were measured weekly to determine height increases, and dry weights were measured following fumigation termination. Height growth and dry weight of trees receiving $O_3+SO_2+NO_2$, O_3+SO_2 and SO_2+NO_2 treatments were retarded compared with control trees after 34 days. Height growth and dry weights were increased, however, in trees receiving SO_2 alone. Trees receiving O_3 alone did not differ appreciably from control trees. Height growth and dry weights of trees subjected to SO_2 , O_3 control, $O_3+SO_2+NO_2$, O_3+SO_2 and SO_2+NO_2 treatments were 258.5 mm and 5.7g, 241.8 mm and 5.0g, 245.2 mm and 4.4g, 107.8 mm and 2.9g, 121.3 mm and 2.4g, and 86.0 mm and 2.2g, respectively.

DEGRADATION OF CARBOHYDRATES BY HORSE SERUM AND SERUM FRACTION IN MYCOPLASMA CULTURE MEDIUM. K. M. Malloy and T. A. Chen. Dept. of Plant Pathol., Rutgers Univ., New Brunswick, NJ 08903.

Horse serum (HS) and serum fraction (SF) at concentrations used in media to study carbohydrate utilization patterns of mycoplasmas degraded certain carbohydrates. HS (final conc. 25% v/v) heated to 80°C for 5 min, 56°C for 50 min, or unheated, was tested against starch, maltose, sucrose and trehalose (final conc. 1% w/v). After incubation at 30°C for 0, 12, 24, 48 and 72 hrs products were separated by paper chromatography. Starch and maltose were degraded to glucose, and the conc. of glucose appeared to increase with time in the unheated and 56°C HS. The 80°C HS showed a slight amount of glucose after 48 hrs. Sucrose was slightly degraded by the unheated and 56°C HS but not by the 80°C HS. Trehalose showed no degradation by any of the three HS treatments. Two-fold dilutions of SF with 1% solutions of the four carbohydrates (30°C for 72 hrs) showed substantial degradation to glucose at the highest dilution (1:128) for starch, maltose, and trehalose; some sucrose was degraded at lower dilutions (1:32).

DETECTION OF BENOMYL-RESISTANT *MONILINIA LAXA* ON APRICOTS. J. M. Ogawa, B. T. Manji, and E. A. Bose. Department of Plant Pathology, University of California, Davis, CA 95616.

Benomyl has been recommended for brown rot blossom blight control in apricots since 1972. In most orchards it is applied at the red bud stage of bloom, but in some a second application is made at full bloom; only a few orchards are sprayed preharvest. Periodically since 1972, resistance of *M. laxa* to benomyl has been monitored. In July 1980, *M. laxa* resistant to 1.0 µg/ml benomyl was isolated for the first time from apricot fruit and later from sporodochia on blighted apricot twigs. These isolates behave differently from benomyl-sensitive *M. laxa* in that only 30-65 percent of the conidia which germinate grow on Difco potato-dextrose agar. The fitness of benomyl-resistant isolates to survive in nature is being studied.

CUMULATIVE EFFECTS OF CHRONIC AND ACUTE OZONE INJURY AND NATURAL SOIL ON EARLY GROWTH AND ROOT DISEASE INCIDENCE IN THREE TOMATO CULTIVARS. W. J. Manning, C. M. Becker, D. R. Cooley, and P. D. Vineis, Dept. of Plant Pathology, University of Massachusetts, Amherst, MA, 01003.

Seedlings of tomato cultivars Bonny Best (BB), Fantastic (F), and Tiny Tim (TT) were transplanted at the second true-leaf stage into pots of steamed (S) soil or non-steamed (NS) soil and placed in two plastic greenhouses. The air in one was charcoal-filtered (CF) and in the other CF plus 0.06 to 0.08 ppm ozone (O₃) for 6 hrs./day, 5 days/week for 8 weeks. The O₃ concentration was increased to 0.12 ppm for one hour each week. Foliar injury was the same regardless of soil with F and TT plants severely injured and BB plants moderately injured. Plants grown in NS soil were generally taller in both CF and O₃ than in S soil. Fresh weights of shoots and fruits and root fresh and dry weights were usually reduced for plants in NS soil in CF and further reduced in O₃. Reddish root lesions, caused by *Pythium* and *Fusarium* were most severe for plants from NS soil from CF, especially for F plants.

CUMULATIVE EFFECTS OF CHRONIC AND ACUTE OZONE INJURY ON EARLY GROWTH AND FRUITING OF EIGHT TOMATO CULTIVARS. W. J. Manning, C. M. Becker, D. R. Cooley, and P. D. Vineis, Dept. of Plant Pathology, University of Massachusetts, Amherst, MA, 01003.

Seedlings of tomato cultivars Bonny Best (BB), Fantastic (F), Floramerica (FL), Heinz 1439 (H), Jet Star (JS), Tiny Tim (TT), Waltham Nema-Resistant (WNR), and Waltham Ozone-Resistant (WOR) were transplanted into pots of steamed soil and placed in two plastic greenhouses. The air in one greenhouse was charcoal-filtered (CF) and in the other CF plus 0.06 to 0.08 ppm ozone (O₃) for 6 hrs./day, 5 days/week for 8 weeks. The O₃ concentration was increased to 0.12 ppm for one hour each week. Severe injury occurred on F, TT, and WNR; moderate to severe on FL, H, and JS; moderate on BB; and slight to moderate on WOR. Avg. plant heights were increased by O₃ for all, except H and WOR. Top fresh weights were not changed by O₃ for WOR and H, reduced for BB, FL and JS, and greatly reduced for F, TT, and WNR. O₃ reduced fruit set for all except WOR. Avg. fruit weights were greatly reduced by O₃ for BB, F, FL, TT, and WNR, decreased for JS, but not for H and WOR.

SCANNING ELECTRON MICROSCOPY OF *ASPERGILLUS FLAVUS* INFECTION OF CORN SILKS. S. F. Marsh and G. A. Payne. Dept. of Plant Pathology, N. C. State University, Raleigh, NC 27650.

Penetration and colonization of corn silks by *Aspergillus flavus* were examined using scanning electron microscopy (SEM). Silks from ears at four stages (unpollinated, milk, dough, dent) were examined 4, 8, and 24 hr after inoculation. The few conidia that germinated on unpollinated silks failed to colonize the silks. Conidia on milk stage silks germinated in 4 to 8 hr and extensively colonized the silks, especially near pollen grains where thick hyphal mats produced numerous conidiophores. Conidia germinated on silks from dough and dent stage ears but hyphal growth was sparse and without conidiophores. Germ tubes either penetrated directly within a few micrometers of the conidia or continued growing across the silk where they 1) remained on the surface, 2) penetrated indirectly through cracks and intercellular gaps, or 3) penetrated directly. Internal colonization by *A. flavus* was restricted to parenchymatous tissue. These internal hyphae showed little branching with growth almost exclusively oriented parallel to the silk axis.

CHLOROTETRACYCLINE AND IN SITU LOCALIZATION OF CALCIUM IN BARLEY PAPILLAE INDUCED BY *ERYSIYPHE GRAMINIS HORDEI*. M. R. Marshall, J. R. Aist and H. W. Israel, Department of Plant Pathology, Cornell University, Ithaca, NY 14853.

Energy dispersive X-ray microanalysis of microsurgically isolated barley papillae (Kunoh, Aist and Israel, unpublished) has indicated that preformed papillae, resistant to penetration by *Erysiphe graminis hordei*, sequester high levels of calcium (Ca⁺⁺); but normal papillae, not resistant to penetration, do not. Neither the distribution of Ca⁺⁺, nor discrimination between constituent and contaminant Ca⁺⁺ are afforded by this technique. Chlorotetracycline (CTC) chelates Ca⁺⁺ in living tissues, yielding a CTC-Ca⁺⁺ complex that fluoresces bright yellow under ultraviolet illumination. When barley coleoptiles containing papillae were incubated in 10⁻⁴ M CTC for 30-45 min, rinsed and examined by epifluorescence microscopy, preformed papillae fluoresced yellow throughout; normal papillae, however, did not. These results indicate that Ca⁺⁺ is located through-

out preformed papillae, and correlate elevated Ca⁺⁺ content with resistance to fungal penetration.

RELATIONSHIP BETWEEN SOIL SALINITY AND POPULATION DENSITY OF *PYTHIUM ULTIMUM* IN THE SAN JOAQUIN VALLEY OF CALIFORNIA. F. N. Martin and J. G. Hancock, Department of Plant Pathology, University of California, Berkeley, California 94720.

Soil from sites in an agricultural area in the San Joaquin Valley of California which did not support saprophytic colonization by *Pythium ultimum* (Low P. *ultimum* soils, LP) were found to have higher concentrations of soluble salts (in particular Na⁺ and Cl⁻) and exchangeable Na⁺ than soils which did support saprophytic colonization (High P. *ultimum* soils, HP). When HP soils were amended with NaCl to provide concentrations of Na⁺ equal to those found in LP soils, the frequency of colonization and the amount of reproduction occurring in colonized leaf fragments was reduced. Leaves in LP soils had a high frequency of colonization by *Pythium oligandrum* and other primary colonizers. There was a negative correlation (r=-0.56) between colonization by P. *oligandrum* and P. *ultimum*. The combined effects of soil salinity and P. *oligandrum* are apparently responsible for the suppressiveness of certain soils toward P. *ultimum* in the study area.

HORIZONTAL DISTRIBUTION AND CHARACTERIZATION OF RHIZOCTONIA-LIKE FUNGI IN TALL FESCUE TURF. S. B. Martin, L. T. Lucas, and C. L. Campbell. Department of Plant Pathology, North Carolina State University, Raleigh, NC 27650.

A 20.9 M² area of tall fescue with a history of brown patch, caused by *Rhizoctonia solani*, was divided into 225 quadrats and sampled in June 1980. Samples consisting of five soil cores (2.0 cm X 5.0 cm deep) were removed from each quadrat and the total organic debris separated by elutriation. Debris, separated by wet sieving and ranging from 250 to 1700 µm, was suspended in 1.5% water agar (50 C) in petri dishes and incubated 24-48 hr at 25 C. Plates were examined microscopically (40-160X) and pieces of debris yielding *Rhizoctonia*-like fungi (RLF) were counted. Colony numbers ranged from 0 to 4.27 per cm³ of soil, and propagule frequency distribution was described by the negative binomial (k=3.94) and the Neyman A distributions indicating moderate clumping of inoculum. Fifty-five isolates from debris indicated *R. solani* to be less numerous (9%) than multinucleate *Rhizoctonia zeae*-like fungi (44%) and binucleate RLF (38%). Two trinucleate RLF and three unidentified RLF were also isolated.

REACTIONS OF *RHIZOCTONIA SOLANI* AND *RHIZOCTONIA*-LIKE FUNGI TO SELECTED FUNGICIDES. S. B. Martin, C. L. Campbell, and L. T. Lucas, Department of Plant Pathology, North Carolina State University, Raleigh, NC 27650.

Isolates of *Rhizoctonia solani*, binucleate *Rhizoctonia*-like fungi (RLF), and multinucleate *Rhizoctonia zeae*-like fungi (RZF) from ladino clover roots and tall fescue that were pathogenic on tall fescue and *R. solani* anastomosis group (AG) tester-isolates were tested for fungicide inhibition of colony radial growth. Benomyl, carboxin, and PCNB were mixed in 70% ethanol and added to 1.5% PDA (50 C) to give concentrations of 0, 1, 10, and 100 mg a.i./L. Growth of AG 1, 3, and 4 tester-isolates and RLF were inhibited by 10 and 100 mg a.i. benomyl/L., but inhibition by carboxin and PCNB at similar concentrations was variable. The AG 2 tester-isolate was inhibited 96 and 100% at 10 and 100 mg a.i. carboxin/L., but was inhibited less by benomyl and PCNB at these concentrations. PCNB was the least effective fungicide tested against RLF and *R. solani* isolates. In contrast, RZF were inhibited less by benomyl than by carboxin or PCNB.

ULTRASTRUCTURAL CHANGES ASSOCIATED WITH TIPBURN DEVELOPMENT IN HEAD LETTUCE. C. Matyac and I. J. Misaghi, Department of Plant Pathology, University of Arizona, Tucson, AZ, presently Department of Plant Pathology, University of Minnesota, St. Paul, MN 55108.

In early stages of tipburn development in lettuce (*Lactuca sativa* var. *capitata* 'Calmar') the plasmalemma was separated from the cell wall in parenchyma cells. In more advanced stages of tipburn, the plasmalemma and membranes of organelles in parenchyma cells progressively degenerated. Ruptured laticifers were found occasionally in tissue only in advanced stages of disease. Thus, the physical change in membranes is probably the initial event in tipburn development and that no role, or only a secondary role, can be assigned to rupture of laticifers in the initiation of tipburn. The ultrastructural changes observed were similar to those changes observed in other plant species subjected to calcium deficient conditions which supports the suggestion that tipburn in head lettuce is a result of calcium deficiency.

BACTERIAL MOSAIC DISEASE ON SPRING WHEAT AND TRITICALE IN ALASKA. J. H. McBeath, Agricultural Experiment Station, University of Alaska, Fairbanks, Alaska 99701; A. K. Vidaver, Department of Plant Pathology, University of Nebraska, Lincoln, Nebraska 68583; and R. L. Taylor, USDA-SEA-AR, Palmer, Alaska 99645.

A disease that causes mosaic type symptoms was observed on cultivars of spring wheat during the 1978, 1979 and 1980 growing seasons at the Palmer Research Center in southcentral Alaska. The severity of this disease varied from year to year, and a wide range of susceptibility was displayed by the spring wheat cultivars tested. In 1980, this disease was also observed on

triticale cultivars in the Delta-Clearwater area of interior Alaska. The severity of this disease on triticale was slight. A gram positive, rod-shaped, non-motile bacterium was found in diseased wheat tissues. This bacterium has been successfully grown on a medium selective for coryneform bacteria. Its characteristics in culture closely resemble *Corynebacterium nebraskense*. Results of inoculation tests indicate this bacterium is pathogenic to wheat plants. Evidence suggests that this disease can be transmitted by contaminated seeds.

ANALYSIS OF THE GENOMIC AND MESSENGER RNAs OF BARLEY STRIPE MOSAIC VIRUS. J. E. McFarland, G. D. Gustafson and A. O. Jackson, Purdue University, W. Lafayette, IN 47907, U.S.A.

RNAs extracted from barley stripe mosaic virus (BSMV) may be resolved by gel electrophoresis into 3 classes exemplified by the Type, North Dakota 18 (ND18), and Argentina mild strains with 2, 3, and 4 RNA components, respectively. Analysis with complementary DNA probes confirmed that RNAs of Type and ND18 have considerable sequence homology. Hybridization with recombinant DNA clones suggests that RNAs 1, 2, and 3 of ND18 share little sequence homology. RNAs 1 and 2 of Type have little homology, but the results suggest that RNA 2 of Type consists of 2 populations of RNA of the same size but different sequences. One population presumably has sequence homology with RNA 2 of ND18 and the other with RNA 3 of ND18. These studies also reveal the presence of a low molecular weight RNA (3×10^5) found in small amounts in BSMV preparations. The complementary DNA and recombinant DNA probes are also being used to identify BSMV messenger RNAs.

REPRODUCTION OF THE PINWOOD NEMATODE, *BURSAPHELENCHUS LIGNICOLUS*, ON *GLOCLADIUM VIRENS*, AN OCCASIONAL INHABITANT OF PINE TISSUE. E. C. McGawley and J. P. Jones, Dept. Plant Path. & Crop Physiol., La. State Univ. Agric. Expt. Sta., Baton Rouge, LA 70803.

Of twenty-eight genera of fungi isolated from *Bursaphelenchus lignicola* (BL) infested pine trees and tested for their ability to support nematode reproduction, 13 were non-hosts, 8 were poor hosts, 6 were good hosts, and 1, *Glocladium virens* (GV), was an excellent host. The growth and sporulation of GV colonies resulting from transfer of 4-mm-d plugs to the center of 90-mm-d PDA plates containing 10,000 BL was significantly reduced below that of controls at 16, 20, and 24°C. At each temperature, inhibition of fungus growth is first apparent at 48 hr after inoculation and is due to feeding by larvae of BL. Nematode-infested colonies of GV exhibit a marked appressed and irregular growth habit with dark brown to black mycelium. Hyphal cells are swollen with thick, dark walls much like chlamydospores. Population increase of BL over a 10-day period ranged from a 3-fold increase at 16°C to a 15-20-fold increase at 24°C.

EFFECTS OF TWO SPECIES OF VESICULAR-ARBUSCULAR MYCORRHIZAL FUNGI ON THE DEVELOPMENT OF FUSARIUM WILT OF TOMATO. A.-C. McGraw and N. C. Schenck, Department of Plant Pathology, University of Florida, Gainesville, FL 32611.

In greenhouse experiments, mycorrhizal or nonmycorrhizal tomato (cv Manapal) seedlings or uninoculated seeds were planted into pots containing infested or uninoculated autoclaved field soil (available phosphorus=34-45 µg/g). Treatments having infested soil contained chlamydospores of either *Glomus etunicatus* or *G. mosseae* at 0.1, 0.5, or 1.0 propagule per gram of soil (ppg) and/or of *Fusarium oxysporum* f. sp. *lycopersici* race 2 at 500 ppg. Mycorrhizal *Fusarium*-inoculated plants exhibited earlier onset of chlorosis and wilt than nonmycorrhizal *Fusarium*-inoculated plants, regardless of inoculum level or species of mycorrhizal fungus. Similar results were obtained whether seedlings or seeds were used. These results indicate that mycorrhizal fungi can enhance the development of *Fusarium* wilt of tomato.

LOCATION OF TOBACCO RINGSPOT VIRUS IN ROOTS OF SOYBEAN. L. A. Markham and J. M. McGuire, California Dept. Agric., 865 W. Napa St., Sonoma, CA., 95476 and Dept. of Plant Pathology, PS 217, University of Arkansas, Fayetteville, AR 72701

Tobacco ringspot virus occurred in all segments of soybean taproots up to 26 mm from the root apex and two wk after mechanical inoculation of primary leaves. Particles were observed in all root tissues except xylem vessels and epidermis. Two to 16 mm from the root apex, complete and empty particles were often embedded in proteinaceous globular structures excreted into the central vacuoles from the cytoplasm. Virus particles in the central vacuole also occurred as paracrystalline arrays, aggregates or scattered particles. Paracrystalline arrays in vacuoles were composed of complete particles, empty shells, or both intermixed. Tubules with virus particles aligned in rows extending through plasmodesmata and/or particles clumped within plasmodesmata were observed infrequently in all root segments. Twenty-four to 26 mm from the root apex, virus was most often found scattered in the vacuole. At 0-2 mm, the virus particles seen were usually in plasmodesmata.

INFECTION OF A TOBACCO LEAF WITH *PERONOSPORA HYOSCYAMI*. W. E. McKeen and A. M. Svircev, Department of Plant Sciences, The University of Western Ontario, London, Canada N6A 5B7.

In a suitable environment the multinucleate conidium of *Peronospora hyoscyami* de Bary begins to germinate immediately. If the conidium is placed on a susceptible tobacco leaf it produces a short lateral germ tube and a club-shaped appressorium

which is surrounded by slime, but on glass and media the germ tube becomes long and branched. As the germ tube and appressorium develop the protoplasm moves out of the conidium. A penetration tube emerges from the bottom of the appressorium and passes through a narrow hole in the epidermal wall, usually near an anticlinal wall, sometimes within 2 hr after inoculation. All the cytoplasm from the conidium and most of the cytoplasm from the appressorium flows into a spherical vesicle, prior to formation of a large plug in the penetration tube. The vesicle which is surrounded by host cytoplasm then produces a lobulate hypha or a secondary vesicle which may send branches into adjoining host cells prior to growing through the lower wall of the infected cell. Infection may be completed in 3 hr.

FUSARIA ASSOCIATED WITH WATERMELON SEED. R. McLaughlin and R. D. Martyn, Department of Plant Sciences, Texas A&M University, College Station, TX 77843.

Twenty-two commercial watermelon seed lots, representing at least six varieties, were examined for the presence of *Fusarium*. *Fusarium* spp. were isolated from eight lots. *Fusarium* was also isolated from seeds obtained from watermelons grown on soil naturally infested with *Fusarium oxysporum* f. sp. *neivum*. Isolations were made from surface sterilized seeds, aseptically dissected for separate plating of cotyledons and seed coats on Komada selective medium. Emergent colonies were single-spored prior to identification on Riddell slides. All isolates were identified as *F. moniliforme*, *F. oxysporum*, or *F. solani*. Fourteen isolates were tested for ability to cause wilt or damp-off in seedlings of watermelon and six other vegetables and for ability to cause wilt in 3-wk-old watermelon plants. Plant debilitation was noted in some plants inoculated with some of the *F. moniliforme* and *F. oxysporum* isolates; however, true vascular wilting was not repeatedly observed with any isolate.

PROTEIN SYNTHESIS IN *XANTHOMONAS VESICATORIA* DURING COMPATIBLE AND INCOMPATIBLE INTERACTIONS WITH *CAPSIDUM ANNUUM*. Michael E. Meadows and R. E. Stall, Department of Plant Pathology, University of Florida, Gainesville, Florida 32611.

Protein synthesis (PS) was determined by measuring incorporation of a ^{14}C -amino acid mixture (^{14}C) into a trichloroacetic acid (TCA)-precipitable material. Electrical conductivity and the amount of intercellular ^{14}C (TCA-soluble radioactivity) were determined simultaneously with PS. Three inoculation and measurement routines were followed. Bacteria were hypodermically injected simultaneously with ^{14}C into the intercellular spaces of pepper leaves and the bacteria removed at hourly intervals to determine PS, or bacteria were injected as before but thoroughly washed before PS was measured, or bacteria were injected without ^{14}C and then exposed to ^{14}C for 5 minutes after removal from leaves before determinations of PS. A comparison of PS in compatible and incompatible interactions revealed no significant differences. We concluded from these results that if bacterial cells are metabolically activated in an incompatible interaction, such "stimulation" is not accompanied by a measurable increase in PS.

THE USE OF COMPARATIVE CYCLOHEXIMIDE SENSITIVITIES FOR THE DIFFERENTIATION OF *ENDOTHIA GYROSA* FROM *E. PARASITICA*. J. A. Micales and R. J. Stipes, Dept. Plant Pathol. & Physiol., Virginia Tech, Blacksburg, VA 24061

The differential sensitivities of *Endothia parasitica* and *E. gyrosa* to cycloheximide can be used to distinguish the species chemotaxonomically. The radial growth of specimen-vouchered isolates of *E. gyrosa* was inhibited 40-60% at 0.01 µg/ml and ceased at 2 µg/ml when the antibiotic was incorporated into 0.5% glucose-0.1% yeast extract-1.5% agar. The growth of *E. parasitica* decreased 6-25% at 1 µg/ml, while traces of fungal growth were detected at 50 µg/ml. A similar trend was observed when conidia-inoculated broth was used. *Endothia gyrosa* was slightly more resistant to cycloheximide, since 2 µg/ml of the compound caused a 38-52% reduction in growth; this level of inhibition occurred with *E. parasitica* at ca. 25 µg/ml. The differential sensitivities to cycloheximide are a simple and effective means of separating the two species.

A TECHNIQUE FOR ISOLATION OF *MACROPHOMINA PHASEOLINA* FROM SOIL. J.D. Mihail and S.M. Alcorn, Plant Pathology Dept., Univ. of Arizona, Tucson, 85721

A technique was developed for the assay of *M. phaseolina* sclerotia in soil using a selective medium consisting of potato dextrose agar (39g/l), bacto-agar (10g/l), chloroneb (as Demosan 65 WP, 100 ppm a.i.) and streptomycin sulfate (250 ppm). The chemicals were dissolved in sterile distilled water and added after autoclaving. Selected soils were crushed through a 2-mm sieve. One-25g of soil were mixed, in 250 ml of 0.525% NaClO in a blender three times for 30 sec at 3 min intervals. With distilled water, this mixture was washed through a 45µ sieve; residue was backwashed into a 250 ml flask to which 100 ml of molten selective medium was added. The mixture was poured into five-six petri dishes and incubated at 31-32°C in the dark. *M. phaseolina* colonies, derived from as few as one sclerotium per gram of soil, were identified in 3-5 days by a ring of fluffy, white mycelium surrounding a central area with black sclerotia. Although several genera of fungi grew on this medium, the early rapid growth of *M. phaseolina* permitted its assay.

REUSING UNATTACHED MDMV-A ANTIBODY-ENZYME CONJUGATE IN THE ENZYME-LINKED IMMUNOSORBENT ASSAY. M.A. Mikel, Cleora J. D'Arcy, and R.E. Ford, Dept. of Plant Path., Univ. of Ill., Urbana 61801

Reuse of the unattached maize dwarf mosaic virus strain A (MDMV-A) γ -globulin-enzyme conjugate in enzyme-linked immunosorbent assay (ELISA) was studied. Polystyrene microtitre plates were coated with MDMV-A γ -globulin at 0.5 μ g/ml. MDMV-A conjugate used at a dilution of 4 μ l/ml detected 50 but not 25 ng/ml purified MDMV-A. The methods of Bar-Joseph et al (Plant Dis. Repr. 63:204-206) were followed. The absorbance at 405 nm after 1, 2, 3, or 4 transfers of γ -globulin-enzyme conjugate through wells containing MDMV-A sap was 54.9, 28.6, 16.4, and 13.7%, respectively, of fresh conjugate in MDMV-A sap wells. Following 1, 2, 3, or 4 transfers of conjugate through wells containing healthy sap, subsequent transfers to MDMV-A sap wells resulted in absorbance at 405 nm of 108.0, 88.1, 74.8, and 73.4%, respectively, of fresh conjugate in MDMV-A sap wells. It seems practical to reuse unattached MDMV-A conjugate recovered from positive or negative ELISA wells, however best results were obtained from conjugate in negative wells.

Patterns of natural fungal infection in a population of *Plantago lanceolata*. Helen L. Miller, Dept. of Botany, Duke University, Durham, N.C. 27706

To implement successful biocontrol of weeds with pathogens, the extent of environmentally and/or genetically based variation in disease susceptibility within the plant population should be considered. This paper reports on natural infection by *Fusarium moniliforme* var. *subglutinans* in inflorescences of *Plantago lanceolata*. Though this research was not conducted for biocontrol purposes, it illustrates ways to examine disease impact in noncrop plants. Fewer and smaller seeds were produced in infected inflorescences than in noninfected inflorescences. Compared to healthy plants, infected plants were less likely to survive or flower in succeeding years. The number of inflorescences produced per plant, its flowering phenology, and its spatial location within the population affected a plant's probability of infection. Infection levels varied among 5 half sib families planted in the field which suggests a genetic component to susceptibility.

RESISTANCE IN 10 SPECIES OF AEGILOPS TO PUCCINIA GRAMINIS TRITICI. J. D. Miller, N. D. Williams and L. R. Joppa, Science and Education Administration, USDA, North Dakota State Univ., Fargo, ND 58105.

One hundred and thirty-nine accessions of 10 *Aegilops* species were tested for reaction to 8 stem rust cultures (*Puccinia graminis* Pers. f. sp. *tritici* Eriks. and E. Henn.) which had been classified for pathogenicity on 18 Sr gene lines. Low and high infection types (IT) were used to show similarity of genes for reaction. Low IT produced by all 4 cultures on 18 of the *Ae. triuncialis* lines, 9 *Ae. tauschii*, 5 *Ae. caudata*, 4 *Ae. ovata* and 1 *Ae. cylindrica* show that these lines may possess 1 or more genes similar to the 18 Sr genes; other comparisons indicate genes different from the Sr genes. Within a species the lines appear different in rust reactions, as shown in *Ae. tauschii* by the high IT produced by 1 culture and low IT by 3 cultures on 14 lines; high by 3 and low by 1 on 16 lines; high and low by combinations of paired cultures on 17 lines, and high IT produced by 4 cultures on 18 lines. A few lines of *Ae. triuncialis* appear to have no adult resistance as shown by resistant seedlings and susceptible adults.

THE RELATIONSHIP BETWEEN AGE AND POSITION OF ONION LEAVES AND SUSCEPTIBILITY TO PURPLE BLOTCH. Marvin E. Miller and Jose M. Amador. Texas Agricultural Experiment Station and Texas Agricultural Extension Service, Weslaco, Texas 78596.

Measurements of onion leaf tissue infected with *Alternaria porri* (Ell.) Cif. were taken at weekly intervals from the time of bulb initiation until bulb maturity to determine the relative susceptibility of a given leaf position over time. The percent of leaf tissue infected by *A. porri* varied according to the position of the leaf on the plant and the duration of time till maturity. Young leaves in the apical leaf positions had a significantly lower percent of tissue infected than did the older leaves on a given date in both field and growth chamber studies. As the plant approached maturity, the percent of tissue infected on a leaf in a given position was significantly greater than at the time of bulb initiation.

THE POSSIBLE USE OF BARLEY STRIPE MOSAIC VIRUS TO ASSAY FOR ANTIVIRAL COMPOUNDS. R. V. Miller, T. W. Carroll, and D. C. Sands, Dept. of Plant Pathology, Montana State University, Bozeman, MT 59717.

An assay for detecting antiviral agents is being developed using Barley Stripe Mosaic Virus (BSMV). To date, most of the potential agents tested have been shown by other investigators to have antiviral, antiplasmid, or antitumor activity. Antiviral combination studies have been based upon the agents mode of action. Synergistic effects and amplifying compounds (individually not exhibiting antiviral activity) are being studied. The assay consisted of solubilizing the test agent or agents in an aqueous solution of 10% dimethyl sulfoxide. BSMV infected Vantage barley seeds exhibiting 50% transmission were allowed to imbibe tenfold dilutions of each solution for 24 hr. prior to planting. After two weeks, the seedlings were assayed for reduced transmission rates and/or symptom severity. Preliminary results have been very encouraging for detection of antiviral agents.

HYPHAL DEVELOPMENT AND PHYTOALEXIN ACCUMULATION IN AN ALFALFA TISSUE CULTURE/PHYTOPHTHORA MEGASPERMA SYSTEM. S. A. Miller,

L. B. Graves, Jr., and D. P. Maxwell, Dept. of Plant Pathology, University of Wisconsin-Madison, Madison, WI 53706.

An alfalfa tissue culture system was used to study host and non-host resistance in alfalfa to *P. megasperma* f. sp. *medicaginis* (Pmm) and *P. megasperma* f. sp. *glycinea* (Pmg), respectively. Four-wk-old calli from breeding lines resistant (M194) or susceptible (M269) to Pmm, and resistant to Pmg, were inoculated with Pmm or Pmg. In the susceptible interaction (M269/Pmm), the top half of calli were covered with aerial mycelia within 48 hr, the underlying tissues were slightly discolored, and hyphae were present throughout the calli. Both host (M194/Pmm) and nonhost (M194/Pmg, M269/Pmg) resistant interactions were characterized by browning of the tissue and the absence of aerial mycelium. Colonization of M194 by Pmm was more extensive than colonization of M194 or M269 by Pmg, but less than in the susceptible interaction. Concentrations of the phytoalexin, medicarpin, in colonized tissue were determined by high performance liquid chromatography.

MYCOFLORA OF LEAVES, PODS AND SEED FROM UNTREATED AND BENOMYL-TREATED SOYBEANS. W. A. Miller and K. W. Roy, Dept. of Plant Path. and Weed Sci., Miss. State Univ., Mississippi State, MS 39762.

Leaves, pods and seed from different positions on untreated and benomyl-treated soybean plants were sampled periodically during two growing seasons and their mycoflora determined. Fifty-five fungal taxa, 11 previously unreported from soybeans, were isolated. Some of the most frequent isolates, in order of prevalence, were: *Alternaria alternata*, *Diaporthe phaseolorum* var. *sojae* and *Phoma* spp. from leaves; *D. phaseolorum* var. *sojae*, *A. alternata* and *Fusarium* spp. from pods; and *Fusarium* spp., *D. phaseolorum* var. *sojae* and *A. alternata* from seed. Frequencies of many of the more prevalent fungi usually increased in plant tissues throughout the sampling period, while frequencies of others often decreased. Some fungi were consistently associated with organs located at certain plant positions. Incidence of most fungi decreased, but incidence of some increased following benomyl treatment; these increases and decreases were greatest in lower plant positions.

VIRUS DISEASES OF BURLEY TOBACCO IN TENNESSEE. Deborah S. Millsap, M. R. McLaughlin, C. H. Hadden, and P. P. Hunter. Department of Entomology and Plant Pathology, University of Tennessee, Knoxville, TN 37916.

Burley tobacco plants were surveyed for virus diseases in Tennessee from July through September, 1980. Leaves collected from ten diseased plants in each of 34 counties were ground in 0.1 M Tris-HCl buffer, pH 9.0, with a mortar and pestle and sap was tested by agarose gel double diffusion with antisera prepared to alfalfa mosaic virus (AMV), tobacco etch virus (TEV), tobacco mosaic virus (TMV), tobacco ringspot virus (TRSV), tobacco vein mottle virus (TVMV) and potato virus Y (PVY). The most prevalent viruses detected were TVMV, TEV, and TRSV, found in 25, 23, and 19 counties, respectively. Potato virus Y was identified in six counties and TMV and AMV in one county each. Double infections of TRSV with TVMV, TRSV with TEV, and TVMV with TEV were also detected. Two TVMV isolates from Tennessee were serologically distinct from a North Carolina isolate (TVMV-NC 148, obtained from Guy Gooding, Raleigh, NC).

IDENTIFICATION OF MUCOR MUCEDO AS A POSTHARVEST PATHOGEN OF FRESH MARKET TOMATO. H. E. Moline, Horticultural Crops Quality Lab and P. D. Millner, Biological Waste Management and Organic Resources Lab, USDA, SEA-AR, Beltsville, MD 20705. A shipment of Mexican winter tomatoes arrived at the Baltimore wholesale market with 60-80% decay. A previously unreported *Mucor* sp., *M. mucedo*, was isolated from the decayed fruit. Mature green and red tomatoes were inoculated with the isolate and while it grew slightly faster on red fruit, it completely rotted all inoculated fruit within 3-4 days at 20 C. Sporulation was inhibited on green fruit and was variable on red fruit with more surface growth and sporulation at high relative humidity. Optimal growth of the fungus occurred at 20-25 C with no growth at 30 C and minimal growth at 0 C. The isolate differs significantly from *Mucor piriformis* previously reported from peaches and pears, and *M. circinelloides* reported from tomatoes.

RESPONSE SURFACE MODELS FOR COMMON RUST OF CORN. P. S. Teng and P. E. Montgomery, Department of Plant Pathology, University of Minnesota, St. Paul, MN 55108.

The relationship between yield loss and disease severity at various crop development stages is a response surface. For sweet corn rust caused by *Puccinia sorghi*, we used response surface methodology designs in 1980 to obtain field data for modeling. Treatments were unreplicated plots with different rust epidemics, obtained by spraying maneb and triadimefon. We compared plots and single corn plants for loss estimation. Rust severity on all leaves of sampled plants was assessed periodically during the season, and fresh weight, length and dry weight of cobs were measured after harvest. Models based on four growth stages and five leaf positions were investigated using fresh weight as the yield parameter. In all cases, single plant models had low r^2 and F values. Using plot data, several model types were satisfactory: % yield loss = f(severity at several growth stages for one leaf position), % yield loss = f(cumulative severity at several leaf positions for one growth stage) and % yield loss = f(severity, growth stage) at one leaf position.

MODELLING LOSSES TO FUSIFORM RUST IN LOBLOLLY PINE PLANTATIONS. K.E. Moore, Int'l Paper Co., P.O. Box 797, Tuxedo, NY 10987

An individual tree growth model (PTAEDA) developed at VPI was modified to reflect the effects of fusiform rust infection. The data base used was from the first 10 years of a heritability study in Bainbridge, Georgia, involving 9,600 trees. A probit analysis was employed to generate probabilities of mortality given year of infection for individual trees. Trees stem-infected by age 3 had a 60% probability of mortality. Trees infected before year 3 exhibited reduced growth relative to their uninfected full sibs. Several disease progress curves were tested for rust effects on yields from plantations. The model predicts that, in longer rotations (35 years), losses in standing volume will be recovered through increased growth of residual trees. Losses in cubic-foot volume are almost entirely reflected in reduced yields from thinning. At the time of crown closure (around age 10) many infected trees occupied codominant positions in the canopy, which would result in a high proportion of infected trees at rotation.

VERTICILLIUM WILT INFECTION RATES IN EGGPLANT AND THE INFLUENCE OF BLACK PLASTIC MULCHING. G. W. Moorman, University of Massachusetts, Suburban Experiment Station, 240 Beaver St., Waltham, MA. 02254.

In 1979 and 1980, commercial eggplant varieties were grown in a field infested with *Verticillium dahliae*. Thirty plants of each variety were mulched with black plastic film while 30 were grown without mulch. During 1979, the apparent infection rates of the mulched populations were consistently lower than rates in the populations on bare ground and yields were greatest in the mulched plants. During 1980 however, mulching did not consistently lower infection rates nor were yields greatly improved by mulching. Apparent infection rates ranged from 0.045 to 0.076 in 1979 and from 0.013 to 0.093 in 1980 depending on the variety and whether or not the plants were mulched. *Verticillium* wilt-infected eggplants generally produced half the yield of healthy plants. Infection rates and yield do not appear to be closely correlated.

FUNGICIDE TOXICITY TO JUNIPER CULTIVARS. L. S. Morrison, Dept. of Plant Pathology, Oklahoma State Univ., Stillwater, OK 74078.

Topical applications of sisthane 2 EC (0.6 ml/liter a.i.); sisthane 2 EC plus dithane M-45 80-W (1.44 g/liter a.i.); dithane M-45 80-W (1.44, 2.88, and 5.76 g/liter a.i.); and triforine 18.2% (1.37, 2.74, and 5.48 ml/liter a.i.) were applied to *Juniperus sabina* L. 'Broadmoor', 'Scandia', 'von-Ehron' and to *J. chinensis* L. 'Sea Green' on 7 and 14 day schedules to test for control of *Phomopsis juniperovora*. Similar unsprayed plants were controls. Triton B-1956 was included at the rate of 0.66 ml/liter with all sisthane and dithane sprays. Plant heights of all cultivars were reduced with increasing triforine concentrations from 1.37 to 5.48 ml/liter when it was applied every 7 days and also with 'vonEhron' treated every 14 days. Dithane M-45 applied every 7 days, with or without sisthane caused similar growth reduction on 'von-Ehron'. All materials caused slight stunting in all cultivars except 'Scandia', but dithane M-45 applied every 14 days caused a slight increase in growth.

FOMES ANNOSUS IN INTENSIVELY MANAGED WESTERN HEMLOCK. H.L. Morton and J.W. Witler. American Tree Consultants, Inc., 1812 Frieze, Ann Arbor, MI 48104 and Crown Zellerbach Corp., Box 368, Wilsonville, OR 97070.

To determine whether *Fomes annosus* causes significant volume or grade loss in western hemlock stands, particularly under intensive management, three N.W. Oregon hemlock stands with various fertilizer treatments and up to 10 thinning over 20 years were sampled by visual examination and incubation of wood disks. In one 34-yr-old stand first thinned at age 15, neither decay nor *F. annosus* was present in 40 trees. In a 55-yr-old stand thinned at age 36, 40% of 20 trees in the unthinned control area and 55% of 20 trees in the thinned areas contained *F. annosus*. However, decay volume from all fungi was small, averaging 0.2% of total merchantable volume in the unthinned area and 0.4% in the thinned (2.1 and 2.8 m³ per ha, respectively). There were no apparent differences between thinning schedules, fertilizer rates, or crown classes. Wounds were important for entry of decay. Two of 52 third-generation understorey seedlings aged 3-17 years old contained *F. annosus*.

STEM AND ROOT ROT OF SWEET POTATO CAUSED BY FUSARIUM SOLANI. J. W. Moyer, C. L. Campbell, and C. W. Averre. Dept. of Plant Pathology, North Carolina State University, Raleigh 27650.

A new disease of sweet potato stems and roots was observed on two farms in 1978 and more extensively by 1980. Symptoms included swollen and split stems near the soil line with colonization extending into the tuberous roots resulting in a firm dark brown to black lesion in the pith. *Fusarium solani* was isolated from diseased tissues. Inoculations with *F. solani* resulted in necrotic lesions on stem cuttings, tuberous roots and sprouts produced from inoculated roots. Necrotic lesions occurred on 20 of 60 sprouts produced from inoculated roots. Necrosis and splitting extended up to 75 mm from the base of these sprouts. Bioassays demonstrated colonization occurred several cm in advance of the lesion. In addition, *F. solani* was isolated from 26 symptomless sprouts and from fibrous roots, but not from sprouts produced by healthy roots. Root symptoms were similar

to those previously reported. The severe stem necrosis and systemic infection has not been previously reported.

CHEMOSTAXIS AS A FACTOR DETERMINING THE INGRESS OF PSEUDOMONAS SYRINGAE PV. PHASEOLICOLA INTO PLANT LEAVES. E. N. Mulrean, N. J. Panopoulos and M. N. Schroth, Department of Plant Pathology, University of California, Berkeley, California 94720.

Ingress of pv. *phaseolicola* into water soaked 'Red Kidney' bean leaves is partly determined by chemical gradients across the stomatal pore. Bacteria accumulated at concentrations several times higher than those in the external medium during extended contact with dilute cell suspensions. Accumulation increased directly as a function of time and was not observed with non-motile strains. Strain NR-18, a motile, chemotactic strain did not show normal accumulation in leaves that had been pretreated with 10⁻¹M L-threonine. Strain C6A, isogenic to NR-18 but non-spreading on semi-solid agar and presumed to be non-chemotactic, accumulated in leaves both in the presence and absence of threonine. The rate of invasion and the equilibrium concentration of bacteria in the substomatal cavity of leaves differed substantially with different kinds of plants. Ingress experiments with che⁺ and che⁻ mutants of *Salmonella typhimurium* suggest that water-soaked bean leaves are an appropriate physical system for the elicitation of bacterial chemotaxis.

THE USE OF IN VITRO METHODS TO RECOVER TMV RESISTANCE IN HAPLOID PLANTS OF NICOTIANA SYLVESTRIS. H. H. Murakishi and P. S. Carlson. Department of Botany and Plant Pathology, Michigan State University, East Lansing, MI 48824.

Plants grown aseptically in storage dishes were inoculated with a Flavam strain of TMV and then exposed to acute gamma radiation of 500 rads. Newly developed leaves were excised, cut into 2 cm wide strips and induced to form calli and whole plants. Most of the calli and developing young plantlets were yellow and obviously virus-infected. However, 5% of the calli were green and gave rise to virus-free plants which were transplanted to soil and grown in the greenhouse. Leaves were detached periodically from virus-free plants, inoculated with TMV-Flavam and incubated in petri plates; 0.1% were resistant based on local lesion assays with Pinto bean plants. Cuttings were taken from resistant, recovered plants and rooted in soil. The rooted cuttings also proved to be resistant to systemic infection by TMV-Flavam as judged by the lack of symptoms in new leaves and our inability to re-isolate virus.

INITIATION AND DEVELOPMENT OF BACTERIAL WETWOOD IN ELM. C. W. Murdoch and R. J. Campana, Dept. of Botany & Plant Pathology, University of Maine, Orono, ME 04469.

Bacterial wetwood in American elm is not well understood as a disease phenomenon. Although established in the central core of trunks in almost every mature elm, little is known about its initiation and establishment. To determine its etiology, a study was conducted including seedlings and mature trees. Isolations and light microscopic sections were made from 100 mature elm fruits and forty, 1-3 year old seedlings. Twenty-five stems each of three age classes: 5-10; 11-25; and 25+ were dissected and examined for wetwood development. The data show that bacteria associated with wetwood in elm are not transmitted by seed. Mixed populations of bacteria were found in the pith of elm seedlings. Early development of wetwood staining was associated with bacterial colonization of branch pith tissue, followed by downward movement of bacteria within the stem. The data suggest that bacteria capable of causing wetwood colonize the pith of elm seedlings, but remain innocuous until stimulated by aging of tissue.

AN ASSAY FOR BRANCHING FREQUENCY IN RHIZOCTONIA SOLANI. S.T. Nameth and V.N. Armentrout, California State Polytechnic University, Pomona, CA 91768.

A quantitative assay was developed to study the effects of carbon sources and other morphogenetic substances on frequency of branching in *Rhizoctonia solani* (AG 4). The unit of measurement used was the Hyphal Growth Unit (HGU) of Trinci, in which the total length of a given hypha, including branches, is divided by the number of hyphal tips present. The HGU for each treatment was determined as follows: a single hyphal tip of *R. solani* was placed on a slide dipped in agar medium containing the tested carbon source. The HGU was calculated from photographs of 9 h colonies. In preliminary studies, growth on various carbon sources yielded different HGU for different treatments. Concentration of carbon source was found to have no effect. When *R. solani* was grown on a medium containing glucose, the concentrations and respective average HGU's were as follows: 0.1 M, 25.1; 0.01 M, 26.1; 0.0001 M, 27.8; 10⁻⁶ M, 30.0. In contrast, 9-hour colonies grown on 1% sorbose, which is known to cause highly compact colonial growth in other fungi, displayed an average HGU of 12.5.

INCREASED DROUGHT RESISTANCE OF 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.) inoculated with soil containing spores of the mycorrhizal fungus *Glomus etunicatum* were grown in a growth chamber under low soil phosphorus conditions (15 ppm P). Non-mycorrhizal (NON-MYC) onions grown under the same con-

ditions were fertilized with a solution of KH_2PO_4 equivalent to 110 kg P/ha (56 ppm) to maintain top growth similar to that of the mycorrhizal (MYC) onions. Four weeks after sowing, one-half of the MYC and NON-MYC onions were subjected to cyclic periods of drought by withholding water. Drought stressed plants were watered each time the soil water potential dropped below -10 bars as measured with calibrated soil moisture blocks. Controls were watered daily. After 12 weeks of growth, drought-stressed MYC plants were 4.3 times larger than drought-stressed NON-MYC plants (1.8 vs. 0.4 g. F. wt.). Well-watered MYC controls were only 1.4 times larger than NON-MYC controls (5.6 vs. 4.0 g. F. wt.). The role of increased phosphorus nutrition of mycorrhizal plants subjected to drought stress will be discussed.

CONTROLLED MICROBIAL RECOLONIZATION OF HARDWOOD BARK COMPOSTS FOR THE SUPPRESSION OF RHIZOCTONIA DAMPING-OFF. E. B. Nelson and H. A. J. Hoitink, Department of Plant Pathology, Ohio Agricultural Research and Development Center, Wooster, OH 44691.

Rhizoctonia damping-off of radish and Celosia was reduced to 20-25% disease in container media prepared from mature hardwood bark composts as compared with peat media (70-96% disease). Suppression in bark was eliminated with heat (60 C for 5 days) or gamma radiation (275 Krad). Addition of 10% (v/v) unheated compost to heat-treated samples restored the suppression. Organisms antagonistic to *R. solani* were isolated from various hardwood bark composts and symptomless seedlings. Some fungal antagonists were also obtained from Rhizoctonia-suppressive soils. Addition of selected antagonists to naturally recolonized bark compost did not reduce the incidence of damping-off. However, addition of antagonists to heat-treated compost or to a peat medium resulted in levels of suppression equal to or better than that of the naturally recolonized compost. Several isolates of *Pseudomonas* and *Trichoderma* were the most effective in restoring suppressiveness to heat-treated composts.

VIRUS-GLOMUS ETUNICATUS INTERACTIONS IN CITRUS ROOTSTOCKS. S. Nemeč, USDA, SEA, AR, Orlando, FL 32803.

Sour orange (S.O.), *Citrus macrophylla* (C.M.), and Duncan grapefruit (D.G.) seedlings were blind-bud inoculated with tristeza virus isolates T-3 and T-1, and citrus leaf rugose virus (CLR-2), respectively, following their growth for 3 months in low phosphorus (P) soil (9-12 ppm) amended with *G. etunicatus* (G.e.), and in soil containing 210 ppm P only. Plants not inoculated with viruses in these soils were controls. Infection of C.M. and D.G. with the viruses in 210 ppm soil 98 days after inoculation and with both organisms in low P soil caused a non-significant slight reduction in growth versus the controls. Growth of S.O. was significantly reduced with dual infection in low P soil and with virus infection in 210 ppm P soil versus the controls. Virus-induced root degeneration was higher on virus-inoculated plants versus the controls. In the G.e. treatments alone, chlamyospore numbers and percent infection generally were higher than in the dual infection treatments. Premycorrhizal infection of S.O. did not minimize the pathogenic effects caused by the most virulent of the three viruses.

STRATEGY FOR USING METALAXYL IN CONTROLLING BLUE MOLD OF BURLEY TOBACCO. W. C. Nesmith, Dept. of Plant Pathology, University of Kentucky, Lexington, KY 40546.

Tests were conducted to determine the efficacy of Ridomil treatments by comparing broadcast (0.56, 1.12 and 2.24 kg/ha), transplant water (0.28 kg/ha) and single and multiple foliar sprays (0.28, 0.56 and 1.12 kg/ha). One set of foliar sprays began July 5 when blue mold first appeared in Ky while a second was initiated Aug 5 when blue mold first appeared in the site. Transplant water and single foliar applications of less than 0.56 kg/ha did not provide acceptable control. Blue mold appeared in plots treated with transplant water, 0.56 kg/ha broadcast and all foliar applications at the same time it appeared in controls. Acceptable control was obtained by the broadcast treatment (1.12 or 2.24 kg/ha) and multiple foliar applications. Blue mold was active in all plots within 10 days of harvest, regardless of the rate or method of application. This observation indicates conditions may be conducive for selecting Ridomil tolerant strains of the pathogen late in the season unless additional precautions are taken.

EFFECT OF INOCULUM DENSITY OF *PSEUDOMONAS SOLANACEARUM* IN SOIL ON THE BACTERIAL WILT INCIDENCE IN TOMATO. W. C. Nesmith and S. F. Jenkins, Jr. Depts. of Plant Pathology, Univ. of Kentucky Lexington, KY 40546 and N. C. State Univ., Raleigh, NC 27650.

Four soils were infested with *Pseudomonas solanacearum* at different inoculum densities, half of each soil was steamed prior to infestation. Disease was assayed by transplanting 17-day-old tomato seedlings into one group of soils the day of infestation and a second group 60 days later. Treatment differences were easily observed at 2.5×10^4 cells/g air-dry soil. The correlation coefficient between inoculum density and disease incidence was $r = 0.88$ when transplanting and infestation occurred the same day, compared with $r = 0.39$ after waiting 60 days to transplant. The soils differed significantly in the amount of disease that developed at similar inoculum densities. Disease incidence did not differ between steamed and nonsteamed soils if transplanting and infestation occurred on the same day but differed markedly following a 60-day waiting period.

PATHOGENIC SPECIALIZATION OF *ERWINIA AMYLOVORA* TO APPLE CULTIVARS. J. L. Morelli and H. S. Aldwinckle, Cornell Univ.,

N.Y.S. Agric. Expt. Sta., Geneva, N.Y. 14456

Twelve isolates of *E. amylovora* were evaluated for their virulence on nine apple cultivars by determining the mean % lesion length resulting from inoculation of vigorously growing shoots on orchard trees. Two Canadian isolates, 266 and 269, exhibited a pathogenic specialization for apple cultivar Quinte, with a mean % lesion length of 43% and 32% on Quinte compared to a mean of 1% for the other ten isolates on Quinte. N.Y. isolate 273, Mich. isolate 307, and Calif. isolate 109 did not differ significantly in their virulence patterns for the nine cultivars. Greenhouse inoculations of apple cultivars Delicious, Idared, and McIntosh resulted in a significantly greater amount of disease with isolate 266 than isolate 273, but there was no significance between isolate 266 and isolate 224 for the three cultivars. However, for Quinte, inoculation with 266 resulted in a significantly greater amount of disease than with either 273 or 224, supporting field observed pathogenic specialization of isolate 266 for Quinte.

STUDIES ON THE SYSTEMIC TRANSLLOCATION OF ^{14}C DOWCO® 444 IN SOYBEANS. R. L. Noveroske, P. Yackovich and W. L. Allen, The Dow Chemical Company, Agricultural Products Department, P. O. Box 1706, Midland, Michigan 48640

DOWCO 444 is a systemic fungicide highly effective for control of root rots caused by phycomycetous fungi including *Aphanomyces*, *Phytophthora* and *Pythium*. Greenhouse and field trials indicate this compound to be most efficacious as a seed treatment. Radiotracer studies were conducted on soybeans, utilizing ^{14}C DOWCO 444 to compare the efficiency of seed vs soil treatments and study the mode of uptake from seed treatment applications. Results confirm maximum efficiency as a seed treatment. Plant uptake occurs mainly through the seed coat into the cotyledons, where it translocates downward into the developing root system. In conjunction with other parameters, radiotracer studies were used to optimize a seed treatment formulation and define end-use rates.

A DEVICE TO SEQUENTIALLY SAMPLE RAIN WATER CONTAINING PLANT PATHOGENS. B.D. Olson and A.L. Jones. Dept. of Botany and Plant Pathology, Michigan State University, East Lansing, MI 48824.

A self-advancing device was designed and developed for sequentially sampling rain. The funnel collects 250 ml of water per 0.5 mm of rainfall. Eight ml of water are siphoned into a collection tube and the remaining 242 ml are discarded. To test the sampler, a sour cherry tree was inoculated on 17, 29 April, 8 and 29 May, 1980 with an isolate of *P. syringae* pv. *morsprunorum* resistant to rifampicin (PsmR). The sampler was placed under the tree and serial samples of runoff rain water collected. Number of colony forming units (CFU/ml) of PsmR in each sample was determined by serial dilution and plating on King's Medium B containing 50 µg/ml rifampicin and 25 µg/ml cycloheximide. The mean number of CFU/ml per sample for rainfalls in June, July, August, September, and October were 1,600, 7.8, 150, 1.5, and 691, respectively, indicating inoculum levels were high early in the season, low in summer and high in fall. The sequential sampler should be useful in epidemiological studies of rain disseminated pathogens.

EFFECTIVENESS OF METALAXYL FOR CONTROL OF TARO SOFT ROT.

J. J. Ooka and K. Y. Matsuura, Department of Plant Pathology, University of Hawaii, Kapa, Hawaii 96746.

Metalaxyl (Ridomil^R) was evaluated as a fungicide to control taro (*Colocasia esculenta*) root and corm rot caused by *Pythium carolinianum*. ED_{50} of metalaxyl incorporated into V-8 juice agar (VJA) for inhibiting mycelial growth and zoosporangial formation was 4 and 2 ppm, respectively. Zoosporangia failed to form from VJA-disk-colonies placed into 10 ppm metalaxyl suspensions during the 24-hr. contact period. The ED_{50} for inhibiting zoosporangial formation in metalaxyl suspension was below 1 ppm. Germination of zoosporangia placed into metalaxyl suspension below 50 ppm was not appreciably affected, even at 1000 ppm metalaxyl 3-7% of the zoosporangia germinated. Treatment of rooted taro setts with 100 ppm metalaxyl 24 hrs. before zoospore inoculation provided almost complete control of root lesions after 3-week incubation at 30°C in modified liquid culture.

ISOLATION OF A *AGROBACTERIUM TUMEFACIENS* STRAIN IMPAIRED IN TUMOR INDUCTION. David Ow, Mario Chamorro, Y. Lee and Z. R. Sung, Departments of Plant Pathology and Genetics, University of California, Berkeley, CA 94720.

Crown Gall tumors are induced by infection with *Agrobacterium tumefaciens* carrying a Ti-plasmid. In order to find out how many genes, both on the bacterial and the Ti-plasmid genomes, are involved in the tumor transformation process, mutants defective in tumor induction were sought. A *tumefaciens* A6 was mutagenized with nitrosoguanidine at a dose that 1% of the surviving colonies were auxotrophs. 334 mutagenized prototrophs were screened on pea plants. Those that did not induce tumors on peas were tested for their ability to utilize octopine as the sole nitrogen and carbon source and the ability to convert lactose to 3-ketoglycosides. One mutant out of 47 tested positive on both tests, indicating that it is an *Agrobacterium* that still contains the Ti-plasmid. Genetic crosses will be carried out to determine if the mutation resides on the plasmid or the chromosome.

FACTORS AFFECTING SOYBEAN SEED VIABILITY IN THE TROPICS. PETER O. OYEKAN, INSTITUTE OF AGRICULTURAL RESEARCH AND TRAINING, F.M.B. 5029, IRADAN, NIGERIA.

Although *Macrophomina phaseolina*, *Phomopsis sojae*, *Colletotrichum dematium* var. *truncata*, *Cercospora kikuchii*, *Fusarium* and *Aspergillus* spp. were commonly associated with seeds of soybean grown in Nigeria, fungicide seed treatment did not improve soybean germination in south-western Nigeria. However, the season when soybean was grown affected seed viability. Soybean grown during the first cropping season of the year (April - July) had a germination of 36%. Seeds from second season crop (August - December) had a germination of 90%. Seeds from an irrigated dry season crop (November - February) had a germination of 96%. The conditions of storage of soybean seeds also affected seed viability. Seeds stored at 5°C for six months had a germination of 86% compared to 59% in seeds stored in a room 28 - 38°C. Soybean varieties were also found to vary in their storing ability at ordinary room condition. Of 21 lines stored at 28 - 38°C for six months, TGX 11-4H, TGX 17-2C, TGX 47-1G, TGX 123-2E and TGX 187-2D had a germination of 70% or above.

EVALUATION OF SOYBEAN CYST NEMATODE POPULATIONS WITH SELECTED NEMATOCIDE TREATMENTS. Einar W. Palm, John Porta, Univ of Missouri, Columbia, MO 65211.

Since soybean cyst nematode (SCN) populations are not usually uniformly distributed in soybean fields, experiments for evaluating the performance of nematocides in customary replicated and randomized designs have certain deficiencies. In order to improve field evaluation of chemical treatments on SCN populations and to better determine the locations of the SCN infestations, a field design using alternate control and treatment rows across the fields was used. In the experiment, 16 treatments of labeled and experimental nematocides were applied in 7-inch bands or directly in the furrow. Criteria for evaluating performance were: 1. comparison of numbers of cysts per gram of dried root in adjacent locations in control and treatment rows at 45 d after planting; 2. ratings of height or other growth characteristics of soybean plants at 45 d; 3. cysts in 100 grams of soil from rows at 100 d after planting; 4. yield data comparing control rows to treatment rows. The information obtained from the cysts/root assessments provided more meaningful evaluation of the performance of the nematocides than yield of growth data.

HELMINTHOSPORIUM MAYDIS BLOCKS RESISTANCE EXPRESSION IN CORN Sergio F. Pascholati and R. L. Nicholson, Dept. Botany and Plant Pathology, Purdue University, W. Lafayette, IN 47907

We have addressed the problem of whether resistance expression blocks susceptibility or whether susceptibility blocks resistance in corn. Anthocyanin accumulation in mesocotyls of the corn hybrid B73_{HT} X Va26_{HT} was used as a quantitative measure of induced resistance. Mesocotyls were inoculated with *Helminthosporium carbonum* (resistant combination) followed by inoculation with *H. maydis* (susceptible combination) at 0, 15, 30, 45, and 60 hr. *H. maydis* blocked the accumulation of anthocyanins at each inoculation interval except at 60 hr after inoculation with *H. carbonum*. Development of typical lesions by *H. maydis* occurred for the 0, 15, 30, and 45 hr challenge inoculations but not for the 60 hr challenge. This suggests that *H. maydis* blocked the expression of resistance.

NEW BIOTYPES OF TRICHODERMA VIRIDE WITH TOLERANCE TO MBC FUNGICIDES. G. C. Papavizas and J. A. Lewis, USDA, SEA-AR, Beltsville, Maryland 20705.

Ten biotypes of *Trichoderma viride* tolerant to MBC fungicides were developed by exposing conidia of the wild strain T-1 to UV light for 100 min. The 10 biotypes differed from T-1 in appearance, growth habit, and sporulation. In dual cultures with pathogenic fungi, biotypes T-1-R1, T-1-R3, and T-1-R4 developed inhibition zones against *Sclerotium cepivorum*, *Verticillium dahliae*, *Fusarium oxysporum* f. sp. *melonis*, and *F. oxysporum* f. sp. *lycopersici*, but not against *Rhizoctonia solani*, *Sclerotium rolfsii*, *Pythium ultimum*, and *Phytophthora capsici*. The wild strain and the other seven biotypes did not inhibit fungal growth. Biotypes T-1, T-1-R3, T-1-R4, T-1-R10 produced the most cellulase; T-1-R4, T-1-R5, T-1-R6, T-1-R8 the most pectinase; and T-1-R1 and T-1-R4 the most amylase. These results indicate that it is feasible to modify the *T. viride* genome to obtain biotypes that will tolerate fungicides for use in integrated pest management systems.

FACTORS AFFECTING CORKY ROOT OF LETTUCE IN CALIFORNIA. C. L. Patterson, C. M. Waters, and R. G. Grogan. Dept. of Plant Pathology, University of California, Davis, CA. 95616

Corky root of lettuce (*Lactuca sativa* L.) recently has become more prevalent in California and has severely damaged lettuce crops. A causal organism has not been isolated; nevertheless, there is evidence that a biological entity is involved. Corky root can be caused in greenhouse trials by incorporating field-infested soil into a sterilized planting mix in a ratio as low as 1:999 v/v. The agent is controlled by fumigation with methylbromide, chloropicrin, or metham sodium. Also it is eliminated from an extract of infested soil heated at 53°C for 10 min, passed through a 0.45 µm millipore filter, or mixed with novobiocin to 50 ppm final concentration. Growth reduction from corky root in field trials can be alleviated by fewer irrigations and by cultural practices that decrease soil compaction and poor aeration. The lettuce cultivars Montello and

Greenlakes, bred in Wisconsin for resistance to corky root, were highly resistant in field trials in California.

INFECTION BIOLOGY AND DYNAMICS OF INOCULUM PRODUCTION BY CRONARTIUM QUERCUM f. sp. FUSIFORME ON LEAF DISCS AND SEEDLINGS OF RED OAK (QUERCUS RUBRA). P. G. Patterson and R. A. Schmidt. Department of Plant Pathology and School of Forest Resources and Conservation, University of Florida, Gainesville, Florida 32611.

The effects of temperature, leaf surface moisture, and leaf age on aeciospore and urediospore germination and appressoria formation were determined on oak in the laboratory. At optimum conditions aeciospores germinated in 5 hr, appressoria which formed only over stomata occurred in 6 hr, and mature uredia and telia developed in 7 days and 9 days (latent period), respectively. Similarly, urediospores germinated in 2 hr, appressoria developed in 6 hr, and the latent period for uredia and telia was 6 days and 7-8 days, respectively. An inoculum density of 1000 aeciospores/cm² of leaf surface resulted in 0.22 uredial and 1.07 telial sori/cm². Similar inoculations with urediospores produced 0.66 uredial and 2.63 telial sori/cm². Uredia did not develop on leaves >9 days old at time of inoculation; telia did not develop on leaves >11 days old at time of inoculation.

OZONE INJURY AND PEROXIDASE ACTIVITY IN HYBRID POPLAR LEAVES OF DIFFERENT AGES. Roy I. Patton* and Michael O. Garraway#. *USDA Forest Service, P. O. Box 365, Delaware, OH 43015 and #Department of Plant Pathology, The Ohio State University, Columbus, OH 43210.

Leaves from 12-week old rooted cuttings of hybrid poplar clone NE-50 (*Populus maximowiczii* x *P. berolinensis*) were examined for necrotic injury and peroxidase activity following fumigation with ozone. Leaves located at nodes 5 (young) and 15 (old) from the terminal bud at the beginning of fumigation, were compared after 2, 4, and 6 weeks of exposure to 0, .05, and .15 ppm of ozone. Old leaves had 2-3 times as much peroxidase activity as young leaves. At .05 ppm ozone, neither young nor old leaves showed necrosis or greater peroxidase activity than the controls. At .15 ppm ozone, however, necrosis occurred and peroxidase activity increased in leaves of both ages. Whereas necrosis and increased peroxidase activity were seen in old leaves at the 2-week harvest, necrosis was not seen in young leaves until the 4-week harvest. Thus, ozone-induced necrosis in young leaves of hybrid poplar is preceded by an increase in peroxidase activity.

SYSTEMIC FUNGICIDE FOR CONTROL OF SNAPDRAGON DOWNY MILDEW (*Peronospora antirrhini*). Albert O. Paulus, Seward Besemer and Jerry Nelson, Plant Pathology Department, University of California, Riverside, CA 92521.

Downy mildew of snapdragon (*Peronospora antirrhini*) caused severe economic loss to bedding and greenhouse flower growers during fall-winter 1981 season in southern California. Local and systemic infection produced stunting, shortened internodes and significantly reduced the quantity and quality of No. 1 flowers. Disease symptoms were rated on a scale of 0 to 10, with 10 indicating excellent disease control. In a nursery trial metalaxyl + maneb had a disease rating of 9; chlorothalonil 2.5; maneb 2 and no treatment 3. Average height of plant for the various treatments was 9, 4.4, 4.7, 4.3 cm, respectively. Metalaxyl + maneb was significantly better than all other treatments and the only effective commercial control. In a flower trial metalaxyl + zineb or metalaxyl alone gave an average of 49 No. 1 flowers for each treatment; metalaxyl + maneb 32; and no treatment 24.

EFFECT OF NITROGEN SOURCE ON AFLATOXIN PRODUCTION. G. A. Payne and W. M. Hagler. Depts. of Plant Pathology and Poultry Science N. C. State University, Raleigh, NC 27650.

The effect of 5 amino acids (asparagine, proline, hydroxyproline, methionine, tryptophan) on growth and aflatoxin production by 2 *Aspergillus* species was examined in an ammonium sulfate-containing medium. The addition of amino acids stimulated growth and toxin production of *A. parasiticus*. Amino acids differed in their ability to stimulate growth and toxin production with asparagine > proline > hydroxyproline > proline + methionine = proline + tryptophan > methionine = tryptophan. The effect of amino acids on growth and toxin production of *A. flavus* was similar to the results above, however proline was more effective than asparagine in stimulating toxin production. Intracellular proline concentration increases in corn under drought stress and may be a factor in increased toxin production in infected corn during stress.

EFFECT OF SILK AGE AND INCUBATION TEMPERATURE ON KERNEL INFECTION BY ASPERGILLUS FLAVUS IN SILK INOCULATED CORN. Gary A. Payne, D. L. Thompson and E. B. Lillehoj. Dept. of Plant Pathology, Dept. Crop Science, SEA, USDA, N. C. State Univ., Raleigh, NC 27650 and Southern Regional Research Center, SEA, USDA, New Orleans, LA 70179.

Silks of corn plants grown in a controlled environment were inoculated with *Aspergillus flavus* 1, 2, 3 or 5 wk after silk emergence. Plants were incubated in 4 day/night temperature regimes (34/30, 26/30, 34/22, or 26/22C) for 22, 26, 29, or 35 days, respectively, to give 477 cumulative thermal units at harvest. Kernels were surface sterilized, plated on selective med-

ia, and rated for infection. Percentages of infected kernels ranged from 2% at 26/22C to 49% at 34/30. Silks inoculated 2 and 3 wk after emergence and incubated at 34/30C had the greatest number of infected kernels, 46 and 49%, respectively. Infected kernels were evenly distributed over the tip, middle, and base of the ears. The increased silk infection by *A. flavus* at high day/night temperatures observed in this study may explain why infection by *A. flavus* is more common in the Southeast.

SPORE LOSS FROM SMALL FIELD PLOTS AND ITS INFLUENCE ON INTERPRETATION OF POTATO LATE BLIGHT EPIDEMICS. R. E. Paysour and W. E. Fry, Department of Plant Pathology, Cornell University, Ithaca, NY 14853.

Epidemics in field plots are influenced by plot size because the proportion of secondary inoculum dispersed outside plot boundaries increases as plot size decreases. We determined the magnitude of spore loss and its effect on epidemic suppression during development of potato late blight in small research plots. A simple theoretical model of spore loss was developed based on an exponentially declining pattern of spore deposition from a point source. Simulation and analytical techniques were used to compute the proportion of spores deposited within and beyond plot boundaries. A disease simulator was used to evaluate the effect of this spore loss on disease increase. A field experiment examined actual epidemic development in square plots of various sizes. Results from both the model and field experimentation verified the intuitive notion that epidemic severity increases asymptotically with plot size. For our experiments, this asymptote was approached with 25 m² plots.

INFLUENCE OF PHYSIOLOGICAL STATUS ON HERITABILITY OF OZONE RESISTANCE IN POTATO. E. J. Pell, N. E. DeVos, H. S. Bittmann, and R. R. Hill, Jr., The Pennsylvania State University and USDA-SEA-AR, University Park, Pa. 16802.

The impact of physiological condition on expression of genes for ozone (O₃) resistance in potato was investigated in the S₁ and F₁ progeny of a 7-parent diallel. Three-wk old plants, which originated from tubers, were exposed to 0.40 ppm O₃ for 3 hr at 21 C and 70% RH in an exposure chamber. General and specific combining ability (GCA & SCA) accounted for most of the variation among hybrids, with GCA contributing approximately 3 fold the variation associated with SCA. Tubers of the diallel were planted in New Brunswick, N.J. and 7-wk old plants were evaluated following an ambient oxidant episode. We observed a similar heritability pattern to that observed in the laboratory. After a second oxidant episode later in the growing season, SCA became more important than GCA. True seedlings, of a morphologically similar age to 3 wk old plants of tuber origin, were exposed to O₃ under controlled conditions, GCA and SCA were of equal importance.

A SIMPLE CLEANING TECHNIQUE FOR RE-USE OF CASSETTES FOR ENZYME-LINKED IMMUNOSORBENT ASSAY. Arthur C. Petersen, Jr. and Ernest E. Bantari, Department of Plant Pathology, University of Minnesota, St. Paul, MN 55108.

Saturated sodium hydroxide-EtOH; H₂SO₄-K₂Cr₂O₇, "Haemo-Sol"TM and "Alcotabs"TM in water solutions were effective for cleaning cassettes used in enzyme-linked immunosorbent assay (EIA) of potato viruses S, X, Y (PVS, PVX, PVY) and oat dwarf virus (ODV). An overnight soaking in NaOH-EtOH or Haemo-Sol, and a 1 week soaking in H₂SO₄-K₂Cr₂O₇ or "Alcotabs" followed by rinses in tap, de-ionized and distilled water and a final oven-drying cleaned the cassettes so that repeated use was possible. Cassettes cleaned with NaOH-EtOH and used for EIA of each virus had higher positive absorbancy A₄₀₅ values than did previously unused cassettes. New cassettes soaked in NaOH-EtOH also developed higher positive absorbancy values (A₄₀₅) than did new nontreated cassettes. These results show that cassettes used for EIA of these viruses can be easily cleaned for repeated use.

FURTHER OBSERVATIONS ON SEASONAL ASCOSPORE RELEASE PATTERN OF EUTYPA ARMENIACAE IN CALIFORNIA. C. H. Petzoldt, W. J. Moller, and M. A. Sall, Department of Plant Pathology, University of California, Davis, CA 95616

Spore trapping studies in Michigan, New York, and Australia have shown an annual ascospore release cycle for *Eutypa armeniacae* (Hansf. and Carter), the causal agent of dieback in grapevine and apricot, consisting of large releases in the fall and spring, and smaller releases in the summer and winter. The spore trapping reported here was done in Davis, Calif. from Jan. 1978 until May 1980 using a Burkard spore trap surrounded by apricot wood containing perithecia of *E. armeniacae*. Ascospores were trapped and counted after releases caused by both irrigation and rainfall. Release occurred in a pattern similar to that previously reported except that few ascospores were trapped in summer. Irrigation in summer did not cause ascospore release, while similar irrigations in spring and fall did. Irrigation and shading allowed *E. armeniacae* stromata to survive the summer in Davis, an area where stromata are not normally found.

RELATIVE IMPORTANCE OF PYTHIUM AND APHANOMYCES AS BEAN ROOT PATHOGENS AT VARIOUS TEMPERATURES. W. F. Pfender, Department of Plant Pathology, University of Wisconsin, Madison, WI 53706.

Beans were grown at 16, 20, 24, or 28 C in pots of pasteurized soil which had been infested with *P. ultimum* and/or *Aphanomyces*

pathogenic to beans at inoculum levels typical of field soils; soil matric potential fluctuated between -25 and -190 mb. Plant emergence was reduced by *Pythium* but not by *Aphanomyces*. Plant dry weights (root + shoot) were measured after 3-6 wk, when trifoliates of check plants were ca. 2/3 expanded. At 16 and 28 C, *Aphanomyces* alone decreased plant weight (compared to uninfected check) by 42% and 62%, respectively, whereas *Pythium* alone caused weight reductions of 76% and 15%, respectively. Thus although *Aphanomyces* causes severe damage at both low and high temperatures and is the more important pathogen at high temperatures, *Pythium* is the more destructive pathogen at low temperatures. The two pathogens acting together caused weight reductions of 73% and 63% at 16 and 28 C, respectively. Percentage of plants killed was higher in the presence of both pathogens than with either pathogen alone.

OBSERVATIONS ON RUST ON YELLOW NUTSEDGE (CYPERUS ESCULENTUS L.) S. C. Phatak, H. D. Wells, D. R. Sumner, D. K. Bell and N. C. Glaze. Georgia Coastal Plain Experiment Station, Tifton, GA 31793.

Nutsedges, the world's worst weeds, are difficult to control, especially in vegetables. Frequently a rust caused by *Puccinia canaliculata* is epidemic on nutsedge in the Georgia Coastal Plain during August-October and frequently kills the nutsedge in the fall. In 1980, rust was found on a few plants in June. Infected plants were potted and placed in no-rust stands of nutsedge at two locations. Symptoms were observed in 12 days, and an epidemic developed within 4 weeks. Plants inoculated with urediospores and incubated overnight at 25-30°C developed symptoms in 12 days. Pustules formed on the abaxial side of the leaves. In a field test with fungicides on cucumber, nutsedge was present in all plots. Infected nutsedge leaves were distributed over the area in September. An epidemic of rust developed in 4 weeks on 80% of the leaf area in non-treated plots. In contrast, in plots sprayed weekly with chlorothalonil, nutsedge proliferated.

SUSCEPTIBILITY OF SOYBEAN LEAVES AT DIFFERENT DEVELOPMENTAL STAGES TO CERCOSPORA SOJINA. D. V. Phillips and H. R. Boerma, Univ. of Ga., Ga. Experiment Station, Experiment, GA 30212.

During a study to determine the inheritance of resistance to *Cercospora sojina* in soybeans, we observed large variations in lesion numbers indicating that leaves were susceptible only during certain developmental stages. Plants which were inoculated by atomizing 0.1 ml of a conidial suspension onto each leaflet were placed in a mist chamber for 72 h. Plants were inoculated at all stages from the first trifoliolate leaf until the full-pod stage. Most of the lesions (85%) occurred on the leaf that was expanding rapidly at the time of inoculation. The same results were obtained on plants maturing normally and on those of the same age where flowering and maturity were delayed by extended photoperiod. The most susceptible stage began when the leaflet was fully open and ended when it was 60-70% expanded. A system of testing for resistance in which only the most susceptible leaves are inoculated and then enclosed in a small plastic bag has given excellent results in the greenhouse and field.

EPIDEMIOLOGY OF VIRUS INFECTION IN STRAWBERRY FRUITING FIELDS OF CENTRAL CALIFORNIA. Annamaria Pisi, Laura J. Seybert, and A. H. Gold, Department of Plant Pathology, University of California, Berkeley, California 94720.

Strawberry viruses detected over 4 years of periodic sampling, and leaf grafting to indexing hosts in the Salinas-Watsonville area of California were, in order of prevalence, Strawberry Mild Yellow Edge, Crinkle, and Mottle. The viruses occurred in strawberry plants alone or in combination. Infections caused by other viruses and mycoplasma-like organisms were rare. Infection spread tended to be short-range, limited to spread from immediately adjacent old plantings, or from infected nursery plants. Some fields in the eastern part of the Salinas Valley became completely infested within one year of transplanting from the nursery, but where rigorous insect control is practiced, infection spread was relatively slow. Though there is some aphid activity through the winter, infection spread did not become appreciable until the spring after the summer planting.

TOLERANCE OF SCLEROTINIA MINOR TO PROCYMIDONE AND OTHER FUNGICIDES. D. M. Porter, and P. M. Phipps, USDA, SEA and VPI&SU, Tidewater Research Center, Suffolk, VA 23437.

Procyimdone-tolerant (P-T) strains of *Sclerotinia minor* were produced in axenic cultures on potato-dextrose agar (PDA) amended with procyimdone. Growth of tolerant strains of *S. minor* transferred to PDA amended with 100 µg/ml procyimdone was similar to that on nonamended PDA. Mycelial growth of fungicide tolerant strains of *S. minor* was similar to nontolerant strains at 15, 21 and 27 C. Growth of P-T strains of *S. minor* on soil plates sprayed with procyimdone was similar to growth on nontreated plates, however, sclerotial production by tolerant strains was slightly less (14%) than nontolerant strains. P-T strains of *S. minor* were cross tolerant to iprodione, vinclozolin and dichloran at 50 µg/ml. Tolerance persisted after 10 weekly hyphal tip transfers to nonamended PDA. Fungicide tolerant strains of *S. minor* were not isolated from naturally infected peanuts treated with fungicides under field conditions in 1979.

THE ROLE OF DANDELION IN THE EPIDEMIOLOGY OF TOMATO RINGSPOT VIRUS-INDUCED DISEASES OF TREE FRUIT. Wilbur Mountain, Charles A. Powell, and Lyle B. Forer, Pennsylvania Department of Agriculture, Harrisburg, PA 17110 and Richard F. Stouffer, Fruit Research Lab, The Pennsylvania State University, Biglerville, PA 17307.

Serological analyses of weeds in tree fruit plantings (apple and peach) with tomato ringspot virus (TmRSV)-induced disease revealed that common dandelion (*Taraxicum officinale*) at many of these sites was latently infected with TmRSV. *Xiphinema* spp. both acquired TmRSV from and transmitted TmRSV to dandelion. The percent seed transmission of TmRSV by five different infected dandelion mother plants was 29, 7, 33, 35, and 23% respectively. TmRSV infection did not quantitatively affect dandelion seed germination although it was associated with delayed germination of some seed. These results provided an explanation for the persistence of TmRSV-induced diseases of tree fruit in spite of clean nursery stock programs.

ROLE OF SEED TUBER IN POTATO PLANT INFECTION BY ERWINIA CAROTOVORA VAR. CAROTOVORA. M.L. Powelson, Department of Botany and Plant Pathology, Oregon State University, Corvallis, OR 97331.

Tubers of a Russet Burbank seed lot were contaminated principally with *Erwinia carotovora* var. *carotovora* (Ecc). Of the 112 Ecc isolates recovered from 59 seed tubers, 68 were serogroup V and 44 were serogroup XV. Tubers from this seed lot were planted in two fields in the Columbia Basin and in one field in the Klamath Basin of Oregon. The serological identity of Ecc isolates recovered during the growing season from potato stems was determined. At the Klamath Basin plot, 63% and 10% of the stem isolates were serogroup V and XV, respectively, with similar recovery ratios at one plot in the Columbia Basin. At a second plot in the Columbia Basin, 8% and 0% of the stem isolates were serogroups V and XV, respectively. Only one known Ecc soil strain (XXIX) was involved to a limited extent in plant infection in all plots. Seed-borne serogroups of Ecc were the predominant strains isolated from infected plants in two of the three plots; however, seed-borne inoculum was not the primary source involved in plant infection in the third plot.

DEVELOPING FUSIFORM RUST-RESISTANT LOBLOLLY AND SLASH PINES. H. R. Powers, Jr. USDA For. Serv., Southeast. For. Expt. Sta., Athens, Ga. 30602

Because fusiform rust, caused by *Cronartium quercuum* f. sp. *fusiforme*, is the most serious disease of loblolly and slash pines, large scale programs are underway to produce rust-resistant strains of pines. One of the largest rust-resistant orchards is being developed cooperatively by the US Forest Service and the Georgia Forestry Commission. Half of this 60 acre orchard is a standard grafted orchard of resistant selections. The other 30 acres is a seedling seed orchard developed with a new concept, the utilization of survivors of rigorous artificial inoculation tests. In addition to providing excellent rust resistance, these open-pollinated seedlings will broaden the genetic base of resistance available for breeding programs. Preliminary tests of the first seed crops have shown levels of resistance equal to or better than the parental material. Estimates are that seedlings from this orchard will reduce the incidence of rust in slash pine by at least 50%, and in loblolly pine by 40%.

DISEASE INTERACTIONS OF BEAN YELLOW MOSAIC VIRUS AND PHYTOPHTHORA SPECIES IN ARROWLEAF CLOVER. R. G. Pratt, W. E. Knight, and O. W. Barnett, USDA-SEA-AR, Mississippi State University, Mississippi State, MS 39762, and Dept. of Plant Pathology & Physiology, Clemson University, Clemson, SC 29631.

Interactions of Bean Yellow Mosaic Virus (BYMV) and *Phytophthora* species (*P. erythrospetia* and *P. megasperma* f. sp. *trifolii*) in arrowleaf clover were evaluated in the greenhouse and field. In the greenhouse, plants infected with BYMV prior to or simultaneously with either *Phytophthora* species developed more severe root and foliar symptoms than did plants infected with the pathogens individually. The increases in severity of symptoms were synergistic. Symptoms in plants infected first with the *Phytophthora* species and subsequently with BYMV were not increased synergistically. Infection of roots by *P. erythrospetia* did not affect the frequency of BYMV infection in arrowleaf clover in the field during three seasons. Results suggest that BYMV and the *Phytophthora* species interact to cause disease complexes in arrowleaf clover, and that the virus and root diseases may be related epidemiologically.

PEST MANAGEMENT DURING POST-HARVEST TREATMENTS TO CONTROL PENICILLIUM EXPANSUM IN STORAGE. D. Prusky, M. Bazak, R. Ben-Aire, and D. Genizi*. Dept. of Fruit and Veg. Storage and *Dept. of Statistics, Volcani Center, Bet-Dagan, Israel.

Development of resistance of *P. expansum* to post harvest benzimidazole treatments and the appearance of imazalil resistant isolates urged a rational program to control storage decay and prevention of fungicide breakdown. A program is proposed based on: 1) each year a new fungicide will be introduced (A,B,...) towards which resistance has not developed; 2) each fungicide will be used the first year alone, the second year as a mixture with a protectant fungicide (P); and the third year it will not be used at all. In each year two alternate dipping treatments will be applied to part of the fruit stored in one single room, for example: 1st year, fungicide A; 2nd year fungicide B and

a fungicide mixture of A+P; 3rd year fungicide C and a fungicide mixture of B+P. The feasibility of this program will be discussed by describing results from disease simulation models.

EPIDEMIOLOGY OF VERTICILLIUM WILT OF COTTON: RELATIONSHIPS BETWEEN PROPAGULE DENSITY, DISEASE, PLANT PHENOLOGY, AND LINT YIELDS. G. S. Pullman and J. E. DeVay, Department of Plant Pathology, University of California, Davis, CA 95616

The epidemiology of Verticillium wilt of cotton was studied in two adjacent fields which contained nondefoliating and defoliating pathotypes of *Verticillium dahliae*. The incidence of plants with foliar symptoms (FS) of Verticillium wilt was related to propagule densities of *V. dahliae* in 7 years of tests. Moreover, disease progress curves were linear with time and their slopes were directly related to propagule densities below 40 propagules/g of soil. The percentages of plants with FS was always less than the percentages of plants with vascular discoloration; differences between these 2 symptoms increased during periods of high air temperatures when FS development was inhibited. Plant growth analysis of diseased and healthy appearing plants indicated a reduction in internode elongation, leaf dry weight, and square production prior to the appearance of FS. Cotton lint yields and open bolls per plant were related to the time when FS appeared.

FACTORS AFFECTING ERUPTIVE GERMINATION OF SCLEROTIA OF SCLEROTIUM ROLFSSII. Z. K. Punja and R. G. Grogan, Department of Plant Pathology, University of California, Davis, CA 95616.

Percent of eruptive germination of sclerotia of *Sclerotium rolfsii* produced in oat cultures and dried for 7-10 hr at 15-20% RH or for 20 hr over CaCl₂ was assayed on nonsterilized field soil, acid-washed quartz sand, or 1% Noble water agar. Maximum germination occurred at 27-30 C, at pH 2.0-5.0, at solute water potentials (ψ_w) of -2.5 to -8.0 bars and at matric water potentials (ψ_m) between 0 and -2 bars. Sclerotial germination was 0-5% at temperatures <12 C, pH above 7.0, ψ_w > -38 bars, ψ_m between -6 and -8 bars, and at depths >5 cm in soil. Low levels (about 30 mM) of nutrients or HCO₃⁻ - CO₃²⁻ anions in 1% Noble water agar inhibited eruptive germination, while various nitrogenous compounds had no effect except at high pH, where free NH₃ was prevalent. Nondried sclerotia germinated eruptively when exposed to vapours from 2-4 μ l of methanol, ethanol, dichloromethane, 2-propanol, 1-butanol, phenethyl alcohol and acetaldehyde in 60 x 15 mm dishes. These factors, and interactions among them, potentially influence disease caused by *S. rolfsii*.

TRANSMISSION OF X-DISEASE AGENT BY INJECTED BEET LEAFHOPPERS. A. H. Purcell and K. Gonot, Department of Entomological Sciences, University of California, Berkeley, CA 94720.

The beet leafhopper *Circulifer tenellus* transmitted the agent of the Green Valley type of X-disease (GVX) to peach, periwinkle, and celery following injections of infectious extracts from *Colladonus montanus* leafhoppers. Sugar beets fed upon by the injected *C. tenellus* developed symptoms characteristic of GVX in other plants and contained mycoplasma-like organisms when examined with Diene's stain, but GVX was not transmitted from symptomatic beet by *C. tenellus* or by *Co. montanus*. Both *C. tenellus* and *Co. montanus* injected with extracts of the agent of the peach yellow leaf roll type of X-disease (PYLRX) transmitted PYLRX to celery but not to sugar beet. In limited trials, *C. tenellus* transmitted neither GVX nor PYLRX following feeding access on celery or periwinkle infected with GVX or PYLRX. The beet leafhopper appears to be an experimental vector of XDA after injection, but there is no evidence so far that it has a role in the natural spread of X-disease.

LEVELS OF VERTICILLIUM DAHLIAE IN A FIELD PLANTING OF ROSEMARY. Robert D. Raabe, Department of Plant Pathology, University of California, Berkeley, California 94720.

In a large field planting of rosemary (*Rosmarinus officinalis*) in the Sacramento Valley in California, *Verticillium dahliae* was found to be infecting a large number of plants. The fungus was monitored in 25 plants at cutting height (approximately 2 feet) for a period of 3 years. Ten stems were cultured per plant. During the months of July, August, and September, the level of fungus recovery was very low. From October through February, the fungus levels increased. In March, the levels decreased, followed by a very rapid increase to the highest levels in April and May. As the planting aged, less infections were found. Cuttings of plants for propagation formerly were made during the winter months when levels of the fungus were moderately high thus accounting, in part, for infections of new plantings.

CARPOGENIC GERMINATION OF SCLEROTIA OF SCLEROTINIA SCLEROTIIFORM. V. L. Radke AND C. R. Grau, Dept. of Plant Pathology, Univ. of Wisconsin, Madison, WI 53706

Carpogenic germination of sclerotia of *Sclerotinia sclerotiorum* is affected by environmental, physical, biological, and chemical factors. Studies were initiated to ascertain the effect of soil-applied herbicides on carpogenic germination of *S. sclerotiorum*. Alachlor, chloramben, dinoseb, linuron, metribuzin, pendimethalin, and trifluralin were applied at rates of 0.5, 1.0, and 2.0 μ g a.i./gram steam sterilized dry soil. Sclerotia were incubated in treated or non-treated soil in glass petrie dishes at 15°C, 100% RH, and at a light intensity of 21.67-

32.5 Meinstains (16 hr day/8 hr night). Stimulatory effects (number of apothecia produced) were displayed by the three rates of metribuzin (+2, +67, +65%), linuron (+26, +5, +36%), trifluralin (+9, +63, +51%), and alachlor (+29, +16, +36) when compared with the untreated controls. Dinoseb (-27, -100, -100%) showed inhibition when compared with untreated controls. Chloramben (-22, +9, +14%) and pendimethalin (-5, +13, +38%) showed variable results.

THE COLONIZATION OF POTATO STEMS BY *ERWINIA CAROTOVORA* SUBSP. *CAROTOVORA* AND *VERTICILLIUM DAHLIAE*. M. K. Rahimian and J. E. Mitchell, Dept. of Plant Pathology, University of Wisconsin-Madison, Madison, WI 53706.

Populations of *Erwinia carotovora* subsp. *carotovora* (Ecc) increased logarithmically in the stem tissue of potato cultivar Norgold Russet (NR), but increased less rapidly in Russet Burbank (RB) after inoculations at a leaf axil with a micro-pipette. Discoloration in the stem sections assayed was confined to the vascular tissue. Populations of weakly virulent strains that caused necrosis at the point of inoculation increased less than those of highly virulent strains that caused rapid death of the plants. Eighty-five percent of NR were killed at inoculum level of 2×10^3 CFU/plant, whereas only 50% of RB were killed with 2×10^7 CFU/plant of the virulent strain. Populations of *Verticillium dahliae* (inoculated via root dip) increased more rapidly in RB stems inoculated 2, 9, and 16 days later with a weakly virulent strain of Ecc than in the plants without Ecc.

HYBRIDIZATION ANALYSIS OF CLOVER YELLOW VEIN AND BEAN YELLOW MOSAIC VIRUSES WITH cDNA. B.B. Reddick and O.W. Barnett. Dept. of Plant Pathology & Physiology, Clemson Univ., Clemson, SC 29631.

Clover yellow vein (CYVV), C-81 and Pratt, and bean yellow mosaic (BYMV), 204-1 and Pratt, virus isolates were purified, the RNA extracted by 0.1M (NH₄)₂CO₃, 0.1M EDTA, 1% SDS on a sucrose gradient, Proteinase K treated and phenol extracted. A single band occurred in polyacrylamide-agarose gel electrophoresis. Complementary DNAs (cDNA) to virus RNA were made using Taylor primers and reverse transcriptase. Hybridization conditions were 10mM Tris-HCl, pH 7.0, 0.56M NaCl, 1mM EDTA, 0.05% SDS at 50C with 15 units S1 nuclease/0.2 ml. Hybridization experiments of the cDNAs (CYVV-Pratt, CYVV-C-81, and BYMV-204-1) to homologous RNAs showed homologies of 70% ± 5%. Hybridization of CYVV-Pratt-cDNA to CYVV-C-81-RNA, CYVV-C-81-cDNA to CYVV-Pratt RNA, and BYMV 204-1-cDNA to BYMV-Pratt RNA gave values of 40-50%. Hybridization of CYVV-cDNA to BYMV-204-1 RNA and BYMV-cDNA to CYVV-C-81 or Pratt RNA gave values close to baseline, 10-20%. Relationship between BYMV isolates and between CYVV isolates is close with a more distant relationship between BYMV and CYVV.

A METHOD FOR QUANTITATIVE INOCULATION WITH POWDERY MILDEW (*ERISYPHE PISI*) OF PEA. P.W. Reeser and D.J. Hagedorn. Dept. of Plant Pathology, University of Wisconsin-Madison 53706.

The evaluation of resistance to powdery mildews may benefit from an improved technique for quantitative inoculation. Conidia were collected from infected peas by suction into 5ml of Sephadex G-25 (medium) in a test tube. The Sephadex/conidia mixture was placed into a 250ml bottle attached to a Schein inoculator, and was dispersed upward from a nozzle at the base of a settling tower. The method was used to inoculate excised pea leaves maintained on a nutrient solution in petri plates covered with parafilm. Inoculum concentration was expressed as density on 2% water agar plates placed in the tower. The germination rate on water agar was 30-40%. Sephadex was removed from the pea leaves after 4 days with a gentle stream of air. Well separated lesions were initiated by single conidia, and were counted at 25x magnification after 6 days. From an inoculum shower which delivered 18.4 conidia/cm², leaves developed a mean of 11.4 lesions per leaf with a standard deviation of 7.8.

TRITICUM DICOCOCCOIDES - A POTENTIAL SOURCE FOR RESISTANCE TO *PUCCINIA STRIIFORMIS*. Reinhold, Mareike, E. L. Sharp (1) and Z. K. Gerechter - Amtai (2). 1. Dept. of Plant Pathology, Montana State University, Bozeman, MT 59717. 2. Volcani Institute, P.O.B. 6, Bet Dagan, Israel.

Triticum dicoccooides, the tetraploid wild emmer indigenous to Israel, provides a very valuable gene pool of resistance to *Puccinia striiformis*. The resistance observed was of different types. Both specific resistance conditioned by dominant major genes and non-specific resistance conditioned by temperature sensitive minor genes were found. The resistance genes were transferred into tetraploid *Triticum durum* and hexaploid *Triticum aestivum*. Transgressive segregation observed in the F₂- through F₄- generations indicated that the minor genes occurring in the wild emmer lines were different from those known to be present in domesticated wheats and thus could contribute to further plant protection. The maternal influence on the expression of resistance genes was investigated.

ASSOCIATION OF A BACTERIUM WITH A DISEASE OF 'TORONTO' CREEPING BENTGRASS. D. L. Roberts, J. M. Vargas, Jr., K. K. Baker, and R. Detweiler, Department of Botany and Plant Pathology, Michigan State University, East Lansing, MI 48824.

Rod-shaped bacteria were consistently found in association with diseased 'Toronto' creeping bentgrass (*Agrostis palustris* C-15) exhibiting wilt symptoms of unknown etiology. Typically, leaves

wilt from the tip back and appear dark green, twisted and shriveled. Crown and root tissue initially appear white and in good health except for some possible internal discoloration. Eventually, leaf blades turned brown, and crowns and roots decomposed. Bacteria were not found in plants without symptoms. In diseased plants, the bacteria were confined to xylem vessels, possessed a rippled cell wall and measured approximately 0.5 µm by 1-1.5 µm. The discovery of bacteria within the xylem of 'Toronto' creeping bentgrass may represent a breakthrough in the unsolved "C-15 problem" which has plagued the elite bentgrass for many years.

NEW HOSTS AS POSSIBLE RESERVOIRS OF MAIZE DWARF MOSAIC VIRUS STRAIN B. Eugen Rosenkranz, USDA, SEA, AR, Dept. Plant Path. & Weed Sci., Miss. State Univ., Mississippi State 39762.

Susceptible wild grasses may provide a clue to the unknown mode of overseasoning of maize dwarf mosaic virus strain B (MDMV-B). The following 20 grasses were found susceptible to MDMV-B upon mechanical inoculation: *Aira elegans* A = annual (symptomless), *Andropogon virginicus* P = perennial, *Chasmanthium laxum* P (symptomless), *Digitaria ciliaris* A, *D. villosa* P, *Echinochloa muricata* A, *E. walteri* A, *Eragrostis amabilis* A, *E. capillaris* A, *E. diffusa* A, *E. eliottii* P, *E. pectinacea* A, *Eriochloa gracilis* A, *Glyceria striata* P (symptomless), *Leptochloa dubia* P, *L. filiformis* A, *Muhlenbergia capillaris* P, *Panicum portoricense* P, *P. scribnerianum* P, and *Setaria faberi* A. Of the 9 perennial hosts, *A. virginicus*, *D. villosa*, *G. striata*, *M. capillaris*, and *P. scribnerianum* occur in the midwestern Corn Belt. Of the 11 annual hosts, *E. muricata*, *E. walteri*, *E. capillaris*, *E. diffusa*, *E. pectinacea*, *L. filiformis*, and *S. faberi* have a wide distribution in the USA. Seed transmission of MDMV-B in these annuals should be investigated.

A CONCEPTUAL MODEL FOR THOSE DISEASES WITH PATHOGEN POPULATION MULTIPLICATION INDEPENDENT OF DISEASE DEVELOPMENT. D. I. Rouse, S. S. Hirano, J. Lindemann, E. V. Nordheim, and C. D. Upper, Depts. of Plant Pathology, Forestry and Statistics, and **AR-SEA, USDA, University of Wisconsin, Madison, WI., 53706.

The classical models that associate production of secondary inoculum with diseased tissue are inappropriate for certain diseases. Examples include certain foliar bacterial diseases in which epiphytic populations of the pathogen on given leaves are the immediate sources of inoculum. These epiphytic populations, regardless of initial source grow in the absence of disease on plant surfaces, including susceptible tissue. The inoculum size is dynamic rather than fixed and disease results from the attainment of a threshold population of pathogenic epiphytes on susceptible leaves. This threshold may be conditioned by environment. Environmentally dependent dose-response models that describe this type of disease progression can be formulated in stochastic terms and have the necessary advantage of incorporating the inherent variability of the pathogen population. Examples of other diseases that appear to fit the model will be described.

VIRULENCE PATTERNS OF *ERISYPHE GRAMINIS* F.SP. *TRITICI* FROM 1976-1980 IN PENNSYLVANIA. M.H. Royer, V.J. Elliott, D.I. Rouse, P.M. Fried, R.R. Nelson, and D.R. MacKenzie, Department of Plant Pathology, The Pennsylvania State University, University Park, PA. 16802

One hundred one single colony isolates of *Erysiphe graminis* f.sp. *tritici* were collected in Pennsylvania from 1976-1978 and 156 were collected in 1980. Races were distinguished by using 9 near-isogenic lines of the wheat variety Chancellor. The occurrence of virulence on Pm1, Pm3a, and Pm3b was rare relative to virulence on Pm2, Pm2+, Pm3c, Pm4, Pm5, and MA for all years. Non-independent occurrences of the following gene combinations were found (χ^2 -square $P < 0.01$) for all years: (p2,p2+), (p2,p5), (p2+,p5), and (p3c,pMA). The observed proportions of races were generally similar, with the exception of a shift to the complex genotype virulent on Pm2, Pm2+, Pm3c, Pm5, and MA in the 1980 population. This shift could not be attributed to varietal resistance in the sampled counties.

A STATISTICAL EXAMINATION OF RACE SURVEY ANALYSES. M.H. Royer, R.R. Hill, R.R. Nelson, and D.R. MacKenzie, Department of Plant Pathology, and *USDA, ARS, Regional Pasture Research Laboratory, University Park, PA. 16802.

The expected frequency of virulence gene combinations in haploid pathogens can be calculated as the product of the individual frequencies of the virulence genes. The expected frequency is then compared to the observed frequency by a χ^2 -square test. An extension of that approach establishes a 2x2 table for the occurrence or non-occurrence of two virulence genes, but can be expanded to accommodate any number of genes. The problems that arise with χ^2 -square for low numbers can be resolved with appropriate computer algorithms. The design of regional race surveys can be evaluated with this approach after the necessary sample size is estimated for the detection of infrequent races at a given level of statistical confidence.

INFLUENCE OF WEATHER AND PLANT MATURITY ON GRAY LEAF SPOT OF CORN. J. C. Rupe, M. R. Siegel, and J. R. Hartman,

Comparisons of in-canopy environmental conditions were made between areas in which gray leaf spot of corn, caused by *Cercospora zeae-maydis* Tehon & Daniels, was present (eastern Ky.) or absent (central Ky.). Disease progress and diurnal aerial spore content were influenced by physiologic age of the plant and by the environment. The disease was restricted to areas which had daily periods of at least 12 to 13 hr. of relative humidity above 90% and 11 to 13 hr. of leaf wetness. During months of disease activity (Aug. and Sept.) temperatures did not significantly differ between the two areas. Initial symptom appearance occurred at anthesis and was delayed by 2 to 3 weeks for every 3 week delay in planting. Aerial spore content was highest in early afternoon and was correlated with a rise in temperature, a drop in relative humidity, and drying.

EFFECT OF THREE SYSTEMIC INSECTICIDES ON SEVERITY OF RHIZOCTONIA ROOT ROT IN SUGARBEET. E. G. Ruppel and R. J. Hecker, U. S. Dept. of Agriculture, SEA, AR, Crops Research Laboratory, Colorado State Univ., Fort Collins, Colorado 80523.

In 1979 and 1980, aldicarb 15G, carbofuran 10G, and phorate 10G were side-dressed at layby at recommended rates on field-grown sugarbeet. Cvs. FC 703 and HH 32, resistant and intermediately resistant to *R. solani* (AG-2), respectively, were planted in May in fields heavily infested with the pathogen. Roots harvested in September were rated on a disease index (DI) scale of 0 to 7 in increasing disease severity. DI classes 0 through 3 were combined to calculate % harvestable roots. A combined analysis of variance showed that aldicarb and phorate significantly increased the DI 0.6 to 1.1 over the nontreated control across cultivars. However, only phorate significantly reduced % harvestable roots as compared to the control. In individual cvs., phorate similarly increased the DI and reduced harvestable roots in both lines, whereas the effect of aldicarb mainly was observed in HH 32. Reasons for the adverse effects of these insecticides on disease severity are being explored.

STUDIES ON SURROGATE FUNGAL ATTRACTANTS FOR INSECT DISSEMINATION OF HYPOVIRULENT STRAINS OF *ENDOTHIA PARASITICA*. John S. Russin and Louis Shain. Dept. of Plant Pathology, Univ. of Kentucky, Lexington, 40546.

Insect dissemination of sparsely sporulating hypovirulent strains of *Endothia parasitica* may be enhanced by introduction of *Ceratocystis microspora* and *C. eucastaneae* into hypovirulent cankers. Old blight cankers which support abundant sporulation of these *Ceratocystis* species were more attractive to insects than young cankers where *Ceratocystis* was absent. *Ceratocystis perithecia* were observed 2 months after inoculation into virulent and hypovirulent cankers whereas no establishment was seen when *Ceratocystis* was inoculated singly or simultaneously with *E. parasitica*. In vitro studies of these fungal interactions showed that both growth and perithecial production of *C. eucastaneae* on blighted bark meal and commercial media were significantly greater than that on healthy bark meal. These results suggest the presence of compound(s) in healthy chestnut bark which are inhibitory to *C. eucastaneae* and that modification of these compounds by *E. parasitica* enhances growth and sporulation of *C. eucastaneae*.

A NEW FUNGUS DISEASE OF CUCURBITS. A. T. Saad and L. L. Black. Dept. Plant Path. & Crop Physiol., La. State Univ. Agric. Expt. Sta., Baton Rouge, LA 70803.

The etiology and host range of a new fungus disease, observed on pumpkin and squash during the last three years in South Louisiana, were studied. Symptoms are numerous small white to tan necrotic spots, circular on the leaf lamina and elongated on stems, petioles, and leaf veins. Lesions frequently are numerous, coalesce, and form large patches. The pathogen has not been identified taxonomically. Colonies on PDA are white with a salmon tint. Conidiophores are phialidic and may be simple or branched. Conidia form in clusters at tips of conidiophores; they are mainly bicelled, hyaline, straight, and measure 2.6 to 3.6 by 7.2 to 12.0 μ m. Cucumber and muskmelon are highly resistant, watermelon and gourd resistant, and pumpkin and squash susceptible, but disease severity varied among 48 cultivars tested. Symptoms in inoculated plants were most severe at 28C, the highest temperature used. "White speck of cucurbits" is the common name proposed for this disease.

VARIATION IN FUNGICIDE DOSAGE ASSOCIATED WITH A NON-AGITATED, CO₂-POWERED, SMALL PLOT SPRAYER. P. L. Sanders and E. P. Gilbride, Department of Plant Pathology, The Pennsylvania State University, University Park, PA 16802.

Large variation in turfgrass dollar spot severity occurred among replications in a 1980 fungicide trial. Variation consistently appeared only in those treatments where rates of fungicide at the lowest limits of efficacy were being tested. The pattern of variation was coincident with the order of rep spraying. Fungicides in the trial had been applied with a CO₂-powered bicycle sprayer without agitation. Since the plots were small and the spraying of three replications could be completed in approximately three minutes from filling, all three replications had been sprayed from the same tankful. To determine the source of variation, the spraying procedure was timed, and spray aliquots were collected at times coincident with rep spraying. Analysis of these aliquots revealed differences in fungicide dosage which could explain the variation in disease control among replica-

tions. Users of non-agitating small plot sprayers should be aware of and take precautions to avoid such misapplication.

INFLUENCE OF SELECTED VINEYARD CULTURAL REGIMES ON CANOPY MICROCLIMATE AND BOTRYTIS BUNCH ROT OF GRAPES. Steven D. Savage and Mary Ann Sall, Department of Plant Pathology, University of California, Davis, CA 95616.

Disease development and several microclimate parameters were monitored in large blocks representing the eight combinations of three paired vineyard management options: two trellising types, the option of midseason vine hedging and the option of a bloom time fungicide application. Significant and similar reductions in associated disease occurred according to whether one of the following was used: one of the trellis types, the hedging procedure, the use of fungicide or combinations of the above. Analysis of the microclimate data indicates that distinctly different diurnal patterns are associated with each hedging or trellising regime particularly with respect to temperature. The options associated with reduced disease are characterized by wider fluctuations and by rapid response to changes in ambient conditions, while the highest level of disease was associated with the canopy conditions most buffered from such changes.

CRUCIFEROUS WEEDS AS SOURCES OF INOCULUM OF *XANTHOMONAS CAMPESTRIS*. N. W. Schaad and J. C. Dianese, Department of Plant Pathology, University of Georgia, Georgia Station, Experiment, GA 30212 and Universidade de Brasilia, Brasilia, 70910, Brasil.

Cruciferous weeds in the transplant growing region of Georgia and the seed production region of coastal California were surveyed for *Xanthomonas campestris*. Four farms in Georgia were surveyed at monthly intervals from January to July 1980 and 19 sites in California were surveyed in April 1980. In Georgia, *X. campestris* was isolated from plants of *Brassica campestris*, *Lipidium virginicum*, *Coronopus didymus*, and *Raphanus sativus* on 2 of 4 farms. In California, *X. campestris* was found in *B. campestris*, *B. nigra*, *B. geniculata*, *R. sativus*, and *Cardaria pubescens* at 7 of 19 sites. Three sites were associated with a cruciferous crop, three were along roads, and one was a grazing area 32 km from a cruciferous crop. In field plots in Georgia *X. campestris* was disseminated from infected weeds to cabbage up to a distance of 12 m. The results suggest that more attention should be given to controlling cruciferous weeds in transplant and seed production fields.

BACTERIA OF CRUCIFER SEEDS ANTAGONISTIC TO *XANTHOMONAS CAMPESTRIS*. N. W. Schaad and R. C. Donaldson, Department of Plant Pathology, University of Georgia, Georgia Station, Experiment, GA 30212.

When assaying crucifer seeds on agar media for *Xanthomonas campestris*, colonies of antagonistic bacteria are sometimes observed. Several of these antagonistic bacteria have been purified and found to inhibit growth of *X. campestris*. Antagonistic bacteria were present in 0.5 to 6 percent of the seed of eight commercial seed lots. All 12 strains of *X. campestris* tested were inhibited by antagonistic strains NC-1 and J-34. The antibiotic spectrum was not limited to *X. campestris*; growth of nine other species of phyto-bacteria were inhibited. Such antagonistic bacteria are common to untreated crucifer seeds but not to seeds treated with Arasan. In agar tests thiram is inhibitory to NC-1 and J-34 but not to *X. campestris*. Inhibition of antagonistic bacteria by fungicidal seed treatments may be responsible for an increase in bacterial disease. Studies are underway to determine if these antagonistic bacteria can be utilized for biological control.

THE ROLE OF CYTOKININS IN HOST REACTIONS TO THE DWARF MISTLETOES (*ARCEUTHOBIMUM*). Bruce Schaffer, Frank G. Hawksworth, S. D. Wulschlegler, and C. P. P. Reid. Colorado State University, 80523, and USDA Forest Service, Fort Collins, Colorado, 80526

The most characteristic symptom of conifers infected by dwarf mistletoes (*Arceuthobium* spp.) is the formation of witches brooms. The chemical basis for this host reaction has long been a subject of speculation. We studied ponderosa pine (*Pinus ponderosa* var. *scopulorum*) infected by *A. vaginatum* subsp. *cryptopodium* in Colorado. Cytokinins were extracted from infected branches, uninfected branches, and mistletoe shoots. The branch samples were a composite of bark and wood tissues. Cytokinins from each sample were separated by Sephadex LH-20 gel chromatography and analyzed by soybean callus bioassay. Uninfected branches had no detectable cytokinins. Cytokinin concentration was highest in dwarf mistletoe shoots. Zeatin, Zeatin-riboside, and 3 other unknown cytokinins were detected. The mistletoe-infected branches also showed some cytokinin activity, but at lower concentrations than in the mistletoe shoots. The possible role of cytokinins in the formation of witches brooms by dwarf mistletoes will be discussed.

A POSSIBLE BIOLOGICAL CONTROL AGENT FOR NET BLOTCH OF BARLEY. A. L. Scharen and M. D. Bryan, USDA, SEA, AR, Dept. of Plant Pathology, Montana State Univ., Bozeman, MT 59717.

A bacterium, *Bacillus licheniformis*, produced metabolites in culture that were antagonistic to *Pyrenophora teres*. In the greenhouse, application of a suspension of the bacterium to leaves of barley seedlings normally susceptible to the net

blotch disease rendered the plants highly resistant to subsequent inoculation with the pathogen. The bacterium had no obvious effects on the barley. Four treatments in the field were 1) Control; 2) Bacteria only; 3) Fungus pathogen only; and 4) Bacteria plus fungus. Bacteria were sprayed on the barley plants one day prior to inoculation with the pathogen. Bacteria established themselves on leaves of barley plants, and apparently prevented infection by the pathogen. Yields of barley were not significantly different from one another among the 1980 field treatments even though symptoms in the diseased plot were severe. Late infection was suspected as the reason for the lack of yield differences.

RESPONSES OF EASTERN COTTONWOOD TO DECAY BY PLEUROTUS OSTREATUS. Beth A. Schmidt and Louis Shain. Department of Plant Pathology, University of Kentucky, Lexington, Kentucky 40546.

A distinct orange zone was observed in cottonwood (Populus deltoides) surrounding a core of decay caused by Pleurotus ostreatus. This orange zone occurred along the annual ring circumscribing the wood present at the time of wounding (barrier zone) as well as through annual rings in inner, older tissue (reaction zone). P. ostreatus and occasionally other unidentified fungi were isolated from decayed wood but not from the orange zone or sapwood. Bacteria were infrequently isolated from all tissues. Histochemical tests with nitro-blue tetrazolium (NBT) indicated that living parenchyma was found less frequently in the orange zone than in sapwood and rarely in incipiently decayed wood. NBT-stained hyphae were observed in decayed wood but not in the orange zone. Tyloses were abundant in the orange zone. Tests are in progress to determine if these observed responses are an effective mechanism of resistance to decay.

METHYL BROMIDE ERADICATION OF THE OAK WILT FUNGUS IN LOGS. E.L. Schmidt, M.M. Rutze, D.W. French, Department of Plant Pathology, University of Minnesota, St. Paul, MN 55108.

Concern over accidental introduction of the oak wilt fungus (Ceratocystis fagacearum) into oak-importing nations prompted assessment of methyl bromide fumigation to eradicate the fungus from logs and lumber. Introduction of pure methyl bromide at a rate of 240 g/m³ of space under a polyethylene cover kept in place for 3 da. eradicated the fungus from naturally infected 1 m log sections of red and bur oak at temperatures down to 5°C in laboratory chamber trials. The fungus was recovered from 30-90% of sapwood isolation attempts in untreated controls. Outdoor trials using 2.4 m logs reduced fungus isolation frequency by 99% (c.f. controls) after 3 da. of fumigation, but 2 da. exposure only reduced isolation success by 62%.

INFLUENCE OF NITRATE AND POTASSIUM ON SEVERITY OF FUSARIUM YELLOW OF CELERY. R. W. Schneider, Department of Plant Pathology, University of California, Berkeley 94720.

Results from several greenhouse experiments indicated that the use of NO₃-N, as compared with NH₄-N, greatly reduces the severity of Fusarium yellows of celery caused by Fusarium oxysporum f. sp. apii. Also, the addition of K⁺, as salts of Cl⁻, NO₃⁻, or SO₄²⁻, at 6.0 to 12.0 meq/kg soil further suppresses disease severity with KCl being the most effective. When 20% of the added N was in the form of NH₄⁺, as NH₄Cl, (NH₄)₂SO₄, or NH₄NO₃, both the NO₃⁻ and K⁺ effects were completely nullified. Field trials conducted over 3 years gave the same results in equivalent treatments. Neither K⁺ nor NO₃⁻ at the concentrations used in these studies was toxic to the pathogen. However, NO₃-N and, to a lesser extent, presence of K⁺ greatly reduced rate of root infection by the pathogen. Thus accumulation of NH₄⁺ in the soil during the early part of the growing season must be avoided in order to obtain significant disease control. Present practices include the use of (NH₄)₂SO₄ and organic-N as preplant treatments.

FACTORS AFFECTING INFECTION OF HORSE RADISH WITH SPIROPLASMA CITRI IN BRITTLEROOT DISEASE. G. Schultz, C. Eastman, J. Fletcher, K. O'Hayer, M. McGuire, and R. Goodman. Illinois Natural History Survey, Champaign, IL 61820; University of Illinois, Urbana, IL 61801.

Spiroplasma citri has been shown to be a causal agent of brittle root in Illinois horseradish. Presence or absence of certain mosaic viruses common in horseradish does not alter susceptibility of horseradish to S. citri, although symptoms may vary. In testing of plant species as hosts or potential reservoirs for horseradish-infecting S. citri, periwinkle as well as turnip and radish have been confirmed as experimental hosts. Circulifer tenellus, known to transmit S. citri to horseradish, transmitted this pathogen to turnip after an inoculation access feed of one hour in tests designed to examine vector transmission efficiency. In feeding and microinjection trials with other leafhopper species, Macrosteles fascifrons and Scaphytopius acutus acutus failed to transmit S. citri from brittle root-affected to healthy horseradish.

EFFECTS OF PLANT DENSITY UPON DISEASE DEVELOPMENT AND YIELD LOSS IN DRY BEANS. Howard P. Schwartz, Botany & Plant Pathology, Colorado State University, Fort Collins, CO 80523.

A series of experiments was planted in 1980 at a highland field research site of the Centro Internacional de Agricultura Tropical (CIAT) in Colombia to study the effects of varying plant population densities upon subsequent disease development and yield losses attributable to various dry bean (Phaseolus vulgaris) pathogens. Each experiment consisted of three entries

planted in a replicated split-plot design which contained three population densities of 67, 133, and 267 x 10³ plants/hectare. Disease development was periodically monitored with standard leaf and overall foliage damage scales, and bean yields were measured in diseased and controlled blocks. Higher plant densities generally favored more severe disease development of anthracnose, angular leaf spot, powdery mildew, halo blight, and common bacterial blight. However, white leaf spot was more severe at lower plant densities. Yield losses ranged from 17 to 73%, depending upon the experiment, plant density, and disease complexes involved.

ALTERATION IN AUXIN LEVELS IN SOUTHERN PINES INOCULATED WITH CRONARTIUM QUERCUM F. SP. FUSIFORME. Dallas Seifers and Vernon Ammon, Department of Plant Pathology and Weed Science, Mississippi State University, Mississippi State, MS 39762.

Auxins were extracted from 3- and 6-month old tissues of inoculated and non-inoculated southern pine trees susceptible, tolerant, and resistant to the fusiform rust fungus. Compared to non-inoculated trees, relatively large increases in auxin-like activity were measured in extracts from susceptible tissue (bulk slash pine) 3- and 6-months after inoculation; only minor increases in auxin activity were measured in extracts from tolerant tissues (slash pine selection FA2) for the same periods. Auxin activity decreased in tissue extracts from resistant trees (shortleaf pine). Qualitative differences and transitions in Rf of auxin-like substances were observed in extracts from trees representing disease reaction groups, between 3- and 6-month sampling periods, and between inoculated and non-inoculated hosts.

RESTRICTED CELL TO CELL MOVEMENT OF A TEMPERATURE SENSITIVE ISOLATE OF ToMV ASSOCIATED WITH A VIRUS-INDUCED REDUCTION IN NUMBERS OF PLASMODESMATA. T. A. Shalla and L. J. Petersen, Department of Plant Pathology, University of California, Davis, CA 95616 and Milton Zaitlin, Department of Plant Pathology, Cornell University, Ithaca, N.Y. 14850.

The LS-1 isolate of tomato mosaic virus (ToMV) is capable of multiplying and moving from cell to cell in intact tobacco leaves at 22° but is restricted in movement when the leaves are transferred to 32° (Nishiguchi et al., J. Gen. Virol. 39, 53-61). Electron microscopy of thin sections revealed a significantly lower number of plasmodesmata between LS-1 infected mesophyll cells at 32° than at 22°. There were also substantially fewer plasmodesmata at 32° in LS-1 infected tissue than in tissue infected with the type strain of ToMV (L) which readily moves from cell to cell at the higher temperature. There were no differences in numbers of plasmodesmata in L-infected or healthy tissue at either temperature. There were no qualitative differences in the structure of plasmodesmata under any conditions.

THE INVOLVEMENT OF VIRAL UNCOATING IN CROSS PROTECTION. J. L. Sherwood and R. W. Fulton, Dept. of Plant Pathology, University of Wisconsin-Madison, Madison, WI 53706.

Nicotiana sylvestris systemically infected (mosaic) by TMV was superinfected by RNA of necrotic strains (NS) of TMV in both light and dark green areas of mosaic leaves, but superinfection by virions occurred only in dark green areas. RNA of NS of TMV infected more efficiently, compared with virions, on mosaic than on healthy leaves. RNA of NS and TMV differed similarly in infectivity on mosaic and healthy N. sylvestris. Superinfection of N. sylvestris leaves locally inoculated with a mosaic-inducing strain of TMV with virions or RNA of NS did not induce lesions until the concentration of the mosaic strain stabilized. Adding a mosaic strain to an NS prior to inoculation reduced lesion numbers on healthy leaves but not on mosaic leaves. Adding RNA of a mosaic strain to an NS reduced lesions on both mosaic and healthy leaves. We suggest that cross protection may result from a nonspecific inability of mosaic plants to support additional viral replication and to a specific inhibition of uncoating of the challenge virus.

CHARACTERISTICS OF BACTERIOPHAGES CON11, CONX AND CONXC INFECTING CORYNEBACTERIUM NEBRASKENSE. Yukio Shirako and A.K. Vidaver, Dept. of Plant Pathology, Univ. of Nebraska, Lincoln, NE 68583.

Corynebacterium nebraskense bacteriophages Con11 and ConX were isolates with strain BEM as the propagating host. Con11 and ConX lysed 4 or 5 of 6 strains of C. nebraskense, respectively. Only ConX infected strain DUN, forming turbid plaques along with a small number of clear plaques. The two plaque types occurred despite repeated (10x) purification from turbid plaques. A clear plaque-forming phage ConXC was isolated from a clear plaque formed on strain DUN. Electron microscopy showed that phages Con11, ConX and ConXC had hexagonal heads, 54 nm in width and long, flexible tails, 200 nm in length. The nucleic acids of Con11 and ConX were isolated and treated with DNase, RNase & alkali; results showed that all were linear, double-stranded DNA. Digestion of phage DNA with restriction endonucleases revealed differences in structure among the three phages. It was deduced that ConXC DNA was a deleted form of ConX DNA. The adsorption rate constants were 4.9 x 10⁻⁹ ml/min for Con11 and 3.2 x 10⁻⁹ ml/min for ConX on strain BEM. The burst size of Con11 was 12.

CONTROL OF CERCOSPORA AND CERCOSPORIDIUM LEAF SPOT ON TWO PEANUT CULTIVARS. F. M. Shokes, D. W. Gorbet, and L. F. Jackson. Univ.

of Florida, Agric. Res. and Educ. Ctr., Quincy, FL 32351, Agric. Res. Ctr., Marianna, Florida 32446, and Dept. of Agron. and Range Sci. Ext., Univ. of California, Davis CA 95616.

'Early Bunch' and 'Florunner' peanut cultivars were tested for response to five fungicide treatments in North Florida, 1979 and 1980. Disease pressure from *Cercosporidium personatum* (CP) was heavy in 1979 and moderate in 1980 but pressure from *Cercospora arachidicola* (CA) was light both years. CP was the predominant fungus in check plots 70 days after planting July 18, 1979 and 89 days after planting August 7, 1980. All treatments had significantly fewer leaf spots, lower percent defoliation and higher yields than the check. Chlorothalonil alone and with flowable S gave significantly better control of both leaf spot diseases than triphenyltin hydroxide plus flowable S, cupric hydroxide plus S, or mancozeb plus flowable S. Cultivars did not differ in relation to CA but under heavy pressure in 1979 'Early Bunch' had more CP leaf spot at two of five sample dates, and in 1979 and 1980 had higher percent defoliation by harvest. Yield differences were non-significant in both tests.

DETERIORATION OF DRIED FRENCH PRUNES RELATED TO POSTHARVEST DECAY FUNGI. P. L. Sholberg, and J. M. Ogawa, University of California, Davis, CA 95616

Deterioration of dried French prunes was expressed by soft, sticky, ulcerated areas on the fruit and sometimes slipping of the skin. The greatest increase in amount of dried, deteriorated fruit was shown after inoculation of fresh fruit with *Rhizopus arrhizus* and *R. stolonifer*; deterioration also occurred with other fungi such as *Aspergillus* and *Penicillium* spp. Under present methods of handling prunes after harvest but before drying, *Rhizopus* spp. were the fungi most likely related to development of deteriorated dried prunes. The following evidence was provided: 1) *Rhizopus* spp. were always observed on harvested fresh fruit when significant amounts of dried fruit deteriorated, 2) fresh prunes inoculated with *Rhizopus* spp. and incubated for 24 h or more suffered severe deterioration, 3) sulfur dioxide fumigation to kill *Rhizopus* spp. on inoculated fruit prevented deterioration, and 4) naturally deteriorated dried fruit obtained during commercial sorting contained polygalacturonase enzyme typically produced by *Rhizopus* spp. during decay of fresh fruit.

ANTIGENIC AND BIOCHEMICAL RELATIONSHIP OF CAPSULAR POLYSACCHARIDE PRODUCED BY *ERWINIA AMYLOVORA* IN VIVO AND IN VITRO. K. Sijam, A. L. Karr and R. N. Goodman. Dept. of Plant Pathology, University of Missouri, Columbia, MO 65211.

Erwinia amylovora produces a capsular polysaccharide *in vivo* and *in vitro*. The polysaccharide produced *in vivo*, "amylovorin" and the polysaccharide obtained *in vitro* "EPS", were compared biochemically and immunologically. Polysaccharides were fractionated by anion exchange and gel filtration chromatography on DEAE Bio-Gel A and Bio-Gel A-150M columns. Amylovorin and EPS eluted in the same fractions from both columns indicating the same molecular size distribution. Both amylovorin and EPS contained LPS as detected by 2-Keto-3-deoxyoctonate (KDO) assay. Amylovorin, EPS, and LPS preparations were subjected to immunoelectrophoresis (IE) using rocket line-, crossed-, and tandem crossed IE. Evidence suggested that amylovorin, EPS, and LPS have common antigenic sites. When EPS and LPS were subjected to crossed IE, three common antigens were detected. Amylovorin, formed a broader and shouldered peak with two distinct antigens. When amylovorin and EPS were compared by tandem crossed IE, two precipitant bands of each fused indicating a commonality for two antigenic sites.

TRANSFER OF CROWN RUST FIELD RESISTANCE FROM *AVENA STERILIS* TO CULTIVATED OATS BY BACKCROSSING. M. D. Simons, SEA-AR, USDA, Dept. of Plant Pathology, I.S.U., Ames, IA 50011.

Fourteen lines of *Avena sterilis* susceptible as seedlings, but with field resistance to *Puccinia coronata* were crossed and backcrossed with the susceptible oat cultivar Clinton. Lines derived from F₁, from BC₁, and from BC₂ plants were selected for cultivated plant type. The effect of crown rust was determined by comparing performance of rusted with rust-free control plants in replicated hill-plot trials. In the rust-free plots, most lines derived from F₁ plants yielded significantly less than Clinton; most lines from BC₂ plants yielded as well as Clinton. Seventy-one percent of the lines derived from F₁ plants, 52% from BC₁ plants, and 27% from BC₂ plants were significantly more resistant, in terms of reduction in seed weight attributable to rust, than was Clinton. Lines combining the yield of Clinton with a significant improvement in resistance appeared in all but one of the populations.

SEED FUNGI FROM FOREST TREE SPECIES OF NEWFOUNDLAND. Pritam Singh. Newfoundland Forest Research Centre, Canadian Forestry Service, St. John's, Newfoundland, Canada.

Seeds of black, white, Sitka and red spruces were assayed for associated fungus flora. Thirty-two fungi were isolated from seeds which had been stored for 6 to 10 months. Seeds washed with water or dusted with 50% thiram powder yielded only a few fungi. Seeds obtained from unopened cones did not yield any fungus but those extracted from partly opened cones yielded a few fungi. Most fungi were externally seed-borne. Pre-germination treatment (at 10°C) from 0 to 5 days increased the number of fungi. Washed or thiram-treated seeds germinated (at 20°C) slightly better (67 to 87%) than the unwashed and untreated seeds (61 to 81%). Pre-germination treatment (at 10°C) of unwashed and untreated seeds for 0 to 15 days induced a sharp decline in germination. The decline was, however, slight and gradual in

washed and thiram-treated seeds, suggesting the usefulness of the treatment before seeding. Since most Newfoundland forests comprise of softwoods and their regeneration depends on quality seeds, occurrence of these micro-fungi and their effect on seed viability is causing concern to foresters on the Island.

COMPARATIVE VIRUS CONTENT OF CEREAL CULTIVARS INFECTED WITH BARLEY YELLOW DWARF VIRUS. M. Skaria, R. M. Lister, J. E. Foster and G. Shaner, Purdue University and USDA, SEA, West Lafayette, Indiana 47907

ELISA of extracts of barley yellow dwarf susceptible ("S") and resistant ("R") cereal cultivars, infected with a PAV-like isolate by viruliferous aphids, indicated statistically significant differences between the virus content of California Mariout (S) and CM67 (R) barleys and Clintland 64 (S) and P70408 (R) oats, but not between Abe (S) and Elmo (R) wheats. The differences observed indicated higher virus contents in the susceptible cultivars, but were influenced by environmental conditions. Thus, in the greenhouse, differences were obvious with the paired oat cultivars, but not with the barley or wheat cultivars. However, in a growth chamber (20°C, 14 h light, at 145 microeinsteins/m²/sec), differences were most obvious between the barley cultivars, and differences between the oat cultivars were less apparent, while no differences were detected between the wheat cultivars. In general, more virus was detected in extracts from roots than leaves.

A NEW ALTERNARIA BLIGHT OF MARIGOLD. Elizabeth J. Smallwood, Luther W. Baxter, Jr., Dept. of Plant Pathology & Physiology, Clemson University, Clemson, SC 29631

This is the first report of an *Alternaria* species on marigold in the U.S. The fungus is pathogenic to both African (*Tagetes erecta*) and French (*Tagetes patula*) marigolds, but will not cause disease symptoms on zinnia and selected members of the family Asteraceae. Symptoms appear as dark-colored lesions on the leaflets, stem, and inflorescence. Severity of the disease is directly correlated with humidity—the higher the humidity, the higher the infection rate. Chemical sensitivity tests in the laboratory suggest that either iprodione or Ciba-Geigy 64251 would provide adequate control of the disease. *In vitro*, the fungus grows well on carrot juice agar (CJA), oatmeal agar, and potato-dextrose agar. Sporulation was best when CJA was amended with oxythioquinox (100 mg/l a.i.) under conditions of alternating light and dark at 22-27°C.

APPLICATION OF MODIFIED ANILINE BLUE TECHNIQUES TO DEMONSTRATE β-1, 3-GLUCANS IN PAPILLAE INDUCED IN BARLEY COLEOPTILES BY *ERYSIPE GRAMINIS HORDEI*. M.G. Smart, J.R. Aist and H.W. Israel. Department of Plant Pathology, Cornell University, Ithaca, NY, 14853.

Initial stages of pathogen-suscept interactions are often characterized by formation of papillae at penetration sites. Correlations of papilla formation and cessation of fungal growth implicate papillae as a barrier to penetration. β-1, 3-glucans reduce permeability in developing meiocytes and have been cited as a papilla component. The fluorescence of aniline blue usually has been used to identify β-1, 3-glucans in tissues but has been shown recently to stain 1,4 linked glucans. Papillae were treated with laminarinase, a β-1, 3-glucanase, and stained subsequently with aniline blue; no aniline blue-induced fluorescence was then seen. The Periodic acid-Schiff's reaction quenched autofluorescence and non-specific wall fluorescence. When this was applied prior to aniline blue the papillae remained quite fluorescent. We conclude that papillae contain β-1, 3-glucans.

PURIFICATION OF SYRINGACIN W-1 FROM CULTURES OF *PSEUDOMONAS SYRINGAE* PSW-1. Mary Smidt and Anne K. Vidaver, Dept. of Plant Pathology, University of Nebraska, Lincoln, NE 68583.

Syringacin W-1, a bacteriocin produced by *Pseudomonas syringae* strain PSW-1, is a rod-shaped particle about 20 nm wide and 75 nm long. It is composed of an outer sheath and inner core. Production of syringacin W-1 is enhanced by induction with mitomycin C. Syringacin W-1 was purified about 500-fold from induced culture lysates by ultrafiltration, rate zonal centrifugation in sucrose gradients, and DEAE-cellulose chromatography. Purified syringacin W-1 is composed of at least four polypeptides which were resolved by SDS polyacrylamide gel electrophoresis. The activity of the bacteriocin was destroyed by exposure to temperatures > 45°C for 10 min, but was stable to freezing at -20°C. Syringacin W-1 was active from pH 5 to 8, but was irreversibly inactivated below pH 4 and above 9. Purified syringacin W-1 was chemically characterized and used for antibody production. Purified bacteriocin preparations are being used in studies of control effectiveness of bacterial plant pathogens.

DUAL DETOXIFICATION OF KIEVITONE AND PHASEOLLIDIN BY *FUSARIUM SOLANI* f. sp. *PHASEOLI*. D. A. Smith, J. M. Herrer and T. E. Cleveland, Plant Pathology Department, University of Kentucky, Lexington, Ky, 40546.

The isoflavonoid phytoalexins, kievitone and phaseollidin, were simultaneously detoxified to kievitone hydrate and phaseollidin hydrate, respectively, by liquid mycelial cultures of *Fusarium solani* f. sp. *phaseoli*. Both phytoalexins (20-25 µg/ml) were transformed in 24-30 hr.

Mycelial dry weight did not increase during detoxification. Previous research (Phytochemistry 16:296 and 19:1673) showed that these phytoalexins were independently detoxified by this fungus; this is the first report of their dual transformation. Kievitone hydratase, the enzyme responsible for kievitone detoxification (Physiol. Pl. Pathol. 14:179) did not achieve comparable simultaneous transformation; only kievitone was detoxified. Multiple phytoalexin detoxification may aid fungal colonization of plant tissues.

THE RELATION OF SEASONAL WEATHER TO FUSIFORM RUST INFECTION IN PINE PLANTATIONS. G. A. Snow and R. C. Froelich. Southern Forest Experiment Station, Gulfport, Miss. 39503

Slash pine trees planted in 1974 at several locations in south Mississippi were severely infected by *Cronartium quercuum* f. sp. *fusiforme* in 1975 and 1978. Infection was moderate in 1977 but very light in 1974 and 1976. Frequent rains and long periods of high humidity occurred in late April and early May during both years when infection was heaviest. Wet humid weather was less frequent in 1977 than in 1975 and 1978 and did not occur in 1976 until the last two weeks in May. Conditions seemed favorable for infection in 1974 but delayed growth on the newly planted trees apparently allowed them to escape infection. An examination of daily weather records from different forest sites show that windspeed and direction and the proximity and orientation of oaks, the alternate host, must be assessed to define weather that results in pine infection.

BOTRYTIS BLOSSOM-END ROT OF BARTLETT PEARS. Noel F. Sommer, Dept. of Pomology, Univ. of Calif., Davis, CA 95616 and Bruce E. Bearden, Farm Advisor, Ukiah, CA 95482.

Blossom-end rot (*Botrytis cinerea* Pers. ex. Fr.) causes important losses in Bartlett pears late in their storage. Inoculum in withered styles and stamens, retained within the floral tube, invades the flesh of postclimacteric fruits. *B. cinerea* was never the dominant fungus in senescent styles and stamens after blossoming. *Alternaria* sp. was almost always present, frequently accompanied by saprophytes. Incidence of *B. cinerea* in blossoms and rot in stored fruits varied between orchards and districts. Control of the storage rot was achieved by certain late-blossom fungicidal sprays or by improved postharvest temperature management.

THE DEMISE OF CERATOCYSTIS ULMI IN DEAD ELM ROOTS ASSOCIATED WITH ANTAGONISTIC MICROFLORA. V.J. Spadafora and R.J. Campana, Dept. of Botany & Plant Pathology, University of Maine, Orono, ME 04469.

The death of *Ceratocystis ulmi* in elm roots killed by disease is associated with other microflora, but their influence on *C. ulmi* is unknown. The survival of *C. ulmi* was investigated, with emphasis on potential antagonistic microflora. A hundred dead roots with streaking typical of Dutch elm disease were excavated from root systems of 20 elms, dead 1-4 years. An additional 25 roots were removed from 5 living diseased elms. Isolations were attempted using aseptic and aseptic techniques. Other microorganisms were screened *in vitro* on PDA for antagonism to *C. ulmi*. *C. ulmi* was not recovered from roots dead beyond one year. Several fungi, bacteria, and actinomycetes inhibited the growth of *C. ulmi* on agar, and limited development of coremia on elm discs. These were species of: *Fusarium*; *Penicillium*; *Trichoderma*; *Bacillus*; and *Streptomyces*. The data indicate that loss of viability of *C. ulmi* in dead root tissues is associated with antagonistic microflora.

CHARACTERIZATION OF FIVE CYLINDROCLADIUM ISOLATES FROM ORNAMENTAL STOCK. James A. Spencer, Department of Plant Pathology and Weed Science, Mississippi State, MS 39762.

Five isolates of *Cylindrocladium* spp., AR and BI from arborvitae (*Thuja aurea* 'Nana'), AL and AZ from azalea (*Rhododendron* sp. 'Redwing'), and KA from Kalanchoe (*Kalanchoe blossfeldiana* 'Vulcan'), were inoculated onto host plants. Azalea was very susceptible and arborvitae moderately susceptible to isolate AL (*C. theae*). Azalea and Kalanchoe were moderately susceptible to isolates AR and KA (both *C. scoparium*). Isolates AZ (*C. theae*) and BI (*C. peruvianum*) produced no symptoms. Isolates AR and KA (*C. scoparium*) differed in vesicle width but were within allotted measurements. Minimal conidial sizes of AZ and AL were smaller than those typical of *C. theae*, and isolate AL also had narrower vesicles. On PDA, isolate AZ outgrew AL at all temperatures tested, from 20 to 32C, except at 32C. Isolates AR and KA had similar growth curves and produced more growth at 32C than the other isolates. Isolate BI produced the most growth at 24 and 28C and was second to AZ at 20C. Differences between AZ and AL may warrant relegating AL to a variety status.

FORMULATION OF BACTERIAL ANTAGONISTS ALTERS EFFICACY FOR FOLIAR DISEASE BIOCONTROL. Harvey W. Spurr, Jr., North Carolina State University and Oxford USDA Laboratory, SEA, AR, Oxford, NC 27565.

Bacterial antagonists completely controlled pathogenic foliar fungi in laboratory tests and provided up to 70% disease control in the field. Commercial formulations of *Bacillus thuringiensis* (Bt) provided significantly more field control of peanut *Cercospora* leafspot (*Cercosporidium personatum*) than unformulated Bt. Therefore, formulation and application methods were studied to improve the efficacy of bacterial

antagonists. Sugar and detergent, two ingredients in commercial formulations of Bt, were evaluated in laboratory bioassays with pathogenic *Alternaria alternata* conidia. Lactose (1-10%) did not alter percent germination but increased germ tube length and infectivity. Tween 80 (0.01-2%) stimulated number and length of germ tubes and infectivity. Triton X-155 (0.01-2%) did not alter germination but decreased germ tube length and infectivity. Thus, the selection and use of formulation ingredients such as sugar and detergent can improve the efficacy of foliar disease biocontrol.

MATURE-LEAF RESISTANCE IN CITRUS TO XANTHOMONAS CAMPESTRIS PV CITRI. R. E. Stall, G. M. Marco and B. I. C. deEchenique. Dept. of Plant Pathology, Univ. of Florida, Gainesville 32611, and I.N.T.A., 3432 Bella Vista, Corrientes, Argentina.

Leaves of susceptible types of citrus became resistant to *Xanthomonas campestris* pv *citri* by 42 days after shoots began growth under field conditions in Argentina. The time was established in tests to determine the proper timing of sprays for control. The mature-leaf resistance was confirmed by analysis of the number of lesions cm^{-2} that developed after infiltration of half-leaves with inocula between 10^3 and 10^4 cells ml^{-1} . The mature-leaf resistance precluded determining levels of susceptibility among citrus types by 28 days after shoots began growth. Levels of susceptibility were distinguished with inoculations made between 14 and 21 days. Mature-leaf resistance was nullified with infiltration of inocula above 10^4 cells ml^{-1} and with inoculations accompanied by injury.

EPIDEMIOLOGY OF PHYTIUM APHANIDERMATUM ROOT ROT IN SUGARBEETS. M.E. Stanghellini, P. vonBretzel, and W.C. Kronland. Department of Plant Pathology, University of Arizona, Tucson, Arizona 85721

During the summer harvest months, sugarbeets are subjected to root-rot caused by *Pythium aphanidermatum*. The onset of the epidemic occurred in late June 1978 and mid-July 1979 and coincided with temperatures greater than 26C at the 10 cm soil depth. Once the epidemic started a constant mortality rate was recorded: 2% of the total beet population died per day resulting in a loss of ca. 100 kg of sugar/ha/day. Soil temperatures in 1980 never exceeded 25C and no root-rot occurred even in fields which contained up to 25 oospores/g of soil. No increase in oospore populations was detected in infected fields during the growing season (September to August). Oospore populations in infested fields exhibited a moderately clumped pattern of distribution (the 'k' parameter of the negative binomial distribution = 1.51).

SAMPLING AND DISTRIBUTION OF PEANUT LEAF SPOT. T. E. Starkey and G. O. Ware, Department of Plant Pathology and Agricultural Expt. Sta., University of Georgia, Athens 30602.

Leaf spot caused by *Cercospora arachidicola* Hori and *Cercosporidium personatum* (Berk. & Curt.) Deighton are the most widely distributed and destructive foliar diseases of peanut (*Arachis hypogaea* L.). Sampling methods have been based upon the assumption that the frequency distribution is normally distributed. The main stems of 1000 plants in a 0.3-ha field of 'Florunner' peanut were sampled to determine incidence and severity of leaf spot. For each stem the number and position of infected and defoliated leaflets, the total number of leaflets, the number and position of leaf spots per leaflet, and the total height of the stem were recorded. The data from each stem were grouped so as to divide the stem into equal segments. The statistical distribution of the disease assessment parameters for each segment of the stem followed either a normal, skewed normal, or negative binomial distribution. The precision and accuracy of disease assessment can be improved by using distribution information in determining sample location and size.

EFFECT OF TEMPERATURE ON SYMPTOMS, VIRUS CONTENT AND NODULE INFECTION IN PHASEOLUS VULGARIS INOCULATED WITH PEANUT STUNT VIRUS (PSV). J.R. Stavelly, R.G. Orellana, and R.W. Harris, USDA, SEA-AR, Applied Plant Pathology Laboratory, Beltsville, MD 20705

Seven days after seeding, plants of four bean cultivars were placed at 15, 20, and 25C with 10 hr. photoperiods, then mechanically inoculated with PSV. Forty days after inoculation growth was poor at 15C, but good at 20 and 25C. PSV symptoms were severe on BBL 274, moderate to slight on BLGV 109 and Pencil Pod Wax, and nearly absent on Rainier. Symptoms were not significantly affected by temperature on Rainier and Pencil Pod, but were more severe on BBL 274 and BLGV 109 at 15 than at 20 or 25C. Serological assay (ELISA) indicated significantly highest virus content in leaves of all cultivars except BBL 274 at 15C. Although nodulation was poor at 15C, functional nodules from inoculated plants contained PSV at all temperatures.

RESISTANCE TO UNITED STATES COLLECTIONS OF UROMYCES PHASEOLI IN PHASEOLUS VULGARIS. J. R. Stavelly, USDA, SEA-AR, Applied Plant Pathology Laboratory, Beltsville, MD 20705.

International Bean Rust Nurseries (IBRN), commercial bean cultivars, and previously reported rust resistant beans were screened against 11 pathogenically distinct collections of *U. phaseoli* from Florida, Maryland, Michigan, New Jersey,

North Dakota, and Tennessee. No bean accession was immune or highly resistant (absence of sporulation) to all rust collections. B-190 and Compuesto Negro Chimaltenango were resistant and 78 VEF 2327-1, Pinto Serrano, PI 313624, and S-434 were at least moderately resistant to all rust collections, with no pustules larger than 500 μ m. From crosses between susceptible cvs. and these lines, F₁ and F₂ populations are being obtained. Several of the IBRN entries, cultivars, and other lines segregated for reaction to one or more rust collections. Pustules larger than 800 μ m developed on most accessions with one or more U. phaseoli collections.

PILI OF PLANT PATHOGENIC BACTERIA. Pim Stemmer and L. Sequeira, Dept. of Plant Pathology, University of Wisconsin-Madison, Madison, WI 53706.

Conditions for the prolific production of common pili (fimbrae) by plant pathogenic bacteria were developed. Bacterial strains were grown for 24 to 48 hr at 28 C in dilute liquid media in drops (approximately 400 μ l) in plastic petri plates. Formwar-coated grids were floated on the culture droplets and then examined by electron microscopy. The presence of pili also was determined by culturing strains on sterile gold grids. More than 60 strains of bacteria, including representatives of the genera Pseudomonas, Erwinia, Xanthomonas, Agrobacterium, Rhizobium, and Corynebacterium were examined. Strains of P. solanacearum, P. savastanoi, P. syringae, A. tumefaciens, R. japonicum, R. trifolii, and R. meliloti formed large numbers of pili. Pili are known to play an essential role in attachment and infection in mammalian systems. The widespread occurrence of pili in plant pathogenic bacteria suggests that they may also be involved in specific attachment to plant cells.

HYPOXYLON MAMMATUM TOXINS WITH SELECTIVE EFFECTS ON CLONES OF POPULUS TREMULOIDES. B.A. Stermer, J.H. Hart and R.P. Scheffer, Department of Botany and Plant Pathology, Michigan State University, East Lansing, MI 48824.

Clones of P. tremuloides varied in sensitivity to toxins from H. mammatum, as shown by effects on leaves and young stems. A leaf assay, sensitive enough to detect toxin in samples containing 10 ng dry weight, was based on uptake of toxin solution by cut petioles. Leaves from a sensitive clone showed black necrosis by 5 h after exposure; another clone tolerated 500-fold more toxin with no obvious damage. Sensitivity of stems was correlated with sensitivity of leaves. Leaves of the sensitive clone responded within 1 h by increased respiration (+36%); O₂ uptake by the tolerant clone was not affected. Toxin caused an increase (+500 to 600%) in leakage of electrolytes from tissues of the sensitive, but not the tolerant, clone, beginning 6 h after exposure. Toxin was partially purified by use of Bio-Gel P-2 and silicic acid columns. Eight host-specific toxic components were recovered. These and other data suggest that the toxins are involved in development of Hypoxylon canker.

SUCRASE ACTIVITY OF SOME SPIROPLASMAS. C. Stevens, Dept. of Agric. Sciences, Tuskegee, Inst., AL 36088. R. M. Cody and R. T. Gudauskas, Dept. of Botany, Plant Pathology, and Microbiology, Auburn Univ., AL 36849.

When filter-sterilized C-63 medium was inoculated with Spiroplasma citri and the AS 576, Brevi (BR), corn stunt, powder puff (PP), and 23-6 spiroplasmas, only BR, PP, and 23-6 showed any growth as determined by titer increase and yellow-color acid reaction of the pH indicator in the medium. The filter-sterilized medium gave a negative test for reducing sugars. These results indicate that BR, PP, and 23-6 produced sucrase. Sucrase activity of these spiroplasmas increased with an increase in cell number and sucrose concentration, and was suppressed by fructose. It is interesting to note that these spiroplasmas which can utilize sucrose were originally isolated from flowers.

HONEY LOCUST DECLINE IN URBAN AREAS. J. A. Stim and E. B. Hime-lick, Department of Plant Pathology, University of Illinois and Illinois Natural History Survey, Urbana, IL 61801.

The decline of thornless honey locust (Gleditsia triacanthos f. inermis) has reached major proportions in central Illinois, particularly in monocultured urban plantings. Inoculations with the fungus Thyronectria austro-americanana (Speg.) Seiler, indicate it is a major cause of decline. Symptoms include cankers that girdle twigs and branches, and in advanced stages of decline, large elongated cankers develop on the trunk. Frequently a borer (Agrius sp.) is associated with cankers and may be a vector for the fungus. The borer invades twigs as well as the main trunk. Isolates of T. austro-americanana have been made from insect bark wounds and galleries. The ubiquitous nature of the disease in recent years is attributed to periods of drought stress resulting in the increased susceptibility of the host to the fungus and attack by bark borers.

CALCOFLUOR STAINING TECHNIQUE FOR FLUORESCENCE MICROSCOPY OF HELMINTHOSPORIUM SATIVUM ON WHEAT LEAVES. C. A. Stockwell and R. T. Sherwood, Dept. of Plant Pathology, The Pennsylvania State University, and U. S. Regional Pasture Research Laboratory, USDA-SEA-AR, University Park, PA 16802

Calcofluor, an optical brightener, permitted assessment of the spatial relation between external fungal infection structures and injured wheat leaf cells. Inoculated tissue, incubated at 12, 20 or 25°C, and cleared in lactophenol was treated with a solution of 0.05% Calcofluor in Tris/HCl buffer (pH 7.0) according to an established procedure (Phytopath. 67:808). Using epifluorescence microscopy (exciter filter 355-425, barrier 460) with this technique, affected epidermal cells autofluoresced yellow and fungal germ tubes, appressoria and superficial mycelia fluoresced a brilliant blueish-white. Non-fluorescing dark-pigmented products which accumulated in injured host cells did not interfere with the visualization of adjacent fungal structures. This study demonstrates the use of Calcofluor with the dematiaceous fungus, Helmintosporium.

LOCALIZATION OF CALCIUM IN RHIZOCTONIA SOLANI-INFECTED BEANS. Virginia Stockwell and Penelope Hanchev, Dept. of Botany and Plant Pathology, Colorado State University, Ft. Collins CO 80523

Calcification of pectins was suggested as a mechanism of resistance of older beans to R. solani and delimitation of lesions on young beans. Several ultrastructural histochemical techniques were used for localization of calcium in healthy and infected plants. Hypocotyl tissue was treated with potassium pyroantimonate (PPA) or ammonium oxalate during fixation. Treatment with PPA, but not with oxalate, resulted in granular deposits in cell walls of healthy and diseased tissue. Granules occurred on the plasma membrane of cells adjacent to lesions and on organelles of damaged cells. Healthy 24 day old cell walls had greater granule density than those 8 day old. The density of wall deposits around lesions was similar to young controls. Wall granules occurring in ruthenium red-positive areas were removed by EGTA. Energy dispersive analysis of x-rays suggested that PPA localized calcium. The results supported increased calcium pectate formation in older beans. Increases in calcium around lesions may occur in the cytoplasm rather than in cell walls.

THE BACTERIOSTATIC ACTIVITY OF THE FLUORESCENT PIGMENT OF PSEUDOMONAS FLUORESCENS. L.J. Stowell, M.E. Stanghellini, and I.J. Misaghi. Dept. of Plant Pathology, Univ. of Arizona, Tucson, AZ 85721

The growth inhibiting activity of Pseudomonas fluorescens (Pf) (ATCC# 13525) and its partially purified pigment were tested against five isolates of Erwinia carotovora var. carotovora (Ecc) and five isolates of Erwinia carotovora var. atroseptica (Eca). Pf was seeded onto the center of petri plates containing King's medium B 72 hr prior to spraying with Ecc and Eca isolates. Of the ten Erwinia isolates tested, three Ecc and two Eca isolates were inhibited in the presence of Pf or its partially purified fluorescent pigment. The growth inhibition of all sensitive isolates was overcome by addition of 100 μ l of 0.1% aqueous solution of FeSO₄ or FeCl₃ to the culture plates 24 hr after seeding with the Erwinia isolates. These results show that the growth inhibiting activity of the fluorescent pigment against certain Erwinia isolates in the presence of low iron concentration is due to its bacteriostatic rather than bactericidal property.

LIGHT AND ELECTRON MICROSCOPY OF PLANT LEAF CELLS FOLLOWING SHORT TERM EXPOSURE TO BROMINE GAS. S. J. Strauss, K. S. Kim and L. E. Murry, Departments of Plant Pathology (first two authors) and Botany & Bacteriology (third author), University of Arkansas, Fayetteville, AR. 72701

Immediate and delayed (24 hr) effects of 20 minute exposure of cowpea primary leaf tissue to 1, 3, and 5 ppm bromine gas were studied with light and electron microscopy. Major cytological modifications included cytoplasmic vacuolation, disruption of cellular membranes, plasmolysis, alteration of nucleolar structure, anticlinal cell wall interdigitation and collapse of the protoplast and/or cell wall. Although degree and type of injury varied, all epidermal and mesophyll cells were affected by the treatments. Spongy mesophyll cells with large air spaces surrounding them were more severely affected by circulation of the bromine gas than the closely packed palisade mesophyll cells. At low bromine concentration, certain cellular changes reverted when the exposed plants were returned to their normal environment; but at 5 ppm bromine, the entire cell population became necrotic and never recovered.

HEAD SMUT OF MAIZE, A NEW DISEASE IN MINNESOTA. Erik L. Stromberg, Assistant Professor and Plant Pathologist, USDA, APHIS, PPQ, Department of Plant Pathology, University of Minnesota, St. Paul, MN 55108.

Head smut of maize, caused by Sphacelotheca reiliana (Kühn) Clint., was first reported as occurring in Minnesota in fields at the Staples Vocational Technical Irrigation Farm, Wadena County where it was found by the author on 1 August 1980. Additional surveys by Stromberg and personnel from the Division of Plant Industries, Minnesota Department of Agriculture, and smut samples submitted by the public have resulted in the location of some 1250 ha of S. reiliana infested fields in Ottertail, Stearns, Todd, and Wadena counties. The incidence of infested fields is associated with light soils under irrigation, soil temperatures of from 22-30°C at germination and emergence, and continuous corn production. Losses from this disease have ranged from a trace to nearly 25%.

PATHOGENICITY OF FUSARIUM ROSEUM 'ACUMINATUM' AND 'AVENACEUM' IN ROOTS OF ALFALFA, RED CLOVER, AND CROWN VETCH. J. C. Stutz and K. T. Leath. Dept. of Plant Pathology, The Pennsylvania State University and U. S. Regional Pasture Research Laboratory, USDA,

F. roseum 'Acuminatum' and *F. roseum* 'Avenaceum' isolated from red clover roots exhibited different and characteristic pathogenic behaviors on nonwounded and wounded red clover roots, inoculated 4 cm. above the root tip. All isolates of *F. roseum* 'Avenaceum' caused necrosis at all inoculation sites; the necrotic area was longer at wounded sites than at nonwounded sites. *F. roseum* 'Acuminatum' isolates did not cause necrosis at nonwounded sites. They did cause necrosis at wounded sites, but it was less extensive than the necrosis caused by 'Avenaceum'. Both *F. roseum* cultivars caused a higher incidence and greater length of necrosis in alfalfa and red clover than in crown vetch.

SOURCES OF INOCULUM OF *PSEUDOMONAS SYRINGAE* PV. *TAGETIS*. D. J. Styer and R. D. Durbin. Dept. of Plant Pathology, UW-Madison and AR, SEA, USDA, Madison, WI 53706.

There are now three known hosts of *Pseudomonas syringae* pv. *tagetis*, all members of the Compositae. Each in various ways can provide inoculum for disease development in the economic hosts: marigold and sunflower. In the case of common ragweed (*Ambrosia artemisiifolia*), a new host, it is necrotic leaf spots and apical shoots. The bacterium can be readily recovered from the shoots by dipping in water. Seed transmission has been reported in sunflower (*Helianthus annuus*); in addition, we have observed necrotic flecks on this host from which the bacterium can spread. In marigold (*Tagetes erecta* and *T. patula*), the bacterium also can spread from necrotic leaf spots and it is seed transmitted. A new potential source of inoculum from this host is stem debris in which pv. *tagetis* has survived for an entire year in the field in Wisconsin. Possibly other Compositae can serve as sources of inoculum for this pathogen.

TILLAGE, FERTILITY, IRRIGATION, AND CORN STALK ROT AND SNAPBEAN ROOT ROT IN IRRIGATED MULTIPLE-CROPPING SYSTEMS
Donald R. Sumner, D. Smittle, J. Hook, and E. D. Thredgill
Coastal Plain Experiment Station, Tifton, GA 31793

On Lakeland sand, corn stalk rot caused by *Fusarium moniliforme* was most severe with frequent overhead irrigations of 3 cm/application with most of the N applied at planting or as a sidedress. Stalk rot was least severe with fewer irrigations of 5 cm/application with most of the N applied through irrigation water. Tillage practices did not influence corn stalk rot severity. In continuous corn, stalk rot was more severe in moldboard plowed plots with banded fertilizer than with broadcast preplant incorporated fertilizer. Fertilization practices did not influence stalk rot in subsoil-planted plots. Application of N by preplant incorporation following corn decreased stand of snapbean, compared with applying N through the irrigation water. Root and hypocotyl disease severity was greater with disking or subsoilplanting than with moldboard plowing (25-30 cm).

INITIATION AND CHARACTERIZATION OF A CULTURED CELL LINE FROM THE CROWN GALLS OF WILD CARROTS. Z. R. Sung and David Ow, Departments of Plant Pathology and Genetics, University of California, Berkeley, California 94720.

Plants infected by *A. tumefaciens* undergo a transformation process whereby tissues proliferate in the absence of exogenously supplied hormones, e.g., auxin. This auxin-independent growth has been observed in other cultured cell lines, i.e., habituated and 5-methyltryptophan (5-MT) resistant (W001) cell lines. Since the mechanism of auxin-independent growth in W001 is well characterized (Sung, 1979, *Planta* 145:339-345) a comparison of the crown gall tissue to W001 may help in elucidating the mechanism of transformation. A crown gall line, CG5, isogenic to W001 has been established from *A. tumefaciens* strain C58. Like W001, CG5 proliferates as "undifferentiated" tissue in auxin-free medium. However, it differs from W001 in that 1) it can photosynthesize while growing autonomously, 2) it is sensitive to 5-MT. The patterns of protein synthesis were compared to that of the normal cell lines by two-dimensional gel electrophoresis and autoradiography.

RAPID METHOD FOR GRAM DIFFERENTIATION OF BACTERIA FROM PLANT MATERIAL WITHOUT STAINING. T. V. Suslow¹, M. N. Schroth¹, and M. Isaka². ¹Department of Plant Pathology, University of California, Berkeley, CA 94720. ²Department of Agriculture, Fukui, Japan 910.

A rapid method for Gram-differentiation of bacteria without staining, adapted from Ryu, 1939 (*Jap. J. Vet. Sci.*, 1:209), was shown to be an accurate technique for identifying bacterial isolates from plant tissues. 74 strains of phytopathogenic and rhizosphere-colonizing bacteria with representative isolates from *Achromobacter*, *Agrobacterium*, *Bacillus*, *Corynebacterium*, *Erwinia*, *Pseudomonas* and *Xanthomonas* were tested to compare traditional Gram-staining methods to the method of Ryu. For this method, bacteria were grown on King's medium B agar plates for 24 hr. at 28°C. A bacterial colony was removed aseptically with a toothpick and placed into a 50 µl drop of 3% (w/v) KOH on a clean glass slide. Gram-negative strains always agglutinated in the KOH forming a stringy, viscous thread when lifted from the slide. Gram-positive bacteria did not react and dispersed in the drop.

ENHANCED DETECTION OF FUNGAL OOSPORES BY USE OF TETRAZOLIUM BROMIDE. E.D. Sutherland, S.D. Cohen, and J.L. Lockwood, Department of Botany and Plant Pathology, Michigan State University, East Lansing, MI 48824.

A 0.1% aqueous solution of [3-(4,5-dimethyl-thiazol-2-yl)-2,5-dimethyl-2H-tetrazolium bromide] (MTT) was added to equal volumes of oospore suspensions prepared from cultures of *Aphanomyces cochlioides*, *A. euteiches*, *Pythium aphanidermatum*, *P. ultimum*, *Phytophthora cactorum*, and *P. megasperma* f. sp. *glycinea* races 1 and 3. The preparations were incubated at 23°C or 35°C for 2, 8, 24, 48, and 72 h. MTT stained more than 85% of the oospores of *P. aphanidermatum*, *P. cactorum*, and *P. megasperma* f. sp. *glycinea*. Very few oospores of the other fungi reacted with MTT. Incubation at 35°C was superior to incubation at 23°C. The optimum incubation time was 8 h for *P. aphanidermatum* and 24-48 h for *P. cactorum* and *P. megasperma* f. sp. *glycinea*. Oospores of *P. megasperma* f. sp. *glycinea* in root tissues and artificially infested soil also were stained with MTT.

ABILITY OF *FUSARIUM* SPECIES TO DEGRADE LIGNIN AND AROMATIC ACIDS. John B. Sutherland and Don L. Crawford. Department of Bacteriology and Biochemistry, University of Idaho, Moscow, ID 83843.

Eighteen strains of *Fusarium*, including representatives of *F. epiphyseria*, *F. lateritium*, *F. moniliforme*, *F. nivale*, *F. oxysporum*, *F. rigidiusculum*, *F. roseum*, *F. solani*, and *F. tricinctum*, were grown at 24°C in aerated liquid media containing lignocellulose from blue spruce (*Picea pungens*) labeled with radioactive carbon. In 60 days, the fungi converted 2.0-4.3% of the labeled lignin to carbon dioxide and 2.7-8.5% to water-soluble compounds. *Fusarium nivale* degraded the greatest amount of lignin (4.3%) to carbon dioxide. The same strains were also grown in liquid media containing aromatic acids with structures similar to lignin monomers. Benzoic, cinnamic, p-coumaric, ferulic, m-hydroxybenzoic, p-hydroxybenzoic, syringic, vanillic, and veratric acids were degraded by nearly all of the strains. The widespread presence of lignin-degrading enzymes in the genus *Fusarium* may enable these fungi to overcome host resistance mechanisms that involve lignification of cell walls.

COMPARISON OF HELMINTHOSPORIUM MAYDIS RACE T TOXIN TO SYNTHETIC COMPOUNDS FOR SPECIFICITY AND TOXICITY. Y. Suzuki, K. Tegmeier, J. M. Daly and H. W. Knoche, Univ. Nebraska, Lincoln, NE 68583.

Native T-toxin(s), seven synthetic compounds, and native toxin(s) reduced by NaBH₄ were compared in specificity for, and toxicity to, Tms cytoplasm maize by a dark CO₂ fixation bioassay of thin leaf slices. Synthetic compounds differed from native toxin in carbon chain length, and number and arrangement of keto and hydroxyl groups. Synthetic C₂₅H₄₀O₆ exhibited host-selective toxicity in the same range as native toxin (ng/ml) while 5 compounds exhibited specific toxicity at µg/ml dosages, providing evidence that the reported structure of native T-toxin(s) is correct. Insolubility of the one ineffective synthetic compound may explain its lack of activity. Chain lengths of C₂₅ to C₁₅ were less active on a molar basis than native toxin (C₂₉-C₄₁). Reduction of keto functions to hydroxyls or alteration of the C₁-C₇-diketo function to a C₁-C₆-diketo arrangement also reduced activity. Activity was drastically decreased by eliminating two hydroxyl functions or two of the four keto functions from a C₂₅-tetraketo, dihydroxy synthetic compound.

PHENOLICS INDUCED BY *LACCARIA LACCATA* ARE ASSOCIATED WITH RESISTANCE TO *FUSARIUM OXYSPORUM* AND *PHYTIUM IRREGULARE* IN PRIMARY ROOTS OF DOUGLAS-FIR SEEDLINGS. D. M. Sylvia and W. A. Sinclair, Dept. of Plant Pathology, Cornell University, Ithaca, NY 14853.

Primary roots of one-month-old seedlings of *Pseudotsuga menziesii*, untreated or inoculated with the ectomycorrhizal fungus *Laccaria laccata*, were challenged with *Fusarium oxysporum* or *Pythium irregulare*. As the pathogens grew from infested seeds across agar coated slides to roots, their rates of growth and their levels of rhizoplane colonization were not influenced by *L. laccata*. Thus antibiotics may have no role in the interaction. However, colonization of the root cortex by each pathogen was significantly inhibited in roots previously exposed to *L. laccata*. Hyphal frequency was inversely proportional to the concn of phenolics that developed in roots exposed either to *L. laccata* or its metabolites. Phenolics induced by *L. laccata* are thus associated with a resistance that protects seedlings from damaging fungal infections.

THE FORMATION OF PLASMID-CHROMOSOME HYBRIDS IN *PSEUDOMONAS SYRINGAE* PV. *PHASEOLICOLA*. L. J. Szabo, J. Voipe and D. Mills, Dept. of Botany and Plant Pathology, Oregon State University, Corvallis, OR 97331.

Pseudomonas syringae pv. *phaseolicola* strain LR700 harbors a single indigenous 98 Mdal cryptic plasmid, pMC7105. A derivative of this strain, LR719, is known to maintain a stable integrated form of pMC7105 within the bacterial chromosome. To obtain a preliminary estimate of the frequency of formation of excision plasmids and the nature of the DNA comprising them, 50 randomly selected colonies of LR719 were analyzed for plasmid content by agarose gel electrophoresis. Five isolates were found to each contain a single plasmid species. Four of the 5 excision plasmids were shown to be 20-50 percent larger than the original plasmid; the fifth was 20 percent smaller. A restriction endonuclease fingerprint analysis of a 130 Mdal

plasmid revealed that essentially all of pMC7105 was contained within the excision plasmid and that the additional DNA was of chromosomal origin. The true episomal nature of pMC7105 in this plant pathogen may be exploited in developing a genetic system analogous to the HFr system of *Escherichia coli*.

CONTROL OF POWDERY MILDEW OF APPLE AND CUCURBITS WITH CGA 64251 BY VAPOR ACTION. Michael Szkolnik, Dept. of Plant Pathology, N.Y. State Agric. Expt. Sta., Geneva, 14456

Cheesecloth treated once with 1-[[2-(2,4-dichlorophenyl)-4-ethyl-1,3-dioxolan-2-yl]methyl]-1H-1,2,4-triazole (Ciba-Geigy CGA 64251, Vanguard) was suspended as a curtain along the center of a 112 m² greenhouse room. The 384 mg (a.i.) of the fungicide in the 6 m² cheesecloth was equiv. to 3.45 mg per m² of room. On the same date and at weekly intervals, paired groups of plants inoculated with powdery mildew spores were placed in this house and in an untreated house. Temperature above 20 C and RH above 90% in both houses favored mildew. In the untreated house severe mildew occurred on all McIntosh apple seedlings inoculated with *Podosphaera leucotricha* and on all muskmelon and cucumber plants inoculated with *Sphaerotheca fuliginea*. In the treated house both hosts remained free of powdery mildew for at least 10 weeks. This control is attributed to vapor action by CGA 64251. Continued control on plants set into the treated house even 9 weeks after the treated cloth was set in place proved persistence of vapor effectiveness.

POTENTIAL FOR BIOLOGICAL CONTROL OF FULVIA FULVUM BY HANSFORDIA IN TEXAS. Ruth Ann Taber, Donald H. Smith, Robert E. Pettit, and Jerral D. Johnson. Texas Agricultural Experiment Station and Texas Agricultural Extension Service, Texas A&M University, College Station, Texas, 77843.

Hansfordia is a genus of mycoparasitic fungi that parasitizes other dematiaceous fungi, particularly foliicolous Cercospora-like parasites in warmer climates. *Hansfordia* was previously reported as a destructive pathogen on the late leaf spot fungus (*Cercosporidium personatum*) on peanuts and now has been found on *Fulvia fulvum* (*Cladosporium fulvum*), leaf mold fungus of tomatoes near Conroe, Texas. It was recovered from discarded tomato leaves invaded by the leaf mold fungus. *Hansfordia* was not observed on diseased plants within the greenhouse where benomyl, maneb, and chlorothalonil were used. *Hansfordia* is sensitive to benomyl. The mode of parasitism on *Fulvia* was similar to that on *Cercosporidium*. Hyphae of *Hansfordia* coiled around *Fulvia* spores and penetrated both spores and hyphae. *Hansfordia* appears to be widely distributed in Texas, is easily cultured and is being tested as a biological control agent.

INTERACTION OF CORYNESPORA CASSIICOLA AND PHIALOPHORA GREGATUM IN SOYBEANS. H. Tachibana, V. Otazu, C. C. Kusek, and A. H. Epstein. USDA-SEA-AR, Dept. Plant Pathology, Seed and Weed Sciences, Iowa State Univ., Ames, IA 50011

Root rot caused by *Corynespora cassiicola* and nodulation reduction were found to occur in soybeans from fields with brown stem rot (BSR), caused by *Phialophora gregatum*, in Iowa in 1980. Statistically highly significant differences of 63.7 and 4.0% were detected for root rot, nodulation scores of 1.26 and 2.41 (based upon 1 = no nodule, 2 = small and few nodules, 3 = large and many nodules) for nodulation reduction, and yields of 3125 and 3508 kg/ha for soybeans from BSR and non-BSR lands, respectively. Crop maturity was 5 to 7 days earlier in the infested land. Soybeans resistant and susceptible to *P. gregatum* seemed to be equally affected, including Williams, Oakland, BSR 301, BSR 302, Pride B216 and A78-227013 in maturity groups III and II. Interactions were detected in soybeans of fields located at Sutherland, Kanawha, Ames, and Burlington in northwest, north central, central and southeastern Iowa, respectively.

THE SURVIVAL OF CERATOCYSTIS FAGACEARUM IN SOUTH CAROLINA. F. H. Tainter and D. L. Ham, Department of Forestry, Clemson University, Clemson, SC 29631.

Turkey oak trees were inoculated with *Ceratocystis fagacearum* on April 30, 1980. Recovery of the fungus steadily decreased from 50% from twigs and 33% from stems at 14 days, to 0% from both stems and twigs at 201 days. These trees wilted slowly over the summer but were still apparently alive at 201 days although many twigs had died. Epicormic branching was profuse on many stems. The moisture content of twigs of inoculated trees did not decrease appreciably until after 178 days. No *Hypoxyton* spp. attack is yet visible in these trees although *T. T.* is common on other stressed red oaks in the area. *C. fagacearum* was recovered at a low percentage from roots during several of the winter months, indicating that the fungus may survive in roots in natural infections.

EXTRACTION OF T-TOXIN FROM NEAR-ISOGENIC LINES OF HELMINTHOSPORIUM MAYDIS RACES T AND O. K. J. Tegtmeier*, O. C. Yoder** and J. M. Daly*, *University of Nebraska, Lincoln, NE 68583 and **Cornell University, Ithaca, NY 14853.

Four near-isogenic lines of *Helmintosporium (Bipolaris) maydis*, differing in monogenically-controlled race and albinism (alb-1) traits, were isolated from tetrads of a single cross. Fourteen day old still cultures, grown in modified Fries medium, were extracted for T-toxin(s) by a procedure used previously. A white precipitate from cultures of race T lines (albino and wild-type) was obtained and assayed for host-selective toxicity; and was

found to be T-toxin. No analogous precipitates were recovered from cultures of race O (albino or wild-type). These findings support the idea that the chemical whose structure was previously identified is T-toxin. The failure to recover from race O cultures a compound analogous to T-toxin(s) indicates that either race O fails to synthesize such a compound or it degrades T-toxin endogenously while race T cannot. To our knowledge this is the first demonstration of a chemically-defined fungal product associated with a single gene for virulence.

STRUCTURE OF FERRIC PSEUDOBACTIN: A SIDEROPHORE FROM A PLANT GROWTH-PROMOTING PSEUDOMONAS. M. Teintze,¹ J. Leong,¹ M. B. Hossain,² C. L. Barnes,² and D. van der Helm,² ¹Dept. Chem., UCSD, La Jolla, CA 92093, & Dept. Chem., U. of Okla., Norman, OK 73019. Both plant growth-promoting *Pseudomonas* B10 and its yellow-green fluorescent iron transport agent (siderophore) pseudobactin enhance plant growth and convert certain disease-conducive soils into disease-suppressive soils. The structure of the title compound has been determined by single-crystal x-ray diffraction methods. The structure consisted of a linear hexapeptide, L-Lys-D-threo-β-OH-Asp-L-Ala-D-allo-Thr-L-Ala-D-N⁶-OH-Orn, in which the N⁶-OH nitrogen of the ornithine was cyclized with the C-terminal carboxyl group and the N⁶-amino group of the lysine was linked via an amide bond to a fluorescent quinoline derivative. The iron-chelating groups consisted of a hydroxamate group derived from N⁶-hydroxyornithine, an α-hydroxy acid from β-hydroxyaspartic acid, and a α-dihydroxy aromatic group derived from the quinoline moiety. The combination of metal chelating ligands and the alternating L- and D- amino acids were unusual. Aspects of the antagonism of pseudobactin against phytopathogenic microorganisms will be discussed.

A FLEXIBLE COMPUTER-BASED SYSTEM FOR MANAGING DISEASE-LOSS DATABASES. P.S. Teng, B.W. Kennedy and D.O. Erstad, Department of Plant Pathology, University of Minnesota, St. Paul, MN 55108.

Voluminous data on crop, environment, husbandry practices and intensities of stress agents are collected in disease-loss surveys. For timely translation of raw data into management information, a computerized system was designed using the Scientific Information Retrieval (SIR) package. The Minnesota Crop Loss Information System (MCLIS), possesses flexibility for use on multicrop, multivisit and multimonthed variable situations. Components of MCLIS are data entry, data verification, data storage in SIR, data summary and report generation, and graphics. Data pertinent to each farm-visit are entered into computer disk files, loaded into the SIR database and then verified. County, region and state means for any variable are presented as tables or computer-drawn maps. MCLIS was validated in 1980 using data collected sequentially from 160 soybean fields. MCLIS is executable on mainframe computers and microcomputers.

ASSESSING CROP LOSSES DUE TO OZONE AND SULFUR DIOXIDE IN MINNESOTA. P.S. Teng, S.V. Krupa and K.R. Kromroy, Department of Plant Pathology, University of Minnesota, St. Paul, MN 55108.

Crop losses caused by ozone and sulfur dioxide were estimated for the 1979 and 1980 seasons using empirical pollutant-loss models developed for each of five crops: alfalfa, soybean, wheat, corn and potato. For each crop/pollutant system, pollutant dosage was characterized in three ways, namely 1) mean dose per hour which exceeded ambient background, 2) mean dose per hour for 24 hours and 3) total dose for 24 hours. The generalized skeleton model for loss estimation was $\sum_{i=1}^n y_i \cdot dt$, where y_i is the contribution to final loss incurred during dt , a specified time period dependent on crop. Loss due to either pollutant on each crop was estimated for each county in Minnesota by coupling monitored pollutant data with each skeleton model. Pollutant regimes for each isopleth region were generated from actual monitored data to give isoloss lines for each crop during the season.

MELOIDOGYNE INCOGNITA AND ROTYLENCHULUS RENIFORMIS INTERACTIONS IN A SWEETPOTATO FIELD. R. J. Thomas and C. A. Clark, Dept. Plant Path. & Crop Physiol., La. State Univ. Agric. Expt. Sta., Baton Rouge, LA 70803.

Meloidogyne incognita (MI) and *Rotylenchulus reniformis* (RR) interactions on three sweetpotato varieties were studied in field plots fumigated with methyl bromide and then infested. RR, MI, and RR + MI-infested soil and roots were added to give 100 RR or MI/500 cc soil and uninfested soil and roots to controls. Plots were sampled monthly. Nematode populations on all three varieties followed similar trends. MI populations peaked in Aug. (2975/250 cc soil for MI and 1568 for MI + RR) and declined in Sept. (1917 for MI and 278 for MI+RR) regardless of RR, but MI was sig. lower with RR for both months. RR with MI was sig. higher in Aug. (4788) than RR alone (3180), but in Sept. RR with MI declined to 2615 while RR alone increased (3438). The interaction RR x MI x month was sig. for both total RR (P₂.01) and total MI (P₂.03). The interaction RR x MI was not sig. for yield, but highly sig. for total cracked fleshy roots (P₂.01).

LEVEILLULA TAURICA ON TOMATO IN UTAH. Sherman V. Thomson, Wayne B. Jones and Richard G. Ballard, Department of Biology, UMC 45, Utah State University, Logan, Utah 84322.

Powdery mildew of tomato caused by *Leveillula taurica* (Lév.) Arn has caused serious losses in Utah since 1978. Identification of the fungus was made in 1980, but pictures of diseased tomato plants and grower descriptions indicate the disease was present at least two years earlier. Field observations indicate that *L. taurica* does not overwinter in Northern Utah but may be imported each year on transplants from Nevada or Florida. The primary outbreaks occurred in fields planted with imported transplants, while plants of the same variety but raised locally did not show symptoms of powdery mildew until late in the season. Chili pepper plants adjacent to infected tomato fields were also infected with *L. taurica*. Conidia were abundant on greenhouse-grown tomatoes but very sparse on field-grown tomatoes. Perithecia of *L. taurica* were found on dry tomato foliage in a Nevada greenhouse in March 1981, but not overwintered foliage of field-grown tomatoes in Northern Utah.

CHROMATOGRAPHIC AND ELECTROPHORETIC BEHAVIOR OF POTATO VIRUS Y (PVY) HELPER COMPONENT (HC). D. W. Thornbury and T. P. Pirone. Plant Pathology Department, University of Kentucky, Lexington, Ky 40546.

Partially purified HC, in 0.1M Tris, 0.02M MgCl₂, pH 7.2, binds to carboxymethyl cellulose, phosphoryl cellulose, and Bio-Rex 70, but not to DEAE cellulose. This indicates that HC is cationic in nature. Recovery from all chromatographic systems is inconsistent and a large amount of starting material is required for recovery of detectable HC activity. Isoelectric focusing of HC in Sephadex G-200 beds using ampholytes in the pH range 8 to 10.5 indicates an isoelectric point less than pH 9.0. However, no activity can be recovered after focusing to equilibrium. Electrophoretic protein profiles of HC and control (healthy tissue) preparations were indistinguishable when examined in SDS-polyacrylamide gels. These results suggest that HC is present in very low concentrations and is probably bound to other proteins in the extract.

A XYLEM-LIMITED, RICKETTSIALIKE BACTERIUM INFECTING RAGWEED. L. W. Timmer, R. H. Brlansky, *B. C. Raju, and R. F. Lee, Univ. Fla., IFAS, AREC, Lake Alfred, FL 33850 and *Univ. Calif., Dept. Plant Pathology, Davis, CA 95616.

A xylem-limited, rickettsialike bacterium (RLB) was transmitted to ragweed by *Oncometopia nigricans* (O. n.) collected in a blight-affected citrus grove. When monthly collections of O. n. were caged on ragweed, grape, rough lemon, and periwinkle, only ragweed became infected. Scanning electron microscopy of pump organs of O. n. from monthly samples revealed up to 10% of the insects carried RLB. *Homalodisca coagulata* and O. n. transmitted the ragweed RLB in cage tests. The ragweed RLB reacted with antisera to Pierce's disease bacteria (PDB) and phony peach bacteria (PPB) in immunofluorescence and enzyme-linked immunosorbent assays, but reacted more strongly with antisera to the PPB. The ragweed RLB formed only small primary colonies on media (PD2) used to culture PDB, but grew well and was established only on media (BCYE) formulated for culture of PPB.

EFFECT OF DEPTH AND RATE OF SEEDING ON COMMON ROOT ROT OF WHEAT IN SASKATCHEWAN. R. D. Tinline, Agriculture Canada Research Station, 107 Science Cres., Saskatoon, Sask. S7N 0X2.

Intensity of common root rot in wheat caused primarily by *Cochliobolus sativus* increased with seeding depth, as did the length of the subcorn internode, that part on which the disease was rated. Differences in seeding rate per row or in distance between spaced plants had no appreciable effect on disease levels. Although yield per plant declined as number of spaced plants per unit area increased, the average percentage loss attributed to disease seemed fairly constant. However, widely spaced plants were slower to mature than those incurring greater interplant competition.

A PRELIMINARY LATENT PERIOD MODEL FOR *VENTURIA INAEQUALIS*. J.R. Tomerlin and A.L. Jones. Department of Botany and Plant Pathology, Michigan State University, East Lansing, MI 48824.

A portable mist chamber was used in the field to maintain leaf wetness on 2 to 3 m tall McIntosh apple trees. Terminal shoots were inoculated periodically between 23 June and 18 August 1980 by atomizing with conidial suspensions of *Venturia inaequalis* (5 X 10⁵ conidia/ml). Leaves were examined daily for scab lesions. Latent periods represented the time between day of inoculation (DI) to first visible lesions. Multiple regression models with a) average temp the week before DI, b) maximum temp on DI, c) average temp on DI, and d) either average temp or cumulative degree days (base 10 C) from DI to 5 days after DI, as independent variables, explained more than 87% of the variation in latent period. We consistently observed longer latent periods than indicated by Mills. Deviation from expected values occurred when maximum temp after inoculation was above 30 C for 1 or more days, suggesting the necessity of a delay for high temperature in the model.

EFFECTS OF ANTIBIOTICS AND METABOLIC INHIBITORS ON GERMINATION OF *PERONOSCLEROSPORA SORGHII* CONIDIA. E.A. Traylor and L.D. Dunkle. USDA-SEA. Dept. of Botany and Plant Pathology, Purdue University, W. Lafayette, IN 47907.
Synchronous sporulation of *Peronosclerospora sorghi*, causal

agent of sorghum downy mildew, is induced by incubating systemically-infected sorghum seedlings at 19 C in darkness and dew for 7.5 hr. Sporulation is followed directly by conidial germination. This lack of a dormant period, sensitivity of conidia to desiccation, and the limited duration of conidial viability have precluded simple, routine use of conidia as inoculum. Attempts were made to interrupt the differentiation sequence between sporulation and germination and to induce dormancy by incubating conidia in metabolic or biosynthetic inhibitors. Antibiotics known to inhibit protein biosynthesis in prokaryotes or eukaryotes prevented conidial germination. Metabolic inhibitors and most inhibitors of RNA biosynthesis also were effective. However, the inhibitory effects of all compounds tested were irreversible, and conidia failed to germinate when transferred to water.

REACTION OF RYEGRASS TO MISSISSIPPI ISOLATES OF *PYRICULARIA GRISEA*. L. E. Trevathan, Department of Plant Pathology and Weed Science, Mississippi State University, Mississippi State, MS 39762.

Seven isolates of *Pyricularia grisea* from crabgrass, three from St. Augustine grass, and one each from soybean, knotweed, smartweed, and ryegrass were artificially inoculated to the ryegrass cultivars, Gulf and Magnolia, in the greenhouse. All isolates tested were pathogenic to ryegrass. The isolate from naturally infected ryegrass was most pathogenic. Colony morphology and growth of the fourteen isolates on potato dextrose agar, V-8 juice agar, and oatmeal agar varied with host source and growth medium. There was no correlation between pathogenicity and colony morphology or growth. The ryegrass cultivar, Gulf, was consistently more susceptible than Magnolia.

ETIOLOGY OF POD AND SEED COAT DISCOLORATION OF WHITE BEANS. J. C. Tu, Research Station, Agriculture Canada, Harrow, Ontario, Canada NOR 1G0

Alternaria alternata (Fr.) Keissler is the cause of the greyish discoloration of pod and seed coat discoloration of white beans (*Phaseolus vulgaris* L.). The severity of pod discoloration varies from dark grey flecks or stipples to dark grey patches which coalesce later. Severely-affected pods often become completely discolored. Seeds within discolored pods show varying degrees of discoloration which persists through processing. *A. alternata* is a phylloplane fungus indigenous in bean fields and is a weak parasite which colonizes the cavities of stomata, and causes restricted infections. The fungus thrives on senescent tissues and sporulates readily. Benomyl and chlorothalonil used in controlling white mold significantly increase the severity of this problem. Tests *in vitro* show that *A. alternata* is insensitive to both fungicides. In the field, benomyl and chlorothalonil inhibit other phylloplane fungi, allowing unimpeded growth and sporulation of *A. alternata*. There is more pod and seed-coat discoloration in the early maturing cultivar Seafarer, than in the late maturing Fleetwood.

A CROP-LOSS MODEL FOR SORGHUM DOWNY MILDEW. Darlene M. Tuleen, R. A. Frederiksen, Plant Sciences, TAES, Texas A&M Univ., College Station, TX 77843.

A model is presented for calculating yield loss in grain sorghum due to systemic sorghum downy mildew caused by *Peronosclerospora sorghi*. It is sensitive to plant population, disease reaction of the hybrid, and rainfall following planting. Equations were developed using data sets from field experiments conducted over several years in South and Central Texas. Empirical data indicate that: 1) a low incidence of systemic infection can thin dense sorghum stands to an optimum plant density and allow the healthy plants to prosper, 2) genetic resistance effectively reduces grain yield losses caused by the disease, and 3) rainfall within 4-7 days after planting is associated with a low incidence of the disease at locations observed. Model estimates were plotted against measured crop yields using seven data sets (from field tests conducted in 1975 and 1979 at two South Texas locations). Multiple regression analysis performed on the data showed that the model simulated grain yield with acceptable precision.

RELATIONSHIP BETWEEN MEMBRANE POTENTIAL AND ATP LEVEL IN *XANTHOMONAS MALVACEARUM* INFECTED COTYLEDONS. C. Ullrich-Eberius and A. Novacky, Institut für Botanik, TH Darmstadt F.R.G. and Dept. of Plant Pathology, Univ. Missouri, Columbia, MO 65211
The transmembrane potential (Em) of cells in cotyledons (1dd) of *Gossypium hirsutum* inoculated with *Xanthomonas malvacearum* is high at the level of control (-170 mV) in light and low at the level of apparent diffusion potential (-90 mV) in dark. The low Em in dark suggests a sharp decrease of ATP supply to the plasmalemma electrogenic pump. We analysed ATP level in diseased and healthy cotton cotyledons. The ATP concentration was found similar in both tissues and remained unchanged in dark. Inhibition of bacteria by rifampicin had no effect on ATP level. Fusicoccin (FC), which stimulates the plasmalemma electrogenic pump in higher plants even at low intracellular ATP concentrations, hyperpolarized Em in healthy and diseased cotyledons by 35 mV in light. However, there was no response to FC in cells of diseased cotyledons in dark. The apparent uncoupling of ATP from plasmalemma electrogenic pump in cells of diseased tissue in dark will be discussed.
(Supported by DFG and NSF)

THE TRANSMISSION OF SUNBLOTCH DISEASE WITH A PURIFIED RNA SPECIES. J. G. Utermohlen, R. J. Drake, P. R. Desjardins, and J. S. Semancik. Department of Plant Pathology, University of California, Riverside, CA 92521.

Dale and Allen (1979) and Mohamed and Thomas (1979) reported a unique RNA species in extracts from sunblotch diseased avocado. Semancik and Desjardins (1980) reported five RNA species (designated ASV 1 through ASV 5) that were found in extracts of sunblotch diseased avocado. The ASV 5-RNA was isolated by sequential electrophoresis in nondenaturing and denaturing polyacrylamide gels. The molecular weight of 70,000 daltons for the ASV 5-RNA was determined by electrophoresis in 5% polyacrylamide, 8 M urea gels. In nondenaturing conditions the ASV 5-RNA molecular weight was 72,000 daltons. Disease symptoms developed within 4 months when isolated ASV 5-RNA was slash inoculated into healthy avocado seedlings. The possible relation of ASV 5-RNA with the four RNA species (ASV 1-ASV 4), as described by Semancik and Desjardins, remains to be resolved.

DEVELOPMENT OF RESISTANCE TO WHITE ROT IN BULB ONIONS. R.S. Utkhede and J.E. Rahe, Department of Biological Sciences, Simon Fraser University, Burnaby, B.C., Canada V5A 1S6
The onion cvs. Ailsa Craig and Wolska grown from commercial seed showed significant resistance to *Sclerotium cepivorum* in field trials on muck soil during 1976, '77 and '78. Resistance was not observed in Ailsa Craig from seed purchased and tested in 1979. Different seed lots of Ailsa Craig and Wolska were compared in 1980 along with selfed and open-pollinated progenies of these cultivars produced from selections from 1978 trials. Significant differences in resistance to *S. cepivorum* were observed among five seed lots of each of the cvs., with the highest level of resistance occurring in a selfed progeny of Ailsa Craig. Percent infection was significantly reduced in plants from gamma-irradiated seed of Ailsa Craig field tested in 1978, and similarly in irradiated seed of Ailsa Craig and Autumn Spice tested in 1979. Inheritance of radiation-induced resistance was demonstrated in selfed and open-pollinated M₂ progenies in 1980. These results confirm the occurrence of useful resistance to *S. cepivorum* in *Allium cepa*. At present, resistance must be assigned to seed lots or breeding lines rather than named cultivars.

CONTROL OF MAIZE CHLOROTIC MOTTLE VIRUS BY CROP ROTATION. J. K. Uyemoto, N. J. Phillips, and D. L. Wilson
Kansas State University, Manhattan, Kansas 66506.

In NC Kansas, continuous corn plantings perpetuate maize chlorotic mottle virus (MCMV), a component of corn lethal necrosis disease (CLND). MCMV survives in infected corn residue from which corn rootworm larvae, a known vector, presumably acquire the virus. In 1979 a plot with 8 replications was planted to 2 corn hybrids (*Zea mays* L.) (one CLND tolerant; the other susceptible) and forage sorghum (*Sorghum bicolor* (L.) Moench). That year MCMV infections were 17% in each corn hybrid and 0% in sorghum. In 1980, the entire plot was planted to the CLND-susceptible hybrid. In the survey of 28 June-2 July, subplots on continuous corn showed 1.6% MCMV infections and 0% on sorghum-corn subplots. Later in the season, the subplots were 12 (continuous corn) and 1% (sorghum-corn). Crop rotation reduced incidence of MCMV and this practice contributed to increased corn yields.

HELMINTHOSPORIUM CARBONUM, A CAUSE OF STALK ROT OF CORN IN IOWA 1981. Nader G. Vakili and G. D. Booth, AR/SEA/USDA, Department of Plant Pathology and Statistics, Iowa State University, Ames, IA 50011.

Helminthosporium carbonum was isolated from 210 of 1,047 pith nodal plates of corn stalks in 1979. Pairs of plants from 65 S₁ lines of BS10 and 70 of BS11 populations were selected as healthy and stalk lodged at ear harvest. The frequency of isolates from stalk lodged was significantly higher, at P=0.001, than from healthy plants in both populations. Koch's Postulates were tested by inoculations of stalk and isolation of the pathogen, followed by foliage and again of stalk before final isolate was identified as A-mating type of *H. carbonum*. The difference between the frequencies of *H. carbonum* isolates from inoculated and control plants was highly significant for trials conducted in greenhouse. *H. carbonum* was only moderately pathogenic to corn foliage but caused rapid and severe necrosis of the nodal plates and internode pith.

A HYPERPARASITE OF HELMINTHOSPORIUM SPECIES ISOLATED FROM CORN. 1981. N. G. Vakili and Lois H. Tiffany. AR/SEA and Iowa State University.

Sphaeronaemella helvella (Karsten) Seeler was associated with isolates of *Helminthosporium carbonum* obtained from nodal plates of pith in *Zea mays*. *S. helvella* grew profusely (10 mm/day) on *H. carbonum* but very slowly in pure culture on APDA medium (10 mm/45 days). Inoculation of *H. carbonum* with ascospore masses of *S. helvella* resulted in conidial production within 48 hours and perithecia within 15 days. Conidia were produced either on phialides as cephalate, catenulate and penicillate forms or directly by budding. Conidia from penicillate heads and ascospores were most virulent on *H. carbonum*. Infected *H. carbonum* conidia were malformed, thickened cross walls and were reduced in size and number. Infected mycelia of *H. carbonum* were vacuolate, light colored, and had reduced growth rate. *H. maydis* and *H. turcicum* were also good substrates for *S. helvella*.

CHARACTERIZATION OF A STRAIN OF SOUTHERN BEAN MOSAIC VIRUS. R. A. Valverde and J. P. Fulton. Department of Plant Pathology,

University of Arkansas, Fayetteville, AR. 72701.

An isolate of southern bean mosaic virus (SBMV), occurring as a contaminant in a desiccated sample of bean common mosaic virus, differed from type SBMV in its reaction on several bean cultivars. This isolate, designated strain SBMV-A was characterized and compared with type SBMV. No difference was evident between the two strains in particle size, shape, electrophoretic mobility, sedimentation coefficient, and molecular weights of nucleic acid and protein. SBMV-A formed spurs with type SBMV against SBMV-A antiserum, but no spurs formed in reciprocal tests with type SBMV antiserum. Both strains were readily transmitted by beetles. Of fifty bean cultivars tested, ten were resistant to systemic infection by the type strain, but were susceptible to SBMV-A. The remainder of the bean cultivars were susceptible to both strains.

FUSARIUM TRICINCTUM AS A PATHOGEN OF SPRING WHEAT. R.H. Vargo, J.S. Baumer and R.D. Wilcoxson, Department of Plant Pathology, University of Minnesota, St. Paul, MN 55108.

Fusarium tricinctum (Corda) Sacc. was routinely isolated from all plant parts of spring wheat from three Minnesota locations during 1979. Single-spore isolates from roots, leaves and heads were spray-inoculated onto leaves and heads of Era wheat and the plants were incubated in a mist chamber for 48 hr; the experiment was repeated except plants were dip-inoculated. Variable necrotic symptoms formed on leaves, leaf sheaths and culms. The symptoms on heads resembled scab except that the kernels were not affected. The fungus was reisolated from necrotic tissues. The lesions continued to expand in size for several weeks and the fungus sporulated from the necrotic tissues in the greenhouse. *F. tricinctum* isolates from soil, oat roots, corn stalks and roots, white clover and moldy corn grain were also pathogenic to Era wheat. Comparable inoculations with wheat isolates of *F. graminearum* Schwabe produced scab but little foliar necrosis.

FUNGI ASSOCIATED WITH SPRING WHEAT IN MINNESOTA. R.H. Vargo, E.L. Stromberg and J.S. Baumer, Department of Plant Pathology, University of Minnesota, St. Paul, MN 55108.

Commercial spring wheat was sampled in 1980 throughout Minnesota from seedling to harvest. Crowns with proximal roots, the upper two leaves and glumes or grain were surface disinfested with 0.5% NaClO-100 ppm Tween 20 for 2 min, incubated for 7-10 da on wire racks with indirect sunlight and 100% RH, and examined microscopically. Common organisms were: *Alternaria alternata*, *Fusarium* spp. and *Bipolaris sorokiniana* on all plant parts; *Cladosporium herbarum*, *Epicoccum* and *Phyllosticta* spp. on leaves; and *Rhizoctonia* sp. on roots. Of the samples infected with *B. sorokiniana*, 90% were symptomless. The following occurred sporadically and/or in low numbers: *Cephalosporium* and *Chaetomium* spp. on all plant parts; *Cladosporium echinulatum*, *Curvularia* spp., *Drechslera tritici-repentis* and *Torula herbarum* on leaves; and *Periconia*, *Stachybotrys* and *Verticillium* spp. on roots. Sterile fruiting bodies in some leaf samples failed to mature after >2 mo of incubation. *Leptosphaeria/Septoria nodorum* were each seen once.

PRODUCTION OF VOMITOXIN AND ZEARELENONE BY FUSARIUM; MICROBIAL ACTIVITY OF T-2 TOXIN, DIACETOXYSCIRPENOL, AND VOMITOXIN: TOXICOKINETICS OF T-2 TOXIN IN SWINE AND CATTLE. R. F. Vesonder, J. J. Ellis, H. R. Burmeister, Northern Regional Research Center, AR, SEA, USDA, Peoria, IL 61604, and V. R. Beasley, W. B. Buck, S. P. Swanson, J. R. Szabo, and R. W. Coppock, University of Illinois, Urbana, IL 61801.

Fusarium spp. belonging to *Fusarium roseum* 'Graminearum' and *F. roseum* 'Culmorum' isolated from grains grown in the Midwest produced vomitoxin and zearelenone on corn at 28 C. Vomitoxin weakly inhibited *Penicillium digitatum*, *Mucor ramannianus* and *Saccharomyces bayanus*. These organisms were inhibited by T-2 toxin and diacetoxy-scirpenol. T-2 toxin was produced by *F. tricinctum* on corn grits. Intravenous administration of T-2 toxin to swine at 0.3 and 0.6 mg./kg. caused vomiting, incoordination, abdominal straining, anuria, and recumbency. The half-life of T-2 toxin in the plasma of swine and the calf was less than 5 minutes.

TAM MILD JALAPENO 1 - A NEW VIRUS RESISTANT MILDLY PUNGENT PEPPER. Ben Villalon, Texas Agricultural Experiment Station, 2415 East Highway 83, Weslaco, Texas 78596.

A virology-breeding program has yielded breeding lines resistant to tobacco etch, pepper mottle, potato Y and tobacco mosaic virus, the major disease factor in the decline of profitable pepper production in Texas. A mildly pungent, multiple virus resistant, machine harvestable, Veracruz-type jalapeno pepper ideally suited for most regions in Texas was developed. This has been designated "TAM MILD JALAPENO 1." Plants averaged 30 inches in height with a strong single stem. Branches yielded 30-50 medium to large fruits. It is well suited for mechanical harvesting, either multi-pick or once over. Fruits possess high levels of resistance to sunburn. "TAM MILD JALAPENO 1" outyielded 4 commercial jalapeno varieties in statewide commercial tests. It has yielded well under severe virus epiphytotic. Highly significant differences in yield were observed between this new variety and commercial varieties when inoculated with the 4 viruses. Other virus resistant different pepper types have been developed.

FATE OF PLASMID RP41 IN ISOLATES OF *PSEUDOMONAS SYRINGAE*. J. R. Vincent and D. W. Fulbright, Department of Botany and Plant Pathology, Michigan State University, East Lansing, MI 48824.

The Inc-P1 plasmid RP41 conferring kanamycin resistance (Kan^R) and containing the *his*⁺ region of *Klebsiella pneumoniae* was conjugatively transferred from *E. coli* JC5466 into *his*⁻met⁻ mutants of *P. syringae* PSSD2. Transconjugants were selected for either histidine complementation (*His*⁺), Kan^R, or both. Loss of RP41 *his*⁺, as measured by loss of the above traits, frequently occurred when selection pressure was removed. When Kan^R*His*⁺ transconjugants of PSSD2 were stored in 0.85% saline at -20°C, 3 phenotypes were recovered upon re culturing. The most frequent phenotype was Kan^R*His*⁻ (RP41 *his*⁺ cured); the other two phenotypes were Kan^R*His*⁻ (RP41 *his*^Δ) or Kan^R*His*⁺ (RP41 *his*⁺). In agarose gels, only the Kan^R*His*⁻ (RP41 *his*^Δ) isolates had an observable plasmid other than the resident plasmid of PSSD2. The apparent absence of RP41 *his*⁺ in Kan^R*His*⁺ isolates may suggest integration of this plasmid into the chromosome. The presence of RP41 *his*^Δ in Kan^R*His*⁻ isolates suggests that the histidine region on the plasmid may play some role in integration.

DOUBLE-STRANDED RNAs ASSOCIATED WITH LA-FRANCE DISEASE OF THE CULTIVATED MUSHROOM. M. P. Wach and C. P. Romaine, Department of Plant Pathology, The Pennsylvania State University, University Park, PA 16802.

Sporophores of the cultivated mushroom *Agaricus bisporus* affected with La-France disease have previously been shown to contain six major species of double-stranded (ds) RNA. We have detected up to ten major dsRNA components in diseased tissue of some mushroom isolates. Diseased tissue was phenol extracted in the presence of 2 M LiCl and the dsRNA was further purified by CF-11 cellulose chromatography. The RNAs obtained were resistant to hydrolysis by ribonuclease A in 0.3 M NaCl but not 0.03 M NaCl, reacted with antiserum to synthetic poly I:C, and showed a marked hyperchromicity ($T_m = 91^\circ\text{C}$) upon thermal denaturation. Molecular weights of 2.57, 2.0, 1.77, 1.6, 1.0, 0.83, 0.54, 0.52, 0.29, and 0.25 $\times 10^6$ daltons were estimated by gel electrophoresis.

ASSESSMENT OF SELECTED MANAGEMENT PRACTICES FOR FLUE-CURED TOBACCO IN EASTERN NORTH CAROLINA. H. Walker Kirby, C. E. Main, G. A. Carlson and F. A. Todd. Department of Plant Pathology, N. C. State University, Raleigh, N. C. 27650.

A survey of 84 randomly selected flue-cured tobacco farmers in 1980 revealed that users of multi-purpose soil fumigants adopted pest management practices more readily than other growers. A total of 74% of the growers applied chemical soil treatments in 1980, although less than 10% submitted soil samples for nematode assay. More than 50% had never observed yield losses due to nematodes in their fields but still expected ca \$700.00/ha returns from the use of nematicides. An estimated 85% of flue-cured fields in N.C. have been classed as having low root-knot infestation. Results from 12 nematicide research tests conducted in such fields between 1978-1980 were used to develop economic models describing optimal control strategies based upon expected and calculated returns. Cases of positive yield and economic return were believed to result from nematicide effects on non-target organisms and/or direct crop response rather than root-knot control per se.

PITH NECROSIS IN FUSIFORM RUST-AFFECTED PINE SEEDLINGS. C. H. Walkinshaw and T. A. Roland, USDA Forest Service, Southern Forest Experiment Station, Gulfport, Mississippi 39503

Reactions of pith parenchyma in 8-week-old slash pine seedlings inoculated with *Cronartium quercuum* f. sp. *fusiforme* were determined by light microscopy. Tissues from eight pine families inoculated with nine rust isolates were fixed, dehydrated, and embedded in paraffin. Stained sections (8-12 μm) contained fungus in pith arms and some inner pith parenchyma at 21 days. Sixty days after inoculation the fungus, if present, spread through the pith. Deposition of tannin in pith parenchyma closely paralleled hyphal growth. Intensity of cellular damage in the pith varied among pine families and among individual progeny of wind-pollinated parents. Less variation occurred among rust isolates. There was a weak correlation between the incidence of pith and cortical necrosis. Hyphae appeared to enter the pith from infected needle traces which contain little necrosis. Response of the pith appears to be a sensitive index of primary tissue damage by this rust fungus.

CULTURAL, PATHOLOGICAL AND ENVIRONMENTAL FACTORS AFFECTING SOYBEAN FUNGICIDE SEED TREATMENT. M. T. Wall, D. C. McGee, and J. S. Burris. Department of Plant Pathology, Seed and Weed Sciences, Iowa State University, Ames, IA 50011.

Seedlots of the soybean cultivars Williams and Cumberland produced in 1978 and 1979 and either mechanically damaged or severely infected by *Phomopsis* spp. were treated with Captan 30DD and Vitavax 200FF or untreated. These were planted in April, mid-May and June 1980 in both well- and poorly-drained soils. Laboratory cold stress tests made in 1980 indicated vigor differences in seed produced in 1978 and 1979; however, field emergence for undamaged and uninfected seedlots for both years did not differ for soil type or planting date nor was it increased by fungicide seed treatment. Mechanical damage reduced emergence in both soil types and for all planting dates; fungicide seed treatment did not improve emergence in these lots. However, seed treatment did improve the emergence of *Phomopsis* spp. infected seedlots under all conditions. No significant differences in yield occurred for any of the treatments.

AGGLUTINATION OF *ERWINIA AMYLOVORA* BY AN AGGLUTININ FROM APPLE SEED AND VISUALIZATION FOR ELECTRON MICROSCOPY. F.M. Wallis and R.N. Goodman. Dept. of Plant Pathology, University of Missouri, Columbia, MO 65211.

A protein extracted from apple seeds agglutinates a number of bacterial species. Although nonspecific, the agglutination factor (AF II) is more active against avirulent strains of *E. amylovora* than either virulent isolates (e.g. strain E₉) or strains of other phytopathogenic or nonphytopathogenic bacteria. With *E. amylovora* E₈ (10^8 cells/ml) detectable agglutination by AF II (45 $\mu\text{g/ml}$) occurred in 2 h. Using *E. amylovora* E₈ (10^3 cells/ml) and 45 $\mu\text{g/ml}$ AF II, agglutination was observed at the 1/2048 dilution. Under identical conditions *E. amylovora* strains E₉, 60b and 101b were agglutinated at dilutions of 1/8, 1/16, and 1/32 respectively. Repeated washing of cells in PBS (0.1M) to remove EPS, did not significantly alter these values. To visualize the relationship between AF II and the bacterial cell surface on agglutination, washed *E. amylovora* E₈ cells were labeled with ferritin-avidin conjugate.

INFLUENCE OF TEMPERATURE ON THE DISEASE REACTION OF SOYBEAN HYPOCOTYLS INOCULATED WITH *PHYTOPHTHORA MEGASPERMA* VAR *SOJAE*. E. W. B. Ward and G. Lazarovits, Research Centre, Agriculture Canada, University Sub Post Office, London, Ontario, Canada, N6A 5B7.

Hypocotyls of soybean seedlings were inoculated with zoospores of race 4 (incompatible) or race 6 (compatible) of *Phytophthora megasperma* var *sojae* and incubated in the laboratory at temperatures from 15 to 40°C. Typical race specific reactions developed up to 25°C but between 27.5 and 32.5°C hypocotyls became increasingly susceptible to race 4. At still higher temperatures hypocotyls were resistant to both races and the seedlings remained healthy. In vitro, the optimum temperature for growth of both races was 25-30°C and growth did not occur above 35°C. Both races were killed by incubation for 24 hr at 40°C but not at 37.5°C. Resistant reactions to race 6 that were induced by exposure to temperatures above 32.5°C became susceptible when seedlings were returned to 25°C. Implications of these results for the interpretation of mechanisms of race-specificity will be discussed.

A New Technique for Evaluating Ear Rot Resistance. H. L. Warren and S. K. Onken. SEA, USDA, West Lafayette, IN 47907

A new inoculation technique was used to evaluate 50 maize (*Zea mays* L.) inbreds in 1979 and 20 in 1980 for resistance to *Diplodia maydis* and *D. macrospora* ear rots. Plants were inoculated in the field 2 weeks prior to anthesis with a 3 ml spore suspension (40,000 spores/ml) placed in the leaf whorl. The percentage of developed ears with ear rot was determined 70 days after inoculation. The technique proved valuable in identifying varying levels of resistance to ear rot. Direct inoculation of the ear with a spore suspension, as previously used, caused severe disease in all inbreds evaluated and failed to indicate the presence of resistance in any of the inbreds tested. Inoculation of inbred B73 in the greenhouse using this technique produced a percentage of ear rot comparable to field inoculations. This new technique is well adapted for mass inoculation of field plots, indicates that varying levels of field resistance exist, and can be completed prior to hand pollination.

ROOT INJURY AND ROOT-INVADING FUNGI OF TRANSPLANTED TREES. G. W. Watson and E. B. Himelick, Department of Plant Pathology, University of Illinois and Illinois Natural History Survey, Urbana, IL 61801.

Root systems of 80 trees, 5-10 cm in diameter, of eight species (Norway, sugar and red maple, green ash, ginkgo, honey locust, hackberry, and little leaf linden) were wholly or partially excavated 1-3 years after transplanting. Isolations were made from root sections exhibiting mechanical damage, wood discoloration and dieback. Selected fungal isolates were tested for their ability to colonize root and stem wood tissue of Norway maple, green ash, and ginkgo saplings. Isolates of *Geotrichum candidum* and *Fusarium oxysporum* were successful invaders of root and stem wood tissue. Norway maple was the tree species most susceptible to colonization, with dormant Norway maples more susceptible than nondormant plants. The carbohydrate content of roots of transplanted trees was higher than in check trees. In vitro tests indicate that carbohydrate content of host tissue may be a factor affecting root colonization by soil-borne fungi.

EVALUATION OF *ASCOCHYTA PTERIDIUM* AS A POTENTIAL BIOLOGICAL CONTROL AGENT OF BRACKEN FERN. Robert Webb and S. E. Lindow, Department of Plant Pathology, University of California, Berkeley, CA 94720.

Ascochyta pteridium, a leaf spotting fungus, was isolated from lesions on bracken fern (*Pteridium aquilinum*) at 9 locations in California. Differences in colony morphology, sporulation capacity, growth requirements in culture and conidial tolerance to desiccation and UV irradiation were observed. *A. pteridium* was not found to be pathogenic on 39 species of 14 plant families, including 13 genera of eusporangiate Pteridophytes. Spore germination and germ tube growth were observed at a minimum of 12 and 15°C, respectively. No germination or growth occurred at 30°C or above. A linear increase of lesion number, stem girdling, and subsequent frond collapse was observed on greenhouse and field grown ferns at increasing inoculum rates from 10^4 to 10^7 conidia per ml. 30% of the frond area was necrotic 4 days after inoculation with 10^5 conidia per ml following 48 hours free moisture at 21°C.

SUBGENOMIC VIRION RNAs OF SOUTHERN BEAN MOSAIC VIRUS. K.A. Weber and O.P. Sehgal. University of Missouri, Columbia, MO 65211.

Southern bean mosaic virus (SBMV, bean strain) virions contain subgenomic RNAs among which are included autonomized messengers of the coat protein. The proportion of the subgenomic RNAs relative to the full-length (28S) genome increased progressively with respect to the infection period. For instance, subgenomic RNAs in virions recovered 8, 16, and 22 days post-infection comprised of 12, 27, and 35% of the total RNA, respectively. No

detectable differences existed in the specific infectivities of virions isolated 8 to 22 days post-infection; however, compared to a sample containing ca. 45% subgenomic RNAs, virions isolated 8 days after infection were 2-3X as infectious. The available evidence suggests that the subgenomic SBMV RNAs are encapsidated *in vivo* and are not the product of any contaminating nuclease activity. Nigerian and cowpea isolates of SBMV were also determined to contain a large quantity of subgenomic RNA.

LATENT INFECTIVITY OF BOTRYOSPHERA VACCINII ON CRANBERRY.

G. J. Weidemann and D. M. Boone, Office of Pesticide Programs, U. S. Environmental Protection Agency, Arlington, VA 22202, and Dept. of Plant Pathology, Univ. of Wisconsin, Madison 53706.

Botryosphaeria (=Guignardia) *vacciniif* (Shear) Barr caused latent infections of cranberry leaves and fruit, and post-harvest decay of fruit in storage. *B. vaccinii* was consistently isolated from surface sterilized cranberry leaves lacking visible disease symptoms. It was never isolated from fruit with pre-harvest decay, but was readily recovered from fruit samples that decayed in storage at 24°C. In growth chambers, infections of cranberry leaves were established most often with a 24-28°C, 72 hour dew period in the dark followed by a 28°C, 12 hour photoperiod incubation. Histological examinations of inoculated, attached leaves demonstrated spore germination, formation of infection structures, and penetration of the cuticle followed by an extended latent period.

SYSTEMIC CONTROL OF PEARL MILLET RUST WITH TRIADIMEFON. Homer D. Wells, Alex Csinos, and Durham K. Bell, SEA-AR and Coastal Plain Station, Tifton, GA 31793.

Seed of Gahi III pearl millet were treated with triadimefon [(4-chlorophenoxy)-3,3-dimethyl-1-(1H-1,2,4-triazol-1-yl)-2-butanone] 25% wettable powder at rates of 1000, 500, 250, 125, and 63 mg a.i. per 100 grams of seed plus an untreated control and seeded at the rate of 10 seed/10 cm pot. Five replications from each treatment were inoculated with uredospores of *Puccinia substriata* var. *indica* at 14, 21, 28 and 35 days after seeding. Phytotoxicity (severe stunting with short, wide thick leaves) resulted from all rates of triadimefon and severity was directly correlated with rates 7 days after seeding but all plants recovered as the experiment proceeded. Rust severity was inversely related to seed treatment rate and length of time after treatment. The treatment of 1000 mg/100 g seed controlled rust completely when inoculated 28 days after planting and permitted only a trace of rust when inoculated after 35 days.

ISOLATION AND GROWTH MEDIUM FOR THE BACTERIA ASSOCIATED WITH PHONY PEACH AND PLUM LEAF SCALD DISEASES. J. M. Wells, B. C. Raju, S. K. Lowe, J. C. Feeley, and G. Nyland. SE Fruit & Tree Nut Res. Lab., USDA, Byron, GA 31008 (1st author); Dept. of Plant Pathology, Univ. of CA, Davis, CA 95616 (2nd & 3rd authors), Center for Disease Control, Bacterial Disease Div., Atlanta, GA, 30333 (4th author).

The rickettsia-like bacteria (RLB) associated with plum leaf scald and Phony peach disease were isolated from diseased but not healthy tissue and cultured on a buffered charcoal-yeast extract medium (BCYE). The medium consists of ACES buffer, 10 g; yeast extract, 10 g; 1 N KOH, 40 ml; activated charcoal (Norit SG), 2.0 g; L-cysteine HCl-H₂O, 0.4 g; ferric pyrophosphate, soluble, 0.25 g; agar, 17 g; and distilled water to 1L. Optimum growth on BCYE medium occurred at a pH range of 6.5 to 6.9 and at 20 to 25°C under aerobic conditions. Maximum diameter of primary colonies was 0.6 mm and was reached in 30 days. Subcultures continued to grow and multiply for 58 days. RLB from BCYE cultures were serologically and morphologically the same as those present in diseased peach and plum.

COMMON ETIOLOGY OF PHONY PEACH AND PLUM LEAF SCORCH DISEASES

J. M. Wells, B. C. Raju, J. M. Thompson, and S. K. Lowe. SE Fruit & Tree Nut Res. Lab, USDA, Byron, GA (1st & 3rd) and Dept. of Plant Pathology, Univ. of California, Davis, CA 95616 (2nd & 4th).

Rickettsia-like bacteria (RLB), previously associated with Phony peach disease (PPD) and plum leaf scald (PLS), were transmitted from PPD-infected peach to plum and from PLS-infected plum to peach by root grafts. Symptoms of PLS appeared on 'Ozark Premier', 'Methley', 'Santa Rosa', and 'Shiro' plum 9 months after receiving root grafts from Phony-infected 'Dixiland' peach. The RLB from graft-inoculated plum were identical to those from PPD, measuring 0.35 x 2.0 µm, and shared similar ultra-structural details including an outer (rippled) trilaminar membrane in the cell wall profile. RLB from plum and from peach reacted positively to immunofluorescence and enzyme-linked immunosorbent assay (ELISA) tests using antiserum prepared against RLB associated with PPD.

THE EFFECTS OF GLOMUS ETUNICATUS AND SOIL PHOSPHORUS ON PHYTOPHTHORA ROOT ROT OF SOYBEAN. T.L. Whatley and J.W. Gerdemann, Plant Path. Dept., Univ. of Ill., Urbana, 61801.

The effects of *Glomus etunicatus* (GE), soil phosphorus, and *Phytophthora megasperma* f. sp. *glycinea* on plant populations and yields were investigated in a factorial field experiment with Harosoy soybeans. With a soil phosphorus (P) level of 75 kg/ha (Bray P₁) *Phytophthora* root rot (PRR) caused a reduction in plant populations of 25% (P=.01) in GE inoculated soybeans and 30% (P=.01) in uninoculated soybeans and a reduction in yields of 10% (P=.1) in GE inoculated soybeans and 16% (P=.05) in uninoculated soybeans. At a P₁ level of 187 kg/ha PRR reduced plant populations by 46% (P=.01) in GE inoculated soybeans and 58% (P=.01) in uninoculated soybeans and yields by 35% (P=.01) in GE inoculated soybeans and 43% in uninoculated soybeans. Losses from *Phytophthora* root rot of both GE inoculated and uninoculated soybeans were greatly increased by high levels of soil phosphorus.

NATURE OF INITIAL HOST RESPONSE TO TWO SPECIES OF HELMINTHOSPORIUM. Harry Wheeler, Department of Plant Pathology, University of Kentucky, Lexington, KY 40546.

Light microscopy of penetration of susceptible leaves of corn by *Helminthosporium maydis* (Phytopath. 47:707-714) and of oats by *H. victoriae* (N. Y. Agr. Exp. Sta. Mem. 315. 1953) has indicated that no host response occurs during the first 12 hr after inoculation. In contrast, electron micrographs (EM) of epidermal cells of corn adjacent to penetrating hyphae of *H. maydis* showed swollen walls and disrupted cell contents 6 hr after inoculation (Physiol. Pl. Pathol. 11:171-178). Similar EM results have been obtained with oats inoculated with *H. victoriae*. Sections spanning entire cells adjacent to penetrating hyphae provide a resolution of this paradox. These reveal that initial cellular disruption is confined to an area along the cell wall and that nuclei show no evidence of damage. Since the nucleus is by far the most prominent organelle in these cells it would mask damaged areas in sections prepared for light microscopy.

MELANIN BIOSYNTHETIC ENZYMES IN CELL-FREE HOMOGENATES OF VERTICILLIUM DAHLIAE AND PYRICULARIA ORYZAE. Michael H. Wheeler, USDA, SEA-AR, National Cotton Pathology Research Laboratory, P.O. Drawer JF, College Station, TX 77841.

Cell-free homogenates were used to study melanin biosynthesis in the imperfect fungi *Verticillium dahliae* and *Pyricularia oryzae*. The homogenates converted 1,3,6,8-tetrahydroxynaphthalene to scytalone and 1,3,8-trihydroxynaphthalene to vermelone. The enzymatic reductions required NADPH as a cofactor but did not occur with NADH, NADP or NAD. The reductive reactions were inhibited by the systemic fungicide tricyclazole [5-methyl-1,2,4-triazolo-(3,4-b)-benzothiazole], and two recently developed compounds pp389 [4,5-dihydro-4-methyltetrazolo-(1,5a)-quinazolin-5-one], and CGA49104 [1,2,5,6-tetrahydro-4H-pyrido-(3,2,1-i,j)-quinolin-4-one]. The reactions were eliminated by heating homogenates to 30-35°C for 30 minutes. The homogenates also dehydrated scytalone enzymatically to 1,3,8-trihydroxynaphthalene and vermelone to 1,8-dihydroxynaphthalene. The dehydration reactions were eliminated after 30 minutes at 55-70°C and were insensitive to tricyclazole.

EVIDENCE FOR AGROBACTERIUM TUMEFACIENS AS CAUSAL AGENT OF ROOT AND CROWN GALL OF ILEX CRENATA CV. HELLERI. R. L. Wick and R. C. Lambe. Dept. of Plant Path. & Phys., VPI & SU, Blacksburg, VA 24061.

Galls have been observed on roots and crowns of stunted *I. crenata* 'Helleri' from Virginia, Tennessee and Georgia nurseries. The galls varied in size from a few mm to 6 cm in dia. They were smooth when small but were knobby to roughened when larger. On occasion, galls produced underground shoots with chlorotic leaves. A study was undertaken to determine the causal agent of the disease. Histology revealed bacterial-like bodies associated with hyperplastic gall tissue. The tissue also contained shoot primordia and disorganized vascular tissue characteristic of galls produced by *Agrobacterium tumefaciens*. Inoculations with a strain of *A. tumefaciens* from the ATCC caused crown galls on a few rooted *Ilex* cuttings in 4 months. A number of agrobacteria-like organisms were recovered from naturally occurring gall tissue but upon reinoculation have not yet produced galls.

DIFFERENTIAL RESPONSE OF TWO CULTIVARS OF ILEX CRENATA TO THIELAVIOPSIS BASICOLA. R. L. Wick and L. D. Moore. Dept. of Plant Path. & Phys., VPI & SU, Blacksburg, VA 24061.

A comparative study of *I. crenata* cultivars Helleri and Hetzi colonized by *T. basicola* was undertaken. Rooted cuttings were inoculated with 100 ml of 1 x 10⁵ conidia/ml. Once a week for 4 weeks, 2 plants of each cv. were harvested and 10-20 roots/plant excised, embedded in wax and sectioned. By the 2nd week after inoculation in two experiments, 50 and 80% of 'Helleri' roots had walled off the pathogen by cell division in the cortex. In 'Hetzi' no cell division occurred after 2 weeks, but after 4 weeks, cell division was seen in 10 and 50% of the roots. 'Hetzi' but not 'Helleri' had a high incidence of colonization by secondary organisms. Therefore, 'Helleri' responded more rapidly to colonization by the pathogen and is more resistant to root disease caused by *T. basicola*.

THE INFLUENCE OF VARIOUS LENGTHS OF PRE- AND POST-INOCULATION FLOODING ON THE SEVERITY OF PHYTOPHTHORA ROOT ROT OF CHERRY. W. F. Wilcox and S. M. Mircetich, USDA, SEA, AR, Department of Plant Pathology, University of California, Davis, CA 95616.

Phytophthora root rot, an extremely destructive disease in California's commercial sweet cherry orchards, is exacerbated by periods of prolonged soil saturation. In order to separate the influence of preinoculation vs. postinoculation saturation on disease severity, Mahaleb cherry rootstock seedlings growing in noninfested UC mix soil were flooded for various lengths of time before and after inoculation with 5×10^4 motile zoospores of *P. cryptogea*. After 3 weeks, disease severity was rated on a scale of zero (no rot) to 5 (100% root rot). Average ratings of 4 experiments were: 0 hr preinoculation flooding with 4 hr postinoculation flooding (0/4), 1.1; 0/8, 1.3; 0/24, 2.1; 0/48, 4.2; 24/24, 1.7; 44/4, 1.4; 40/8, 1.5; 48/24, 1.4. Disease severity associated with prolonged saturation appears to be a result of phenomena occurring in the presence of the zoospore inoculum; it does not appear to result from a predisposition of the host to infection prior to contact with the inoculum.

A FRAMEWORK FOR MOTILITY AND MORPHOLOGY IN SPIROPLASMAS. H.J. Wilson and Robert M. Goodman, Department of Plant Pathology University of Illinois, Urbana, IL 61801.

Spiroplasma citri, isolated from horseradish plants from southern Illinois, was cultured on LD8 and/or DSM4 liquid medium and subjected to a variety of incubation and fixation protocols in an effort to stabilize *in situ* filament formations for EM observations and measurements. Agents and conditions of primary concern included deuterium oxide, vinblastine sulfate, DMSO, glutaraldehyde, glutaraldehyde-paraformaldehyde, and diverse osmotic conditions. EM observations on these preparations revealed an *in situ* central filament system extending the length of the organism and a lateral filament system which intersects the central system at regular points along its length. A filamentous component appeared to be associated with the plasma membrane. These findings mark the first time an *in situ* filament system has been demonstrated in any of the spiroplasmas. Implications of its importance as a framework for motility and morphology will be presented.

IDENTITY, PATHOGENICITY, AND CONTROL OF PHYTHIUM SPP. FROM SELECTED TURF PLOTS AND GOLF GREENS. A. S. Windham and J. A. Spencer, Department of Plant Pathology and Weed Science, Mississippi State University, Mississippi State, MS 39762.

Pythium aphanidermatum, *P. acanthicum*, *P. debaryanum* and isolates resembling *P. ultimum* and *P. pulchrum* were isolated from turf plots and golf greens. All fungi were obtained using the soil particle isolation technique on corn meal agar (CMA) amended with 50 ppm Pimaricin and 33 ppm Penicillin-G. *P. aphanidermatum* isolates were highly pathogenic to annual ryegrass (*Lolium multiflorum*) at ca. 27 C in the greenhouse. The others were slightly pathogenic. Etridiazol, metalaxyl, propamocarb, and pyroxychlor effectively prohibited growth of *P. aphanidermatum* in vitro at rates of 0.19 and 0.38, 0.024 and 0.048, 0.16 and 0.32, and 0.02 and 0.08 mg a.i./ml of CMA, respectively. Chemicals applied as foliar sprays to ryegrass in the greenhouse at rates of 56.8 and 113.6 g a.i. etridiazol, 7.1 and 14.2 g a.i. metalaxyl, 47.4 and 94.8 g a.i. propamocarb, 7.1 and 23.7 g a.i. pyroxychlor/93m² gave good control of *P. aphanidermatum* at the lower rate and excellent control at the higher rate.

REACTION OF ISOLATES OF FUSICLADIUM EFFUSUM TO JUGLONE. Gary Windham and Clinton H. Graves, Jr., Department of Plant Pathology and Weed Science, Mississippi State University, Mississippi State, MS 39762.

Eight isolates of *Fusicladium effusum*, the causal agent of pecan scab, were assayed for their reaction to commercially prepared juglone (5-hydroxy-1, 4-naphthoquinone). Juglone is a natural constituent of pecan, *Carya illinoensis* and is thought to be a possible resistance factor in pecan to *F. effusum*. The isolates included four which, in previous studies, were pathogenic to excised nuts of many pecan cultivars tested and four which were pathogenic to only a few of the cultivars. Each isolate was incubated 14 days at ca. 24C in 50 ml aliquots of potato dextrose broth (PDB) amended with 5, 10, 50, 100, 500 µg juglone/ml PDB. Juglone inhibited the mycelial growth of all isolates at 100 µg/ml and all except one isolate of each pathogenic group at 50 µg/ml. Juglone at 10 µg/ml did not significantly inhibit growth of any isolates.

PLANT HEIGHT EFFECTS ON DISEASE INCIDENCE AND SYMPTOM SEVERITY OF BEAN POD MOTTLE VIRUS INFECTION OF SOYBEANS. Mark T. Windham and John P. Ross, Department of Plant Pathology, North Carolina State University, Raleigh, NC 27650.

Bean pod mottle virus (BPMV) incidence and symptom severity data were taken on 9 pairs of F₆ progeny rows (composited in the F₅) of a Forrest (severe BPMV symptoms) X Semmes (mild BPMV symptoms). Differences in average plant height between each row pair ranged from 10 to 34 cm. Bean leaf beetles transmitted BPMV from mechanically inoculated rows equidistant from the row pairs. Four weeks after inoculation of the virus-source rows, disease incidence, height, and symptom severity data were recorded for each row pair. Correlations between height of lines and disease incidence or symptom severity, 0.775 and 0.789 respectively, were significant ($p=0.05$). Soybean lines evaluated for BPMV resistance (symptom severity) using beetle vectors

should be grouped according to height to reduce variability in BPMV transmission associated with row to row variation in plant height.

DIPLODIA PINEA IN SOUTH AFRICA. M.J. Wingfield, Department of Plant Pathology, University of Stellenbosch, Stellenbosch 7600 South Africa, presently, Department of Plant Pathology, University of Minnesota, St. Paul, MN 55108; and P.S. Knox Davies, Department of Plant Pathology, University of Stellenbosch, Stellenbosch 7600 South Africa.

Diplodia pinea is one of the most important pathogens of plantation grown conifers in South Africa. The planting of *Pinus pinaster* and *P. radiata* has been limited to hail-free areas due to dieback caused by *D. pinea* on these species after hail. During a recent survey of forest plantation diseases in South Africa, *D. pinea* was found associated with a wide range of disease symptoms; dieback after hail, tip blight of young trees and seedlings, dead top of *P. radiata* and root injury. An association was also found between *D. pinea* and insect damage.

A SERODIAGNOSTIC TECHNIQUE DEVELOPED FOR ORCHID GROWERS TO DETECT CYMBIDIUM MOSAIC (CYMV) AND ODONTOGLOSSUM RINGSPOT (ORSV) VIRUSES. G.C. Wisler, FDACS, Div. Plant Ind., Gainesville, FL 32601, F.W. Zettler, and D.E. Purcifull, IFAS, Plant Pathology Dept., Univ. FL, Gainesville, FL 32611.

A serodiagnostic technique based on the immunodiffusion test of Purcifull and Batchelor (Univ. FL Agric. Exp. Stn. Bull. 788) was developed. Diagnostic antisera with titers of 1/8 were obtained when the immunogen was either nondegraded (CYMV) or degraded by boiling in 1% sodium dodecyl sulfate (SDS) containing 0.1% 2-mercaptoethanol (CYMV and ORSV). Intact orchid leaf discs (6 mm) cut with a paper punch were inserted into antigen wells for testing. The immunodiffusion medium contained 0.8% Noble agar, 0.5% SDS, and 1.0% NaCl in 0.05 M Tris-HCl (pH 8). This indexing procedure was used successfully by 2 orchid growers on a trial basis. Up to 100 samples/hr were indexed by 2 persons. Survey results showed high virus incidence in cultivated orchids (27% of 1328 samples in >18 genera), but no infection was noted in any of the 401 samples collected from their native habitats (>9 genera from 27 old- and new-world countries).

UPTAKE OF HOST-SPECIFIC TOXINS BY NEAR-ISOGENIC CULTIVARS OF SORGHUM. T.J. Wolpert and L.D. Dunkle. USDA-SEA, Dept. of Botany and Plant Pathology, Purdue Univ, W. Lafayette, IN 47907. Seedlings of near-isogenic cultivars of sorghum susceptible (S) or resistant (R) to *Periconia circinata* were treated with 500 ng/ml of the host-specific toxins Ia or IIa produced by the pathogen. Uptake of the toxin (removal from solution) during a 12-hr incubation period was quantified by high-pressure liquid chromatography. Uptake by S-seedlings was rapid during the first 3-6 hr and then the rate declined. R-seedlings took up only small quantities of the toxins at a slow rate. Precise quantitation of uptake by S-seedlings was hindered by the appearance of an associated compound in the medium that eluted very closely to the respective toxin (Ia or IIa). Treatment of seedlings with cycloheximide (5 µg/ml) or cordycepin (50 µg/ml) for 6 hr prior to treatment with toxin prevented uptake of toxin and protected seedlings against toxin-induced symptoms. The results suggest a protein-mediated binding or uptake of toxin at the plasma membrane in the S-genotype. However, two-dimensional gel electrophoretic analyses did not reveal qualitative differences in the membrane proteins of S- and R- genotypes.

FIELD EFFICACY OF PHYTOPHTHORA PALMIVORA FOR CONTROL OF MILKWEED VINE. S.H. Woodhead, Abbott Research Center, Long Grove, IL 60046; W.H. Ridings, Clemson University, Clemson, SC 29631; C.L. Schoutties, FDACS, Division of Plant Industry, Gainesville, FL 32602; R.K. Clark, Abbott Laboratories, North Chicago, IL 60064; N.E. El-Gholl, FDACS, Division of Plant Industry, Gainesville, FL 32602.

Rate, formulation and environmental factors were examined in field efficacy trials of *Phytophthora palmivora* (DeVine™) control of *Morrenia odorata* (strangler or milkweed vine). Citrus infested with the weeds were treated in 1978, 1979 and 1980 with the fungus and reevaluated in each successive year. Reduction of milkweed vine populations exceeded 90% within one or two years. Control of the vine has continued for two years following a single treatment.

SURVEY METHODS FOR AND INCIDENCE OF FOMES ANNOSUS IN TRUE FIRS (ABIES SPP). J. J. Worrall and J. R. Parmeter, Jr., Department of Plant Pathology, University of California, Berkeley, California 94720.

A rapid and simple survey technique involving examination of stump tops following commercial thinnings in previously unthinned true firs indicated decay in 16 (2.6%) of 624 small saw-timber sized trees. Plots immediately adjacent to the thinnings were uprooted, discs were taken from each tree, and all symptomatic or wounded roots were cultured. *Fomes annosus* was found in 4 (2.4%) of 168 trees. Since no previous cutting was done in these stands, some form of direct or wound invasion is postulated, and evidence suggested that direct root infection was involved. Following thinning, 104 (30%) of 349 stumps were colonized by *Fomes annosus*. Substantial reservoirs of inoculum on bark surfaces may increase the likelihood of stump or wound colonization.

EFFECT OF PLANTING DATE ON SEPTORIA NODORUM SEVERITY IN WHEAT. F. E. Wright, Department of Agronomy, Arkansas State University, State University, AR 72467.

Severity of *Septoria nodorum* was observed during 1978 and 1979 on two cultivars, Hart and Coker 68-15, each planted at two different dates, early (October 10) and late (November 10). Fungicide treatments (Benomyl and Mancozeb) were used as a comparison. Both cultivars were severely infected with *S. nodorum* at the late planting date in the untreated plots. Significantly less *S. nodorum* infection was observed on Coker 68-15 compared to Hart. Fungicide applications significantly reduced symptoms of *S. nodorum* on both cultivars and planting dates. Numbers of seeds per spike were reduced at the late planting date. The reduction in seeds per spike may have resulted from planting date and later maturity rather than *S. nodorum* infection. Seed weight was significantly reduced in the late compared to the early plantings for both years. The fungicide treatments significantly reduced the amount of *S. nodorum* seed infection. Yield was significantly higher in both cultivars at the early planting date.

DETECTION OF MACROPHOMINA PHASEOLINA FROM SUNFLOWER PLANTS INFESTED WITH CYLINDROCOPTURUS ADSPERSUS. S. M. Yang, and D. F. Owen. USDA-SEA-AR, Bushland, TX 79012 and Texas A&M University Agricultural Research Station, Lubbock, TX 79401.

The symptoms of charcoal rot of cultivated sunflower in the Texas High Plains area are a gray discoloration of stalks and formation of many black sclerotia in the stem and vascular bundles. Sunflower plants infected with *M. phaseolina* and infested with *C. adpersus* show a black and brown discoloration of the stem only, or this discoloration may be accompanied by gray areas. The vascular bundles may become partially to completely disintegrated, and most stalks near the base are hollow and black with mixtures of frass and fragments of vascular bundles. The etiologic agent of charcoal rot (*M. phaseolina*) can be detected on potato-dextrose agar amended with antibiotics. The fungus was detected in most of stem weevil-infested plants with or without gray areas on the stems. The pathogen was obtained from the internal tissues of tap roots, stalk epidermis, vascular bundles, stem weevil larvae and frass and caused gray and brown discoloration when inoculated to sunflower plants.

INDUCED TELIOSPORE FORMATION BY PHAKOPSORA PACHYRHIZI (SOYBEAN RUST) ON TEN HOSTS. C. C. Yeh, J. B. Sinclair and A. T. Tschanz. Dept. of Plant Pathology, Univ. of Illinois, 1102 S. Goodwin, Urbana, IL 61801 and AVRDC, P. O. Box 42, Shanhua Tainan, Taiwan.

Teliospores of *P. pachyrhizi* were induced on the following hosts in a growth room programmed for 12-hour photoperiods (2,060 lux), 60 to 100% relative humidity and diurnal temperatures of 24 + 1C max for day and 15 + 1C for night: *Cajanus canjan*, *Glycine canescens*, *G. javanica*, *G. max*, *G. wightii*, *Phakyrhizus erosus*, *Phaseolus lunatus*, *P. vulgaris*, *Rhynchosia minima* and *Vigna unguiculata*. Telia were produced ad- and ab-axially, singly or in clusters after uredia formation at the edge of uredia or lesions and first on lower and then on upper leaves. Increased inoculum concentration increased number of telia/cm². More telia were observed on lower than upper leaves and more on TK5 than PI 230971. Telia were induced on soybean leaves with uredia after 2 weeks at 10 or 15C and 3 weeks at 20C.

MULTIPLE HARVESTING OF CERCOSPORA SPP. CONIDIA FROM CULTURE PLATES. C. C. Yeh, J. T. Yorinori and J. B. Sinclair, Dept. of Plant Pathology, Univ. of Illinois, 1102 S. Goodwin, Urbana, IL 61801

Culture plates with V-8 juice agar for *Cercospora soja* and V-8 juice plus dead-soybean-plant-tissue for *C. kikuchii* were inoculated by spreading a mycelial suspension of each fungus over the agar surface using a camel's hair brush. Plates were incubated under 12-hours alternating dark and coolwhite fluorescent light for 4 to 5 days at 25C. A suspension of conidia and mycelia was obtained by adding 10-15 ml of distilled water to a plate and sweeping the surface with a sterile camel's hair brush. A desired inoculum concentration was prepared from the stock. Excess moisture was allowed to evaporate for about 20 to 30 minutes, the plates recovered and replaced in the incubator. A second harvest of inoculum was gathered after 24 to 36 hours. Three to four harvests were obtained from the same plates, without contamination. The technique is useful for preparation of inoculum for field inoculation.

A PRELIMINARY REPORT OF REDUCED INFECTION BY SPIROPLASMA CITRI AND VIRESCENCE IN WHITEWASH-TREATED PERIWINKLE. R. K. Yokomi¹, M. Bar-Joseph^{2,3}, G. N. Oldfield¹, & D. J. Gumpf². ¹USDA, SEA, AR, Univ. Calif., Riverside, 92521, ²Dept. of Plant Pathology, Univ. Calif., Riverside, 92521, ³On sabbatical from the Volcani Center, Bet Dagan, Israel.

A periwinkle (*Catharanthus roseus*) plot was established in the fall of 1980 to test if whitewash application can reduce infection by *Spiroplasma citri* and the virecence agent. Both pathogens are transmitted by leafhoppers. Whitewash treatments were: 9.7% kaolinite with 0.3% montmorillonite; 5% hydrated lime. Phorate (3.6 Kg AI/ha), a systemic insecticide, was included as a separate treatment as a chemical standard. White-wash applications were made at ca. weekly intervals while phorate was applied once at transplant time. Disease incidence in both whitewash treatments was significantly lower ($p < .05$) than that of the untreated control: hydrated lime = 3.2%; kaolinite-montmorillonite = 4.4%; control = 10.6%. Phorate plots

averaged 5.2% which was lower than the control but was not statistically different.

REPRODUCTION OF DIFFERENTIALLY SELECTED SOYBEAN CYST NEMATODE POPULATIONS ON RESISTANT SOYBEANS. L. D. Young, USDA, SEA, AR, West Tennessee Experiment Station, Jackson, TN 38301

Soybean cyst nematode (SCN), *Heterodera glycines* Ichinohe, was differentially selected on seven soybean [*Glycine max* (L.) Merr.] cultivars or plant introductions (PI) in SCN race 4 infested soil from three fields. The populations were selected by growing the soybean lines in infested soil for 30 days, collecting the SCN females from the plant roots, and using the females as inoculum for the next cycle of selection. Eleven generations of selection on Bedford and PI 88,788 resulted in a large increase in reproduction on these two lines and little reproduction on PI 89,772 and PI 90,763. Selection on PI 89,772 and PI 90,763 resulted in a large increase in reproduction on these PI's and little reproduction on Bedford and PI 88,788. The data suggest that SCN population levels can be managed by rotating cultivars carrying the PI 89,772 and PI 90,763 genes for SCN resistance with cultivars carrying the PI 88,788 genes for SCN resistance.

TESTING PERONOSPORA TABACINA FOR SENSITIVITY TO METALAXYL. T. R. Young. CIBA-GEIGY Corp., P. O. Box 1090, Vero Beach, FL 32960.

A method was developed to test isolates of *P. tabacina* for sensitivity to the fungicide metalaxyl. These tests are part of a CIBA-GEIGY program to determine if resistance to metalaxyl has occurred. Isolates were collected from tobacco fields in which metalaxyl was applied but blue mold was not controlled. These tests were conducted in Nicaragua and the United States.

GROWTH PROMOTION OF ORNAMENTAL PLANTS BY TREATMENT WITH RHIZO-BACTERIA. G. Y. Yuen and M. N. Schroth, Department of Plant Pathology, University of California, Berkeley, California 94720

Two strains of plant growth promoting rhizobacteria, E6 and B10 were tested for growth promotion on 10 species of ornamental plants representing 9 families. Seeds or rooted cuttings of test plants were dipped in aqueous suspensions of bacterial cells and planted in Delhi soil. Growth was determined by measuring wet weight of plant tops. Treatment with both bacterial strains increased growth of *Vinca minor*, *Mathiola incana* and *Zinnia elegans*, with the highest increase shown in treatment of *Z. elegans* with E6 (+146% over untreated check). *Impatiens balsamina* responded positively only to B10 while *Dianthus caryophyllus* responded positively only to E6. Six species showed no response, or a negative response occurred when inoculated with either bacterium. *Tagetes erecta* exhibited the most negative response (-44%) to E6. These results suggest that response to these 2 bacterial strains differ among the host species.

CONTROL OF PHOMOPSIS SPP. IN SOYBEAN SEEDS WITH HOT SOYBEAN OIL AND ETHANOL. Tom Zinnen and J. B. Sinclair, Dept. of Plant Pathology, Univ. of Illinois, 1102 S. Goodwin, Urbana, IL 61801.

Soybean seeds were immersed in heated soybean oil with temperatures ranging from 70C for 5 minutes to 160C for 10 seconds. Treatments that decreased *Phomopsis* spp. recovery and left seeds viable ranged from 5 min at 70C to 10 seconds at 140C. In 34 of 85 treatments, the rate of germinated-clean seeds was greater than the nonheated control. Treatment of seeds with low incidence of *Phomopsis* infection showed that the increase in germination was due to control of *Phomopsis* spp. and other seedborne fungi. The incidence of bacteria-decayed seeds increased with increased temperature and length of treatment. *Phomopsis* spp. was recovered from 6% of soybean seeds soaked in 95% ethanol for 3 days, and from 40% of nontreated seeds. Recovery of *Phomopsis* spp. from seeds of Amsoy 71, Clark 63, Corsoy and Williams soaked in 95% ethanol for 4 minutes varied from no change in Clark 63 to a 50% reduction in Corsoy.

BRANDES: A SOURCE OF RESISTANCE TO MAIZE DWARF MOSAIC IN SWEET SORGHUM. N. Zumbo and K. C. Freeman, U. S. Sugar Crops Field Station, Meridian, MS 39301

Four sweet sorghum lines, Mer. 75-6, Mer. 76-1, Mer. 77-2, and Mer. 77-7, each showing good resistance to maize dwarf mosaic under field conditions in Mississippi, Ohio, and Kentucky, are all derived from crosses involving 'Brandes'. Brandes exhibits good resistance to mosaic in the field with a range normally of 1 to 5% infection under conditions of high mosaic spread. In 1971, a year of exceptionally high mosaic incidence, Brandes showed 30% infection in Ohio. Brandes is a selection from a cross of 'Collier 706C' x 'MN 1500'. Both Collier 706C and MN 1500 are susceptible to high levels of mosaic in the field. With the current interest in sweet sorghum for alcohol production in the United States as well as in many other countries, it is important that sources of resistance to this widespread disease be identified and made available to sorghum breeders.