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ABSTRACTS

VIRUS INCIDENCE AND SPREAD IN PEPPER FIELD PLOTS TREATED WITH REFLECTIVE MULCH AND OIL. G. N. Agrios, M. E. Walker, Dept. of Plant Pathology; D. N. Ferro, D. Corredor, Dept. of Entomology, Univ. of Mass., Amherst, MA 01003

The incidence and spread of cucumber mosaic virus (CMV) and potato virus Y (PVY) were determined by periodic visual observations of symptoms and ELISA testing of pepper plants receiving four different treatments: reflective mulch, mineral oil, mulch and oil, and control. Two plants in each of the 16 plots were inoculated with CMV June 22. The first natural infections appeared July 13. The rate of symptom appearance and spread was significantly slower in plots receiving mulch and oil, or mulch alone, than in control plots, or plots receiving only oil. Aphid counts showed that mulched plots had fewer aphids landing on them than other plots. Symptoms seemed to spread independently of the inoculated plants in the plots. ELISA tests for CMV and PVY showed that as of Aug. 26 each virus was present in approximately equal numbers of plants, with the lowest number of infected plants in mulched plots and highest in untreated plots.

SEASONAL FLUCTUATIONS OF TOBACCO MOSAIC VIRUS AND TOBACCO RINGSPOT VIRUS WITHIN TISSUES OF WHITE ASH TREES. L. A. Amico and J. D. Castello. Department of Environmental and Forest Biology, State University of New York, College of Environmental Science and Forestry, Syracuse, NY 13210.

Leaf tissue, and bud and cambial tissue were sampled from three fixed locations on the crowns of 23 rural white ash (*Fraxinus americana* L.) trees weekly from May 18 through October 5, 1981. Root tissue from 18 of the 23 trees also was sampled weekly. The samples were collected, frozen at -20 C, and indexed in February, 1982 for tobacco mosaic virus (TMV) and tobacco ring-spot virus (TbRSV) by enzyme linked immunosorbent assay (ELISA). Tobacco mosaic virus was detected consistently in 14 of 23 trees and TbRSV was detected consistently in 17 of 23 trees. Root tissue was the most reliable tissue from which to detect both viruses throughout the growing season. The ability to detect TMV within ash tissue increased as the season progressed.

APPLICATION OF A LESION COUNTING PROCEDURE IN DETERMINING THE SEASONAL DYNAMICS OF BOTRYTIS LEAF BLIGHT IN A COMMERCIAL ONION DISEASE MANAGEMENT PROGRAM. J. T. Andaloro, K. B. Rose, and J. W. Lorbeer. Dept. of Integrated Pest Management, Cornell Univ., Geneva, NY 14456; Dept. of Plant Pathology, Cornell Univ., Ithaca, NY 14853.

Botrytis leaf blight of onion caused by *Botrytis squamosa* was monitored on 3,000 acres of onions in the New York Pest Management Program during 1979-1982. The number of lesions/leaf on the 3 oldest green leaves on each of 5 contiguous plants at 5-10 sites along a V or diagonal pattern provided for early season detection of leaf blight with a moderately high estimate of the disease level. Lesion counts and occurrence of secondary conidia were reported weekly to growers in graph form as an evaluation of fungicide effectiveness and potential disease pressure. The seasonal dynamics of Botrytis leaf blight, as measured by lesion counts, varied according to weather, frequency of fungicide application, leaf senescence, and cessation of new leaf production.

ASSESSMENT OF DISEASE CONTROL STRATEGIES ON COMMERCIAL ONIONS IN THE NEW YORK PEST MANAGEMENT PROGRAM. J. T. Andaloro, K. B. Rose, and J. W. Lorbeer. Dept. of Integrated Pest Management, Cornell Univ., Geneva, NY 14456; Dept. of Plant Pathology, Cornell Univ., Ithaca, NY 14853.

Three major diseases of field onions in upstate New York, Botrytis leaf blight (*Botrytis squamosa*), downy mildew (*Peronospora destructor*), and onion smut (*Urocystis magica*) were monitored on 3,000 acres of commercial onions enrolled in the New York Onion Pest Management Program from 1979-1982. Botrytis leaf blight was the most consistently serious of the three diseases during the period and was suppressed by weekly applications of mancozeb and/or chlorothalonil from mid-June until mid-August. Leaf blight management strategies included the use of: a critical disease level, weekly lesion counts, leaf wetting periods, green leaf counts, and the time of secondary production of conidia. Growers made an average of 9 fungicide applications/season. Fungicide costs averaged \$65/acre/season, approximately 30% of the total pesticide costs.

A MICROPLOT TECHNIQUE FOR THE STUDY OF DRY BEAN YIELD RESPONSES TO ROOT ROTS. P. A. Arneson, A. H. C. van Bruggen, D. M. Wolock, and C. H. Whalen. Department of Plant Pathology, Cornell University, Ithaca, NY 14853.

Development of models for predicting yield losses resulting from root rots of dry beans requires study plots in which plant growth approximates that in commercial fields but in which soil environmental variables and levels of soil infestation can be somewhat controlled or at least reliably monitored. Microplots were created by burying 30 cm-high bands of fiberglass ("Crystalite") to a depth of 25 cm to enclose plots 1.2 m² or 1.2 x 1.8 m. The top 15 cm of soil was removed, mixed in a concrete mixer with the appropriate inoculum diluted with vermiculite, and replaced and leveled within the enclosures. Beans grown to maturity in CSI plots had root systems more nearly like field-grown than container-grown plants.

IMPACT OF SIMULATED ACID RAIN TREATMENTS ON YIELD OF POTATO. C. J. Arny, E. J. Pell, L. S. Evans and K. F. Lewin. Dept. of Plant Pathology and Center for Air Environment Studies, The Pennsylvania State University, University Park, PA 16802; Manhattan College, Bronx, NY 10471; and Brookhaven National Lab., Upton, NY 11973.

The effects of simulated acid rain treatments on yield of *Solanum tuberosum* cv. 'Superior' were investigated at Brookhaven National Laboratory (BNL) in summer 1982. Eight 5x5 Latin squares of Superior were grown under standard fertilization, irrigation, and pest control practices. Two inner rows per 4-row plot were either sprayed 3 times per week from May 26 to August 13 with simulated acid rain solutions at pH 5.6, 4.1, 3.3, 2.7 or not sprayed. Composition of the simulated acid rain solution was comparable to that of ambient rain at BNL. All plots were exposed to ambient rainfall. No apparent foliar injury due to the treatments was observed. Tubers were harvested and graded 2 weeks after vines were killed with a desiccant. Average yields of #1 tubers were 22,400; 21,970; 22,670; 22,990; and 22,540 kg/ha for pH 5.6, 4.1, 3.3, 2.7, and ambient rainfall treatments, respectively.

CHEMICAL CONTROL OF DIPLODIA PINEA AND USE OF THE WHOLE TREE AND INDIVIDUAL LIMB METHODS. P. R. Bachi and J. L. Peterson.

Dept. of Plant Pathology, Cook College, NJAES, Rutgers Univ., New Brunswick, New Jersey 08903.

An experiment using whole Scots pine trees in a Christmas tree nursery was used to compare the disease control effectiveness of chlorothalonil at two rates, benomyl, and a full-rate benomyl & mancozeb combination. Chlorothalonil provided less protection from *D. pinea* infection than the other fungicides. In another experiment using individual limbs of mature Austrian pine trees; benomyl, a half-rate benomyl & mancozeb combination and a full-rate benomyl & mancozeb combination were compared when varied as to time and number of applications. The half-rate benomyl & mancozeb combination provided less control than the other fungicides. The full-rate benomyl & mancozeb combination provided the best protection in both experiments. Comparing 1982 and 1981 data, the individual limb method is consistent with chemical control data taken from small whole trees. New Jersey Agricultural Experiment Station No. K-11410-3-82.

THE EFFECT OF SOIL WATER POTENTIAL ON *DIPLODIA PINEA* GROWTH IN THREE *PINUS* SPECIES. P. R. Bachi and J. L. Peterson. Dept. of Plant Pathology, Cook College, New Jersey Agricultural Experiment Station, Rutgers University, New Brunswick, N.J. 08903.

Containerized Scots, Austrian and Japanese black pine seedlings were subjected to soil water potentials of -1, -6 to -8, -12 to -15 bars. They were inoculated with *Diplodia pinea* mycelium through an incision on the main stem and incubated in a growth chamber for 9 days at 22 ± 1C, 100% RH and incident light of 75.3 lux for 10 hr/day. Increasingly negative soil water potentials caused significantly greater *D. pinea* growth regardless of tree susceptibility to the fungus. Scots and Austrian pine were more susceptible to *D. pinea* than Japanese black pine. In a second experiment a light intensity of 11836 lux for 12/hr day did not alter tree response to the pathogen. The data supports field observations of increased incidence of *Diplodia* tip blight on droughted or stressed trees. New Jersey Agricultural Experiment Station No. K-11410-2-82.

COMPARISON OF SOIL DEBRIS ISOLATION AND PELLET SAMPLER METHODS FOR ENUMERATION OF *RHIZOCTONIA SOLANI* PROPAGULES IN SOIL. B. Bandy, L. Specht and S.S. Leach, Dept. of Botany and Plant Path, University of Maine and USDA/ARS, Orono, ME 04469.

Two methods for enumerating propagules of *R. solani* in soil, a modified H₂O₂-soil debris isolation technique and a pellet sampler-selective medium technique, were compared for efficiency of *R. solani* detection. The soils studied were previously cropped with corn, millet, buckwheat, oats and annual ryegrass. There were no significant differences in propagule counts between the two methods. In terms of cost of materials and labor, the pellet sampler method was superior. The soil debris isolation method allows for the direct observation of individual propagules and may be useful in some types of studies. Propagule counts did not correlate well with incidence of disease on potatoes, possibly because some crops favor large populations of nonpathogenic AG-types which are morphologically indistinguishable from pathogenic strains.

A DIFFERENCE IN VIRUS TITER OF TWO CUCUMBER MOSAIC VIRUS ISOLATES AS MEASURED BY ELISA AND APHID TRANSMISSION. M. T. Banik, T. A. Zitter and M. E. Lyons. Department of Plant Pathology, Cornell University, Ithaca, NY 14853.

Spread of cucumber mosaic virus (CMV) on a muskmelon farm in Washington Co., NY appeared to be unusually rapid when compared to spread of CMV on a similar farm 24 km away. An isolate from the former (CMV-243) was compared to an isolate from the latter (CMV-241) in greenhouse tests. Percentage virus transmission by single *Aphis gossypii* transfer and spectrophotometric ELISA readings were used to assess virus titer in muskmelon plants over a 7 wk period. Results indicated a high correlation between the two techniques for each isolate. During the initial week after inoculation, the level of transmission of CMV-243 was significantly higher than that of CMV-241. No difference in transmission was detected between the two isolates in the final 6 wks of the study. The apparent rapid increase of CMV-243 titer early in infection could provide one explanation for the difference in spread observed in the field.

EVIDENCE THAT THE ACTIVITY OF A PUTATIVE NECROTOXIN OF *ERWINIA AMYLOVORA* IS DUE TO THE ACTION OF INORGANIC SALTS. D. W. Bauer and S. V. Beer, Department of Plant Pathology, Cornell University, Ithaca, NY 14853.

Necrotoxin preparations (NP's) were produced as described by Buchanan and Starr (Curr. Micro. 4:63-68) after growing *Erwinia amylovora* in pear cell suspension culture (PCSC). NP's induced necrosis of pear and apple seedlings, inhibited growth of PCSC, and killed PCSC cells. Preparations from PCSC treated with the nonpathogen *E. herbicola* and purified similarly also induced necrosis. When a NP was subjected to ultrafiltration, only the filtrate (exclusion limit ~ 500 d) had necrosis-inducing ability. A solution of the inorganic salts used in the PCSC medium having electrical conductivity similar to the NP, induced necrosis of pear seedlings that was indistinguishable from that induced by NP. When NP was ashed, redissolved and neutralized, necrosis-inducing ability was retained. The necrosis-inducing activity of NP evidently is due to the presence of inorganic salts that are concentrated during purification and is not a product of the bacterium or of the host-pathogen interaction.

APPLE IPM IN MASSACHUSETTS: A SUMMARY OF THE 5-YEAR DISEASE MANAGEMENT PROGRAM. Christopher M. Becker, Ted R. Bardinelli, Daniel R. Cooley, and William J. Manning, Dept. of Plant Pathology, Univ. of Mass., Amherst, MA 01003.

The Massachusetts disease management program centered on the management of the apple scab fungus (*Venturia inaequalis*). Percent *V. inaequalis* ascospore maturity was determined by weekly pseudothecial squashes. Modified hygrothermographs monitored temperatures and wetting periods to determine Mills' infection periods. Fungicide applications were recommended to growers using this information, tree phenology data, and estimates of fungicide residues. During the 5-year program, IPM growers made 5.6% to 18.2% fewer fungicide applications. This resulted in a \$9.30 to \$33.28 savings per acre. The reduced cost of fungicides saved IPM growers from \$7.79 to \$15.31 per acre, despite slightly higher incidence of percent diseased fruit at harvest. Alternative fungicide application techniques were explored, and a fungicide residue bioassay was developed to aid in timing sprays.

AN AGAR DIFFUSION FUNGICIDE RESIDUE BIOASSAY IS FIELD TESTED IN MASSACHUSETTS. Christopher M. Becker, William J. Manning, and Kristin G. Pategas, Dept. of Plant Pathology, Univ. of Mass., Amherst, MA 01003.

Four Massachusetts apple growers participated in a disease management program to test the potential of a bioassay for captan or thiram residues using an agar diffusion technique (modified from Bardinelli, Phytopathology 71:557). Plates of potato dextrose agar (PDA) were seeded with 5 x 10⁴ spores/ml of *Saccharomyces fibuliger*. One 6 mm disc was removed from each leaf in each cluster or terminal. Discs were placed with adaxial sides down in appropriate sequence on seeded PDA plates, and incubated at 22 C for 15 hrs. Clear zones around discs were measured, averaged together, and compared to dose/response curves. Fungicide applications were applied by growers only when residues were below thresholds for primary scab management. Growers reduced the average number of fungicide applications for the season from 11.8 to 10.5, with no increase in the percent of diseased fruit.

SCLEROTINIA LEAF SPOT OF APPLE IN MASSACHUSETTS. Christopher M. Becker, Dept. of Plant Pathology, Univ. of Mass., Amherst, MA 01003.

Sclerotinia sclerotiorum causes calyx end rot of apple fruits. In June 1982, the fungus was also isolated from spots on apple leaves. Leaves in contact with nonpollinated, wilted blossoms, or with immature fruit that were developing calyx end rots, developed light brown spots 1 to 3 cm in diameter. Isolations from the spots on potato carrot agar consistently yielded a rapidly-growing white fungus with black sclerotia 4 to 10 mm in diameter, typical of *S. sclerotiorum*. This is the first reported isolation of this fungus from apple leaves. To determine conditions necessary for leaf infection by the fungus, controlled inoculation experiments were conducted using *S. sclerotiorum* mycelium. Results showed that leaf wounding or leaf contact with infected fruit under free moisture conditions provided conditions that allowed invasion by *S. sclerotiorum*.

RELATIONSHIP OF *UREDINOPSIS MIRABILIS* WITH *PARADIPLOPSIS TUMIFY* AND *DASINEURA BALSAMICOLA* IN NEEDLES OF *ABIES BALSAMEA*. D.R. Bergdahl and M. Mazzola. Department of Forestry, University of Vermont, Burlington, VT 05405

Uredinopsis mirabilis (fir-fern rust) and Paradiplosis tumifex (balsam gall midge) annually attack emerging needles of Abies balsamea resulting in premature needle abscission in mid-summer (July-August) and early fall (late September-October), respectively. Dasineura balsamicola is an inquiline of P. tumifex. On July 22, 1982, 2,329 needles from twigs of 30 trees were examined. U. mirabilis aecia were observed on 7% and P. tumifex symptoms on 24% of the needles examined. Of those needles infested with P. tumifex, 11% had U. mirabilis infections. All U. mirabilis-infected tissues on bagged branches abscised in midsummer, resulting in 0% survival of P. tumifex and D. balsamicola. In contrast 86% of P. tumifex and 100% of D. balsamicola remained alive in needles not infected with U. mirabilis.

POPULUS AS A MODEL FOR STUDYING DEFENSE MECHANISMS IN BARK-- CHARACTERIZATION OF COMPONENTS. A.R. Biggs, W. Merrill, and D.D. Davis. Dept. of Plant Pathology, The Pennsylvania State University, University Park, PA 16802.

Defense responses in bark are triggered by mechanical wounding and pathogen infection. Structural and chemical changes associated with defense are characterized by formation of three distinct tissue types: reaction zone tissue (RZT), nonsuberized impervious tissue (NIT), and necrophylactic periderm (NP). RZT is characterized by autofluorescence, positive reactions with phlorogucinol and orcinol, negative reactions with Sudan IV, lacmoid, the Maule and chlorine-sulfite tests, and permeability with the F-F test. NIT possesses the same characteristics as RZT except it is impervious to the passage of F-F test solutions, NP forms only after the completion of NIT and consists of suberized phellem, a phellogen and phelloderm. NP is temporally, histochemically, and morphologically distinct from RZT and NIT. The rate of structural and chemical changes in bark is positively correlated with relative turgidity.

THE EFFECT OF XYLOSE AFTER VARIOUS INCUBATION TIMES ON SPORULATION OF BIPOLARIS MAYDIS RACE T AND ON pH AND AMMONIUM LEVELS IN THE CULTURE MEDIUM. T. W. Bischoff and M. O. Garraway. Dept. of Plant Pathology, The Ohio State Univ., Columbus, OH 43210 and Ohio Agr. Res. and Devel. Cntr., Wooster, OH 44691.

Sporulation, pH and NH_4^+ levels were determined after 6, 10 and 14 days of incubation of Bipolaris maydis race T in the dark at 28°C on a glucose (10 g/l), L-asparagine (4 g/l) medium without (G) or with (GX) D(+) xylose (2 g/l). Sporulation of BMT was significantly higher on GX than G after 6, 10 or 14 days of incubation. The pH rose after 6, 10 and 14 days from 5.8 to 6.2, 8.0 and 8.3 on GX and to 6.6, 8.1 and 8.2 on G. Moreover, the NH_4^+ levels after these incubation times were 69, 389 and 344 $\mu\text{moles NH}_4^+ / 20 \text{ ml}$ of GX medium and 212, 406 and 351 $\mu\text{moles NH}_4^+ / 20 \text{ ml}$ of G medium. The pH and NH_4^+ levels recorded in the medium after incubation with the fungus were comparable to those observed when NH_4OH was added as NH_4OH to an unseeded medium. Thus, the changes in pH in the presence of xylose or after various incubation times appear related to NH_4^+ levels in the medium.

Establishment and survival of a double-marked strain of Pseudomonas syringae pv. tomato on tomato and other crops. W.G. Bonn and B.H. MacNeill, Research Station, Agriculture Canada, Harrow and Dept. of Environmental Biology, University of Guelph, Guelph Ontario. A nalidixic acid and rifampicin-resistant mutant (G13) of a pathogenic strain of Pseudomonas syringae pv. tomato was applied to plots of tobacco, pepper, eggplant, potato, jimsonweed, nightshade, oats, wheat and four cultivars of tomato. Following inoculation G13 was recovered from symptomless leaves by washings plated onto King's medium B amended with 100 $\mu\text{g/ml}$ each of nalidixic acid and rifampicin. The mutant strain established itself on all crops except nightshade and survived briefly (at least three days) on tobacco, pepper, potato, jimsonweed and wheat. It was detected on oats eight days after inoculation and on eggplant after 17 days. Conversely, it survived on symptomless tomato leaves throughout the sampling period, however after the third sampling (eight days after inoculation) the observed G13 may have arisen from secondary spread from bacterial speck lesions developing on H2653, H1630 and New Yorker tomatoes. The resistant cultivar Ont. 7710 which remained symptomless maintained an epiphytic population of G13 throughout the season.

A TECHNIQUE TO STUDY THE SURVIVAL OF OOSPORES OF PHYTOPHTHORA CAPSICI IN HOST TISSUE. J. H. Bowers, S. A. Johnston, and G.

C. Papavizas. Rutgers University, New Brunswick, NJ 08903; and USDA, Beltsville, MD 20705.

A technique was developed to study the production and survivability of oospores of Phytophthora capsici in infected pepper tissue. Peppers were planted in a soil-less planting mix in 5 X 5 cm square flats. After 5-6 weeks the flats were placed in plastic trays, saturated with water, and 1 ml of a sporangia suspension ($10^4/\text{ml}$) was pipetted into each square. After 3 hr the flats were drained and placed on a greenhouse bench. Wilting and stem lesions were noticeable in 7-10 days and after 3 weeks the plants were harvested. Oospores formed mainly in the stem and roots near the soil surface when both mating types were added, but did not form when only a single mating type was used. Oospore viability was determined with a bioassay technique which involved drying and grinding the crown section and mixing it with sand in which a 5-6 week-old pepper plant was transplanted. After 2-4 weeks at 75 C, 60% of the plants were infected with P. capsici. Since no reliable quantitative methods are available for determining oospore viability at present, this technique will be useful in estimating oospore viability qualitatively.

FACTORS AFFECTING THE SURVIVAL OF PHYSIOLOGIC RACES OF PUCCINIA CORONATA AVENAE ON AVENA STERILIS IN ISRAEL. U. Brodny, I. Wahl, and J. Rotem. Dept. of Plant Pathology, The Pennsylvania State University, University Park, PA 16802; Dept. of Botany, Tel-Aviv University, Ramat-Aviv, Tel-Aviv 69978, Israel; and Dept. of Plant Protection, The Volcani Center, Bet Dagan 50250, Israel, respectively.

Distinct differences were found in physiologic characteristics among different isolates of Puccinia coronata avenae. Many isolates from various ecological locations were studied and especially of races 276 and 263. (Race 263 is less common in nature than race 276). This study shows that the higher relative survival ability of isolates of the race 276 as compared to isolates of race 263, results from their specific physiologic characters. These characters were expressed by a shorter period between inoculation and the appearance of uredia, higher infection density, higher yield of urediospores per uredium and extended longevity of urediospores.

ASSOCIATIONS BETWEEN THE EFFECTS OF SPRING NITROGEN LEVEL ON DISEASE SEVERITY, YIELD, AND YIELD COMPONENTS OF WINTER WHEAT. S. C. Broscious, J. R. Frederick, J. A. Frank, and H. G. Marshall, Dept. of Plant Pathology and USDA-ARS, Center for Cereals Research, The Pennsylvania State University, University Park, PA 16802.

The effects of row width, seeding depth, seeding rate, and spring nitrogen fertilization on the severity of powdery mildew and Septoria blotch, yield, and yield components were evaluated at 5 sites in PA. No significant interactions between nitrogen fertilization and the other factors occurred for any of the variables studied. Yields did not significantly increase when more than 33.6 kg N/ha were applied at any location. The effect of nitrogen on tiller #/m² was inconsistent. Seed #/spike significantly increased with nitrogen level, as did the severity of powdery mildew and Septoria blotch. Thousand kernel weights significantly decreased with incremental addition of spring nitrogen. This response and the positive relationship between nitrogen and disease severity may partially explain the failure of yields to increase through the full range of nitrogen levels.

APPLICATION OF COMPUTER CARTOGRAPHY FOR MAPPING HAZARD OF FUSIFORM RUST. Robert I. Bruck, Dept. of Plant Pathology, N. C. State Univ., Raleigh, NC 27650

Hazard maps have been proven to be valuable tools for integrating pest management recommendations into the forest management system. Freehand contour and proximal rust gall incidence maps for the state of Mississippi were obtained from the literature. Incidence data at 230 geographical coordinates were analyzed by the Harvard SYMAP contour and proximal cartography programs. Isorhythmic polygon maps were generated utilizing 4 gall hazard levels (0-25, 26-50, 51-75, 76-100% of trees galled) with an Apple II plus microcomputer and Tektronix 4662 color graphics plotter. Contour programs appeared to weigh values too lightly while proximal programs overweighed values. Computer drawn maps, however, were generally more accurate than both proximal and contour freehand maps in assessing site hazard. Computer misclassification of plots was generally under 3 percent.

ACCELERATED REMOVAL OF PESTICIDES FROM LEAF SURFACES BY ACIDIC RAIN. E. J. Butterfield and J. Troiano, Boyce Thompson Institute, Ithaca, NY 14853.

Rainfall is recognized to be a significant factor in the removal of pesticide residues from leaf surfaces. The effects of rainfall intensity and duration on removal of pesticide deposits have been modeled but the effects of acids in rainfall have not been described. We have conducted experiments to evaluate the effect of simulated acidic rain on the removal of pesticide deposits. These experiments were performed by applying 10 µl drops of pesticide suspensions to primary leaves of snap bean, allowing the deposits to dry overnight, then subjecting the plants to simulated rainfall at a pH of 5.6, 4.6, 3.8 or 3.0. In experiments with both field-grown and greenhouse-grown plants, increasing acidity accelerated removal of triphenyltin hydroxide (TPTH) so that all detectable TPTH was removed by the first 2 cm of rain at pH 3.0. Similar effects with other fungicides have been demonstrated and will be discussed.

DISTRIBUTION AND SURVIVAL OF PSEUDOMONAS SYRINGAE INJECTED INTO SMALL ELM STEMS FOR CONTROL OF DUTCH ELM DISEASE. R.J. Campana, V. Spadafora, C.D. Murdoch, J. Hoch and D. Zimel, Department of Botany and Plant Pathology, University of Maine, Orono, ME 04469

Effectiveness of bacteria to inhibit the Dutch elm disease fungus in living elms is based on distribution and survival in xylem. A study on distribution of *P. syringae* from injection sites in lower stems to upper stems involved 180 small elms (*Ulmus americana* L.). Trees 10-25 cm in diameter and 4-7 m in height were injected from June to August in 1980 or 1981. Detection of oxidase negative Pseudomonads was determined on BCBRVB Sands media. Recovery of bacteria in twigs 2-112 days after injection was less than 4 percent. Recovery in trunks 1 or 2 years after injection was attempted from injection holes and above. Isolations decreased with increased distance from holes, with less than 22 percent of the trees positive above 30 cm. Bacteria survived in 93-96 percent of injection holes after 1 or 2 years. *P. syringae* had limited distribution after injection, but survived at least two years at injection sites.

REDUCTION OF POSTHARVEST BLUEBERRY DECAYS IN COLD STORAGE BY CONTROLLED CO₂ ATMOSPHERES. R. A. Cappellini and M. J. Ceponis. Postharvest Research Center, Cook College, Rutgers University, New Brunswick, New Jersey 08903.

Four tests were conducted in 1982 with Bluetta and Bluecrop blueberries in a continuous flow of 10, 15, and 20% CO₂ both in air and with 2% O₂. Berries were stored in 5-mil polyethylene bags in each atmosphere for 2 weeks at 20°C after which they were removed from the bags and held at 21°C for an additional 3 days. Decay incidence averaged 3.6% in untreated lots and less than 0.7% in treated lots immediately after cold storage. It increased to 11.7, 17.3, and 32.6% in untreated lots whereas after 1, 2, and 3 days at 21°C, respectively, CO₂-treated berries had no more than 2.8, 11.6, and 22.3% decay for the corresponding holding periods. The most effective applications were those with 20% CO₂ followed closely by those with 15% CO₂. Reduced O₂ levels had no apparent influence on decay but appeared to adversely affect berry flavor. New Jersey Agricultural Experiment Station No. K-11220-2-82.

SEASONAL DISTRIBUTION OF TOBACCO MOSAIC VIRUS IN 'MORAINÉ' ASH. J. D. Castello, L. A. Amico and P. Shiel. Department of Environmental and Forest Biology, State University of New York, College of Environmental Science and Forestry, Syracuse, NY 13210.

Tobacco mosaic virus (TMV) was transmitted on three occasions from leaves of 'Moraine' ash (*Fraxinus holotricha* var. 'Moraine') displaying mosaic symptoms. The symptoms first appeared in late June and remained until leaf fall in late October. Virus also was detected by electronmicroscopic examination of clarified, symptomatic ash leaf tissue. In addition, enzyme-linked immunosorbent assay (ELISA) tests for TMV in tissue from nine ash trees collected weekly from May through October, 1981 consistently detected the virus. Virus distribution, as determined by ELISA, was uniform in some trees but uneven in others. Tissue collected later in the growing season was a more reliable source of virus than tissue collected earlier.

INFECTION OF HONEYDEW MELONS BY XANTHOMONAS CAMPESTRIS. M. J. Ceponis, J. M. Wells and R. A. Cappellini. Postharvest Research Center, Cook College, Rutgers University, P.O. Box 231, New Brunswick, NJ 08903

Approximately twenty percent of Ecuadorian honeydew melons

(*Cucumis melo*) in a 7920-carton shipment to New York by boat in December, 1981 was damaged by irregularly-shaped, tan to brown surface lesions up to 4 cm in diameter. Tissue transfers from lesions to yeast extract-dextrose-calcium carbonate (YDC) and King's medium B agar produced yellow bacterial colonies on both media. The same bacterium was later isolated from several honeydew melons imported from Guatemala. The pathogenicity of the bacterium was demonstrated by wound-inoculating sound Ecuadorian and Venezuelan honeydew melons. Developing lesions were very firm, slow in development at 21°C, and restricted to the rind. Metabolic tests confirmed the bacterium to be a pathovar of *Xanthomonas campestris*. There are no previous reports of a *Xanthomonas* species causing a parenchymatous disease of honeydew melons.

HYBRIDOMAS PRODUCING ANTIBODIES SPECIFIC FOR PLANT PATHOGENIC SPIROPLASMAS. T. A. Chen, Y. X. Chen and H. T. Hsu. Department of Plant Pathology, Rutgers University, New Brunswick, NJ 08903 and American Type Culture Collection, 12301 Parklawn Drive, Rockville, MD 20852.

Monoclonal antibodies specific for *Spiroplasma citri* and the corn stunt spiroplasma (CSS) were obtained from selected hybridomas grown *in vitro*. The hybridomas were produced by fusing mouse myeloma cells (P3X63Ag8-643) and spleen cells from BALB/C mice immunized with either one of the spiroplasmas. Hybridoma formation from five fusion experiments ranged from 8 to 43%. Specific antibody secretions from these cell clones were detected by screening aliquotes from hybridoma culture media using indirect ELISA with biotinylated anti-mouse IgG. Monoclones were selected by cloning antibody-forming hybridomas under limiting dilution with pre-conditioned medium in which mouse fibroblasts (L929) had been cultured.

PRESENCE OF PECTOLYTIC ERWINIA SPP. ON TRUE POTATO SEED. P. D. Colyer and M. S. Mount, Dept. of Plant Pathology, Univ. of Mass., Amherst, MA 01003.

"Explorer" potato seeds were examined for the presence of pectolytic bacteria. Seeds were enriched for *Erwinia* by incubation in Meneley and Stanghellini broth for 48 hr. One-tenth ml of broth was plated on crystal-violet polypectate medium and observed for pitting after 48 hr. Pectolytic fungi, yeast, and bacteria were recovered. Through Gram stains and a series of biochemical tests some of the bacteria were identified as *Erwinia* spp. (ca. 2.0%). External contamination of the seeds could be removed with a 2 minute soak in 10% Clorox without affecting germination. A low percentage of the seeds were contaminated internally. These results suggest true seed may be another source of *Erwinia* inoculum.

OBSERVATION ON INJURY CAUSED TO TREES BY HERBICIDE. ARTHUR C. COSTONIS, SYSTEMICS, INC., 138 MILL STREET, WESTWOOD, MA 02090

This paper reports on observations over a four year period on the injury caused to shade trees by herbicide applied to lawns to manage weeds. The injury symptoms vary from slight yellowing of leaves to severe leaf necrosis and abundant leaf drop. Some trees are killed outright within the season of treatment. Herbicides containing 2,4D and MCCP derivatives have been identified as causing severe damage.

FIELD EVALUATION OF OXIDANT INJURY ON DELAWARE SOYBEANS. C. R. Curtis, R. B. Carroll, J. B. Helbig, Department of Plant Science, University of Delaware, Newark, DE 19711; USDA-APHIS, PPQ, 522 No. Central Ave., Rm. 201, Phoenix, AZ 85004.

In 1980 symptoms resembling oxidant injury appeared on all of the soybean variety trials located at Georgetown, Delaware. A field evaluation was conducted on 26 varieties to determine the probable cause of the foliar injury. Plantings were made on May 29, 1980 with three replications per variety and observed weekly. Symptoms appeared on July 31, 1980 after a period of high temperatures and oxidant levels. All varieties were rated for prevalence of injury. The most tolerant were Bay, Williams, Baron, York, Union, Essex and Forrest. All others were more sensitive, especially Kent. There were no statistical yield differences among varieties. High temperatures and below average rainfall in 1980 placed the varieties under environmental stress. It is possible that if the soil moisture stress was reduced greater injury would have been observed.

INTEGRATED PEST MANAGEMENT FOR NEW ASPARAGUS: EFFECTS ON YIELD. John P. Damicone, William J. Manning, Dept. of Plant Pathology; David N. Ferro, Dept. of Entomology, Univ. of Mass., Amherst, MA 01003.

The effects of soil fumigation with Vorlex (R) (35 gal/acre), insecticide sprays with diazinon (1/2 lb. a.i./acre), asparagus cultivars 'Mary Washington' and 'Rutgers Hybrid 202,' and weed control with simazine (2 lbs. a.i./acre) were evaluated in a split-split plot. In the third growing season, yield was determined as weight of marketable spears (greater than 8 mm diam.) harvested six times over two weeks. Fumigation (33% increase) and insecticide sprays (77% increase) resulted in significantly greater yield ($p = 0.01$) compared to nontreated plots. Weed control (10% increase) and cultivar R.H. 202 (7% increase) resulted in higher yields that were not significant. Fusarium incidence in all treatments was identical (100% crown infection). These results indicate that the severity of asparagus decline is affected by pests other than crown rotting fusaria. Management of the entire pest complex results in increased yield in spite of the presence of fusaria.

Lower Branch Dieback, A New Disease of Northeastern Dogwoods. M. L. Daughtrey, Dept. of Plant Pathology and L.I. Hort. Res. Lab, Cornell University, Riverhead, NY 11901 and C. R. Hibben, The Brooklyn Botanic Garden Research Center, Ossining, NY 10562

Since 1977, both native and cultivated dogwoods (*Cornus florida*) have shown distinctive symptoms of decline in southeastern NY. This condition has also been observed in southern CT, northern NJ, and eastern PA. Symptoms include progressive dying back of twigs and branches, beginning in the lower part of the canopy; leaf blight; and twig, branch, and trunk cankers. Initial studies indicate that the recent decline of northern dogwoods may be caused, at least in part, by infection by *Discula* sp. following some predisposing climatic event. Acervuli of *Discula* sp. have been consistently associated with twig dieback and leaf blight. Observations of lesion development indicated that infection proceeds from leaves and flower buds into twigs, and through the bases of water sprouts into bark and cambial tissues of the main branches and the trunk. The declining trees showed a marked reduction in radial growth commencing in 1976-1977, corresponding to years marked by colder than normal winters.

ACQUISITION OF METEOROLOGICAL SUPPORT DATA FOR EPIDEMIOLOGICAL RESEARCH. J. M. Davis, R. I. Bruck, G. B. Runion, Department of Plant Pathology, N. C. State University, Raleigh 27650.

Two micrometeorological towers were used to obtain temperature, relative humidity, and leaf wetness measurements during a fusiform rust epidemiology experiment. Wind, rainfall and solar radiation measurements were made in an obstruction-free area about 0.4 km from the site. Field Experiments showed that temperature and relative humidity measurements that reflect actual environmental conditions require sensors that are aspirated and shielded from radiation. The three-sensor tower aspiration system was constructed from polyvinylchloride (PVC) pipe which is inexpensive, easy to work with, and readily available in a variety of sizes. The system can be used with almost any micrologger system. Radiation shielding was provided by wrapping the PVC sensor housing pipe with 2 cm thick closed cell rubber material insulation which was covered with aluminum foil. Results indicated that measurements made with this system reflect actual environmental conditions.

NATURAL VIRUS INFECTION IN SILVERY AND NONSILVERY LINES OF *CUCURBITA PEPO* L. Robert F. Davis and Oved Shifriss, Departments of Plant Pathology and Horticulture and Forestry, respectively, Rutgers University, New Jersey Agricultural Experiment Station, Cook College, New Brunswick, New Jersey 08903.

A silver-leaved breeding line, NJ260, and a green-leaved cultivar, Early Prolific Straightneck (EPS), of summer squash (*Cucurbita pepo* L.) were compared for virus disease development under natural conditions. Severity of disease was consistently lower in NJ260 than in EPS throughout the season. About 6 wk after planting, 99% of EPS and 28% of NJ260 plants showed symptoms of infection by cucumber mosaic virus and the severe strain of bean yellow mosaic virus. By the end of the season all plants of both lines had developed symptoms, although EPS plants were much more severely affected. Disease related survival was 96% in NJ260 until the first frost, whereas in the EPS plants death began at midseason and at the last reading before frost only 19% of the plants were alive. New Jersey Agricultural Experiment Station, Publication No. K-11191-1-82.

STUDIES ON A BASIDIOMYCETE ISOLATED FROM ALFALFA IN EGYPT. H.I. Seif El-Nasr*, O.Z. Abdel-Azim*, and K.T. Leath**. *Plant Protection Department, National Research Centre, Dokki, Cairo, Egypt and **U.S. Regional Pasture Research Laboratory, ARS-USDA, University Park, PA 16802.

An unidentified basidiomycete from alfalfa roots was compared with a similar basidiomycete, *Marasmiellus inoderma*, from sugar cane and maize. The alfalfa isolate grew at 38C, whereas the *Marasmiellus* isolates did not. The alfalfa isolate was pathogenic to alfalfa, sugar cane and maize, but *Marasmiellus* isolates did not attack alfalfa. In controlled inoculations, the basidiomycete from alfalfa readily colonized alfalfa root surfaces with rhizomorph-like growth and caused rot of both lateral roots and taproots. Hyphae were observed intracellularly in the cortex and epidermis. A basidiocarp was produced by the alfalfa basidiomycete in culture. Based upon growth studies, cross-inoculations, and basidiocarp characteristics, the fungus from alfalfa appears to belong to the genus, *Marasmius*.

SURVEY OF FOLIAR DISEASES OF ALFALFA IN THE MAJOR PRODUCTION AREAS OF EGYPT. H.I. Seif El-Nasr, Research Plant Pathologist, Plant Protection Department, National Research Centre, Dokki, Cairo, Egypt, and K.T. Leath, Research Plant Pathologist, U.S. Regional Pasture Research Laboratory, University Park, PA 16802

A survey was made over 5 years in several regions of Egypt to determine the incidence and severity of foliar diseases of alfalfa (*Medicago sativa* L.). Rust (*Uromyces striatus*), common leaf spot (*Pseudopeziza medicaginis*), and *Stemphylium* leaf spots (*Stemphylium botryosum*, *S. vesicarium*, *S. globuliferum*) were the most severe disease problems. Powdery mildew (*Erysiphe* sp.), downy mildew (*Peronospora trifoliorum*), black stem (*Cercospora zebrina*), and alfalfa mosaic virus were observed but were of lesser importance. Foliar diseases were more prevalent and severe in northern Egypt than in the south. Peak disease periods varied as to time of year, depending upon the specific disease and location. (Research funded by Grant No. PG-Eg-183, Proj. No. EG-ARS-69, Int. Prog. Div., USDA).

DYNAMICS OF INVASION BY *VERTICILLIUM ALBO-ATRUM* AND RESPONSE IN SUSCEPTIBLE AND RESISTANT POTATO STEMS. Jacinta Ferrari and W.E. Sackston, Dept. of Plant Science, Macdonald Campus of McGill University, Ste. Anne de Bellevue, Quebec, H9X 1C0, Canada.

The potato cultivars Kennebec (K) (susceptible) and Russet Burbank (RB) (resistant) were inoculated with *Verticillium albo-atrum* under controlled conditions. Tyloses were observed 1 day after inoculation in K, and 3 days after inoculation in RB. From 5 to 21 days after inoculation they were present in more of the vessels higher above the point of inoculation in RB than in K. The pathogen was recovered from stem sections 6 cms above the point of inoculation in K and 2 cms in RB 1 day after inoculation; 10 and 6 cms respectively after 3 days; and 12 cms in K and 10 in RB after 5 days. Mycelium was observed near the point of inoculation in some vessels of K 5 days after inoculation, and at 8 cms in 15 to 35% of the vessels after 21 days. Mycelium was observed in occasional vessels near the point of inoculation in RB 5 days after inoculation and in below 1% of the vessels at 8 cms after 21 days.

INTERACTION OF SOYBEAN WITH *XANTHOMONAS CAMPESTRIS* PV *GLYCINES*-AN ULTRASTRUCTURAL STUDY. W. F. Fett, S. B. Jones, Eastern Regional Research Center, 600 E. Mermaid Lane, Phila., PA 19118 G. Gaard and L. Sequeira, Univ. of Wisconsin, Dept. of Plant Pathology, Madison, WI 53706.

The interaction of virulent and avirulent strains of *Xanthomonas campestris* pv. *glycines* (Xcg), causal agent of bacterial pustule disease, with the susceptible soybean cv. Clark and the near-isogenic resistant cultivar Clark 63 was studied at the ultrastructural level. At 24 to 48h after inoculation, cells of avirulent Xcg strains were localized next to host leaf mesophyll cell walls and surrounded by highly electron-dense material. The enveloped bacteria often had severely distorted cell walls, some were undergoing lysis, and most had lost their cellular definition. In Clark and Clark 63, cells of virulent Xcg strains were not enveloped by highly electron-dense material and appeared viable. Thus, envelopment and subsequent lysis of avirulent Xcg strains appears to be an active defense response of soybean. A similar defense response does not appear responsible for resistance of Clark 63 to virulent Xcg.

EAR ROT OF SWEET CORN CAUSED BY FUSARIUM SPECIES. N. L. Fisher, L. V. Gregory, and J. E. Ayers. Fusarium Research Center, The Pennsylvania State University, University Park, PA 16802.

An ear rot of sweet corn at the eating stage has been observed yearly since 1979 in field plots in two locations in Pennsylvania. Several species of Fusarium were isolated from pink-red rotted areas on ears, including F. moniliforme, F. poae, and others not commonly associated with corn ear rot. Some of these Fusarium species may produce mycotoxins. Inoculation experiments with isolates of F. poae and F. moniliforme on sweet corn cultivars in 1981 and 1982 confirmed pathogenicity of some isolates. Differences were noted in susceptibility among eight cultivars inoculated with F. poae. Infection was more severe in plants infected with maize dwarf mosaic virus and on insect damaged ears although physical damage was not necessary for infection to occur. Environmental conditions such as moisture and temperature in the field affected disease development and also influenced the predominant Fusarium species isolated each season.

AN INEXPENSIVE, 7-DAY RECORDING VOLUMETRIC SPORE TRAP. D.M. Gadowry and W.E. MacHardy, Department of Botany and Plant Pathology, University of New Hampshire, Durham, New Hampshire 03824.

A recording volumetric spore trap has been designed, constructed, and tested that can be assembled in approximately 4 hours at a cost of less than 200 dollars for parts. The trap will operate on AC or DC current and is constructed of polyvinyl chloride (PVC) pipe and sheet. Spores are drawn through a slit orifice and are deposited on a clear tape mounted on the cylinder of a chart drive mechanism. The trap will sample 15 L/min when a 12 VDC power source is used. Although similar in appearance and operation to the Burkard volumetric spore sampler, the trap efficiency equaled or exceeded that of the Burkard trap in field and laboratory studies.

TAN SCLEROTIA OF SCLEROTINIA SCLEROTIUM FROM LETTUCE. L. E. Garbrandt, S. A. Johnston, and J. L. Peterson. Plant Pathology Department, Cook College, New Jersey Agricultural Experiment Station, Rutgers University, New Brunswick, New Jersey 08903.

A tan sclerotia-forming strain of Sclerotinia was found on a diseased lettuce plant in the field in the spring of 1981. Apothecia produced from the tan sclerotia were white, while apothecia produced from black sclerotia of Sclerotinia sclerotiorum are typically brown. The tan sclerotia lacked a dormancy period, with myceliogenic germination occurring on potato dextrose agar and moist sand. Although ascospores of the tan isolate were slightly larger and more irregular than those of S. sclerotiorum, other morphological and pathological aspects of the two isolates were similar. The tan sclerotia isolate is considered an aberrant strain of S. sclerotiorum. New Jersey Agricultural Experiment Station No. K-11140-1-82.

INFECTIVITY OF ECTOMYCORRHIZAL SPAWN PRODUCED BY THE BUTLER COUNTY MUSHROOM FARM, INC. J. M. Genua, W. Merrill, and L. C. Schisler, 211 Buckhout Laboratory, The Pennsylvania State University, University Park, PA 16802.

The infectivity of mycorrhizal spawn produced by the Butler County Mushroom Farm, Inc., Worthington, PA (BCMF), was tested in the greenhouse on 8-week old container grown conifer seedlings. BCMF recently patented a process for producing fungal spawn in bulk under pure culture conditions, thus avoiding the problem of competing antagonistic fungi that have limited the effectiveness of other commercial mycorrhizal inocula. Pisolithus tinctorius inoculum colonized Colorado blue spruce, Scotch pine, and Douglas-fir seedlings. Cenococcum graniforme induced mycorrhizal formation on Scotch pine and Douglas-fir; but not on Colorado blue spruce. Laccaria laccata (isolates S238A and T813-2) and Hebeloma crustuliniforme established a mycorrhizal relationship with Douglas-fir, the only species tested. The percentage of feeder roots colonized per species varied from 20-80% depending on the fungal symbiont tested.

WHAT BLOCKS VA MYCORRHIZAE IN BRASSICA?
Marian C. Glenn, Plant Pathology, U. Wisconsin-Madison and Dept. of Biology, Tufts University, Medford, MA, 02155

Effects of mustard oils (MO; prominent S-compounds in brassica) on VAM fungi were examined using B. napus and B. campestris

grown in 15 cm plates on mineral salts agar with or without S. Excised roots cultured in S-free media were also used. Germinating spores of Glomus mosseae or Gigaspora gigantea were placed near roots and hyphal response was monitored at 70-200x. Brassica elicited fewer, shorter hyphal branches than compatible hosts, and branching was closer to roots, regardless of MO level. Hyphal branching occurred near brassica if a host root was also present, but brassica was not penetrated. These data suggest that the host rhizosphere provides a fungal growth stimulus lacking in brassica, but fungal growth stops at the brassica root surface. Since VAM penetrate nearly all plants, brassica roots differ from most plants in some basic way other than production of MO.

FUSARIUM WILT OF BIRDSFOOT TREFLOIL IN VERMONT AND NEW YORK. A. R. Gottlieb and H. Doriski, Plant & Soil Science Dept., University of Vermont, Burlington, VT 05405.

Trefoil seed production has been severely limited along the Champlain Valley due to plant mortality during establishment and severe thinning in 2- and 3-year-old stands. New seedlings often develop normally until early summer. As soil moisture is reduced and temperature increases, plants show signs of wilt on warm sunny days and recover at night. In a matter of days, plants no longer recover from wilt and die. The exteriors of tap roots from wilting plants appear normal. Longitudinally sectioned roots revealed brown discoloration of the stele from which Fusarium oxysporum was consistently isolated. Isolates were tested for pathogenicity on trefoil in pasteurized soil. Within 2 weeks 20-80% mortality was observed. After 4 weeks, survivors were sectioned and Fusarium was isolated from roots which displayed a brown discoloration of stele tissue and stem tissue of plants displaying wilt symptoms. Anatomical studies of root and stem tissue revealed hypertrophy and hyperplasia of parenchyma, vascular plugging, and the presence of mycelium.

POTENTIAL FOR SOFT ROT DEVELOPMENT IN STORED AND PRE-CUT IDAHO SEED POTATOES. David F. Hammond, Maine Seed Potato Board, Ashland, ME 04732

The potential for bacterial soft rot development in seed potatoes was monitored for 29 seed lots grown in eastern Idaho in 1980 and stored through the spring of 1981. Comparisons were made on whole tubers with respect to storage period, seed class variety and method of nuclear seed propagation. The soft rot potential declined as storage time progressed due to decreased susceptibility to decay and reduced bacterial populations. Less soft rot developed in potatoes derived from stem-cutting programs than did in potatoes of a similar seed class produced from selected tubers. Temperature conditioning during storage of whole and cut seed produced a significant reduction in soft rot potential. Resistance to decay by Erwinia carotovora var. carotovora was observed following temperature conditioning. Reduction in susceptibility to decay in pre-cut seed was observed when tubers were stored in environments suitable for suberization and wound healing. The length of time required to reduce susceptibility at elevated temperatures was 1/3 to 1/2 that required to condition at normal potato storage temps.

A PHYTOPARASITIC NEMATODE ASSOCIATED WITH GRAPES. M. B. Harrison, K. Hirano, and H. Cheng. Plant Pathology Dept., Cornell University, Ithaca, NY 14853, Chiba University, Chiba, Japan, and Nanjing Agricultural College, Nanjing, China.

Grape vines in an area of the Cornell Experiment Station at Fredonia, New York were observed to be making less growth than normal. This area was selected for a nematode trial and was sampled prior to treatment. A nematode belonging to the genus Meloidoderita was recovered from both soil and the grape roots. Trials showed that neither mint nor Polygonum were hosts of the nematode from grape. Females became swollen but lack a protruding vulva and at maturity possessed the typical cystoid body containing all the eggs. Males developed outside the root and lack a functional stylet. Several morphological features as well as host range differences indicate that the nematode from grape is a new species of Meloidoderita. This nematode is similar to but not identical with the nematode reported as M. kinjanovae from Mentha in Russia or the as yet unnamed Meloidoderita sp. from Polygonum at Beltsville, Maryland.

PHYTOPHTHORA ROOT AND CROWN ROT OF CHERRY IN NEW YORK STATE. J. E. Hayes and H. S. Aldwinckle, Department of Plant Pathology, New York State Agricultural Experiment Station, Cornell University, Geneva, NY 14456.

Isolations were made from diseased root and crown tissues of 23 cherry trees obtained from six orchards in western New York. *Phytophthora megasperma* and an unidentified *Phytophthora* sp. were isolated from trees in three and two orchards, respectively. At least two species of *Pythium* were also isolated. These isolates as well as other isolates of *P. megasperma* from apple, alfalfa, soybean, and cherry were each tested for pathogenicity on 4-month-old Mahaleb cherry seedlings grown in pasteurized orchard soil. The New York isolate of *Phytophthora* sp. from cherry killed all 6 test seedlings. *P. megasperma* isolates from cherry in California, apple, alfalfa, and soybean killed 4, 1, 1, and 1 seedlings, respectively. One seedling grown in *Pythium*-infested soil died. No seedlings grown in non-infested soil died.

ETIOLOGY AND CONTROL OF DAMPING-OFF OF PARSLEY IN SOUTHERN NEW JERSEY. D. E. Hershman, E. H. Varney, and S. A. Johnston, Cook College, NJAES, Rutgers University, New Brunswick, NJ 08903.

A recent survey of parsley fields in S. Jersey has revealed that *Pythium ultimum*, *P. irregulare* and, to a lesser extent, *Rhizoctonia solani* are responsible for a widespread damping-off problem. In pathogenicity tests, most isolates of *P. ultimum* and *P. irregulare* were highly pathogenic, while isolates of *R. solani* varied considerably in pathogenicity. In temperature controlled sandbeds, the *Pythium* spp. were equally pathogenic at 15, 23, and 30 C. *R. solani*, however, was much less pathogenic at 15 C than at either 23 or 30 C. A similar response was obtained in studies using environmental growth chambers. In greenhouse chemical control tests, parsley was seeded into *Pythium*-infested soil and drenched with one of the following fungicides: Ridomil ZEC (1 gal/A), Previcur 70S (2.66 pt/A), Captan 50W (7 lb/A), and Banrot 40W (4 lb/A). As measured by stand density and fresh weight, only Ridomil and, to a lesser extent, Previcur provided significant control of damping-off. A field test during the summer of 1982 further demonstrated the effectiveness of Ridomil, but not of Previcur. NJAES, Publ. No. K-11140-2-82.

THE PATHOGENICITY OF *COLLETOTRICHUM GRAMINICOLA* TO TWO TURFGRASS SPECIES. V. Herring and N. Jackson, Department of Plant Pathology and Entomology, University of Rhode Island, Kingston, RI 02881.

Agrostis palustris L. cv. Penncross and *Poa annua* L. were utilized as hosts in a laboratory investigation to determine the pathogenicity of 5 isolates of *Colletotrichum graminicola* (Ces) Wilson obtained from diseased *Agrostis* spp. putting green turf. Spore or mycelium inoculum administered to axenically grown host plants of the host, resulted only in the superficial infection of the plants after a 4 week incubation period. Mycelium supporting appresoria, stromal masses and mature acervuli developed primarily on the outer leaf sheaths and basal stem regions, less frequently on leaf laminae and roots. Limited colonization of the tissues was observed. Proliferation of fungal structures and the amount of colonization was increased with increasing temperature and when nutrients were supplied to the host plants. However, altering these environmental parameters did not result in severe disease symptoms and the conditions which predispose turf to severe anthracnose damage remain obscure.

IDENTIFICATION OF TOMATO RINGSPOT VIRUS AND MYCOPLASMA-LIKE ORGANISMS IN STUMP SPROUTS OF ASH. C.R. Hibben and J.A. Reese. Brooklyn Botanic Garden Research Center, Ossining, NY 10562

Mature ash (*Fraxinus americana*) at a site with ash dieback were felled in 1980. Sprouts growing from stumps were assayed for virus and mycoplasma-like organisms (MLO) in 1982. A sap transmissible virus was recovered. Sucrose density-gradient centrifugation of partially-purified virus resulted in two nucleic acid-containing components, with estimated sedimentation coefficients of 120S and 132S. By serology the isolate was identified as a tomato ring-spot virus. Longitudinal sections of sprouts were treated with Dienes' stain to identify MLO in the phloem. MLO were detected in sprout samples of all stumps. The possibility of combined or sequential virus and MLO infection should be included in the etiology of ash dieback.

EFFICACY OF UBI-A815 EXPERIMENTAL FUNGICIDE FOR PREVENTATIVE AND AFTER-INFECTION CONTROL OF APPLE SCAB. Kenneth D. Hickey, The Pennsylvania State University, Fruit Research Laboratory, Biglerville, PA 17307-0309.

UBI-AS15-30W (1-[N-(4-chloro-2-trifluoromethylphenyl)-propoxy-

acetimidoyl]-imidazole), a broad-spectrum fungicide, was highly effective in controlling *Venturia inaequalis* when used in both protectant and/or post-infection spray schedules. Field evaluations, under moderate to severe disease pressure, were made on 3 cultivars in 1981-82. Dilute sprays were applied in a standard protectant schedule or 2 to 4 days post-infection. When used at 75 mg a.i./L timed at 7-day (prebloom) and 14-day (postbloom) intervals, UBI-A815 provided a level of control equal or superior to a benomyl/mancozeb standard, bitertanol, fenarimol or prochloraz. Spray applications timed 48, 72 and 96 hours after the beginning of infection periods gave control equal to bitertanol, fenarimol, triforine, and Vanguard used at equal or comparable rates. No phytotoxicity was observed with the use of A815 at rates of up to 250 mg a.i./L.

THE IMPACT OF CULTIVARS ON THE DEVELOPMENT OF POTATO EARLY BLIGHT. J.D. HOLLEY, R. HALL and G. HOFSTRA. UNIVERSITY OF GUELPH, GUELPH, ONTARIO. N1G 2W1.

Small unsprayed plots of three experiments designed in randomized complete blocks, incorporating three potato cultivars, were assessed every seven to fourteen days for early blight (*Alternaria solani*) in 1980 and 1981. In 1980, the rates of disease development (r values from transformed data) for Kennebec, Chieftain and Norchip were 0.162, 0.195 and 0.240. The r values in 1981 were 0.222, 0.253 and 0.298 in one field and 0.150, 0.173 and 0.193 at a second location. Rates of disease progress on the three cultivars differed significantly from each other (Fisher's protected LSD) in each experiment. Kennebec showed greater resistance than Chieftain and Chieftain had greater resistance than Norchip at each location. The rate-reducing resistance identified in this study may affect the amount and timing of chemical spray required for disease control.

PHYTOTOXIC SUBSTANCE IN THE CULTURE FILTRATE OF CORN STUNT SPIROPLASMA. Hsing-Hsiung Hou and Tseh-An Chen, Department of Plant Pathology, Cook College, Rutgers University, New Brunswick, New Jersey 08903.

After corn stunt spiroplasma was cultured for 14 to 21 days in R-2 medium, a phytotoxic substance was isolated and partially purified from culture filtrate by methanol extraction, chloroform extraction, and thin layer chromatography. This phytotoxic substance showed absorption maximum at 210 nm. It caused leaf-chlorosis and growth-retardation of corn shoots and Vinca cuttings. It also caused the agglutination and chlorosis of isolated corn mesophyll protoplasts. Whether the toxic substance is a metabolite of the spiroplasma or a product of lysed cells is still unknown.

DETECTION AND MEASUREMENT OF APPLE MOSAIC VIRUS IN APPLE CALLUS, SUSPENSION CELLS AND PROTOPLASTS THROUGH ELISA. C. D. Hurwitz and G. N. Agrios, Dept. of Plant Pathology, Univ. of Mass., Amherst, MA 01003.

Callus and suspension cultures were initiated from leaves, stems, petals, fruits, buds and crown galls from virus free and from apple mosaic virus infected trees. Protoplasts were isolated from healthy and infected callus and suspension cultures treated with 2% cellulysin and 0.5% macerace. Indirect ELISA was effective in detecting virus and determining relative concentration in infected callus and suspension cells, in isolated protoplasts, and in infected leaves taken directly from apple trees. Diluting callus and infected leaf sap at 1/500 resulted in optimum results by lowering background readings. Grafting of virus infected callus of crown gall origin proved that the virus remained infective in the callus. ELISA readings suggested that virus concentration in cultured cells is slightly lower than that in newly infected leaves, but higher than that in older infected leaves.

O₃ RESPONSE OF POTATO LEAF PROTOPLASTS FROM TWO DIFFERENTIALLY TOLERANT CULTIVARS. B. L. Illman and E. J. Pell, Dept of Plant Pathology and Center for Air Environment Studies, The Pennsylvania State University, University Park, PA 16802.

The objective of this experiment was to assess the importance of the plasma membrane in determining differential tolerance of plants to ozone. Leaf protoplasts from 'Cherokee' and 'Norchip', O₃ sensitive and tolerant potato cultivars, respectively, were exposed to 219 ± 31 ppm O₃ or commercial-tank air

which were supplied by continuous flow to the gas space above a stirred protoplast suspension. At 0, 1, 3, 5, 10 & 15 min samples were collected, and viability and lysis of protoplasts was determined. Retention of fluorescein diacetate was used to determine viability; numbers of protoplasts/ml solution were used to measure lysis. Increasing numbers of protoplasts were killed up to 10 min of O₃ exposure based on both criteria; no additional changes were observed at 15 min. Dose response curves were similar for both cultivars. The experiments did not support the hypothesis that O₃ tolerance is accounted for at the membrane level.

SCANNING ACOUSTIC MICROSCOPY OF BARLEY PAPILLAE IMPLICATED IN POWDERY MILDEW RESISTANCE. H. W. Israel*, J. R. Aist*, M. C. Stolzenburg*, R. Hammer†, and R. L. Hollis†. *Department of Plant Pathology, Cornell University, Ithaca, NY 14853; and †IBM Thomas J. Watson Research Center, Yorktown Heights, NY 10598.

In some interactions, resistance of barley to primary penetration by *Erysiphe* involves environmentally and genetically mediated responses that culminate in papilla formation. Variations in acoustic response (indicative of changes in density, elasticity, and viscosity) of papillae in living coleoptile cells encountered by the fungus were recorded in 1.5 μm resolution images obtained with scanning acoustic microscopy (SAM), in conjunction with correlative differential interference contrast (DIC) light microscopy. At encounter sites where the parasite was repelled, acoustic image contrast was usually pronounced; where it was not repelled, contrast was less evident. At some sites, parasite and host features not seen by DIC were observed by SAM. For the first time, superficial fungal structures were also SAM-detected. It is suggested that viscoelastic barriers may play a role in some types of active disease resistance.

USE OF APPLE SEEDLINGS TO DETECT *PHYTOPHTHORA CACTORUM* IN APPLE ORCHARD SOILS. S. N. Jeffers and H. S. Aldwinckle, Department of Plant Pathology, New York State Agricultural Experiment Station, Cornell University, Geneva, NY 14456.

Phytophthora species are recovered from soil by direct plating onto a suitable agar medium or by baiting with susceptible plant material. *P. cactorum*, unlike most *Phytophthora* spp., was inhibited on a selective medium containing hymexazol, a chemical used to restrict *Pythium* contamination. However, a bioassay using 2- to 3-wk-old Grimes Golden apple seedlings to bait the fungus from soil has been successful. Seedlings were added to a 60-ml subsample of soil flooded with distilled water. Characteristic sporangia of *P. cactorum* were abundant on necrotic hypocotyls after 4-7 days. Air drying and moistening the subsamples before flooding greatly enhanced detection. Incubation at 21 C was superior to incubation at 27 C. Other species of *Phytophthora* implicated in crown rot of apple are not detected by this assay.

RECOVERY OF *AGROBACTERIUM TUMEFACIENS* BIOVAR 3 FROM GRAPEVINE CUTTINGS. B. H. Kätz and T. J. Burr, Department of Plant Pathology, New York State Agricultural Experiment Station, Cornell University, Geneva, NY 14456.

Agrobacterium tumefaciens (AT) biovar 3 was recovered from apparently healthy grapevine (*Vitis vinifera* L.) cuttings in 1982. Dormant cuttings were collected from 11 vines (five cultivars) in January and rooted in sterile sand. To check for the presence of AT, developing callus and roots were macerated in sterile distilled water and plated on a modified New and Kerr medium. Pathogenicity of strains was tested on sunflower. AT was recovered from 5 of 11 vines, from 5 of 24 individual callus samples, and from 3 of 13 individual root samples. Host range and biovar of pathogenic strains were determined using standard tests. All strains were pathogenic on sunflower, tomato, and grapevine, and identified as biovar 3.

EFFECT OF LEACHATE FROM SAPROPHAGOUS NEMATODE-INFESTED COMPOST ON THE MYCELIAL GROWTH OF *AGARICUS BRUNNEESCENS*. T. D. Kaufman, J. R. Bloom and F. L. Lukezic, Dept. of Plant Pathology, The Pennsylvania State University, University Park, PA 16802.

Yields of commercial mushrooms can be reduced by infestations of free-living nematodes. To determine if leachate from nematode-infested compost was involved, mushroom compost was treated as follows: spawned with mushroom cultivar PSU-348; PSU-348 plus filtered, water leachate from nematode-infested compost; PSU-348 plus *Caenorhabditis elegans* (Maupas) Dougherty and associated

organisms; unspawned compost. Treatments were replicated 20 times. Each week for a total of 4 weeks samples were assayed for laccase to determine mycelial biomass. The control spawned with PSU-348 alone produced significantly more mycelium than the other treatments. There was no significant difference between the yield of mycelium produced in the leachate or nematode-infested treatments until the fourth week. At that time the yield was higher in the leachate treatment. The results show that the leachate alone from nematode infested compost can reduce the yield of mushroom mycelium.

REACTION OF FOUR MUSHROOM CULTIVARS TO INFESTATIONS OF SAPROPHAGOUS NEMATODES AT TWO MOISTURE LEVELS. T. D. Kaufman, F. L. Lukezic and J. R. Bloom, Dept. of Plant Pathology, The Pennsylvania State University, University Park, PA 16802.

The 4 mushroom cultivars used in this study were PSU-310 (white), PSU-348 (off-white), PSU-324 (cream) and PSU-344 (brown). Treatments included spawned and spawned-nematode inoculated compost for each cultivar and unspawned controls. *Caenorhabditis elegans* (Maupas) Dougherty was the infesting nematode. Initial moisture level of compost in the first experiment was 73.5% and 77.6% in the second experiment. At weekly intervals over a 4 week period, 5 replicates from each treatment were harvested and subjected to laccase analysis to estimate mycelial biomass. Cultivars PSU-310, PSU-324 and PSU-348 produced similar amounts of mycelium and PSU-344 produced noticeable less mycelium over the course of each experiment. The nematode infested treatments for each cultivar produced significantly less mycelium than the spawned treatments free of nematodes. At the higher moisture level virtually no mycelium was produced by any of the cultivars infested with nematodes.

YEARLY TRENDS IN CADMIUM AND LEAD CONTENT OF ROADSIDE TREES IN NEW JERSEY. Janet Kazimir, Bruce Clarke and Eileen Brennan. Rutgers University, N.J.A.E.S., New Brunswick, N.J. 08903

Leaf samples from roadside trees in New Jersey were analyzed for Cd and Pb from 1974 to 1982. Traffic volume at the sites ranged from 25 to 60,000 vehicles/day. The Pb content of foliage generally correlated with traffic volume and was species dependent. Conifers accumulated more Pb than the deciduous species. Approximately 25% of the Pb could be removed by mild washing of the leaves. A significant decrease in Pb content of foliage occurred in trees at the most heavily travelled site in 1977 as a result of government restrictions on the lead content of gasoline. The Cd content of tree foliage did not relate to traffic volume, and there was no significant change over the years. The amount of Cd that could be removed by washing was insignificant. Vehicular traffic evidently is not a significant source of Cd. These results demonstrate that trees can be used as bioindicators of ambient levels of Pb and also as a sink for Pb pollution. New Jersey Agricultural Experiment Station # K-11151-5-82.

A GNOTOBIOTIC SLANT-BOARD TECHNIQUE FOR STUDYING ROOT DISEASES. W.A. Kendall and K.T. Leath. U.S. Regional Pasture Research Laboratory, University Park, PA 16802.

A compact chamber is described for the gnotobiotic culture of plants that permits access to the roots for root disease studies. The chamber is constructed of sheet aluminum and has a clear autoclavable polypropylene covering over the upper (shoot) section. Roots of red clover and alfalfa grow between sheets of blotter paper that are held in an autoclavable polypropylene bag and moistened with a nutrient solution. One side of the root section of the chamber is removable for access to the roots. One treatment can be applied to the entire root system; or multiple treatments are possible at discrete locations on branch roots. Length of rot or the effect of disease on root elongation can be readily measured. Most studies are completed when plants are about 4 weeks old. The gnotobiotic chambers are maintained in plant growth chambers to provide controlled climatic conditions.

DEVELOPMENT OF PHYTOPHTHORA ROOT ROT IN NURSERY BEDS OF 3-YR-OLD FRASER FIR. C. M. Kenerley and R. I. Bruck, Dept. of Plant Pathology, N.C. State Univ., P.O. Box 5397, Raleigh, NC 27650.

The development of *Phytophthora* root rot of 3-yr-old Fraser fir seedlings from irregular natural disease foci was monitored during the 1981 growing season. Propagule density of *P. cinnam-*

momi was quantitatively assayed at 9 sampling dates along transect lines within plots. Seedlings exhibiting symptoms of Phytophthora root rot were individually assigned coordinates within a plot for mapping purposes. Synagraphic computer mapping was used to develop propagule density contours, slope contours, and mortality maps of each plot. Mortality of seedlings was generally greatest along decreasing slope gradients. Presence and increase of P. cinnamomi propagules preceded observable mortality with centers of greatest densities advancing away from the original disease foci. Highest propagule densities were recorded after extended periods of soil temperature > 20C with propagule densities declining as soil temperatures decreased.

INHIBITION OF GREMMENIELLA ABIETINA BY PSEUDOMONAS FLUORESCENS ON RED PINE SEEDLINGS. G.R. Knudsen and G.W. Hudler, Dept. of Plant Pathology, Cornell University, Ithaca, N.Y. 14853.

Pseudomonas fluorescens (strain R10a), isolated from red pine shoots, inhibited germination of conidia of Gremmeniella abietina on needles of red pine seedlings. Suspensions of R10a (10^8 CFU/ml) in water or dilute nutrient broth were adjusted to pH 3.6 or 5.6 and atomized onto potted seedlings. Other seedlings received sterile control treatments. 10^6 conidia/ml were sprayed onto all seedlings, which were then incubated at 14 C in plastic bags. Conidia were sampled by pressing excised needles against double-stick tape affixed to microscope slides. Persistence of R10a was monitored by washing excised needles and plating dilutions onto a selective medium. Germination of conidia was highest (54%) at pH 3.6 plus nutrients and minus R10a. Germination was lowest (2%) and recovery of fluorescent pseudomonads greatest at pH 5.6 with nutrients and R10 added. Germination was lower at all pH and nutrient levels when R10a was present than in corresponding bacteria-free treatments.

AN ANALYSIS OF THE VIRUS-LIKE PARTICLES ASSOCIATED WITH LAFRANCE DISEASE. K. Koons, L. C. Raid, and C. P. Romaine, Dept. of Plant Pathology, The Pennsylvania State University, University Park, PA 16802.

To further clarify the etiology of LaFrance disease of the cultivated mushroom, Agaricus bisporus, 19 diseased sporophore isolates were analyzed for virus-like particles (VLPs) by electron microscopy and for dsRNA by polyacrylamide gel electrophoresis. All isolates contained predominantly 19 nm and 25 nm spherical VLPs and various mixtures of dsRNAs. Ten of these isolates were further examined by electron microscopy, an agar diffusion sero-assay, and an enzyme-linked immunosorbent assay for mushroom bacilliform virus (MBV). In addition to the spherical VLPs, 7 of the 10 isolates contained MBV. A positive reaction in both serological tests was dependent upon the presence of MBV particles but not the spherical VLPs. The data illustrate that MBV is serologically distinct from the spherical VLPs and that the latter may have a more important role in the etiology of LaFrance disease.

THE EFFECT OF POTASSIUM SORBATE AS A POTATO SEED TREATMENT TO CONTROL CERTAIN PATHOGENIC FUNGI. S.S. Leach, B.J. Bandy and C.W. Murdoch, N.E. Plant, Soil and Water Laboratory, USDA/ARS, University of Maine, Orono, ME 04469.

Potassium sorbate (KS) was evaluated as a control agent on white potato for Rhizoctonia solani, Verticillium albo-atrum, Fusarium roseum 'Sambucinum' and Helminthosporium solani. All fungi were tested for growth on amended agar plates in vitro. Viability of tuber-borne R. solani sclerotia following KS dip seed treatments were determined. Potato cultivar Atlantic tubers were wounded, inoculated with a 5×10^4 spore/ml suspension of F. roseum, and dip treated with 1, 2 and 4% KS solutions. Two separate field tests (RCB) were made with tubers dip treated with 1, 2 and 4% KS. KS was shown to inhibit the growth on agar of R. solani at 400-500ppm, V. albo-atrum at 200-300ppm and F. roseum at 500ppm. KS seed treatment (4%) was an effective inhibitor of R. solani sclerotial germination after 18 days, but was not effective in controlling F. roseum caused dry rot under storage conditions.

THE EVALUATION OF A NEW METHOD TO IDENTIFY POTATO CLONES RESISTANT TO RHIZOCTONIA SOLANI KUHN. S.S. Leach, B. Bandy and C.W. Murdoch. USDA/ARS, N.E. Plant, Soil & Water Lab; Botany and Plant Pathology Dept., University of Maine, Orono, ME 04469.

Resistance of white potatoes to Rhizoctonia solani Kuhn in a potato breeding program is generally not studied until very

late in the cultivar selection process, therefore, many sources of resistance may be overlooked. This new method utilizes seedlings grown from true seeds insuring maximum genetic diversity for resistance. True potato seeds were germinated on 8mm plugs of potato dextrose agar on which pathogenic isolates of Rhizoctonia solani were actively growing. Seedlings which survived were transplanted into flats containing a sterile soil-less peat-perlite mix and later to individual pots for tuber development. Tubers produced showed no symptoms caused by R. solani. Sixty-eight percent of all seeds and 48% of the seedlings produced were found to exhibit some resistance to R. solani. Based on these observations the use of seedlings from true potato seed as a fast and accurate method of identifying resistance to R. solani appears feasible.

CLOVER CYST NEMATODE ON RED CLOVER IN PENNSYLVANIA. K.T. Leath J.R. Bloom, R.R. Hill, T.D. Kaufman and R.A. Byers. U.S. Regional Pasture Research Laboratory, USDA-ARS, and Department of Plant Pathology, The Pennsylvania State University, University Park, PA 16802.

Stands of red clover (Trifolium pratense L.) usually decline prematurely, and often the cause is not known. A stand seeded in 1978 declined rapidly during 1979, and the clover cyst nematode, (Heterodera trifolii (Goff.) Oostenbrink, was identified in roots and soil. This is the first report of that nematode in Pennsylvania. In 1980, red clover was seeded into the infested areas with and without carbofuran. Plants in non-carbofuran plots were severely stunted by cyst nematode activity. With carbofuran, establishment was comparable to that in non-infested soil. Forage yield in 1981 was significantly higher in the carbofuran treatment. Cyst counts in July 1981 per 200 g of soil were 112 in the non-carbofuran and 58 in the carbofuran treatment. The clover cyst nematode may be a significant factor in premature stand failure of red clover in other locations.

PURIFICATION OF POTYVIRUSES BY COLUMN CHROMATOGRAPHY. C. R. Lee, J. D. Lei, and G. N. Agrios, Dept. of Plant Pathology, Univ. of Mass., Amherst, MA 01003.

For experiments with potyviruses that require small amounts of highly infective virus, column chromatography provides a much quicker method for virus purification than differential and density gradient centrifugation. Potato virus Y (PVY) and maize dwarf mosaic virus (MDMV), both belonging to the potyvirus group, were successfully purified from tobacco and corn leaves, respectively, by passing them through a column containing Sepharose 4B or Sepharose CL-4B. After sap is treated with n-butanol (PVY) or chloroform (MDMV) and the virus is precipitated with polyethylene glycol (PEG) 6,000, the resuspended virus is placed on a 0.9 cm dia. 55 cm long Sepharose gel column. The virus is eluted in the 10th to 15th one-ml fractions, with the peak in the 12th fraction. Under our conditions, the yield of column purified virus was equal to or several times that obtained with sucrose density gradient centrifugation, showed a typical UV absorption curve and was highly infective in systemic host assays.

REPLICATION AND SPREAD OF MAIZE DWARF MOSAIC VIRUS WITHIN CORN PLANTS OF DIFFERENTIAL RESISTANCE. J. D. Lei and G. N. Agrios, Dept. of Plant Pathology, Univ. of Mass., Amherst, MA 01003.

Resistant, moderately resistant, and susceptible corn varieties and F1 hybrids were used to study the mechanism of MDMV-resistance in corn. Similar 4-cm-long sections of leaves were mechanically inoculated with MDMV-B and the replication and spread of the virus in the plants were monitored with ELISA. All varieties supported high concentrations of MDMV-B in the inoculated sections. The virus moved into the adjacent sections of the inoculated leaves in all corn lines but only the susceptible varieties became systemically infected and showed mosaic symptoms. When all leaves of each plant were inoculated, all susceptible varieties and a hybrid with a moderately resistant parent also became systemically infected while none of the plants of the other lines became systemically infected in any of the treatments. This suggests that the resistance genes of some resistant lines in a hybrid are apparently overcome by high inoculum pressure while resistance genes from other lines are not.

INCUBATION PERIOD OF SEPTORIA CANKER AND LEAF SPOT ON INOCULATED POPULUS HYBRIDS. R. Long, T. W. Bowersox, and W. Merrill, School

of Forest Resources and Dept. of Plant Pathology, The Pennsylvania State University, University Park, PA 16802

Two isolates of *Septoria musiva* Pk. were inoculated into *Populus* hybrid NE-388 (*P. maximowiczii* X *P. trichocarpa*) using four different methods to determine incubation period and probable infection courts in a greenhouse study. Trees inoculated with stipules and petiole removed, buds removed, and at non-wounded lenticels developed cankers in 22, 23, and 30 days, respectively. Infection incidence varied from 30-100% (average=70%) in stipule and petiole inoculations; 60-70% (average=67%) in bud inoculations; and 0.0-3.3% (average=1.1%) in non-wounded lenticel inoculations. Leaf spots developed 19 days after atomizer application of a spore suspension. Infection incidence for leaf inoculations varied from 25-75% (average=54%). These results confirm field observations that stipules, petioles, and buds are major infection courts whereas lenticels do not appear to be significant infection courts.

PSEUDOMONAS VIRIDIFLAVA ASSOCIATED WITH STEM NECROSIS OF MATURE TOMATO PLANTS. F. L. Lukezic, R. G. Levine, and A. A. MacNab, Dept. of Plant Pathology, The Pennsylvania State University, University Park, PA 16802.

Isolation for the presence of bacteria from mature tomato stems with necrotic streaks yielded bacteria that produced a blue pigment on yeast carbonate dextrose agar. Pathological tests showed that these organisms would induce a necrotic streak when injected into healthy tomato plants. Physiological tests identified the strains as *Pseudomonas viridiflava*, a bacterial pathogen usually associated with leaf spots and necrosis of young plants. A subsequent pathogenicity test demonstrated that the pathogen probably enters the plant via injury sites. Inoculation of the bacteria into fruit walls demonstrated that the bacteria will cause a necrotic collapse of the fruit wall as well as stems.

FORECASTING MATURITY OF *PSEUDOTHECIA* OF *VENTURIA INAEQUALIS*. W. E. MacHardy & D. M. Gadoury, Dept. Botany & Plant Pathology, Univ. New Hampshire, Durham, 03824.

Several models have been published that estimate maturity of *pseudothecia* of *Venturia inaequalis*, but none can forecast maturity for a specified future date. A system described here forecasts ascospore maturity by combining a degree-day model of ascospore maturation (Gadoury & MacHardy, *Phytopathology* 72:901-904) with a model for predicting degree-day accumulation. The degree-day accumulation model was developed from 23 years of historical weather data. The system was able to accurately predict ascospore maturity up to one month in advance during 1979-1982. The added time and flexibility for making spray decisions that this system allows when used in disease management programs represent significant improvements over other methods of ascospore maturity estimation and assessment.

EFFECTS OF OZONE AND SULFUR DIOXIDE ON MYCORRHIZAL FORMATION AND GROWTH OF LOBLOLLY PINE. M. J. Mahoney, J. M. Skelly, and B. I. Chevone, Department of Plant Pathology and Physiology, Virginia Polytechnic Institute and State Univ., Blacksburg, Virginia 24060.

Loblolly pine seedlings were fumigated for 35 consecutive days, 6 hr/day, with a 0.07 ppm ozone and 0.06 ppm sulfur dioxide, singly and in combination, or with charcoal-filtered air. Half of the seedlings in each treatment were inoculated with *Pisolithus tinctorius* and half remained uninoculated. Seedling height growth was measured weekly. Top and root dry weight and percent mycorrhizal formation were determined following fumigation termination. The experiment was repeated once. Mycorrhizal formation was not affected significantly, and height growth of mycorrhizal and nonmycorrhizal seedlings generally was unaffected. Top dry weight of nonmycorrhizal seedlings was significantly reduced by 4 of 6 pollutant treatments during both experiments, whereas mycorrhizal seedling top weight was reduced by only 1 of 6 pollutant treatments. Root dry weight of nonmycorrhizal seedlings was significantly reduced by all pollutant treatments but was not reduced by any treatment of mycorrhizal seedlings.

THE INFLUENCE OF FIVE PERCENT APPLE REPLANT SOIL ON GROWTH OF CHERRY AND PEAR SEEDLINGS. W. F. Mai and Teresa Mullens,

Department of Plant Pathology, Cornell University, Ithaca, NY 14853.

The addition of 5% field soil (FS) [5 parts FS + 95 parts pasteurized soil (PS)] from an apple replant orchard has been shown to reduce the growth of apple seedlings (cv. Northern Spy) approximately 50% compared to growth in 100% PS. Growth in 100% FS was reduced approximately 85%. The purpose of this research was to determine the influence of the addition of 5% FS from an apple replant orchard on growth of seedlings of cherry (cv. Mahaleb) and pear (cvs. Bartlett and French Common) in a 6 wk period. Compared to growth in 100% PS soil the addition of 5% FS reduced growth of Mahaleb cherry seedlings 55% in one experiment and 36% in a second experiment. The growth of Bartlett pear seedlings was reduced 55% and of French Common pear seedling 70%.

NATURAL SOIL AFFECTS RESPONSE OF *POA PRATENSIS* TO SO₂ AND SO₂ + NO₂. William J. Manning, Dept. of Plant Pathology, Univ. of Mass., Amherst, MA 01003.

Pasture soil was used in two composts: as heated soil (100 C, 3 hrs) (HS) and as non-treated natural soil (NS). *Poa pratensis* 'Monopoly' seedlings were transplanted into HS and NS and placed in wind tunnels at 20 C and 0.4 m/sec air flow. Light intensity was 300 $\mu\text{Em}^{-2}\text{s}^{-1}$ for 15 hrs/day. Fifteen seedlings in each compost were continuously exposed to ambient air, or 6 ppm SO₂ or 6 ppm SO₂ + 6 ppm NO₂ for 50 days. All plants in NS were smaller and grew slower than those in HS. SO₂ + NO₂ injury appeared first on plants in NS and was more extensive at harvest. SO₂ stimulated growth of plants in HS and NS, but decreased root growth in NS. SO₂ + NO₂ had varying effects on plants in HS, but consistently reduced growth of plants in NS. Use of NS allowed determination of pollutant effects that would not have been evident if only HS had been used.

PERIODS OF SPORE DISSEMINATION FOR *UREDINOPSIS MIRABILIS* ON *ABIES BALSAMEA* AND *ONOCLEA SENSIBILIS*. M. Mazzola and D.R. Bergdahl, Dept. of Forestry, Univ. of VT, Burlington, VT 05405

Sporulation of *Uredinopsis mirabilis* was monitored in two balsam fir (*Abies balsamea*) plantations in Vermont. One plantation (Williston) was in the Champlain Valley of west central VT and the other in the northeast (Wolcott). Silicone coated microscope slides and .7cm glass tubes with double stick-cellophane tape were used to trap basidiospores, aeciospores and urediospores of *U. mirabilis*. Pycniospore and teliospore development was noted by examining infected tissues. Amphiospores were not found. At Williston, basidiospores were disseminated May 5 - June 7, 1982, but major infection of balsam fir did not occur until May 19. Pycnia were apparent by June 5 and aeciospores were disseminated June 9 - July 27 with peak dissemination June 20. On *Onoclea sensibilis* uredia were present on June 28 and urediospore dissemination continued periodically until frost. Basidiospore and aeciospore dissemination was delayed by approximately 14 days in Wolcott (colder site) when compared to Williston.

RELATIONSHIPS AMONG THE ECTOMYCORRHIZAL FUNGUS, *PISOLITHUS TINCTORIUS*, SOIL AND ROOT POPULATIONS OF *PRATYLENCHUS PENETRANS*, AND GROWTH OF PEACH TREES. Susan R. McCouch and Richard A. Rohde, Dept. of Plant Pathology, Univ. of Mass., Amherst, Massachusetts 01002.

Spores of *Pisolithus tinctorius* were placed around the roots of Garnet Beauty/Halford and Harbinger/Siberian C peach trees at the time of planting. Rhizosphere populations of *Pratylenchus penetrans*, and root infection by both lesion nematodes and an indigenous species of VA mycorrhizal fungus were assessed and related to growth of the two scion/rootstock combinations. Amending the soil with *P. tinctorius* stimulated *P. penetrans* populations around all trees during the first growing season. Garnet Beauty/Halford tree growth was negatively correlated with nematode populations. Growth of Harbinger/Siberian C trees was stimulated when *P. tinctorius* was amended into the soil. *P. tinctorius* was not mycorrhizal on peach. VA mycorrhizae colonized a greater percentage of Harbinger/Siberian C roots than Garnet Beauty/Halford roots.

THE EFFECT OF VIROID INFECTION OF *CHRYSANTHEMUM MORIFOLIUM* ON PITH MACERATION BY *ERWINIA CHRYSANTHEMI*. R. J. McGovern, R. K. Horst, and R. S. Dickey, Cornell University, Ithaca, NY 14853.

Pith maceration of cuttings from the chrysanthemum cv. 'Bonnie Jean' by *E. chrysanthemi* was reduced by prior infection with the viroids: chrysanthemum stunt (CSV); symptomless and symptom-producing strains of chrysanthemum chlorotic mottle; mild and severe strains of potato spindle tuber; and by citrus exocortis. A decrease in pith maceration was observed from 24-60 and 17-60 days following CSV-infection, when plants were maintained at 27C, 22 klux, and 29C, 32 klux, respectively. Less consistent trends in pith maceration reduction were observed in the cases of the other viroids; the initial appearance and duration of the decrease varied widely among viroids and occurred from 10-60 days following viroid inoculation. Bacterial growth was not inhibited *in vitro* by diffusates from viroid-infected stem segments or partially purified viroid preparations. No difference in virulence was observed in bacteria reisolated from CSV-infected or CSV-free plants.

RHABDOCLINE NEEDLECAST IN PENNSYLVANIA. W. Merrill, A. Biggs, L. Zang, L. Forer, V. Wagner, and B. Towers, Department of Plant Pathology, The Pennsylvania State University, University Park, PA 16802 and Pa. Dept. Environ. Res., Middletown, PA 17057

Rhabdocline needlecast of Douglas-fir was reported in 1952 from a single plantation in northeastern Pennsylvania and not found again until 1979. In 1979-82, Christmas tree plantations and landscape nurseries in seven eastern Pennsylvania counties from the NY border to Philadelphia had up to 85% of the trees infected, with up to 95% loss of second-year needles. Both *R. weirii* subsp. *oblonga* and *R. pseudotsugae* subsp. *pseudotsugae* occurred in some plantations; no attempt was made to quantify relative frequencies of the two pathogens. This is the first report of the latter subsp. east of northern Michigan, and a 203 Km southward extension of the range of the disease in eastern NA. Some affected plantations in isolated areas originated from seedlings imported from northern New England where the disease has been known to occur since the 1930's.

INTRODUCTION OF *ENDOCRONARTIUM HARKNESSII* INTO CENTRAL PENNSYLVANIA. W. Merrill, N. Wenner, and B. Towers. Pa. State University and Pa. Dept. Environm. Resources, 210 Buckhout Lab, University Park, PA 16802.

Endocronartium harknessii, native to hard pines in western NA and to jack pine in northern NA, was introduced into PA where it is a serious pathogen of Scots pine. An isolated infection center was found in a Clearfield Co. ponderosa pine provenance study established in 1969 by the US Forest Service. Basal galls on 1968 internodes indicate initial infection occurred in the seedbed. The seedlings were imported from a Nebraska nursery within the natural range of *E. harknessii* and with a history of gall rust. The long incubation period prevents detection of the pathogen in seedlings; however, in surveys made 1 and 2 years after planting, the galls would have been visible and could have been rogued prior to sporulation. The latter was not done. This example illustrates the danger of moving planting stock from areas of known pathogen occurrence into locales free of those pathogens, and that management foresters should know some forest pathology.

EFFECT OF BLIGHTED CULL PILES IN THE MANAGEMENT OF POTATO LA BLIGHT THROUGH BLITECAST. Agustín B. Molina, Jr. and D. R. MacKenzie, Dept. of Plant Pathology, The Pennsylvania State University, University Park, PA 16802.

The effectiveness of "Blitecast" in the management of potato late blight (*Phytophthora infestans*) was evaluated in the presence of cull piles as sources of inoculum. Cull piles were simulated by putting 100 kg of blight infected tubers at the upwind ends of each experimental plot. These plots were either sprayed with mancozeb (1.6 lb Dithane M-45/acre) according to "Blitecast," 7-day interval, or no spray. The development of epidemics was monitored from sampling areas at varied distances from the cull piles. Late blight disease was observed in both the unsprayed and "Blitecast" plots. The onset of epidemic was detected before the first "Blitecast" spray was carried out. Average apparent infection rates were .17 and .12 for unsprayed and "Blitecast" sprayed plots, respectively. No disease development was noted on plots sprayed at 7-day intervals. Disease severity decreased with distance from the cull pile.

BACTERIA ASSOCIATED WITH PINK EYE AFFECTED POTATO TUBERS. C.W. Murdoch, L.J. Potaro and S.S. Leach, N. E. Plant, Soil and Water Laboratory, USDA/ARS, University of Maine, Orono, ME 04469.

The pink eye disease of potato (*Solanum tuberosum*) has been reported to be caused by the bacterium *Pseudomonas fluorescens*, although considerable doubt exists as to the true identity of the pathogen and the role other bacteria may have on disease development. Isolations were made from 40 tubers (cultivar Kennebec) showing visible symptoms. Tissues associated with lesion margins were surface sterilized and plated on trypticase soy or nutrient agar incubated aerobically at 23 or 30 C. Isolates were identified using standard bacteriological methods. Results show that several species of bacteria were present at lesions including: *Ps. fluorescens*; *Ps. putida*; *Enterobacter agglomerans*; *Bacillus*, *Erwinia* and *Arthrobacter* spp. Further evaluation is needed to determine the role of mixed bacterial populations on pink eye disease development and those conditions favoring tuber infection and symptom expression.

NONPATHOGENIC STEM INHABITING BACTERIA (NPB) - FUTURE AGENTS FOR BIOCONTROL OF PLANT PATHOGENS. C.W. Murdoch and S.S. Leach, N.E. Plant, Soil and Water Laboratory, USDA/ARS, University of Maine, Orono, ME 04469.

Nonpathogenic stem inhabiting bacteria, designated as NPB, are common in most plants but their significance has not been fully evaluated. Previous studies have shown that bacterial associations exist within stem vascular tissue of potato. To obtain NPB for future evaluation and development, isolations were made from 32 plants each of cultivars Kennebec and BelRus grown from cut or whole seed, treated (TBZ 1500ppm) or untreated. A total of 187 isolates were obtained which were representative of several genera. By genetic engineering, existing NPB might be utilized to control vascular pathogens and/or increase available nutrients or plant growth promoting substances *in situ*. NPB might also be modified and applied as seed treatments or soil amendments to take advantage of existing bacteria-plant relations. NPB may be possible future agents for effective biological disease control and plant growth promotion.

DAMAGE TO ELM FROM INJECTION WOUNDS IN SMALL TREES. C.W. Murdoch, D. Zimel, J. Hoch and R.J. Campana, Botany and Plant Pathology Department, University of Maine, Orono, ME 04469

Previous association of bark cracks with injection wounds in elm was limited to large trees. Similar damage in small trees prompted a study to determine its extent and severity. Ninety eight small elms (7-18 cm. dbh) injected with thiabendazole or sucrose from 1975-1982 by gravity or pressure systems were examined for wound-related cracking or bleeding. Fifteen percent of the trees had cracks associated with wounds, and 16 percent showed evidence of bleeding from injection holes. Of 249 holes, 15 (6 percent) had cracks and 26 (10 percent) were bleeding. Length of cracks above wounds varied from 5-274 cm (average 160); cracks below wounds extended from 0-14 cm (average 12). The data are clear in demonstrating similar, but less severe damage from injection wounds in small elms compared to large ones.

THE USE OF DISEASE INCIDENCE TO ESTABLISH SUB-LETHAL DOSAGES OF SYSTEMIC FUNGICIDES TO MANAGE PLANT DISEASES. R. R. Nelson, R. D. Schein, G. Thomas, O. Borges, and M. H. Royer, Dept. of Plant Pathology, The Pennsylvania State University, University Park, PA 16802.

We have demonstrated the potential to manage powdery mildew of winter wheat at acceptable levels by the use of sub-lethal dosages of triadimefon (Bayleton) which reduce the epidemiological fitness of the pathogen. The principle would seem to apply to a variety of diseases when complete control is not essential. No single sub-lethal dosage can be recommended for all areas or in a given area between years due to varying epidemiological factors. Disease incidence of wheat powdery mildew and other diseases can be used to predict disease severity with reasonable precision. Therefore, we propose that disease incidence at the time of fungicide application can be used to establish the sub-lethal dosage necessary to manage disease to threshold levels under the given conditions.

SPECIFIC EFFECTS OF SOYBEAN MOSAIC VIRUS (SMV) ON N₂-FIXATION RATE, TOTAL N AND UREIDE-N IN GLYCINE MAX AND G. SOJA. R. G. Orellana and S. L. Reynolds. Plant Protection Institute, ARS, USDA, Beltsville, MD 20705.

The effect of SMV on growth and some physiological parameters of *G. max* 'Hill' and 'Essex' and *G. soja* PI's 424-005 and 373-693-B, was studied. At planting, seed were treated with *Rhizobium japonicum* strain 110 in broth culture. Compared with virus-free plants, soybeans in the pod-fill stage and systemically infected with SMV, exhibited reduced top and nodule weights and N₂-fixation rates as determined by the acetylene reduction assay. Ureide-N transport and total N were consistently higher in SMV-infected plants. Host reactions to SMV were rated as 434-005 > Essex > Hill > 378-693-B with symptoms ranging from severe to transient chlorotic mottle. SMV-infected *G. soja* had significantly lower N₂-fixation rates and accumulated more ureide than infected *G. max*. Results indicate that even though N₂-fixation rate and ureide-N level were directly associated in virus-free plants, infection with SMV reversed this relationship in both soybean species.

CHESTNUT BLIGHT CANKER SIZE IN RELATION TO STARCH IN WOOD.
Andrea Ostrofsky and Alex L. Shigo. USDA Forest Service, P.O. Box 640, Durham, New Hampshire 03824.

An inverse relationship between canker area and starch level suggest that energy reserves have a direct bearing on the tree's effectiveness in limiting invasion of *Endothia parasitica*. Five American chestnut trees were girdled at 76 and 122 cm above ground on May 18, 1982. One week later these trees plus five trees not girdled were wounded at heights of 53, 99, and 145 cm and inoculated with *Endothia parasitica*. Trees were harvested 56 days after inoculation and canker area measured. No difference in canker size was found between treatments. Each stem was cut into 3 sections and split longitudinally through the cankers. Wood sections from both treatments were stained with IKI and rated for starch content. Mean canker area was greatest (7.5 ± 4.0 cm²), intermediate (4.9 ± 4.0 cm²), and smallest (1.8 ± 0.6 cm²), respectively, on sections with no, low, or moderate starch content.

AMOUNT AND DISTRIBUTION OF TOTAL EXTRACTABLE PHENOLS IN BARK OF AMERICAN BEECH IN RELATION TO THE BEECH BARK DISEASE. William D. Ostrofsky and Robert O. Blanchard. Dept. of Botany and Plant Pathology, University of New Hampshire, Durham, 03824.

The Folin-Ciocalteu technique was used to determine the amount of total extractable phenols in bark sections obtained from behind wounds on stems of American beech. Wounds were made by removing a 10 mm diameter disc of bark to a depth of about 0.5 mm on trees determined to be either susceptible or apparently resistant to the beech bark disease. Wounds were either inoculated with *Nectria coccinea* var. *faginata* or left uninoculated. The amount of total phenols in tissue sections cut from behind wounds on susceptible trees was significantly lower (P=0.05) than in sections from behind wounds on apparently resistant trees. Wounds inoculated with the fungus had less phenols (P=0.05) in tissues nearest the wound surface than those left uninoculated. Highest phenol levels were always found in bark sections obtained nearest the vascular cambium. These data suggest that phenols may play a role in resistance and that phenol levels are in some way influenced by the pathogen.

QUANTITY OF RUBP-CARBOXYLASE IN THREE CULTIVARS OF ALFALFA STRESSED BY O₃. E. J. Pell and N. S. Pearson, Dept. of Plant Pathology and Center for Air Environment Studies, The Pennsylvania State University, University Park, PA 16802.

Experiments were conducted to determine the impact of O₃ on RuBP-carboxylase content in alfalfa. One thousand seedlings each of cv. 'Ladak', 'Vernal' and 'Moapa 69' were exposed to 0.30, 0.25 and 0.25 ppm O₃, respectively, in a controlled environment chamber. Nonozone plants were maintained in a companion chamber. Forty-eight hours after exposure to O₃, samples of leaf tissue were harvested from leaves with and without visible injury and from nonozone leaves. RuBP-carboxylase was extracted and partially purified by Sephadex g-25 gel filtration followed by DEAE cellulose ion exchange chromatography. Proteins were separated using SDS-polyacrylamide gel electrophoresis; RuBP-carboxylase bands were then quantified with a scanning densitometer. RuBP-carboxylase was reduced 50, 35, and 90% in samples without visible symptoms and 97%, 71% and to undetectable levels in visibly injured samples in Ladak, Vernal and Moapa 69, respectively.

RELATIONSHIP BETWEEN COLONY NUMBER, TOTAL SPORULATION/LEAF AND RECEPTIVITY IN POWDERY MILDEW OF WHEAT. J. R. Pelletier and

R. D. Schein, Dept. of Plant Pathology, The Pennsylvania State University, University Park, PA 16802

Inoculum densities ranging from 10 to 70 conidia/cm² of isolate 13 of *Erysiphe graminis* f. sp. *tritici* (EGT) were applied with a settling tower to the adaxial surface of primary leaves of 16 day-old seedlings of Chancellor, Hart, Knox and Titan winter wheats. Chancellor is designated as highly susceptible, while the latter three possess varying degrees of slow-mildewing resistance. Spores were collected daily for the duration of the infectious period and counted with a Coulter Counter⁶ (model ZB). A positive curvilinear relationship was found between total sporulation/leaf (TS/L) and colonies/leaf (C/L). All cultivars had similar carrying capacities (maximum possible TS/L), but differed in the C/L necessary for this to be reached. EGT's capacity to compensate for low C/L by increased sporulation/colony was cultivar-dependent. Cultivars also differed in receptivity (colonies/conidium applied), but this was not correlated with sporulation/colony.

TOLERANCE OF *SCLEROTINIA HOMEOCARPA* (BENNETT) TO IPRODIONE AND CHLOROTHALONIL. A. Pennucci and N. Jackson, Department of Plant Pathology and Entomology, University of Rhode Island, Kingston, RI 02881

Two isolates of *Sclerotinia homocarpa* from *Agrostis palustris* cv Penncross putting green turf showing field tolerance to iprodione were grown on fungicide amended medium. When transferred to a concentration series of iprodione from 125 to 4000ppm, both isolates grew rapidly at all concentrations. Iprodione tolerant isolates also grew on medium amended with chlorothalonil in a similar concentration series. No growth by these same isolates was seen on media amended with triadimefon or benomyl. In laboratory tests, isolates tolerant to iprodione also exhibited tolerance to vinclozolin and an analogue, BAS 436. An isolate of *S. homocarpa* obtained from turf plots previously sprayed with chlorothalonil grew on chlorothalonil amended medium at concentrations up to 4000ppm. This isolate was not tolerant to iprodione. Evidently, isolates tolerant to iprodione may be cross-tolerant to chlorothalonil but the reverse is not true.

DISPERSAL OF *VERTICILLIUM ALBO-ATRUM* IN THE VASCULAR SYSTEM OF ALFALFA. B.W. Pennypacker and K.T. Leath. Department of Plant Pathology, The Pennsylvania State University and the U.S. Regional Pasture Research Laboratory, University Park, PA 16802

Alfalfa plants (*Medicago sativa* L.) were inoculated with spores of *V. albo-atrum* and grown in slant board culture in a growth chamber. Plants were examined histologically at four day intervals until the final symptoms of Verticillium wilt appeared. Eight days after a root dip inoculation, the fungus had colonized the entire stem. *Verticillium albo-atrum* was present only in the xylem vessel elements, where it sporulated freely. Germinated spores were frequently observed in these vessels. Serial isolations from field grown plants indicated that *V. albo-atrum* was non-continuous in the host stem during the early stages of colonization. Such an isolation pattern is indicative of spore translocation in the host. Histological evidence coupled with isolation data indicated that internal sporulation was probably the mechanism facilitating rapid colonization of the host by *V. albo-atrum*.

HOST RANGE STUDIES OF *PUCCINIA CARDUORUM*, A PATHOGEN OF *CARDUUS NUTANS*. D. J. Politis and W. L. Bruckart, Plant Disease Research Laboratory, P.O. Box 1209, Frederick, MD 21701.

Six isolates of *Puccinia carduorum* from Eurasia have been evaluated for use in biological control of *Carduus nutans* (musk thistle). One isolate of *P. carduorum* has been studied extensively for host range following the centrifugal phylogenetic testing method (Wapshere, PANS 29:295, 1975). Twenty-three of 27 ecotypes of *C. nutans* from North America and Europe were highly susceptible to attack by the isolate. Twenty closely related plant species in 16 genera from the following tribes in the Compositae Family also have been tested: Anthemideae, Arctotideae, Asterieae, Cichorieae, Cynareae, Eupatorieae, Helenieae, Heliantheae, Mutisieae, and Senecioneae. All species were resistant to infection under our conditions except artichoke (*Cynara scolymus*). The pathogen is not as aggressive on artichoke as it is on musk thistle based on observed rate of pustule development, number of pustules, and pustule size.

CROSS PROTECTION AGAINST *VERTICILLIUM* IN SUNFLOWER. Doris Price and W.E. Sackston, Dept. of Plant Science, Macdonald Cam-

pus of McGill University, Ste. Anne de Bellevue, Quebec, H9X 1C0, Canada.

Possible cross protection against *Verticillium dahliae* in sunflowers (*Helianthus annuus*) was investigated by inoculating the susceptible CML62 or Arrowhead with avirulent isolate P6 from cotton or VN, a relatively avirulent isolate from sunflower, as inducers and the virulent sunflower isolates V58, VS, or VM, in challenge inoculations. Simultaneous inoculations of CML62 with P6 or VN with any of V58, VS, or VM reduced severity of infection as measured by stunting, percentage of leaves showing symptoms, and severity of symptoms. Simultaneous inoculation of Arrowhead with P6 and VM reduced disease severity. An inducing inoculation of Arrowhead with P6 followed by a challenge inoculation with VM 2 or 7 days later indicated some protection at both the 2-day and the 7-day intervals. There was no antagonism between any pairs of isolates grown on potato dextrose agar or V-8 juice agar.

THE EFFECTS OF DICAMBA, DSMA, AND DCPA ON SELECTED POPULATIONS OF PLANT-PARASITIC NEMATODES ASSOCIATED WITH KENTUCKY BLUEGRASS. Anthony D. Radice and Philip M. Halisky, Department of Plant Pathology, Rutgers University, New Jersey Agricultural Experiment Station, Cook College, New Brunswick, New Jersey 08903.

The effects of dicamba (3,6-dichloro-o-anisic acid), DSMA (disodium methanearsonate), and DCPA (dimethyl tetrachloroterephthalate) were studied on populations of lance (*Hoplolaimus* sp.), stunt (*Tylenchorhynchus* sp.), and ring (*Macroposthonia* sp.) nematodes in laboratory, greenhouse, and field experiments. Results of greenhouse tests showed that DSMA indirectly enhanced nematode populations presumably by stimulating root growth, top growth, and total biomass. Field studies were conducted on 2.0 x 3.0 m turf plots during a period of five months, with herbicide applications made at recommended field rates. The results indicated that dicamba and DCPA had no adverse or stimulatory effects on the three populations of nematodes. The DSMA treated plots contained a significantly higher population of stunt nematodes. No visible phytotoxicity was observed in any of the turf plots. New Jersey Agric. Exp. Sta., Publ. No. K-11130-4-82.

A GREENHOUSE STUDY ON THE EFFECT OF OZONE AND ACID PRECIPITATION ON SUCCESSIVE CUTTINGS OF 'SARANAC' ALFALFA. J. Rebbeck and E. Brennan. Rutgers University, N.J.A.E.S. New Brunswick, N.J.

Alfalfa was grown in a clay loam soil in 17.5 cm pots in an air-filtered greenhouse from Feb to July 1982. Twelve weeks after seeding the pots were given one of the following treatments: (1) once each week plants were exposed to O₃ for 7 hr period during which the O₃ level was increased from .05 to .15 ppm and then decreased back to .05 ppm (2) twice each week plants were exposed to simulated acid rain (pH 3.0 or pH 5.6) for 15 minutes (3) plants were exposed to O₃ and acid rain treatments on intermittent days. After 4 weeks the alfalfa was harvested, and the new growth was subjected to the same three treatments. Acid rain alone or combined with O₃ significantly reduced the N₂ content of the 1st cutting, but fresh and dry weight or % dry weight were unchanged. In the 2nd cutting acid rain or O₃ alone significantly lowered the N₂ content and fresh and dry weight, but the combination of rain and O₃ decreased only the fresh weight. A synergistic effect of acid rain and O₃ was not demonstrated in this study. N.J.A.E.S. #K3-11151-82.

Lesion development and population growth of *Xanthomonas phaseoli* on the leaf surface on bean plants exposed to HF. K. L. REYNOLDS and J. A. LAURENCE. Boyce Thompson Institute, Ithaca, NY 14853

Kidney bean plants were exposed in controlled-environment chambers to 0, 1, or 3 $\mu\text{g F m}^{-3}$ for 5 days before, after, or both before and after inoculation with rifampin-resistant *X. phaseoli*. Bacterial suspensions were sprayed on each plant to establish a leaf-surface population on the first trifoliolate leaf and a lesion on the second trifoliolate leaf. At 5 day intervals leaves were collected, measured, and washed. Washings were serially diluted, plated, and counted to estimate leaf-surface *X. phaseoli* populations. Lesions were measured daily for 5 days after first appearance of symptoms. Increasing post-inoculation exposure HF conc caused significant decreases in initial lesion size, increases in latent period, and decreases in leaf-surface populations on days 5 and 10 after inoculation, as well as a significant decrease in the 5-day initial growth rate. Increasing HF conc prior to inoculation resulted in a significant decrease in 5-day populations and growth rates.

OZONE-ENHANCED LEACHING OF ONION LEAF TISSUE IN RELATION TO LESION PRODUCTION BY *BOTRYTIS CINEREA*. D. L. Rist and J. W. Lorbeer, Department of Plant Pathology, Cornell University, Ithaca, NY 14853.

Leaching of electrolytes into dew on leaves of onion plants in a dew chamber was enhanced by prior exposure to ozone. The mean electrical conductance of dew collected from the two oldest non-senescent leaves of plants exposed to 318 μgm^{-3} ozone for 4 hr (176 μmhos) was significantly greater (5% level) than the conductance of dew collected from the corresponding leaves of plants not so exposed (96 μmhos). Only slight ozone-induced necrosis developed on a few leaves of exposed plants. Significantly more lesions (1.50 cm^{-2} leaf surface) developed on leaves inoculated with conidia of *Botrytis cinerea* suspended in dew from exposed plants than on leaves inoculated with a conidial suspension of the same concentration prepared with dew from non-exposed plants (0.35 cm^{-2} leaf surface). Leachates from leaves exposed to ozone may have stimulated lesion production because of abnormally high nutrient concentration.

OZONE PREDISPOSES ONION TO ENHANCED INFECTION BY *BOTRYTIS CINEREA* AND *B. SQUAMOSA*. D. L. Rist and J. W. Lorbeer, Department of Plant Pathology, Cornell University, Ithaca, NY 14853.

The ability of ozone to enhance leaf infection of onion by *Botrytis cinerea* and *B. squamosa* was demonstrated. The enhancement occurred both in the presence and absence of macroscopically visible leaf injury caused by ozone. When plants were inoculated with *B. cinerea* after a 4 hr exposure to 318 μgm^{-3} ozone, significantly more lesions cm^{-2} of leaf surface developed on leaves of plants inoculated immediately (0.66), 24 hr (0.80), or 96 hr (0.87) after exposure than on leaves of non-exposed plants inoculated at corresponding times (0.12, 0.20, and 0.25). When plants were inoculated with *B. cinerea* immediately after exposure to 239 μgm^{-3} ozone for 5 hr day⁻¹ for 4 days, significantly more lesions again developed on leaves of exposed (0.92) vs. non-exposed plants (0.45). Infection by *B. squamosa* was enhanced on exposed (2.85) vs. non-exposed plants (1.90) only after a 4 hr exposure to 498 μgm^{-3} .

PINEWOOD NEMATODES AS PART OF THE PINE WILT COMPLEX IN MASSACHUSETTS. R. A. Rohde, Dept. of Plant Pathology, Univ. of Mass., Amherst, MA 01003.

Pinewood nematodes, *Bursaphelenchus xylophilus*, were recovered from dead or dying Scots, red and Japanese black pines on Cape Cod and from Scots pine logs in central Massachusetts. In all cases, trees were in poor condition from age, site condition, or disease. Longhorn beetles, *Monochamus carolinensis*, emerging from infected trees contained 0 to 3,500 nematode juveniles. Feeding by beetles on small branches sometimes led to infection and dieback of larger branches of Japanese black pine. Logs cut from trees with no wilt symptoms contained pinewood nematodes, blue stain fungi and *Monochamus* larvae after 3 months.

EVALUATION OF A WHITE MOLD FORECASTING SCHEME IN A SNAP BEAN PEST MANAGEMENT PROGRAM. K.B. Rose, J. T. Andaloro, and J. E. Hunter, Depts. of Integrated Pest Management and Plant Pathology, NYS Agric. Exp. Sta., Cornell University, Geneva, NY 14456.

A disease forecasting scheme for white mold was tested in a pilot pest management program on 2,400 acres of snap beans in N. Y. in 1981 and 1982. Rainfall, canopy density, and blossom development were measured weekly. Soil moisture was measured weekly in 1981 and twice per week in 1982 with a portable, quick draw tensiometer. The interaction of these parameters was plotted on a "white mold control chart" to aid growers in making fungicide treatment decisions in commercial test plots. Based upon the measurements, disease potential categories and the recommended treatments were: minimal (no spray), light (spray need uncertain), moderate (spray), and heavy (spray twice). Disease potential and treatment recommendations were updated on a 3-7 day basis during bloom. During 1981, white mold did not develop in 17% of the fields when it was predicted, whereas it did develop in 6% of the fields where it was not predicted. The forecast scheme was modified in 1982 to correct for these false negative predictions.

THE INFLUENCE OF THE INTERACTION OF HOST AND PATHOGEN GENOTYPES ON THE RESIDUAL EXPRESSIONS OF "DEFEATED" MAJOR GENES.

M. H. Royer and R. R. Nelson, Dept. of Plant Pathology, The Pennsylvania State University, University Park, PA 16802

Nine near-isogenic lines (isolines) of "Chancellor" winter wheat that differed in race-specific powdery mildew (Pm) resistance genes affected several expressions of parasitic fitness of *Erysiphe graminis* f. sp. *tritici* that are influential in the rate of disease development. Fitness genes other than virulence genes operated to effect the isolate differences observed on isolines with the same Pm genes. Similarly, different isolates influenced the relative ability of the isolines to express residuality compared to Chancellor. Therefore, experiments investigating the degree and frequency of residuality should use many isolates or field plots. Preliminary field data from plots that were naturally infected with mildew generally supported the ranking of isolate residuality that was observed in the growth chamber.

THE RELATIONSHIP BETWEEN RACE FREQUENCY AND PARASITIC FITNESS. M. H. Royer and R. R. Nelson, Dept. of Plant Pathology, The Pennsylvania State University, University Park, PA 16802

Racial surveys frequently record the increased frequency of certain virulence genes within pathogen populations and selected isolates are used to evaluate certain parameters of relative parasitic fitness in an attempt to predict future population shifts and potential epidemics of plant diseases. Similar studies with "representative" isolates have been conducted, with conflicting results, to illustrate that "complex" races with unnecessary virulence genes are less fit to persist than "simple" races with few, if any, unnecessary virulence genes. Data from research with powdery mildew of winter wheat are presented to suggest that the experimental methods used to test these assumptions may be of doubtful validity.

CONTROL OF PHYTHIUM BLIGHT OF TURFGRASS WITH PHOSETHYL ALUMINUM. Patricia L. Sanders, Dept. of Plant Pathology, The Pennsylvania State University, University Park, PA 16802.

Phosethyl aluminum (fosetyl) exhibited no in vitro fungitoxicity at 1, 10, or 100 µg/ml PDA against 25 isolates of *Pythium*, including *P. aphanidermatum*, *P. mamillatum*, *P. torulosum*, *P. dissotocum*, *P. artotrogas*, *P. periplocum*, *P. graminicola*, and *P. ultimum*. In field studies on mature 'Pennfine' perennial ryegrass, the chemical applied at 8 oz/1000 square feet provided statistically significant reduction of *Pythium* blight (*P. aphanidermatum*) through 4 weeks after application. The action of phosethyl aluminum in suppression of *Pythium* blight may be indirect, involving biotransformation or the elicitation of anti-fungal responses to *P. aphanidermatum* in the host. Such chemicals, termed elicitors, may be free from some of the effects on non-target species associated with fungicide use.

STABILITY OF BENOMYL SENSITIVE ISOLATES INTRODUCED INTO A BENOMYL RESISTANT POPULATION OF *SCLEROTINIA HOMEOCARPA*, YEAR II. Patricia L. Sanders, Dept. of Plant Pathology, The Pennsylvania State University, University Park, PA 16802.

In spring 1981 four benomyl-sensitive isolates of *S. homoeocarpa* were distributed individually across a creeping bentgrass fairway containing persistent populations of benomyl resistant *S. homoeocarpa*. During summer 1981 the populations in these strips and an uninoculated strip were sampled and tested for sensitivity to benomyl. Throughout summer 1981 the proportion of sensitive isolates recovered from the inoculated strips remained high (30-89%), while only 1% of the isolates recovered from the uninoculated strip were benomyl sensitive. The populations in the test area were again sampled and tested for sensitivity to benomyl in June, July, and August, 1982. Throughout summer 1982 the populations of *S. homoeocarpa* in the four inoculated strips and in the uninoculated strip contained less than 1% sensitive isolates. Reintroduction of sensitive isolates was ineffective as a method for overcoming stable high resistance levels in this fungicide-modified population.

LOCATING SOURCES OF RESISTANCE TO BEAN YELLOW MOSAIC VIRUS IN RED CLOVER S.T. Sim, K.T. Leath, and C.P. Romaine. Department of Plant Pathology, The Pennsylvania State University and the U.S. Regional Pasture Research Laboratory, University Park, PA 16802.

Symptomless red clover (*Trifolium pratense* L.) plants from old

fields and seedlings from commercial seed sources were inoculated with bean yellow mosaic virus (BYMV) and evaluated for resistance. Three inoculation methods were used: mechanical, natural field exposure and aphid feeding. Disease resistance was evaluated using leaf symptoms and the enzyme-linked immunosorbent assay (ELISA). Of 588 field plants, 44% developed symptoms under greenhouse conditions; 3% of the remaining plants became infected during field exposure and 17% of those became infected after mechanical inoculations. Of 502 Kenstar seedlings mechanically inoculated 20% became infected. 32% of the remaining plants became infected following field exposure and 11% of those became infected after another mechanical inoculation. Green peach aphids are being used in controlled feedings in an attempt to infect all plants that remain symptomless and ELISA negative.

DE-ICING SALT INDUCED DECLINE OF WHITE PINE AND SUGAR MAPLE IN NEW JERSEY. M. Simini and I. Leone. Plant Pathology Dept. N.J. A.E.S., Rutgers Univ. New Brunswick, NJ 08903

40-yr.-old sugar maples exposed to runoff from a heavily salted road had significantly less shoot growth during a 5-year period than trees not exposed to runoff. Trees on the runoff side had severe decline symptoms. Trees protected from the runoff showed no decline symptoms. Calcium and sodium levels, pH, and bulk density of the soil were significantly higher on the runoff side. Tree decline in this particular situation may be due to high soil salinity resulting in adverse soil conditions. 15-year old white pines had severe foliar necrosis on the side facing the road following winter storms. Chloride content was significantly higher in leaves facing the road. Injury appeared to be the result of toxic foliar chloride levels. N.J.A.E.S. Publication No. 11351-K2-82.

A NO-RESPONSE EXHIBITED BY RED SPRUCE SEEDLINGS EXPOSED TO VARYING DOSES OF OZONE. J. M. Skelly, Y.-S. Yang, and M. J. Mahoney. Department of Plant Pathology and Physiology, VA Polytech. Inst. and State Univ., Blacksburg, VA 24060.

Two-year-old seedlings of red spruce (*Picea rubens*, sarg.) were examined for foliar sensitivity to O₃ as part of a study to determine etiological agents involved in an observed decline of this species in New England. Seedlings were planted in 1 L pots containing Spasoff mix amended with 1 g of 14N-14P-14K Osmocote R. Seedlings were maintained in a greenhouse supplied with charcoal filtered air. Exposures began when new needles were 1-wk-old and were conducted in Continuously Stirred Tank Reactors utilizing 0.00, 0.12, and 0.25 ppm O₃ in two treatment durations: 1) a single 6-h exposure and 2) exposure for 6 h day for 14 consecutive days. Foliar injury was not observed on seedlings exposed to the various doses of ozone. Potted red spruce seedlings are apparently tolerant to ozone; however, further lower dose studies (seasonal duration) should follow to provide more conclusive evidence of tolerance.

THE RETENTION AND REDISTRIBUTION OF CAPTAN ON APPLE FOLIAGE. F.D. Smith & W.E. Machardy, Dept. Botany & Plant Pathology, Univ. New Hampshire, Durham, 03824.

Captan residues on foliage of apple trees were monitored during 1980 and 1981 by a spectrophotometric analysis. Deposits of Captan 50 WP (2.4g/L) sprayed to runoff ranged from 5 to 13 µg/cm², with the greatest deposits occurring early in the growing season. Residues on mature leaves decreased to 1-3 µg/cm² by 7 days and 1-2 µg/cm² by 14 days after application. Residues on young, expanding leaves also decreased, but less than expected on leaves in the lower-interior canopy when leaf expansion was considered, presumably due to redistribution of captan from the upper to lower canopy by rain. Leaves that emerged after application had residues of 0.7-1.8 µg/cm² 7 days after application. Earlier studies showed that weekly applications of Captan 50 WP at 2.4 g/L effectively controlled apple scab. Our data may explain the effectiveness of such a spray program and support a minimum residue (threshold) of captan for scab control, under orchard conditions, of 1.0-2.0 µg/cm².

THE SHORT TERM RESPONSE OF SILVER MAPLE TO ROOT APPLICATIONS OF CADMIUM. Gretchen C. Smith and Eileen Brennan. Plant Pathology Department, Cook College, New Jersey Agricultural Experiment Station, Rutgers University, New Brunswick, N.J.

Two-year old silver maple (*Acer saccharinum* L.) were grown for

2 weeks in sand culture amended with 5.0 or 20.0 ppm CdCl₂. A foliar chlorosis induced by cadmium was accompanied by a decrease in foliar iron content whereas zinc content of the leaves was unaffected by cadmium. Foliage in stages of active growth was more sensitive to Cd phytotoxicity than mature foliage. Visible wilting was not a primary symptom of Cd phytotoxicity although leaf resistances increased and foliar water contents decreased at the high Cd treatment level. Adverse growth effects including reduced stem height and leaf number were observed only where gross root injury was visible at 20 ppm Cd. Reduction in leaf area, fresh and dry weights of the leaves developing during Cd treatment were also noted. New Jersey Agricultural Experiment Station No. 11352-K3-82.

EVALUATION OF SIMPLE AND COMPLEX POTATO LATE BLIGHT FORECASTS. V. J. Spadafora, A. E. Apple, J. A. Bruhn, and W. E. Fry, Dept. Plant Pathology, Cornell Univ., Ithaca, NY 14853.

A simple potato late blight forecast, sensitive only to host resistance, was compared in field experiments to a complex method, sensitive to host resistance, weather and fungicide characteristics. Both forecasts were developed from analysis of computer simulation models. The simple method recommended longer fixed application intervals for resistant than for susceptible cultivars. The complex forecast recommended application intervals adjusted throughout the season according to weather. Fungicides applied according to either method suppressed disease to less than 5% final disease. Unsprayed plots were destroyed by late blight. Fewer sprays were applied to the resistant than the susceptible cultivar using either method. Although under the conditions of this experiment both methods performed equally well, fungicides were used more efficiently with the complex method.

INCORPORATING FUNGICIDE CHARACTERISTICS INTO POTATO LATE BLIGHT FORECASTS. V. J. Spadafora, W. E. Fry, and J. A. Bruhn. Dept. Plant Pathology, Cornell University, Ithaca, NY 14853.

Models of the tenacity and efficacy of triphenyltin hydroxide and captafol were developed from greenhouse and field experiments. Initial deposition was assumed to be similar to that previously described for chlorothalonil. Models describing fungicide tenacity were developed from the results of simulated rainfall experiments. Both fungicides were removed by artificial rainfall according to a negative exponential. Tenacity increased slightly as deposits aged. Forecasts, sensitive to weather, cultivar resistance and fungicide characteristics, were developed using simulation analysis. Residue levels were permitted to decline to lower levels on the foliage of moderately resistant cultivars than on that of more susceptible cultivars. Differences in the tenacity and efficacy of fungicides were reflected in spray recommendations when weather and cultivar are the same.

FORMATION, PURIFICATION, AND REGENERATION OF PROTOPLASTS FROM *AGARICUS BRUNNESCENS*. Mark Spear and D. J. Royse, Dept. of Plant Pathology, The Pennsylvania State University, University Park, PA 16802.

Agaricus brunnescens protoplasts can be generated using .85 M MgSO₄ and a mixture of cellulase, chitinase, and Lysozyme. Critical to high yield is the age of the mycelium (4 da), the length of digestion time (18-20 hr), as well as the source and concentration of enzymes used. Yields of 350 thousand protoplasts per ml can be expected. These are purified by centrifugation and filtering then regenerated in a low temperature medium.

THE EFFECT OF CROP ROTATION AND TILLAGE ON POPULATIONS OF RHIZOCTONIA SOLANI, AND THE RESULTING INCIDENCE OF RHIZOCTONIA DISEASE ON POTATOES. L. Specht and S.S. Leach, Dept. of Botany and Plant Path., Univ. of Maine and USDA-ARS, Orono, Maine.

Sweet corn, Japanese millet, buckwheat, white oats, and annual ryegrass were evaluated for their effectiveness for reducing the incidence of disease in potato fields caused by *Rhizoctonia solani*. The effect of incorporating the rotation crop residue as an immature or mature amendment was also evaluated. A soil

pellet sampler-selective media technique was used to enumerate propagules of *R. solani*. The incidence of disease in the field was evaluated using a disease rating index that takes into account all important aspects of disease that occurs on the plant. The buckwheat rotation resulted in significantly higher populations of *R. solani*, but the resulting incidence of disease was moderate. Except for Japanese millet, tillage practice did not significantly affect disease. It is suggested that buckwheat selects for strains of the pathogen that are weakly or nonpathogenic to potatoes.

RNA POLYMERASE ACTIVITY IN A VIRUS-LIKE PARTICLE-ENRICHED FRACTION FROM *AGARICUS BISPORUS*. A. Sriskantha and C. P. Romaine, Department of Plant Pathology, The Pennsylvania State University, University Park, PA 16802.

Replication of mycoviruses is typically mediated by a virion-associated RNA-dependent RNA polymerase. A virus-like particle (VLP)-enriched fraction (122,000 g, sediment) from LaFrance disease-affected sporophores of *Agaricus bisporus* was found to have a 10-15 fold higher RNA polymerizing activity than the comparable fraction from healthy sporophores. The VLP fraction-associated enzyme was dependent on the presence of the four nucleoside triphosphates and Mg⁺⁺ and was insensitive to actinomycin D, α -amanitin, and rifampicin. ³H-UMP incorporation proceeded linearly for 30 minutes and reached a maximum at 2 hours of incubation. The ³H-labelled polymerase reaction product eluted in the dsRNA, DNA, and, to a lesser extent, ssRNA fractions upon CF-11 cellulose chromatography and was 90% sensitive to hydrolysis by 4 M KOH. The precise nature of the polymerase reaction product is under investigation. The properties of the enzyme in infected tissues thus far revealed are characteristic of an RNA-dependent RNA polymerase.

COLONIZATION OF ORGANIC MATTER IN SOIL BY PHYTOPHTHORA MEGASPERMA. J. P. Stack and R. L. Millar, Dept. Plant Pathology, Cornell Univ., Ithaca, NY 14853.

The ability of *Phytophthora megasperma* (isolate Pm20) to reach and colonize organic matter in a field soil was investigated. Distinction of Pm20 (a metalaxyl insensitive isolate) from indigenous *P. megasperma* was possible on a Pm20 selective medium. Roots from 8-week-old alfalfa plants were cut into 0.5 cm segments (RS) and buried in nonsterile soil 0.5, 1.0, or 2.0 cm from a root segment previously colonized by Pm20. After 21 days, the RS were retrieved and placed on Pm20 selective medium. At 4 and 15° C and at -10 and 0 mb ψ_m , Pm20 readily colonized RS (up to 100%) at each distance. Colonization of RS was rare at 24° C regardless of ψ_m and at -100 mb regardless of temperature. Pm20 also colonized RS of black medic and birdsfoot trefoil. Colonization of organic matter by *P. megasperma* may significantly increase its survival potential.

A PREVIOUSLY UNDESCRIBED BLIGHT DISEASE OF Highbush BLUEBERRY IN NEW JERSEY. A. W. Stretch, USDA, ARS, Blueberry and Cranberry Research Center, NJAES, Rutgers University, Chatsworth, New Jersey 08019.

A previously undescribed blight disease of highbush blueberry (*Vaccinium corymbosum*) has been observed since the early seventies only in the Sheep Pen Hill producing area near Pemberton, New Jersey. The causal factor is undetermined at present. Symptoms develop in the spring just prior to full bloom when a blighting of both flowers and new vegetative growth occurs. As the season progresses a second flush of growth occurs on affected plants masking the initial blighted growth by the end of June. This disease is serious economically because there is a partial to total loss of fruit production. Surveys have demonstrated active, random spread in all cultivars grown in the Sheep Pen Hill area. The two most important cultivars, Bluecrop and Weymouth, are particularly susceptible. Spread to other blueberry producing areas is a distinct possibility since plants are propagated for sale in this area.

NEW TECHNIQUE FOR STUDY OF FUNGICIDE REDISTRIBUTION IN THE CONTROL OF APPLE SCAB. Michael Szkolnik, Dept. of Plant Pathology, N. Y. State Agric. Expt. Sta., Geneva, NY 14456.

A new technique to study redistribution in fungicidal protec-

tion calls for (1) precision spraying and drying of Saran screen panels, (2) placement of these panels horizontally on a turn-table, (3) placement of unsprayed potted greenhouse trees beneath each panel, (4) application of desired overhead rainfall, (4) inoculation of trees with conidia of *Venturia inaequalis*, and infection of trees in the mist chamber for 30 hr at 18 C. With a 7 mm rainfall fungicides redistributed from the screen to the trees provided protection to the extent of over 90% with dodine, mancozeb, metiram, and captafol; 70-90% with captan, ferbam, sulfur, and glyodin; and 50-70% with benomyl or fenarimol. Control with a 14 mm rain was over 90% with dodine, mancozeb, and metiram; 70-90% with captafol, captan, thiram, and sulfur F1; and 50-70% with sulfur Wp, ferbam, glyodin, and fenarimol. When the screens were dried and a second 7 mm rainfall succeeded an earlier 7 mm rainfall onto new unsprayed trees only dodine residue provided over 90% control.

SENSITIVITY OF WEIBULL MODEL PARAMETER ESTIMATES. Wayne M. Thal, C. Lee Campbell, and L. V. Madden, Departments of Plant Pathology, (1,2) NC State University, Raleigh 27650, (3) Ohio State University, Wooster 44691.

The Weibull model $[y=1-\exp(-1/b[X-a]^c)]$ has been proposed as a flexible model to describe plant disease progress. The sensitivity of Weibull parameter estimates was tested by generating data with the logistic, monomolecular, Gompertz and Bertalanffy-Richards ($m=1/2$) models using varying levels of initial disease (y_0), rate parameter (r), data point spacing and censoring. Four parameter estimation methods were used; the Marquardt and Gauss-Newton algorithms gave the most consistent estimates. High correlations were generally seen among estimates, implying possible overparameterization of the model. With data from all models, altering 'r' or data point spacing had little effect on the Weibull 'c' parameter estimates. The 'c' value was sensitive to y_0 and censoring when logistic of Gompertz generated data were used. This may have applications of the Weibull model questionable under some circumstances.

IS ACID RAIN A FACTOR IN WOUND RESPONSE OF RED MAPLE? Linda H. Tower, Plant Path. Dept. Rutgers University, New Brunswick, NJ 08903. Alex L. Shigo, USDA Forest Service, NE Forest Exp. Sta., Durham, N.H. 03824, Eileen Brennan, Plant Path. Dept. Rutgers University, New Brunswick, N.J. 08903.

Wounds to forest trees decrease their economic value for timber by providing ingress for microorganisms that can discolor and decay the wood. Many factors have been identified that affect the wound response and the resulting amount of discolored and decayed wood. Recently, acid precipitation has been cited as a possible cause of several tree declines. We conducted a study to determine if a simulated acid rain solution affected wound response and the amount of discolored wood associated with the wounds. Red Maple trees were wounded in early summer with a hand saw at the Massabesic Experimental Forest in Alfred, Me. Bottles were attached above the wound, and 1 liter of acid solution was dripped into the wound once a week for 7 weeks. It was found that the low pH treatments did not cause a significant increase in the amount of discolored wood associated with these wounds. The lower pH solutions may have actually reduced the amount of discolored wood associated with the wounds. #K4-1151-82

PREDICTING THE EFFECTS OF ACIDIC RAIN ON THE RETENTION OF PESTICIDES ON SURFACES OF LEAVES. J. Troiano and E. J. Butterfield, Boyce Thompson Institute, Ithaca, NY 14853.

The intensity and duration of rain events are important factors that need to be included in the modeling of the retention of pesticides on surfaces of leaves. The relationship of total amount of rainfall to the loss of pesticides has been mathematically described as an exponential decay function. Elevated concentrations of H^+ , SO_4^{2-} , and NO_3^- in simulated rain events (acidic rain) increased the removal of the fungicide tryphenyltin hydroxide from primary leaves of 'Provider' snap bean plants. A model of the form $y = \beta_0 e^{-\beta_1 x}$ was derived for each level of acidity where y was the amount of fungicide retained, β_0 the initial concentration of applied fungicide, x the cm of rainfall, and β_1 the coefficient of x . A first order relationship was measured between β_1 and acidity in rain, as measured by concentration of H^+ . Prediction of the effect of acidity in rain could be made by employing this relationship as a subroutine for the generation of coefficients of the exponential decay function. Other factors and parameters that need to be considered will be discussed.

Gabrielle Tung and S. N. Linzon, Phytotoxicology Section, Air Resources Branch, Ontario Ministry of the Environment, Toronto, Canada, M5S 1Z8.

A specific symptomatology and histopathology pattern of injury caused by simulated acid rain (pH 2.0-5.6) on 8 tested plant species is described. The key features of acid rain injury included: Incipient injury localized as whitish pitted intercostal lesions specifically associated with concave areas near trichomes and fine veins on the adaxial leaf surface; primary tissue injury starting from the upper epidermal cells and expanding with additional acidic rain applications; stimulation of irregular growth (hyperplasia, hypertrophy) to the peripheral non-injured tissues with vascular injury occurring only after all surrounding mesophyll parenchyma had collapsed. These features diagnostically differentiate acidic rain injury from those caused by other major gaseous air pollutants which enter leaf tissues mainly through stomates first attacking mesophyll tissues. Other acidic chemical sprays usually burn leaf tissues directly with no lesion development pattern.

EFFECT OF INOCULUM LEVELS OF RHIZOCTONIA SOLANI ON HYPOCOTYL INFECTION AND PLANT DEVELOPMENT OF DRY BEAN. Ariena H. C. van Bruggen, C. H. Whalen and P. A. Arneson, Department of Plant Pathology, Cornell University, Ithaca, NY 14853.

The effect of eight levels of *Rhizoctonia solani* on hypocotyl infection and plant development of dry bean was tested in 2.2 m² microplots. The upper 15 cm of soil from each plot was mechanically mixed with sclerotia (0 to 1000 per kg dry soil). At higher inoculum levels emergence was significantly delayed, but final stand was only slightly reduced. Percentages of plants infected and proportions of hypocotyl area diseased increased with increasing inoculum levels. Canopy volume and dry weight at podset were not related to inoculum level, but canopy volume was negatively correlated with proportion of hypocotyl area diseased.

DOUBLE-STRANDED RNA IN THE CULTIVATED MUSHROOM: INCIDENCE AND VARIATION. M. P. Wach and C. P. Romaine, Dept. of Plant Pathology, The Pennsylvania State University, University Park, PA 16802

LaFrance disease of the cultivated mushroom, *Agaricus bisporus*, is considered to have a viral etiology based on the observation of virus-like particles in diseased tissues. To determine whether a relationship exists between LaFrance disease and virus-specific dsRNAs, healthy and diseased sporophores were collected at commercial farms and analyzed for dsRNA by polyacrylamide gel electrophoresis and ethidium bromide staining. dsRNA was detected in 19 of 65 (29%) sporophore isolates and was associated with decreased yields and deformed sporophores. Isolates contained from 3 to 12 dsRNA species with molecular weights from 0.21 to 4.3 x 10⁶. dsRNA was not observed in healthy sporophore isolates. The correlation between a pathologic condition and the presence of various dsRNA patterns supports the involvement of multiple viruses or virus genotypes in the etiology of LaFrance disease.

FURTHER CHARACTERIZATION OF DOUBLE-STRANDED RNA ASSOCIATED WITH LA FRANCE DISEASE. M. P. Wach and C. P. Romaine, Dept. of Plant Pathology, The Pennsylvania State University, University Park, PA 16802.

A dsRNA preparation from a LaFrance disease-affected sporophore isolate of the cultivated mushroom, *Agaricus bisporus*, contained 9 dsRNA species of 0.47, 0.50, 0.76, 0.90, 1.33, 1.47, 1.52, 1.75, and 4.3 x 10⁶ MW, as determined by polyacrylamide gel electrophoresis. Visualization of these nucleic acids by electron microscopy and contour length measurements revealed 6 major size classes of 0.40, 0.72, 0.84, 1.14, 1.44 and 1.68 MW. Further studies were conducted to elucidate the relationship of the dsRNAs to the virus-like particles (VLPs) also present in the isolate. Extraction of sporophores at pH 6 revealed 19 and 25 nm spherical particles and 2 dsRNA species (1.33 and 4.3 x 10⁶ MW) in a VLP-enriched fraction (122,000 g, sediment). Extraction at pH 8, however, yielded 19, 25, and 34 nm particles and all 9 dsRNA species. This is suggestive evidence that the dsRNAs implicated in LaFrance disease are VLP-associated or possibly vesicle-bound.

HISTOPATHOLOGICAL DIFFERENTIATION OF ACID RAIN INJURY FROM O₃, SO₂, HF AND OTHER ACIDIC SPRAYS ON LEAF TISSUES.

THE EFFECTS OF ATRAZINE RESIDUES ON THE APPARENT INFECTION RATE OF POWDERY MILDEW OF WHEAT. G. R. Watson, H. Cole, Jr., and J.

A. Frank, Dept. of Plant Pathology and USDA-ARS, Center for Cereals Research, The Pennsylvania State University, University Park, PA 16802.

A field experiment was conducted in 1982 at Rock Springs, PA to determine the effect of atrazine on the apparent infection rate (r) of powdery mildew on wheat. Winter wheat cultivars, which vary in the degree of susceptibility to powdery mildew, were planted into a field where atrazine had been previously applied preemergence to a corn crop. Atrazine rates used were similar to those used by corn growers in PA. Disease assessments were made four times through the growing season with resulting powdery mildew severities being transformed to logits. Linear regression of logits against time were performed for each atrazine level with regression coefficients taken as estimates of r. Confidence intervals were set around each r to determine if disease progressed at a similar rate in control and atrazine treated plots. Estimates of r were also subjected to t-tests for homogeneity. Results of comparisons of r showed atrazine had no effect on apparent infection rate.

A HIGHLY INFECTIOUS STRAIN OF THE PLUM LEAF SCALD BACTERIUM.

J.M. Wells, B. D. Horton and B.C. Raju. USDA, ARS, Hort. Crops Res., Rutgers Univ., New Brunswick, NJ; USDA, ARS, Southeastern Fruit and Tree Nut Res. Lab., Byron, GA 31008.

A fastidious, Gram-negative, rod-shaped bacterium causes plum leaf scald disease (PLS), a production-limiting disease in the southeastern U.S. A strain of the PLS bacterium has been found which is morphologically distinct from the type strain and which is more infectious. Typical symptoms of PLS were produced on 16 of 20 clonally-propagated plants inoculated with the infectious strain compared to symptoms on 6 of 20 plants inoculated with the type strain. The infectious strain grew as a continuous lawn on BCYE medium and colonies were iridescent green compared to opalescent colony growth of the type strain. Colony growth peaked at 10 days at 21C on BCYE agar compared to 20 days for the type strain. The type strain and the infectious strain were indistinguishable serologically, and the composition of their cellular fatty acids was identical. The infectious strain of the PLS bacterium is designated the green strain (ATCC 33674).

ISOLATION AND CULTURE OF THE BACTERIUM CAUSING PHONY DISEASE OF PEACH. J.M. Wells and B.C. Raju. USDA, ARS Horticultural Crops Quality Research, Rutgers Univ., New Brunswick, NJ 08-03; and Dept. of Plant Pathology, Univ. of California, Davis, CA 95616.

Fastidious, Gram-negative bacteria isolated on BCYE agar medium from peach trees with symptoms of phony disease and then inoculated into peach rootstocks caused stunting and severe rosetting of terminal twigs of 3 out of 4 'Lovell' and 3 out of 10 'Halford' seedlings. Xylem-limited, rod-shaped bacteria 0.35 μ m ave diameter and 0.5 μ m maximum length were present in all inoculated peaches with symptoms typical of phony disease, and were reisolated on BCYE medium 18 months after inoculations. The serology, morphology, and ultrastructure of the reisolated bacteria was identical to that of bacteria present in naturally-infected peach trees, and to that of the bacteria used for the original inoculations.

SUSCEPTIBILITY OF PONDEROSA PINE TO ENDOCRONARTIUM HARKNESSII IN PENNSYLVANIA. N. Wenner, W. Merrill, and B. Towers, Dept. of Plant Pathology, The Pennsylvania State University, University Park, PA 16802 and Pa. Dept. Environ. Res., Middletown, PA 17057

In 1969 the USDA Forest Service established a ponderosa pine provenance study on a strip mine spoil bank in central Pa. Seedlings from 49 sources, from various geographical regions of western US, were planted in six replicated blocks of 10 trees each. Based on growth rate and survival, 11 provenances were rated superior for spoil bank reforestation. Endocronartium harknessii, an endocyclic rust, was inadvertently introduced on some seedlings and spread without control. In 1982 each tree was examined and the number of galls counted. Levels of infection ranged from 0-53%, with from 0 to > 300 galls/tree, and varied greatly both within and among provenances from the same geographical region. Three recommended provenances appeared to have some resistance to the pathogen, but six were moderately to highly susceptible, indicating they should not be used where this pathogen occurs.

ASSAY OF SEEDLING ROOT DEVELOPMENT FOR DETECTING A SOIL CONDUCTIVE TO APPLE REPLANT DISEASE. S. W. Westcott III,

W. F. Mai, and S. V. Beer. Department of Plant Pathology, Cornell University, Ithaca, NY 14853.

One effect of apple replant disease is inhibition of root growth. An assay was developed based on numbers of lateral roots on apple seedlings 2 weeks after germination in soil containing 4-100% (v/v) of a soil conducive to replant disease. In 12 of 15 trials the conducive soil suppressed production of lateral roots (23-39 roots/seedling) relative to those produced in steamed soil from the same source (35-51 roots/seedling). Pratylenchus penetrans, which occurs in the conducive soil, was added at 30 nematodes/cc soil to steamed soil or to 20% (v/v) conducive soil. Lateral root production was suppressed from 40 to 32 roots/seedling only in steamed soil. There was no additive effect of nematodes on inhibition of root growth resulting from conducive soil (25 roots/seedling). Therefore, nematode effects were not separated from other causes in the assay. This rapid assay may expedite research on the etiology of apple replant disease.

EFFECTS OF FUSARIUM SOLANI F. SP. PHASEOLI AND PYTHIUM ULTIMUM ON ROOT ROT AND PLANT DEVELOPMENT OF DRY BEAN. D. M. Wolock, C. H. Whalen and P. A. Arneson, Department of Plant Pathology, Cornell University, Ithaca, NY 14853.

Determining the roles of Fusarium solani f. sp. phaseoli (Fsp) and Pythium ultimum (Pu) in root rot and yield suppression will aid the development of a dry bean pest management program. To obtain this information, field plots of red kidney beans were infested with the two organisms, alone and in combination. Pu typically caused brown hypocotyl lesions, whereas those caused by Fsp alone or together with Pu were reddish-brown. Fsp reduced stand height, while Pu did not. The pathogens, acting synergistically, reduced stand density, caused severe root pruning, and hastened senescence.

EFFECTS OF PEANUT MOTTLE VIRUS INFECTION ON PEANUT NODULATION AND NODULE FUNCTION. S. Wongkaew and J.F. Peterson, Department of Plant Science, Macdonald Campus of McGill University, 21,111 Lakeshore Road, Ste. Anne de Bellevue, Quebec, Canada, H9X 1C0.

Peanuts infected with peanut mottle virus (PMV) showed differences in symptom expression, magnitude of yield reduction, and nodulation pattern, depending on whether they harbored an effective or ineffective rhizobial strain. Virus infection delayed the onset of nitrogenase activity (C₂H₂ reduction), and reduced it on a per plant basis, in plants with effective Rhizobium. The correlation between leghemoglobin content and nitrogenase specific activity shown by healthy plants was lacking in infected plants. Various methods indicated the presence of PMV in tissues of both effective and ineffective nodules.

FACTORS AFFECTING MYCELIAL GERMINATION OF SCLEROTIA OF SCLEROTINIA MINOR. L. A. Wymore and J. W. Lorbeer. Department of Plant Pathology, Cornell University, Ithaca, NY 14853.

Mycelial germination (MG) of sclerotia of S. minor is considered important for infection of lettuce and studies of the infection process require sclerotia capable of undergoing MG. Up to 90% of sclerotia produced on autoclaved wheat kernels and incubated at 21 C on moist autoclaved quartz sand in Petri dishes underwent MG. MG occurred most rapidly when sclerotia were air-dried at 21 C and 40-50% RH, rehydrated, and cold-treated at 3 C for 1-2 wk prior to incubation at 21 C. Up to 30% of sclerotia produced on potato dextrose agar, collected from infected lettuce plants, or separated from organic soil underwent MG, but their response to air-drying and cold treatment was similar to that of sclerotia produced on wheat kernels. Prolonged air-drying (longer than 4 wk), freezing of hydrated sclerotia at -14 C, or alternately wetting and drying sclerotia reduced MG and increased the proportion of hyphal germination (HG). HG may be extensive and macroscopically resemble MG.

FUNGICIDAL CONTROL OF LETTUCE DROP CAUSED BY SCLEROTINIA MINOR. L. A. Wymore, J. W. Lorbeer, and D. P. LoParco, Department of Plant Pathology, Cornell University, Ithaca, NY 14853.

Lettuce drop is a destructive disease in New York and no effective commercial control measure has been available. Results of fungicide spray trials (1978-1982) demonstrated the feasibility of chemical control. Vinclozolin (Ronilan 50WP) or iprodione

(Rovral 50WP) applied weekly (spray directed at sides of plants) at 1.68 kg a.i./ha (3 lb formulated/a) beginning 3 wk after planting and continuing until 1 wk before harvest gave excellent control, even when weather conditions were highly favorable for disease and when large numbers of sclerotia were present in soil (up to 48/100 g soil). These fungicides also gave excellent control at lower concentrations and with fewer sprays when disease pressure was less. Benomyl (Benlate 50WP, DPX 3866 75DF), procymidone (DPX 4424), and dicloran (Botran 75WP) were less effective; thiabendazole (Mertect 340F 42.3F), mancozeb (Manzate 200 80WP, DPX 7331 3.8F), and chlorothalonil (Bravo 500 4.17F) were ineffective.

VIRUSES ON VEGETABLE CROPS ALONG THE MEDITERRANEAN COAST OF TURKEY. Mehmet A. Yilmaz, Robert P. Davis, and Eugene H. Varney. Department of Plant Protection, Agricultural Faculty, Cukurova University, Adana, Turkey (senior author only) and Department of Plant Pathology, Rutgers University, New Jersey Agricultural Experiment Station, Cook College, New Brunswick, New Jersey 08903.

The Mediterranean coast of Turkey is the leading vegetable growing area in Turkey. Due to virus infection the yield of these crops is lower than expected. Leaves of tomato, pepper, watermelon, lettuce, squash, bean, and soybean with virus-like symptoms were collected from Antakya, Adana, Mersin, or Antalya provinces and brought to the USA as lyophilized tissue for identification. These samples were tested by biological assay, serology, and leaf-dip electron microscopy. The principal viruses found were four isolates of tobacco mosaic virus (TMV) from tomato, lettuce mosaic virus from lettuce, cucumber mosaic virus from watermelon, soybean mosaic virus from soybean, and TMV, potato virus Y, and tobacco etch virus from pepper. Viruses from bean and squash have not yet been identified. Additional information about these viruses will be presented. New Jersey Agricultural Experiment Station, Publication No. K-11191-2-82.

VIABILITY OF CONIDIA OF *GREMMENIELLA ABIETINA* SPRAYED ON NEW SHOOTS OF *PINUS RESINOSA*. S.J. Zajchowski and D.R. Bergdahl. Department of Forestry, Univ. of Vermont, Burlington, VT 05401

Conidia of *Gremmeniella abietina* were collected from the field, concentrated in distilled water (DW) and sprayed (285,000 spores/ml) on seedlings and branches of *Pinus resinosa*. Inoculated tissues were maintained in the field and greenhouse up to 20 days. At each sampling conidia were washed from the foliage with DW, concentrated and plated on 1.5% malt agar with 275 ppm streptomycin sulfate. Spore viability was determined by percentage germination after 24 hrs. Spore viability (initially 92%) decreased as days of treatment increased and was most variable for field exposures. In the greenhouse, viability after 20 days was 25% and 20% for seedlings and branches, respectively. Spore viability in the field remained high on seedlings (45%; protected from rain) after 20 da, but was only 2% for spores on unprotected branches. These data show that conidia of *G. abietina* remain viable for up to 20 days after primary dissemination. Conidia are known to be redistributed and prolonged viability should enhance the chance for infection.

ENVIRONMENTAL STABILITY OF STAGONOSPORA LEAFSPOT RESISTANCE IN REED CANARYGRASS. K.E. Zeiders and R.T. Sherwood. U.S. Regional Pasture Research Laboratory, University Park, PA 16802

Disease resistance in a cultivar is most beneficial if the resistance is effective throughout the range of environments encountered during commercial use of the cultivar. To evaluate the environmental stability of reed canarygrass for reaction to *Stagonospora* leafspot (caused by *S. foliicola*) 25 genotypes were scored for natural infection in replicated field plots with or without irrigation (for wastewater renovation) under 2-cut and 3-cut management systems during 2-4 growing seasons. Interactions were tested by orthogonal contrast analysis. Four genotypes were consistently resistant, and five were consistently susceptible, with others being intermediate or variable.

Twelve genotypes showed significant interactions for one or more environmental factor; this involved 4, 2, 3, and 5 genotypes showing interactions for irrigation, cutting management, harvest date, and year, respectively. The genotypes showed greater stability for disease resistance than for certain other agronomic traits tested in this study.

ENZYME-LINKED IMMUNOSORBENT ASSAYS FOR LUTEOVIRUSES OF SMALL GRAINS IN CHINA. Guang-he Zhou, Zhou-min Cheng, You-ting Qian, Xiang-cai Zhang, and W. F. Rochow, Plant Pathology Department, Cornell University, Ithaca, NY 14853, and ARS, U.S. Dept. of Agriculture, and Chinese Academy of Agricultural Sciences.

Wheat and oat plants with symptoms of infection by barley yellow dwarf viruses were collected in 6 provinces of China. A 3-g sample of each of 149 plants was finely chopped, dried, and shipped to Ithaca for tests with antisera against 4 characterized luteoviruses (RPV, MAV, PAV, RMV). Homologous and heterologous reactions of 83 samples permitted division into 5 groups. Twenty seven were similar to MAV; 29 others reacted strongly with MAV antiserum, but lacked the usual heterologous reaction with PAV serum. For 23 samples reactions with sera for MAV and PAV were similar to that of SGV, an isolate for which we do not yet have antiserum. Two others each were similar to RPV or RMV. Results of tests of 66 samples were negative, possibly a reflection of virus variation and specificity of the assays.

RELATIVE ABILITY OF FIVE STAGES OF *SCHIZAPHIS GRAMINUM* TO TRANSMIT A BARLEY YELLOW DWARF LUTEOVIRUS. Guang-he Zhou, Laura A. Tufford, and W. F. Rochow, Plant Pathology Department, Cornell University, Ithaca, NY 14853, and ARS, U.S. Department of Agriculture, and Chinese Academy of Agricultural Sciences.

The four instars of *S. graminum*, together with the adult stage, were evaluated as vectors of SGV, an isolate of barley yellow dwarf virus transmitted specifically by this aphid. In each of four experiments, more first and second instars transmitted virus than did third instars, which were better vectors than fourth instars or adults. Following 1-day acquisition feeding by 133-213 individuals of each stage, percentages that transmitted virus were 36, 29, 11, 3, and 2, respectively. Virus transmission by adults was not improved by infesting plants with more than one aphid or by increasing the usual 5-day test feeding period to 10 days. When first instars were transferred each day to 27 successive test plants, virus transmission by first and second instars was still better than that of other stages, but 5 of 21 viruliferous aphids did transmit SGV as adults.

COMBINED BENOMYL/DODINE RESISTANCE IN A POPULATION OF *VENTURIA INAEQUALIS*. M.G. Zuck and F.L. Caruso, Dept. of Botany/Plant Pathology, Univ. of Maine, Orono, ME 04469.

Thirty monoasporic or monoconidial isolates of *V. inaequalis* were obtained from a Maine commercial orchard where benomyl and dodine had given poor control of apple scab for the past 2 yr. Isolates were subcultured through four generations and screened after the 2nd and 4th transfers for fungicide sensitivity on PDA plates amended with dodine (2, 1, 0.8, 0.6, 0.4, 0.2, 0.1 µg/ml), benomyl (25, 10, 5, 2, 1 µg/ml), and benomyl (5 µg/ml) + dodine (1, 0.4, 0.2, 0.1 µg/ml). Conidia were examined at 24 and 96 hr after streaking for germination and germ tube morphology. All isolates were resistant to dodine at 1 µg/ml, and 15 isolates were resistant to dodine at 2 µg/ml. Five isolates were resistant to benomyl at 10 µg/ml, and another five were resistant to benomyl up to 5 µg/ml. The ten isolates which displayed resistance to benomyl and dodine, when tested against these compounds separately, were also resistant when plated on media containing both compounds. Resistance was unchanged between the 2nd and 4th generations.