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ABSTRACTS

FOLIAGE WEIGHTS USED TO DETERMINE PERCENTAGE OF INFECTION BY UREDINOPSIS MIRABILIS AND CHRYSOMYXA WEIRII. D.S. Abrahamson and D.R. Bergdahl. Department of Forestry, The University of Vermont, Burlington, VT 05405.

Twelve branch samples were collected from each of 22 Abies balsamea (current year's growth) and 10 Picea pungens (previous year's growth) infected with Uredinopsis mirabilis and Chrysomyxa weirii, respectively. All infected and healthy needles were removed, separated, counted and the percentage of infection determined. Fresh and oven dry weights for all separated samples were taken and the percentages of infection determined on a weight basis. Using regression analysis, both fresh and oven dry weight percentages were found highly correlated with percentages determined by needle counts. Values of R^2 correlating weight-based with counting-based percentages were 0.92 and 0.99 (U. mirabilis) and 0.93 and 0.97 (C. weirii) for fresh and dry weights, respectively.

PROPERTIES OF RNA POLYMERASE FROM A MYCOVIRUS OF RHIZOCTONIA SOLANI. B.P. Bandy, S.M. Tavantzis, Dept. of Botany and Plant Pathology, University of Maine, Orono, ME 04469.

Virus-like particles (VLP's), 33 nm in diameter, were purified from an isolate of Rhizoctonia solani (Rhs 717) containing double-stranded RNA (dsRNA). The dsRNA segments isolated from the purified VLP's, comigrated in PAGE with dsRNA extracted from the mycelium of Rhs 717. RNA polymerase activity was shown to be associated with the VLP's. Virus particles and RNA polymerase activity cosedimented in linear sucrose gradients, and in CsCl gradients. Optimum polymerase activity was found at pH 7.5 and 37°C. The optimum concentration for the essential Mg^{2+} cation was 3mM. Actinomycin D had no inhibitory effect on the enzyme. The incorporation of 3H -UMP into acid insoluble products was proportional to the virus concentration. The products of the polymerase reaction were found to be dsRNA and hybridized to Northern blots of dsRNA extracted from purified VLP's or mycelium of Rhs 717.

EFFICACY OF BAYLETON AND BENODANIL IN THE MANAGEMENT OF UREDINOPSIS MIRABILIS ON ABIES BALSAMEA. D.R. Bergdahl and M. Mazzola, Department of Forestry, The University of Vermont, Burlington, VT 05405.

The systemic fungicides bayleton (Triadimefon) and benodanil (2-Iodobenzanilide) were evaluated for efficacy in the management of Uredinopsis mirabilis (Peck) Magnus on Abies balsamea (L.) Mill. Fungicides were applied to runoff using a hand sprayer on a weekly or biweekly basis beginning at budbreak and extending for up to 5 wk through May and June, 1984. Bayleton (25 T.O.F.) was applied with Agri-dex as a spreader-sticker at the following concentrations: 1.0 and 2.0 oz a.i./100 gal. Applications of benodanil (50 WP) were at 0.38, 0.75 and 1.50 lbs a.i./100 gal. Foliage samples were collected in mid-July, 1984 and percent needle infection determined by needle counts. All fungicide treatments significantly ($p=.005$) reduced incidence of U. mirabilis on A. balsamea when the initial applications were started at budbreak. No phytotoxic effects were observed for any treatments.

BIOLOGICAL CONTROL OF GREY SNOW MOLD ON CREEPING BENTGRASS. L.L. Burpee, L.M. Kaye, L.G. Goultz and M.B. Lawton, Department of Environmental Biology, University of Guelph, Guelph, Ontario N1G 2W1.

Field studies were conducted in 1983 and 1984 to determine the

effects of Typhula phacorrhiza (isolate T011) and T. ishikariensis var. ishikariensis (isolate T004) alone and in combination on creeping bentgrass (Agrostis palustris). Isolate T011 was nonpathogenic. Isolate T004 caused foliar blight and crown decay. Significantly less necrosis was observed in plots infested with a combination of the two isolates than in plots infested with isolate T004 alone. Sections of a creeping bentgrass golf green, with a history of infection by T. ishikariensis, exhibited 44 and 70% less snow mold when infested with 100 and 200 g/m² of rye-grain inoculum of T. phacorrhiza in 1983 and 1984, respectively. Antibiosis, parasitism or hyphal interference was not evident among the isolates after 6 wk incubation at 1C or 10C on malt agar or water agar.

ASH YELLOWS AND ASH DECLINE IN MASSACHUSETTS. K. P. Carr and T. A. Tattar, Department of Plant Pathology, Shade Tree Laboratories, University of Massachusetts, Amherst, MA. 01003.

A disease of Fraxinus spp., presumably caused by mycoplasma-like organisms (MLOs) and called ash yellows by Matteoni and Sinclair [Phytopathology 75:355-360], has been observed throughout Massachusetts. Using Dienes' stain, MLOs were detected in the phloem sieve tubes of established white ash (Fraxinus americana L.) and in newly planted green ash (F. pennsylvanica var. lanceolata (Borkh.) Sarg.). MLO-infected white ash were observed in forest, street, and park sites. Ash yellows symptoms in Massachusetts included deliquescent branching, reduced apical and radial growth, chlorosis, early autumn coloration, and dieback. Witches'-brooms were seen less frequently than reported by Matteoni and Sinclair in New York State. Wherever declining ash were observed, ash yellows symptoms were present. In Massachusetts, the symptoms of ash yellows and ash decline appear to be closely related.

EFFECTS OF OXYTETRACYCLINE (OTC) THERAPY ON MYCOPLASMA-LIKE ORGANISMS (MLOs) INFECTING WHITE ASH IN MASSACHUSETTS. K. P. Carr and T. A. Tattar, Department of Plant Pathology, Shade Tree Laboratories, University of Massachusetts, Amherst, MA. 01003.

MLO-infected white ash (Fraxinus americana L.) were injected with OTC using 2 injection methods. Mauget microinjection capsules containing 160 mg active ingredient (a.i.) OTC were injected at a rate of 1 capsule per inch trunk diameter at breast height (d.b.h.). Other MLO-infected ash were treated with 1.5, 2.0, 2.5, or 3.0 g of 947 ug/mg a.i. OTC solubilized in 500 ml distilled water reservoirs and injected through gravity infusion. Dienes' stain was used to detect MLOs in phloem sieve tubes. MLOs could be detected 2 days post OTC injection but could not be detected 7 days post OTC injection. MLOs were again detected 30 days post OTC injection. Absence of MLOs within declining ash following OTC therapy may provide additional support for their involvement in ash yellows.

PRODUCTION OF MONOCLONAL ANTIBODIES AGAINST GREEN LEAFBUG SPIROPLASMAS-LB-12. Z. W. Chen, J. D. Lei, and T. A. Chen, Department of Plant Pathology, Rutgers University. NJAES, New Brunswick, NJ 08903.

Ten stable hybridoma monoclones secreting antibodies against green leafbug spiroplasma (LB-12) were obtained by fusing spleen cells of LB-12-immunized mice with NS-1/1-Ag4-1 myeloma cells. ELISA was used to test the reaction of these monoclonal antibodies

to 6 other spiroplasmas of serogroup I, i.e. *Spiroplasma citri*, Honeybee (AS 576), corn stunt (I-747), Maryland flower (M55), Cocos, and P40 spiroplasmas. Nine monoclonal antibodies specifically reacted to LB-12 but not to the 6 spiroplasmas. One monoclonal antibody reacted to all 7 spiroplasmas tested. The monoclonal antibodies were also found to have positive reaction in the deformation test against LB-12.

EARLY BLIGHT SUSCEPTIBILITY OF POTATOES AS AFFECTED BY EARLY MATURITY AND LATE BLIGHT RESISTANCE. B. J. Christ, Dept. of Plant Pathology, The Pennsylvania State University, University Park, PA 16802.

Twelve cultivars of potato were inoculated with an isolate of *Alternaria solani* to examine the correlation of early blight susceptibility with plant maturity and late blight susceptibility. Cultivars with different maturities and degrees of late blight resistance were selected and planted in 3 row blocks in an RCB with 3 replications. One leaf on the center plant of each middle row was inoculated. Lesions were counted 9 and 12 days after inoculation and spread of disease was recorded 14 days after inoculation. Buckskin, a late maturing cultivar, had more early blight lesions than some of the early maturing cultivars. Few lesions developed on Katahdin which is moderately susceptible to late blight. However, there was no correlation between susceptibility to early blight and maturity or late blight susceptibility.

OZONE AND ROOT AND CROWN ROT: INTERACTIVE EFFECTS ON GROWTH OF ALFALFA. Daniel R. Cooley and William J. Manning, Dept. of Plant Pathology, Univ. of Massachusetts, Amherst, MA. 01003.

Six-week-old seedlings of alfalfa (*Medicago sativa* L.) cultivars Honeoye, Iriquois, Saranac AR, and Vernal were used. Half of the seedlings of each cultivar were planted in pots containing non-steamed soil (NS) from an alfalfa field with decline symptoms. The other half were planted in pots containing soil from the same field that had been steamed twice before use. Plants were exposed to carbon-filtered air (CF) or CF plus ozone (O₃) (0.06-0.08 ppm, 5 days/week, 7 hrs/day, for 13 weeks). Plants were randomly-sampled at 5, 10, and 13 weeks and evaluated for growth, symptoms, and incidence of *Fusarium oxysporum*, *F. solani* and *F. avenaceum*. Both NS and O₃ significantly reduced growth, with no significant cultivar effect. Combined soil and O₃ effects were greater than additive, indicating synergism.

TEMPERATURE-SENSITIVE DEVELOPMENT OF FUNGAL LEAF SPOTS IN SPRING WHEAT CULTIVARS DIFFERING IN RESISTANCE. W. C. da Luz and G. C. Bergstrom, Dept. of Plant Pathology, Cornell University, Ithaca, NY 14853.

Development of spot blotch (*Cochliobolus sativus*), tan spot (*Pyrenophora tritici-repentis*) and *Septoria nodorum* spot (*Leptosphaeria nodorum*) in spring wheat cultivars differing in resistance to each disease was observed in plants maintained at post-inoculation temperatures ranging from 12 to 32 C. Foliar necrosis and lesion number per unit area increased with increasing temperature up to maxima at 24 C for *Septoria nodorum* spot, 24-28 C for tan spot, and 28 C for spot blotch. Incubation periods were highest at low temperatures; with increasing temperature, they decreased progressively up to 24 C in *Septoria nodorum* spot but decreased to level values at 20 C and above in tan spot and spot blotch. At the temperature optima for spot blotch and *Septoria nodorum* spot, disease development was indistinguishable between resistant and susceptible cultivars. Expression of tan spot resistance was also diminished by optimal temperature, but to a lesser extent.

CROWN DENSITY AND ITS CORRELATION TO GIRDLING ROOT SYNDROME (GRS). Robert P. d'Ambrosio, Ambrose Laboratories Ltd., Eastchester, N. Y. 10709.

In 1983, 832 roadside trees (690 *Acer platanoides* and 142 *A. saccharum*) approximately 30 years old were surveyed in Eastchester and New Rochelle, N. Y. using 42 different entries per tree. 48% of these trees (400) did not exhibit any of the presently believed causes of GRS, namely; planted too deeply, raised grades, container grown or restricted growing spaces. These trees were classified as atypical and divided into 2 groups; atypical with GRS 86% (343 trees) and atypical without GRS 14% (57 trees). The 57 trees that had NO GRS had 4 times the number of old wound-closure scars on their trunks and higher crowns. The results of this study suggests that early and periodical pruning of lower branches should be considered as a cultural control of GRS by Urban Foresters and Landscapers.

EFFICACY OF FOSETYL-AL AND METALAXYL AGAINST PHYTOPHTHORA PARASITICA ON POINSETTIA. M. Daughtrey and M. Macksel, Department of Plant Pathology, Cornell University, L. I. Horticultural Research Laboratory, Riverhead, N.Y., 11901.

A vascular wilt incited by *Phytophthora parasitica* has caused substantial poinsettia cutting losses in New York since 1981. Techniques for establishing infection by *P. parasitica* on cuttings of 'Annette Hegg Dark Red' were tested: 5 mm-diam. plugs of mycelium on corn meal agar were buried 2 cm into peat-lite mix beside the cutting, or were bound against 5 cm-long razor abrasions on the stem with Parafilm. Only stem inoculations led to symptom development. Brown cankers began to form at the wound site in 4 days, and black streaks extended up the stem prior to wilting and death. A drench of metalaxyl (Subdue 2E) at 0.037 g a.i./L (75 ml per 11.25 cm diam. pot) 24 hours before stem inoculation successfully prevented infection, whereas fosetyl-Al (Aliette 80W) at 1.9 g a.i./L did not. Foliar applications of fosetyl-Al at 4.8 g a.i./L, at 1, 3, 7 or 14 days before inoculation, were also ineffective.

IDENTIFICATION AND CHARACTERIZATION OF ZUCCHINI YELLOW MOSAIC VIRUS (ZYMV) FROM SOUTH CAROLINA. R. F. Davis, Dept. Pl. Path. Cook College, N.J. Agr. Expt. Sta., New Brunswick, N.J. 08903; and M. K. Mizuki, Dept. Pl. Virol., Inst. Biologico-S. Paulo, Brazil, C.P. 7119.

A virus causing severe foliar mosaic and malformation was isolated from Dixie hybrid squash in three counties of South Carolina. These isolates were mechanically inoculated onto 28 plant species and reproduced the severe symptoms of vein-clearing, mosaic, necrosis, blistering and stunting on zucchini squash. Indirect ELISA of original samples and purified preparations showed that they are related to other strains of zucchini yellow mosaic virus (ZYMV). Purified preparations of the virus showed an A260/A280nm ratio of 1.25. Flexuous particles measuring ca. 720nm were consistently observed in the electron microscope and the particles became decorated with antibodies to ZYMV after serologically specific electron microscopy. Based on these results it can be concluded that the South Carolina isolates are ZYMV.

RHIZOCTONIA POD AND BEAN ROT OF BABY LIMA BEANS IN NEW YORK STATE. H.R. Dillard and G. Wallis, Dept. of Plant Pathology, N.Y.S. Agr. Expt. Station, Cornell Univ., Geneva, NY 14456.

In 1984 a pod and bean rot was observed on baby lima beans grown in western New York. Reddish-brown sunken lesions frequently developed on pods that were in contact with the soil surface. Infected seeds showed tan to reddish-brown discoloration. *Rhizoctonia solani* was isolated from discolored seeds and pods. Of the seven *R. solani* isolates, two belong to anastomosis group (AG) 1 and five to unknown groups. The sexual state of the fungus (*Thanatephorus cucumeris*) was induced under laboratory conditions for the two AG1 isolates. Cultures of the isolates belonging to AG1, and two isolates of unknown AG, were brown and produced numerous small sclerotia. Cultures of the remaining three isolates were light brown and produced few large sclerotia. All isolates are multinucleate. Inoculation of intact lima bean pods or detached seeds with sclerotial masses of all isolates or potato-dextrose agar disks colonized for 3 days with *R. solani* mycelium produced lesions similar to those observed in the field.

ASSOCIATION OF RHIZOCTONIA SOLANI AND RHIZOCTONIA-LIKE FUNGI WITH STRAWBERRY ROOT SYSTEMS IN MASSACHUSETTS. J. L. Drozdowski and W. J. Manning, Department of Plant Pathology, University of Massachusetts, Amherst, MA. 01003.

Commercial strawberry fields in three regions of Massachusetts were surveyed during the 1984-85 growing season to evaluate the incidence of strawberry plant decline due to death of the perennial root system. Root systems of apparently healthy and declining plants were collected on a monthly basis. Samples from root systems were washed in sterile distilled water for 24 hrs. Isolations were made from the surface tissues (epidermis and cortex) and interior vascular tissues (stele) of the crown, primary and secondary perennial roots, and from transient rootlet tips. *Rhizoctonia solani* Kuhn and Rhizoctonia-like fungi were consistently isolated from crown and root tissues in both healthy and declining plants. Isolates from surface and interior tissues of secondary perennial roots were most numerous, indicating a possible role of these fungi in depleting carbohydrate reserves necessary for winter dormancy and spring crop production.

SEED-BORNE SPECIES OF *FUSARIUM* IN WINTER WHEAT FROM EASTERN CANADA. J. Duthie and R. Hall. Department of Environmental Biology, University of Guelph, Guelph, Ontario, Canada N1G 2W1*

The incidence of *Fusarium* species in 162 samples of winter wheat seed collected in Eastern Canada in 1983 and 1984 was determined. Infestation was estimated by plating untreated seed directly on *Fusarium*-selective agar medium; infection was estimated by plating surface-disinfested seed. A total of 3,955 colonies representing 14 species were isolated from 31,650 seeds. Ninety-four percent of samples (27% of seeds) were infested and 42% of samples (1.0% of seeds) were infected with *Fusarium*. Species most commonly infesting seeds were *E. sporotrichioides*, *E. avenaceum*, *E. poae*, *E. equiseti* and *E. graminearum* (8.1%, 5.7%, 5.6%, 3.5%, and 1.9% of seeds, respectively). Species most commonly infecting seeds were *E. poae*, *E. avenaceum*, and *E. graminearum* (0.3%, 0.2%, and 0.1% of seeds, respectively). *Fusarium poae*, *E. sporotrichioides*, *E. graminearum*, and *E. avenaceum* infested up to 90%, 47%, 17%, and 53% of seeds per sample, respectively; they infected up to 4%, 4%, 4%, and 11%, respectively.

SIMULATED ACID RAIN TREATMENTS IN RELATION TO NITROGEN METABOLISM AND YIELD OF GREENHOUSE GROWN SOYBEANS. Elliott, C. and E. Brennan, Department of Plant Pathology, Cook College-NJAES, Rutgers University, New Brunswick, NJ 08903.

In 1984 and 1985, 'Williams' soybean plants were exposed to simulated acid rain of pH 3.0, 3.5, 4.0 or 5.0 for one hour, twice a week, beginning two weeks (1984) or five weeks (1985) after planting and continuing until physiological maturity. At various growth stages (V7, R2, R5, R6) certain parameters relating to nitrogen metabolism were measured, and at maturity yield data were collected. There was no visible foliar injury in 1984, but in 1985 plants treated with pH 3.0 rain had necrotic lesions on expanding leaves at growth stage R2. Foliar nitrate reductase activity, as well as percent nitrogen, in 1984, was stimulated by pH 3.0 rain compared to pH 5.0 rain treatment at V7; but there was no effect at other growth stages. In 1984 and 1985, nitrogenase activity measured at R2 was greatest in plants treated with pH 3.0 rain. There was no significant difference in the yield of soybeans among rain treatments. New Jersey Agricultural Experiment Station, Publ. No. K-11151-2-85.

FACTORS DETERMINING THE HYPOVIRULENCE OF FIVE SIMILAR STRAINS OF ENDOTHIA PARASITICA FROM THE SOUTHERN APPALACHIAN MOUNTAINS. J. Elliston, The CT Agr. Exp. Sta., Box 1106, New Haven 06504.

Five highly debilitated, dsRNA-containing strains were studied to determine and compare the factors that contribute to their abnormalities. Strains were isolated from American chestnut growing in the southern Appalachians and were similar to *E. parasitica* strain EP-60 from Michigan. Each produced single-conidial isolates (SCI) like the parent strain and normal SCI (with characteristics typical of *E. parasitica*). Representative normal SCI were dsRNA-free, had normal levels of virulence when compared with four standard strains, and produced ascospores typical of *E. parasitica*. Cytoplasmic agents were transmitted into the standards and each infected standard yielded normal SCI and SCI like the original strain. Four different dsRNA patterns were found which differed slightly from the pattern for agent H_{M1} from EP-60. Thus, the five strains appear to have normal nuclear genetic backgrounds and contain four slightly different agents which resemble, but are distinct from, agent H_{M1}.

EXPRESSION OF EXTREME RESISTANCE TO POTATO VIRUS X (PVX) IN SOLANUM ACAULE PROTOPLASTS. D.M. Ferrara and S.M. Tavantzis, Botany and Plant Pathology Department, University of Maine, Orono, ME 04469

Certain lines of the wild potato species *Solanum acaule* express major gene resistance to PVX. Protoplasts were obtained from PVX-resistant and PVX-susceptible lines of *S. acaule*, inoculated with purified PVX, and then assayed for PVX at various times after inoculation by enzyme-linked immunosorbent assay (ELISA) and infectivity on local lesion host *Gomphrena globosa*. The proportion of protoplasts infected with PVX at various times after inoculation was assessed by staining with fluorescein isothiocyanate labelled PVX antibody. Nucleic acid hybridization was used to verify the presence of PVX RNA in the inoculated protoplasts. Protoplasts from PVX susceptible lines of *S. acaule* were found to contain from two to six times more PVX than those from extremely resistant lines. The results suggest that extreme resistance to PVX is expressed at the cellular level in *S. acaule*, and appears to interfere with virus replication in the protoplasts.

* = Student Paper Competition

CUCUMBER MOSAIC VIRUS (CMV) IN PEPPERS (*CAPSIUM ANNUUM* L.) IN NEW YORK, AND ASSOCIATED YIELD LOSSES. Diane A. Florini and T. A. Zitter, Cornell Univ., Ithaca, NY 14853.

In a 1980 survey of viruses affecting peppers in 13 New York counties, we found CMV on 38 farms in 11 counties and tobacco mosaic virus (TMV) on seven farms in five counties. Of 182 samples assayed by differential host range or by enzyme-linked immunosorbent assay (ELISA), 53% & 9% contained CMV & TMV, respectively. Slight differences among 10 CMV isolates were seen on a 22-plant host range. One of these was used to inoculate two groups of 56 pepper transplants (cv. Superset), one on 6/9 and one on 7/7/81. Symptoms and yields of these and of 112 uninoculated plants were recorded twice weekly till the first killing frost. The percentage of marketable yield (fruit wt./plant) which was lost decreased linearly as infection by CMV was delayed. Plants infected within 2 mo. of transplanting produced 63% less marketable yield than healthy plants, though total yield was the same. Plants infected 3-4 mo. after transplanting produced as much marketable yield as healthy ones.

TIME COURSE STUDIES USING ELISA TO EVALUATE DETECTION OF CUCUMBER MOSAIC VIRUS INCLUSIONS IN BELL PEPPER. Diane A. Florini and T. A. Zitter, Cornell Univ., Ithaca, NY 14853

Four- and 12-wk old pepper plants were inoculated with CMV. Halves of inoculated leaves and leaves just distal to them were removed at 2-day intervals for 16 days. Mesophyll sections from leaf halves were stained with Azure A and examined with light microscopy. The same leaves were assayed with indirect ELISA. Inclusions were first detected in symptomless, inoculated leaves 4 days after inoculation, but only 9% & 25% of the sections contained inclusions in 12- & 4-wk old plants, respectively. ELISA reactions were weak at this time, but strong when inclusions were most easily detected. For 12-wk old plants, inclusions were detected in 25% of inoculated leaves 6-10 days after inoculation. For 4-wk old plants, inclusions were found in 50% of systemically infected leaves 10-12 days after inoculation. Because CMV inclusions were distributed so irregularly in mesophyll tissue, CMV was detected more reliably by ELISA when titer was low.

INTEGRATION OF FUNGICIDE AND INSECTICIDE APPLICATIONS IN APPLE ORCHARDS. David M. Gadoury & W.E. MacHardy, Dept. Botany & Plant Pathology, Univ. New Hampshire, Durham 03824.

In many New England orchards, from bud break to pink and from fruit set to mid- or late-July, the only pesticide applications required are fungicides to control apple scab (*Venturia inaequalis*). Our objective was to develop a strategy to eliminate sprays for apple scab that did not coincide with a need to control other diseases or insects. In an orchard with a small overwintering population of *V. inaequalis*, pre-pink fungicide sprays were replaced by a single post-harvest application of thiophanate-methyl that suppressed ascocarp formation of *V. inaequalis*. Subsequent sprays were timed to coincide with the need to control rust, fruit rots, and several insect pests. Pre-pink sprays did not enhance control of apple scab or other diseases in 1983, 84, or 85. Fungicide sprays were also unnecessary between fruit set and mid-July in 1985. The relationship between density of overwintering inoculum and the selection and scheduling of fungicide sprays will be discussed.

SEROLOGICAL DETECTION OF *PORIA PLACENTA* (FR.) CKE. USING ELISA. Jody Jellison Goodell and Barry S. Goodell, 113 Nutting Hall, University of Maine, Orono, Maine 04469.

Polyclonal antisera to *Poria placenta* was used to detect the fungus in culture. Antisera reacted preferentially to six *P. placenta* isolates and to *P. carbonica* in the enzyme-linked immunosorbent assay (EIA). Slight cross-reaction was observed with *Schizophyllum commune*, *Haematostereum sanguinolentum* and *Peniophora pseudo-pini*. No cross-reaction was observed with four non-decay fungi tested. The ELISA reaction was diminished but not eliminated in the presence of ground wood extractives. Work is continuing to develop this system to detect and identify *P. placenta* in culture and for the detection of incipient decay in wood.

A PSEUDOMONAS SPECIES ISOLATED FROM LIVE OAKS ANTAGONISTIC TO SEVERAL TREE PATHOGENS. Garold Gregory¹, Robert Lewis², Lawrence Schreiber³, Nick Roberto¹, Jann Ichida³, and Jacquelyn Thomas³, USDA, FS, 359 Main Rd., Delaware, OH 43015 USDA, FS, Box 227, Stoneville, MS 38776, and USDA, ARS 359 Main Road, Delaware, Ohio 43015.

A bacterium, tentatively identified as *Pseudomonas maltophilia*,

isolated from an oak, *Quercus virginiana*, in Texas was found to be antagonistic in vitro to tree pathogens - *Ceratocystis ulmi*, *C. fagacearum* and *Verticillium dahlia*. An antibiotic produced on potato dextrose agar was purified by chromatography on a Sephadex LH-20 and a high-pressure liquid chromatographic (HPLC) column. The antibiotic was located in a single HPLC peak and inhibits *Sclerotinia homeocarpa* in addition to the previously mentioned fungi. The antibiotic is stable to autoclaving and is not inactivated by protease. A rifampicin and streptomycin resistant mutant of this bacterium has been developed to aid in its identification in tests for survival and distribution in plants. Experiments are underway to test this organism as a biocontrol agent for oak wilt and Dutch elm disease.

POPULATION DYNAMICS OF *BURSAPHELENCHUS XYLOPHILUS* IN WOOD CHIPS OF *PINUS STROBUS*. S. Halik and D.R. Bergdahl. Department of Forestry, The University of Vermont, Burlington, VT 05405.

Freshly cut eastern white pine (*Pinus strobus* L.) wood was chipped, placed in plastic bags (325 g ea.) and inoculated with an isolate of *Bursaphelenchus xylophilus* (Steiner and Buhner) Nickle from P. *strobus*. All inoculated and uninoculated (control) chips were placed in a growth chamber at 30°C for up to 8 wk. Nematodes were extracted at 2 wk intervals using a modification of the Baermann funnel technique. Populations of *B. xylophilus* increased about 30X after 8 wk. Histological studies showed juvenile nematodes present in resin canals and tracheids of wood chips. Wood staining fungi were more abundant on uninoculated chips than on nematode-infested chips.

DISTRIBUTION OF NEEDLECAST DISEASES ON DOUGLAS-FIR CHRISTMAS TREES IN NEW HAMPSHIRE. T.C. Harrington, Dept. of Botany and Plant Pathology, Univ. of New Hampshire, Durham, 03824.

Twenty-nine sites in New Hampshire with Douglas-fir (*Pseudotsuga menziesii*) Christmas tree plantations were examined in 1984 for the presence of Rhabdocline and Swiss needlecast. Rhabdocline needlecast was found at 17 sites and Swiss needlecast at 9. Of the 11 sites where no disease was detected, 7 were recent plantings (1980 or 1981) and 4 were older, probably disease-free plantations that may have been planted with clean stock. Rhabdocline *pseudotsugae* subsp. *pseudotsugae*, reported for the first time in New England, was found throughout the state and was more prevalent than *R. weirii* subsp. *oblonga*. Neither *Phaeocryptopus gaumannii* (cause of Swiss needlecast) nor *R. weirii* were detected near the Seacoast in southeastern NH. Absence of *R. weirii* in the 10 plantations in southeastern NH but presence in 9 of the other 19 sites is consistent with the distribution of this species in Pennsylvania and may be due to some environmental limitation.

AN EARLIER ORIGIN OF THE DUTCH ELM DISEASE. F. W. Holmes, Shade Tree Laboratories, University of Massachusetts, Amherst, MA. 01003. (also Dept. Plant Pathology)

In January 1922, Dina Spierenburg published a second article with the identical title "Een onbekende ziekte in de iepen." (Plantenz. Dienst, Wageningen, Verslagen & Mededelingen #24: 31 p). Here she described isolating a "Cephalosporium-Graphium" mixture from discolored wood in the growth layers of 1912 and 1913 of several Dutch elm diseased (DED) elms in Renkum, Netherlands, and layers of 1913-15 of another in Rotterdam. Her photos show that she had the same fungus as that which Schwarz that same year named *Graphium ulmi*. Her distribution map for 1921 showed DED in all provinces of The Netherlands. If one accepts Belgian and French DED distribution reports (although those were not based on cultures), the epiphytotic center appears to have been near Antwerp, and in view of later experiences with DED spread, the European infestation appears to have begun about 1900 to 1905. World War I events are unrelated to DED origin.

SAPSTREAK OF SUGAR MAPLE: APPEARANCE OF LUMBER FROM DISEASED TREES AND LONGEVITY OF *CERATOCYSTIS COERULESCENS* IN AIR-DRIED LUMBER. David R. Houston, USDA, 51 Mill Pond Road, Hamden, CT 06514.

Ceratocystis coerulescens (Cc), the incitant of sapstreak disease in sugar maple, *Acer saccharum*, causes a distinctive stain in the xylem. Some concern exists that Cc could be brought to Europe on diseased wood. This study was conducted to determine the appearance of diseased lumber and the fate of Cc during air drying. Ten diseased trees were felled on 23 Oct. 1984, cut into boards 1.25 in thick, and sticker-piled in 6x4x4 ft piles. Stained surfaces changed quickly on drying from water-soaked yellow-green to dark brown, and eventually to light brown. Wood moisture contents fell to about 20% by 31 Dec. 1984 and to below 15% by 15 April 1985. Cc grew out and sporulated

next to stain streaks on some boards, and many common molds grew luxuriantly only on stained wood. Cc was isolated, infrequently, from surface mycelium through 28 Dec. 1984 and from stained wood through 2 April 1985.

MECHANISM OF DEPENDENT TRANSMISSION BY APHIDS FOR TWO RELATED ISOLATES OF BARLEY YELLOW DWARF VIRUS. J. S. Hu and W. F. Rochow, Dept. of Plant Pathology, Cornell University, Ithaca, NY 14853, and ARS, U.S. Dept. of Agriculture.

Parallel studies were made of preparations of oats singly- or doubly-infected with MAV and PAV to probe mechanisms of dependent transmission of MAV by *Rhopalosiphum padi* in the presence of the related PAV isolate. We used monoclonal antibodies specific for MAV and polyclonal antibodies made specific for PAV (by absorption with MAV preparations) in 2-site enzyme immunosorbent assays (EIA). Virus particles trapped by PAV-specific antibodies reacted with MAV-specific antibodies in preparations made only from doubly-infected plants in each of 5 tests. When such virus preparations were first absorbed with antibodies specific for either virus, the amount of virus that reacted in 2-site EIA was eliminated or reduced. These results suggest that some virions in the mixed infection contain epitopes for both MAV and PAV, and that the mechanism for dependent transmission of MAV with PAV may be phenotypic mixing.

Tar Spot on Norway Maple in Upstate New York. G.W. Hudler and M.T. Banik, Dept. of Plant Path., Cornell Univ., Ithaca, NY and S.G. Miller, Oneida Co. Cooperative Extension, Utica, NY.

Tar spot (*Rhytisma acerinum*) has been found on Norway maple (*Acer platanoides*) in Oneida Co. for the past 5yr. In 1984, many large (15m tall) trees were prematurely defoliated by the pathogen. Periodic exam of leaves from the field in 1984-85 indicated that the pathogen overwintered on leaves infected the previous year and liberated ascospores during rainy periods in May and June. First symptoms on new leaves were irregular, chlorotic spots. Within 2wk, numerous discrete black pseudostromata (2mm dia.) appeared on upper surfaces of the spots; these rapidly enlarged and coalesced to form large (2cm dia.) stromata. Pycnidia bearing allantoid conidia (1.5µm X 8.5µm) formed in the stromata in mid-Aug. Nearby red, silver, and sugar maples showed no signs of infection by *Rhytisma* spp. Based on gross morphology of the stroma, apparent host range, and cultural characteristics, we believe that this species differs from *Rhytisma* spp. on other maples in NY.

INFLUENCE OF ALFALFA BLOTCH LEAFMINER ON SPRING BLACK STEM DEVELOPMENT IN ALFALFA LEAVES. C. S. Huftalen and G. C. Bergstrom, Dept. of Plant Pathology, Cornell University, Ithaca, NY 14853.

Severities of alfalfa blotch leafminer (ABLM)-induced injury and spring black stem (SBS) leaf spot, caused by *Phoma medicaginis*, were shown by others to be positively correlated on alfalfa in the field. In laboratory experiments with detached leaflets and intact plants, wounds, made by ABLM or artificially, produced a significant but transitory predisposition of leaflets to SBS. Leaflets with larval mines exhibited more disease than did leaflets with only pinholes (feeding or oviposition wounds) or mechanical wounds. Nonwounded leaflets developed disease comparable to wounded leaflets but after a time lag. Results of experiments in closed chambers suggested that volatile factor(s) from ABLM-injured tissue may stimulate SBS. ABLM adults vectored *P. medicaginis* at low frequency and in a nonpersistent manner. We suggest that ABLM activity is not likely a major factor in development of SBS epidemics in the Northeast.

POTENTIAL OF FILTRATES FROM CULTURES OF *VERTICILLIUM ALBO-ATRUM* IN SCREENING ALFALFA FOR RESISTANCE. Karen Ireland, Dept. of Plant Path., Penn State Univ., and K.T. Leath, USDA-ARS, U.S. Regional Pasture Research Lab., University Park, PA 16802.*

The reaction of cuttings and leaflets of alfalfa to cell-free filtrates from potato-dextrose broth cultures of *Verticillium albo-atrum* was examined. Cuttings from susceptible Saranac alfalfa had significantly higher severity scores after uptake of filtrate than resistant cultivars, Maris Kabul and NAPP-34. NAPP-34 and Maris Kabul had a higher incidence of resistant plants than Saranac. Susceptible cuttings displayed *Verticillium*-wilt-like symptoms by 7 days after uptake of filtrate. Leaves of susceptible plants of Maris Kabul became chlorotic and necrotic in filtrate, but those of NAPP-34 displayed only a necrosis of the leaflet margins. Susceptible leaflets became chlorotic when pressure infiltrated with filtrates. Seventeen percent of Saranac and 70% of NAPP-34 plants were scored as resistant when leaflets were infiltrated. Assays involving stem cuttings or leaf infiltration of alfalfa have potential as screening procedures.

* = Student Paper Competition

GAEUMANNOMYCES CYLINDROSPORUS ASSOCIATED WITH DISEASED TURFGRASS IN RHODE ISLAND. Noel Jackson and P.J. Landschoot, Dept. of Plant Pathology/Entomology, University of Rhode Island, Kingston, RI 02881.

Perithecia of Gaeumannomyces cylindrosporus Hornby et al. were found associated with diseased Poa annua and Lolium perenne respectively at two locations in Rhode Island during July 1984. Identity of the fungus was confirmed by Mr. John Walker. This constitutes the first field record of G. cylindrosporus. The anamorph, derived from ascospores, conformed with the description of Phialophora graminicola (Deacon) Walker. The latter occurs commonly on roots of grasses in Europe and is considered a weak pathogen with potential as a biological control agent for take-all diseases of cereals and turf. More recently, P. graminicola has been implicated in the United States as the causal agent of summer patch disease of Poa pratensis turf. Investigations into the biology of the Rhode Island isolate of P. graminicola and other Phialophora-like fungi from turfgrass roots are in progress.

THE EFFECT OF GLOMUS MOSSEAE COLONIZATION AND SOIL PHOSPHORUS CONTENT ON SUSCEPTIBILITY OF CUCUMBER TO PSEUDOMONAS LACHRYMANUS AND COLLETOTRICHUM LAGENARIUM. C. James and F.L. Caruso, Department of Botany and Plant Pathology, University of Maine, Orono, ME 04469.

SMR 18 cucumber plants colonized by Glomus mosseae (50, 100, 200, 300 or 400 g/pqt) usually had significantly more lesions caused by 10^5 , 5×10^4 and 10^4 conidia/ml C. lagenarium and 10^8 cells/ml P. lachrymans than nonmycorrhizal control plants. In plants receiving soil phosphorus at 25, 50, 100, 200 or 400 μ g P per gram of soil, lesion numbers increased with increasing levels of P. Mycorrhizal plants when treated with 300 g of mycorrhizal inoculum had greater tissue levels than those receiving 100 g/pot but this did not result in significant increases in lesion numbers of C. lagenarium. Increased levels of soil P resulted in increased lesion counts up to 100 μ g of P per gram of soil for both mycorrhizal and nonmycorrhizal plants. At 400 μ g lesion numbers were comparable.

INCIDENCE AND DISTRIBUTION OF FUSARIUM SPECIES IN SHELLED CORN FROM PENNSYLVANIA AND MARYLAND. Nikola Jeschke and Paul E. Nelson, The Pennsylvania State University, 211 Buckhout Lab., University Park, PA 16802

The incidence and distribution of Fusarium species was determined in 18 samples of shelled corn intended for poultry feed in Pennsylvania and Maryland. Fusarium species were isolated by plating half-kernels of corn on Nash-Snyder medium. Samples contained either low amounts of Fusarium accompanied by high amounts of decay fungi such as Aspergillus and Penicillium species, or high amounts of Fusarium with very few other genera present in low amounts. Samples of the former type contained more broken and discolored kernels. Fusarium moniliforme was the most prevalent species isolated and occurred in all samples; F. subglutinans also was isolated frequently. Individual isolates of other Fusarium species were present in small numbers. F. moniliforme, a fungus readily isolated from corn kernels, has been associated with a serious mycotoxicosis of horses and human esophageal cancer in South Africa.

USE OF ISOZYME ANALYSIS TO DETERMINE GENETIC SIMILARITY IN THE PADDY STRAW MUSHROOM. VOLVARIELLA VOLVACEA. M. H. Jodon¹, D. J. Royse¹, G. G. Antoun², and B. May³. ¹Penn State University, ²Agricultural Research Center, Giza, Egypt and ³Cornell University.

Nineteen lines of Volvariella volvacea, representing both commercial and wild germplasm, were obtained from worldwide sources. For isozyme analysis, the lines were grown in potato-dextrose yeast-extract broth for 2 to 3 wk. The mycelium was harvested, frozen, allowed to thaw, then crushed with a glass rod to release intracellular enzymes. The samples were surveyed for activity for 40 enzymes by starch gel electrophoresis. Twelve loci (Aat, Acp-2, Dia, Est-4, Gpi, Lap-1, Pep-GL, Pep-LLL-1,2, Pgm, Pgd, Sod) were monomorphic; six loci (Ada, Gpt, Pep-PAP, Np, Mdh, and Mpi) were polymorphic. Ten unique genotypes were distinguished among the 19 lines. Nei's and Rogers' measures of genetic identify and cluster analyses were performed to determine genetic relatedness. Lines with identical alleles expressed at the same loci may have originated from the same genetic source.

LESION DENSITIES RESULTING FROM PRIMARY APPLE SCAB INFECTIONS. J. D. Kaplan and W. E. MacHardy, Department of Botany and Plant Pathology, University of New Hampshire, Durham, NH 03824.*

A different plot of McIntosh trees in a 0.5 ha apple orchard

* = Student Paper Competition

was left unsprayed for each infection period during the 1984 and 1985 primary scab seasons. Each plot contained 6 trees arranged in two rows of 3 with an inoculum source of approximately 1700 scabbed leaves arranged in a ring in the center of each plot. Six volumetric spore traps were placed within the canopy of each of 4 trees, and one trap was placed with the inoculum source. Lesion densities on expanding cluster leaves corresponded with airborne ascospore densities throughout the primary season, but a relationship between lesion density on terminal leaves and airborne ascospore density was not evident. On most trees, fruit scab was less than 1.0% and never greater than 2.6%. The low density of primary lesions relative to the inoculum dose has important implications for scab management in commercial orchards with low levels of overwintering inoculum.

VOLUME OF STAIN AND DECAY NOT RELATED TO AMBROSIA BEETLE ATTACK IN OAKS KILLED FOLLOWING GYPSY MOTH DEFOLIATION. D. Karasevicz and W. Merrill, Dept. of Plant Pathology, The Pennsylvania State University, University Park, PA 16802

Biodeterioration of oak trees which die following gypsy moth (Lymantria dispar) defoliation in central PA involves a complex succession of organisms. Ambrosia beetles are pioneer sapwood invaders; their tunnels often provide infection courts for stain and decay fungi. Cross-sectional disks from dead red oaks (subgenus Erythrobalanus) were removed at butt and mid-merchantable bole heights. Trees dead one and two growing seasons had one beetle entrance hole per 470 and 184 sq cm of bole surface area, respectively. Adjacent "healthy" check trees killed via girdling and dead one-and-a-half growing seasons had one entrance hole/86.5 sq cm of bole surface area. Although stain and decay often began in or around ambrosia beetle galleries, by the end of two years the volume of stained and decayed wood was not correlated with intensity of beetle attack.

OZONE AND ACIDIC PRECIPITATION: EFFECTS ON THE GROWTH OF MYCORRHIZAL AND NON-MYCORRHIZAL PAPER BIRCH AND WHITE PINE SEEDLINGS. Kevin D. Keane and William J. Manning, Dept. of Plant Pathology, Univ. of Massachusetts, Amherst, MA. 01003.

Four-week old seedlings of paper birch (Betula papyrifera Marsh) and White pine (Pinus strobus L.), infected or non-infected with Pisolithus tinctorius (PT), were grown in non-steamed (NS) or steamed (S) soil and exposed to carbon-filtered air (CF) or CF plus ozone (0.06-0.08 ppm, 5 days/week, 7 hours/day) and simulated acidic precipitation (pH 3.5 or 5.6, 10 minutes/day, 2 days/week) for 11 weeks. Ozone (O₃) caused significant reductions in root weight (RW), stem weight (SW), leaf weight (LW), leaf area (LA) and leaf number (LN) in paper birch. NS soil and PT caused increases in FW, SW, LW, LA, shoot height (SH) and % mycorrhizal infection (MI). PT also increased LN. Pine seedlings infected with PT had significantly larger SH and SW. MI was significantly affected by three two-way interactions; pH x PT, soil x PT and air x PT. In both paper birch and white pine, PT infections resulted in compensation for some growth reductions caused by O₃.

DISEASES OF JERUSALEM ARTICHOKE IN QUEBEC. Christiane Laberge and W. E. Sackston, Dept. of Plant Science, Macdonald College, Ste. Anne de Bellevue, Que., Canada H9X 1C0.

Apical chlorosis (Pseudomonas syringae pv tagetis) was observed in our experimental plots in 1984 and 1985 on scattered plants of Jerusalem artichoke (JA) (Helianthus tuberosus). Cultures resembling N and CN strains of the pathogen isolated in 1985 induced AC symptoms on inoculated JA and on oilseed sunflowers (H. annuus). About 13% of plants with AC in our JA plots in 1985 died; about 80% apparently recovered. Typical Verticillium wilt symptoms developed on JA plants injected when 2 weeks old with spore suspensions of V. dahliae isolates from sunflowers. No symptoms developed on JA plants in a Verticillium nursery where susceptible sunflowers showed severe symptoms. Wilt, stalk rot, and tuber rot (Sclerotinia sclerotiorum) affected five JA plants in experimental plots in 1984 and 1985; over half the crop was destroyed in a 2.5 ha farm field in 1984. Erysiphe cichoracearum developed profusely on HA plants in both years.

THE EFFECT OF RESISTANT POTATO CULTIVARS ON DECLINE IN NUMBER OF GLOBODERA ROSTOCHIENSIS CYSTS WITH VIABLE EGG CONTENT. J. A. LaMondia and B. B. Brodie, Dept. of Plant Pathology and USDA, ARS, Cornell Univ., Ithaca, NY 14853.

Resistant potato cultivars were grown for up to 5 four-week growth cycles in pots inoculated with Globodera rostochiensis eggs in cysts. Viable cyst contents were determined after each cycle by examining 100 cysts. Median egg content of cysts declined from 462 to 113, 6, 2, 1 and 0, and the number of cysts with viable contents declined

from 100 to 99, 88, 71, 59 and 23 after 1-5 plant growth cycles, respectively. After 5 cycles, 2 cysts contained 10-49 eggs and 21 cysts held <10 eggs. A similar decline in number of cysts with viable contents was observed in the field, with the same tendency for cysts to retain eggs at low densities. We propose that this phenomenon may act as a survival mechanism to allow the population establishment after transfer of one or a few cysts which may be several years old.

ISOLATION AND PRELIMINARY CHARACTERIZATION OF *ERWINIA CAROTOVORA* SUBSP. *CAROTOVORA* (ECC) MUTANTS DEFECTIVE IN POLYGALACTURONATE CATABOLISM AND MUTANTS EXHIBITING ORANGE-PIGMENTATION. C. H. Liao and R. L. Hammell, USDA, ARS, Rutgers Univ., New Brunswick, NJ 08903.

An overnight culture of Ecc (SR319) mutagenized with N-methyl-N'-nitrosoguanine (200 µg/ml, 2 hr) was grown in a minimal medium (MM) containing polygalacturonate (pG, 0.4%). Actively-growing prototrophic cells were selectively killed after repeated incubation of the culture with 200 µg/ml each of carbenecillin and lysozyme (2-3 hr). After the 3rd enrichment cycle, mutants were selected by replica-plating on MM containing pG, pectin, or glucose. Among 4,500 colonies tested, 86 (or 1.92%) were unable to grow on MM-pG (or pectin). At least 3 classes of mutation were detected: (1) Mutants that fail to utilize galacturonate, (2) Mutants that excrete 5-7fold higher level of pectate lyase (in MM-glu) than the wild-type, and (3) Mutants that display orange-pigmentation, which appears to be regulated by carbohydrate metabolism.

DIFFERENTIATION OF GARLIC VIRUSES. X. Liu, J.F. Peterson, and R. Crête. Department of Plant Science, Macdonald College of McGill University, Ste. Anne de Bellevue, Quebec H9X 1C0 and Station de Recherche, Agriculture Canada, St-Jean-sur-Richelieu, Quebec J3B 6Z8.

The major component of virus preparations purified from garlic (*Allium sativum*) showing mosaic symptoms was a relatively straight carlavirus-like particle. More flexuous potyvirus particles were also present in centrifugally homogeneous preparations. Gel electrophoresis was used to differentiate viral components in purified preparations. A rabbit antiserum was produced and shown to react mainly against the latent virus, though it also detected the potyvirus. Viruses in garlic extracts were detected by double diffusion tests in agar gels containing sodium dodecyl sulfate, enzyme-linked immunosorbent assays (ELISA), dot-immunobinding assays, and immunoblots of proteins transferred to nitrocellulose after gel electrophoresis.

WHITE OAK (*Quercus alba* L.) BASAL AREA INCREMENT IN SECOND-GROWTH AND OLD-GROWTH STANDS IN CENTRAL PENNSYLVANIA. R. Long and D. D. Davis, Dept. of Plant Pathology, The Pennsylvania State University, University Park, PA 16802.

Three-ring analysis of second-growth and old-growth stands was used to evaluate the potential effects of anthropogenic stress on basal area increment (BAINC) of white oak. Second-growth stands on both good (site index=77; average age=78) and poor (site index=54; avg. age=84) sites showed no evidence of synchronous decreases in BAINC after removal of climatic effects with a cubic spline curve. BAINC slopes were continuously positive on 5 of 15 trees at the poor site and 8 of 15 trees at the good site. The remaining trees showed variable though non-synchronous slope changes. In an old-growth stand (130-423 yrs.; avg. age=231), a stand averaged BAINC curve indicated a decrease in positive slope (slower rate of increase) since the mid-1950's. A synchronous decrease of BAINC since 1950 occurred in 20 of 33 trees with no apparent relation to age or size class.

PRODUCTION OF MASSIVE NUMBERS OF OOSPORES OF *BREMIA LACTUCAE*. J. W. Lorbeer and D. P. LoParco. Department of Plant Pathology, Cornell University, Ithaca, NY 14853

Massive numbers of oospores of *Bremia lactucae* were produced repeatedly by crossing two New York isolates (17-11 and 5-81-SS1) of opposite mating type in dual inoculations on detached first and second true leaves of cultivar Ithaca lettuce seedlings. The leaves were washed, dried, and placed on Nytex screens resting upon moistened filter paper discs in 5 cm Pyrex petri dishes in glass incubation trays. Water suspensions of sporangia (10^7 /ml) of both isolates were combined and the leaves sprayed to run-off. Lids were placed on the dishes, the trays sealed with plastic wrap, and the leaves then incubated under cool white fluorescent lights at 14 C with a 12 hr photoperiod (initiated by the dark period). Massive numbers of oospores formed uniformly throughout each

leaf in 7-12 days. The Nytex screens prevented the leaves and oospores from adhering to the filter paper and facilitated sonification to separate oospores from dried leaf tissue.

EFFECT OF PROTEIN SOURCE ON THE RESISTANCE OF *PSEUDOMONAS SYRINGAE* PV. *TOMATO* TO COPPER AND DITHIOCARBAMATE BIOCIDES. F. L. Lukezic, R. Levine, and A. A. MacNab, Dept. of Plant Pathology, Penn State University, University Park, PA 16802

Field results have demonstrated that combinations of Cu and dithiocarbamate biocides provide better control of bacterial induced plant diseases than when either is used alone. Proposals for the increased control include an alteration of the bacterial cell, increasing its sensitivity to Cu and/or more Cu in solution due to the dithiocarbamate. Our evidence suggests an alteration of the cell is involved. Sensitivity of cells apparently depends on the protein used for growth. Unwashed inoculum grown in different protein sources affected resistance to the biocides. This effect was eliminated by washing. Where increased resistance occurred, this was neutralized by cation removal with ion exchange resins. Resistance could be restored by addition of cations eluted from the resins. Within the scope of experiments reported, synergism of biocides was regulated by components of the cell's capsule or membrane.

DIURNAL PERIODICITY OF AECIOSPORE DISSEMINATION OF *UREDINOPSIS MIRABILIS* INTERRUPTED BY PRECIPITATION. M. Mazzola and D.R. Bergdahl, Department of Forestry, The University of Vermont, Burlington, VT 05405

Aeciospore dissemination of *Uredinopsis mirabilis* (Peck). Magnus (fir-sensitive fern rust) was monitored during June and July, 1984 in a plantation of *Abies balsamea* (L.) Mill. (balsam fir) in Wolcott, VT. Kramer-Collins 7 d volumetric air samplers were used to collect aeciospores. Precipitation events and relative humidity (RH) also were recorded. Aeciospore dissemination showed a diurnal periodicity during dry periods. Spore numbers usually increased as RH decreased during the morning, peaked around midday and were very low during the night. This diurnal pattern of dissemination was interrupted during periods of precipitation. Spore numbers abruptly increased at the start of a precipitation event but during extended periods of precipitation a rapid decline in spore numbers was observed after about 3 h. Approximately 70% of the aeciospores of *U. mirabilis* were disseminated during periods of precipitation.

CYTOPATHOLOGY OF FOLIAR NECROSIS IN THE CHRYSANTHEMUM MORIFOLIUM CULTIVAR PINK MARBLE. R. J. McGovern, R. K. Horst, and H. W. Israel. Plant Path. Dept., Cornell University, Ithaca, N.Y. 14853.

Symptomatic leaves of the *Chrysanthemum morifolium* cultivar Pink Marble were studied using 2-25 µm thick unfixed, 5% glutaraldehyde-fixed, and glycol methacrylate-embedded sections, 50-60 nm thick epoxy resin-embedded sections, and 70% lactic acid-cleared whole mounts. Light and electron microscopy showed that hypertrophy, necrosis and lignification of the phloem and phloem parenchyma were more pronounced at 32 C than at 16 or 24 C. Electron microscopy revealed the presence of pleomorphic, 0.2-0.8 µm-diameter, membrane-bounded mycoplasma like organisms in the phloem and phloem parenchyma. Affected mesophyll cells collapsed, or exhibited wall hypertrophy consisting, in part, of callose-like wall appositions. Necrotic flecks were often near leaf veins and at 24 C were arranged in nearly concentric rings. Selective necrosis of guard cells was often observed.

GRAFT TRANSMISSION OF THE AGENT OF CHRYSANTHEMUM FOLIAR NECROSIS AND DETECTION BY FLUORESCENCE MICROSCOPY. R. J. McGovern, R. K. Horst, S. O. Kawamoto, and K. F. Weaber. Plant Path. Dept., Cornell University, Ithaca, NY 14853.

The agent of chrysanthemum foliar necrosis was graft transmitted from *Chrysanthemum morifolium* cultivar Pink Marble to cvs. Bonnie Jean, Illini Sparkler x Illini Sparkler (IS x IS) and Fanfare. Symptoms occurred 3-4 weeks following grafting at 32 C and included necrotic flecks in new leaves of the first two cvs. and yellow flecks along veins of lower leaves of Bonnie Jean. Yellow reticulation and total leaf necrosis were observed in Fanfare. Detection of the agent and/or localization of its cytopathic effect utilized autofluorescence and induced fluorescence by acridine orange-o, ethidium bromide, and berberine sulfate. Fluorescence was observed by all procedures in the phloem of symptomatic leaves of IS x IS but not in controls. Symptomatic leaves of Bonnie Jean, but not controls, showed autofluorescence in the phloem and bundle sheath, and induced fluorescence in the phloem by acridine orange and berberine sulfate.

SURVEY OF VIRULENCE GENES IN *ERYSIYPHE GRAMINIS* F. SP. *TRITICI* IN SOUTHERN ONTARIO FOR 1983 AND 1984. J. G. Menzies and B. H. MacNeill, Department of Environmental Biology, University of Guelph, Guelph, Ontario, Canada, N1G 2W1.

Field surveys of the virulence characteristics of *Erysiphe graminis* f. sp. *tritici* (Egt) in southern Ontario were conducted in 1983 and 1984. Mass isolates of Egt were collected in May, July, and October of each year at ten sites using mobile winter wheat nurseries consisting of twelve differential isolines. The general virulence formula was /PmMa, Pm1, Pm2, Pm3a, Pm3b, Pm3c, Pm4, Pm5. Resistance genes Pm1, Pm3a, and Pm3b were effective against most of the mass isolates. The most common isolate recovered from the universal susceptible (Chancellor) was the universal avirulent race p0 (13%), followed by isolates with virulence genes p2, p5 (11%), pMa, p3c (9%) and pMa, p2, p5 (9%). Some of the mass isolates possessed as many as six virulence genes: eg. pMa, p2, p3b, p3c, p4, p5. Possibly more extensive sampling would reveal isolates with virulent genes matching all known Pm genes in existing wheat breeding lines.

BIOASSAY FOR METALAXYL IN POTATO LEAF TISSUE.

M.G. Milgroom and W.E. Fry. Dept of Plant Pathology, Cornell University, Ithaca, NY 14853

A simple bioassay was developed for quantifying metalaxyl in small samples of potato leaf tissues. Metalaxyl is extracted from leaf disks (1-4 cm²) by soaking in 100% methanol (2 ml) in 12 X 75 mm glass culture tubes. Disks are removed after 24 h and methanol is evaporated by placing tubes in a water bath (75 C) leaving crude leaf extracts in the tubes. Efficiency of extraction is greater than 95%. One ml of molten corn meal agar is added to each tube, autoclaved and poured into a 35 X 10 mm plastic petri dish. Radial growth of *Phytophthora boehmeriae* after 96 h at 24 C accurately quantifies metalaxyl in the range 5-50 ng/ml. In samples determined to be >50 ng, *P. boehmeriae* is removed and *P. citrophthora* is used in similar way on the remaining medium to quantify metalaxyl in the range 50-750 ng/ml.

ISOLATION, PURIFICATION, AND ASSAY OF ASPARAGUS VIRUSES I AND II IN NJ. M.S. Montasser and R.F. Davis, Dept. of Plant Pathol., N.J.A.E.S., Rutgers Univ., New Brunswick, NJ 08903 USA

Two virus types were isolated from asparagus plants in New Jersey and previously identified as asparagus virus I (AV-I NJ) and II (AV-II NJ). AV-I NJ was purified from locally infected *Chenopodium quinoa* Wild. leaves and antibodies were prepared in mice. Indirect ELISA was successfully used for AV-I NJ detection in asparagus tissues. For AV-II NJ, bioassay test on *C. quinoa* was used to detect this virus. Two methods of purification were compared in combination with two ways of sample preparations. Fresh plant tissue yielded more virus than frozen tissue. Ultraviolet absorption spectrum of purified virus preparation was characteristic with an A₂₆₀/A₂₈₀ ratio of 1.3 for AV-I NJ, and 1.6 for AV-II NJ. Purified preparations of both viruses were infective and consistently contained flexuous and quasi-isometric particles for AV-I and II, respectively. Surveys of these two viruses revealed that AV-I was present in 45% and AV-II in 12% of random field samples. Both viruses were also detected in asparagus grown in the greenhouse.

PYTHIUM ROOT ROT OF GERANIUMS ASSOCIATED WITH HIGH FERTILIZATION RATES. G. W. Moorman. The Pennsylvania State University, Dept. of Plant Pathology, 211 Buckhout Lab., University Park, PA 16802.

Pythium ultimum Trow. caused mortality in 76% of the seed geranium population fertilized with 15% N-16% P-17% K soluble fertilizer applied to supply 600 µg/g N. At levels of 150, 300, and 450 µg/g N, 8%, 32%, and 36% of the inoculated populations respectively, died. All plants treated with metalaxyl one week before inoculation and 90% of those treated one day after inoculation remained healthy. Eighty eight percent of the plants treated with propamocarb one day after inoculation remained healthy. None of the fungicides tested provided adequate control when applied one week after inoculation, the time when symptoms first appeared. All fungicide tests were conducted on plants grown at 600 µg/g N.

WOOD DISCOLORATION ASSOCIATED WITH *SEPTOBASIDIUM PINICOLA* INFECTION OF *PINUS STROBUS*. C.W. Murdoch, R.J. Iuili and K. Ellor, Department of Botany and Plant Pathology, University of Maine, Orono, ME 04469.

A severe infection of white pine (*Pinus strobus* L.) by *Septobasidium pinicola* Snell was observed in a 20-30 yr 8.1 ha, mixed species stand in eastern Maine. The fungus had infected 38% of individual pine stems but infections were not correlated with size class, growth rate, or crown position (P=0.05). An unusually high number of *S. pinicola* fructifications were observed on stems, branches and branch bases where infection was associated with swellings, bark cracks, pine bark aphids (*Pineus strobi* Htg.) and scale insects. Brown sapwood discolorations 1-6 mm in depth and extending beyond the border of the hymenium, were observed under 41 of 50 fructifications. The origin of this discoloration could not be determined. In view of the wood discoloration, stem disfiguration, and insect presence associated with *S. pinicola*, this fungus may have the potential to be a contributing factor to a reduction in white pine wood quality.

MANAGEMENT OF EYESPOT ON WINTER WHEAT IN ONTARIO. K. Nelson and J.C. Sutton, Department of Environmental Biology, University of Guelph, Guelph, Ontario, Canada N1G 2W1.*

The progress of eyespot caused by *Pseudocercospora herpotrichoides*, inoculum densities of the pathogen, and effects of fungicides on the disease were examined in field plots of winter wheat in 1983-84 and 1984-85. Disease incidence was higher in early-sown (10-20 Sept.) than late-sown (28-30 Sept.) wheat. Lesions in the early-sown wheat were observed initially on 9 November, 1983 and 17 April 1985 and increased mainly between mid-April and mid-May. Peak spore counts on stubble and in rainwater were observed about 14-21 April in cool wet weather. Triadimenol, nuarimol, SN 84364 and imazalil used as seed treatments failed to suppress eyespot in spring. Benomyl was ineffective when applied as a foliar spray in October 1984, but suppressed eyespot by >50% when applied the following spring on 26 April, 10 or 24 May; Feeke's scale 3 - 6. In 1985, a foliar spray of prochloraz plus MBC was more effective than benomyl, DPX H6573 or thiabendazole when applied on 29 April or 19 May.

AN ASSAY FOR THE VIRULENCE OF *ERWINIA AMYLOVORA* USING MALUS (APPLE) TISSUE CULTURE. J.L. Norelli, H.S. Aldwinckle and S.V. Beer, Depts. of Plant Pathology, N.Y.S. Agr. Expt. Station, Cornell Univ., Geneva, NY 14456 and Ithaca, NY 14850.

A rapid, efficient method to determine the virulence of strains of *E. amylovora* (Ea) on *Malus 'Novole'* has been developed. Shoot tip cultures of 'Novole' are propagated, rooted and inoculated *in vitro*. Rooted, 1- to 3-cm long plantlets are inoculated by dipping scissors in a 10⁷ cfu/ml suspension of Ea and then bisecting one or more leaves. Ten days later, plantlets inoculated with Ea strain 266, which is virulent on 'Novole', show typical fire blight symptoms including necrosis and watersoaking. However, plantlets inoculated with Ea strain 273, which is avirulent on 'Novole' but fully virulent on most other apple cultivars, show no fire blight symptoms ten days later. When several strains of Ea were assayed for their virulence on 'Novole' there was a positive correlation between results obtained from the tissue culture assay and from inoculation of potted 'Novole' plants in the greenhouse.

HAPLOIDY IN BASIDIocarps OF *ARMILLARIA BULBOSA*, A MEMBER OF THE *ARMILLARIA MELLEAE* COMPLEX. Diane Cope Peabody and Robert B. Peabody, Department of Biological Sciences, Bridgewater State College, Bridgewater, MA 02324 and Biology Department, Stonehill College, North Easton, MA 02357.

Fluorescence microspectrophotometric measurements of 4', 6-diamidino-2-phenylindole-stained DNA in 12 nuclear cycle stages of *Armillaria bulbosa* indicate that unmatd monosporous hyphae and monokaryotic cells of basidiocarps, including gill trama, pileus hyphae and stipe hyphae, are haploid. Since the haploid basidiocarp presumably develops from an earlier diploid stage, i.e., compatible mated monosporous hyphae, it is possible that the haploidization leading to basidiocarp formation results in a genetic mosaic.

OCCURRENCE OF *PSEUDOPEZIZA TRACHEIPHILA*, CAUSAL AGENT OF ROTBRENNER, ON GRAPE IN NEW YORK. R.C. Pearson, B. Dubos*, and R.P. Korf**, NYS Agr. Expt. Stn., Geneva, NY 14456, *INRA Bordeaux, France, and **Cornell Univ., Ithaca, NY 14853.

A leaf scorch of grapevine, identical to Rotbrenner, a disease in European vineyards caused by the fungus *Pseudopeziza tracheiphila* Müll.-Thurg., has recently been observed in New York vineyards. Symptoms have been observed on *Vitis vinifera*, *Vitis* hybrids, wild *Vitis* and Virginia Creeper (*Parthenocissus quinquefolia*). Lesions on leaves progress from yellow to reddish brown, retain a yellow margin and are

* = Student Paper Competition

strictly delimited by the major veins. Hyphae in sine wave patterns were observed in vessel elements from diseased tissue. When placed in a moist chamber at 19 C, excised necrotic tissue developed gelatinous apothecia in 3 days, that contained paraphyses and asci with four reniform ascospores (10-12.7 x 20.9-30 μ). The fungus also produced asci containing four ascospores when cultured on malt agar. The fungus has been identified as *P. tracheiphila*. This is believed to be the first report of this fungus in North America.

AN APPARATUS FOR STUDYING TEMPERATURE AND WATER POTENTIALS IN RELATION TO SURVIVAL OF BOTRYTIS CINEREA IN DEAD STRAWBERRY LEAVES. T. Peever and J.C. Sutton, Department of Environmental Biology, University of Guelph, Guelph, Ontario, Canada N1G 2W1.

An apparatus was developed as a closed system in which air of a desired temperature and water potential (Ψ) could be circulated for extended periods. The apparatus was positioned inside an incubator to provide temperature control ($\pm \leq 1.0C$). To maintain Ψ , an airstream with flow rate of 0.25 l/min was bubbled through a saturated solution of an appropriate salt and then channelled through 8 specimen chambers. Temperature and Ψ of the airstream was monitored continuously using a thermocouple and dew-point hygrometer. For survival studies, strawberry leaf disks were autoclaved, inoculated with the pathogen, incubated to allow colonization and placed inside the chambers. Sporulation capacity of *B. cinerea* on the discs was examined at intervals. The pathogen was able to sporulate after exposure at 40C and -50 MPa (± 10 MPa) for at least 167 hr.

IMPACT OF O₃ AND/OR ACID RAIN ON C₂H₄ EMISSION BY OATS. E. J. Pell and M. Puente, The Pennsylvania State University, University Park, PA 16802.

We tested the null hypothesis that acid rain (AR) did not exacerbate O₃ induced C₂H₄ emission in oat plants. Three experiments were conducted with 2-wk old oat plants: I-plants were exposed to 588 $\mu\text{g}/\text{m}^3$ O₃ from 0830-1130 hr. From 1300-1400 hr, plants were treated with simulated AR at pH 2.8, 3.8, 4.6 or 5.6. There were 10 plants/treatment in 3 replicate experiments. II-similar to experiment I except the AR treatment was conducted only at pH 2.8. III-plants were treated with AR pH 2.8 from 1500-1600 hr and the next day with 588 $\mu\text{g}/\text{m}^3$ O₃ from 1200-1500 hr. There were 25 plants/treatment in each of 2 replicates of experiments II and III. In each experiment, plants were treated with O₃ or AR alone or in all combinations. Following treatment, the first and second leaves of each plant were excised and C₂H₄ was quantified by gas chromatography. In all experiments, O₃ induced significant increases in C₂H₄. AR never induced C₂H₄ either as a single stress or in combination with O₃.

AGE-RELATED CHANGES IN RECEPTIVITY OF POTATO LEAVES TO *ALTERNARIA SOLANI* IN THREE POTATO CULTIVARS. J.-R. Pelletier and W.E. Fry. Dept. of Plant Pathology, Cornell University, Ithaca, NY 14853.

Receptivity (colonies/spores applied) was assessed at 7 to 12 day intervals in 1984 and 1985 on field-grown Kennebec, Norchip and Rosa potatoes (*Solanum tuberosum*). Leaves from 15-cm canopy strata were detached and quantitatively inoculated with isolate 4R of *A. solani* (Ell. & Mart.) Sor. In both years, receptivity was similar (0.1-0.2) for the three cultivars early in the season, then increased rapidly (to 0.3-0.5) 60-75 days after planting. Receptivity was highest in lower strata. In 1984, the time of onset of increased receptivity occurred about 8 days earlier in early-maturing Norchip than in Kennebec and Rosa. In 1985, time of onset was similar for all cultivars. Cultivar differences in time of onset of increased receptivity were not correlated to cultivar maturity class, differential rates of tuberization or ratio of tuber to leaf and stem dry weights over time.

DISTINGUISHING PHYTOTOXICITY AND PATHOGENICITY BY FUNGI IN GROWTH RETARDANT TREATED TURFGRASS. Annamarie Pennucci and Noel Jackson, Univ. Rhode Island Kingston, R.I. 02881

To determine if fungi play a role in the leaf discoloration and loss of density common in plant growth retardant (PGR) treated turfgrass, 3 rates of mefluidide, amidochlor, maleic hydrazide, paclobutrazol and flurprimidol were applied to monostands of grass in 3 successive years. A succession of fungal pathogens were isolated annually, but leaf discoloration was associated primarily with the leaf spot fungi. Other diseases contributing to discoloration included red thread, stripe smut, dollar spot and leaf rust. Number of lesions per leaf, fungal spores, diseased crowns and resulting dead plants followed a sigmoid curve whose duration was a function of the PGR used. Biweekly counts revealed a geometric increase in lesion number from <1

to 12 per leaf, resulting in yellow/brown leaf discoloration. Disease incidence, severity and duration increased after PGR application according to the following ranking: mefluidide = amidochlor > maleic hydrazide > flurprimidol > paclobutrazol.

IN VITRO GROWTH PROMOTION OF SEVERAL TURFGRASS PATHOGENS BY PLANT GROWTH RETARDANTS. Annamarie Pennucci and Noel Jackson Univ. of Rhode Island, Kingston, R.I. 02881

Five commercially important plant growth retardants (PGR) were added to artificial media to determine if PGRs play a direct role in disease promotion. Total growth and growth rate were increased in all isolates tested of *Rhizoctonia*, *Limonomyces*, *Laetisaria*, *Sclerotinia*, *Bipolaris* and *Drechslera* spp. All PGRs reduced the time necessary for spore germination. All PGRs caused an increase in spore germination percentage, germ tube length, hyphal branching and secondary conidial production according to the following ranking: mefluidide \geq amidochlor > maleic hydrazide > paclobutrazol \geq flurprimidol. Though all isolates responded similarly, the intensity of response demonstrated a PGR x isolate interaction. PGR effects are concentration dependent, and sigmoid functions can be drawn for each parameter. Applications of PGRs will result in changes in spore morphology which may make identification difficult.

EFFECT OF VERTICILLIUM ALBO-ATRUM ON THE FLOWERING OF RESISTANT ALFALFA CULTIVARS. B.W. Pennypacker, K.T. Leath, and R.R. Hill, Jr., Penn State Univ. and USDA-ARS, U.S. Regional Pasture Research Lab., University Park, PA 16802.

Three resistant alfalfa cultivars (Vertus, WL 316, NAPB 108) and one susceptible cultivar (Saranac AR) were examined to determine whether infection by *V. albo-atrum* delayed or suppressed flowering. A minimum of 64 plants/cultivar was tested by inoculating stubble with a spore suspension of the pathogen. Control plants were treated with water. Plants were greenhouse grown and were scored for the presence of buds and/or flowers five times during two growing periods. There was no significant difference over time in the mean flowering score of inoculated plants during either growing period. Significant differences were present among cultivars. Control plants had significant increase in mean flowering score over time during both growing periods and also had significant differences among cultivars. Lack of increase in mean flowering score over time indicates that *V. albo-atrum* suppresses rather than delays flowering.

LOW TEMPERATURE STORAGE OF PUCCINIA HELIANTHI. Anne-Marie Prud'homme and W. E. Sackston, Dept. of Plant Science, Macdonald College, Ste. Anne de Bellevue, Que., Canada H9X 1C0

Field collections of uredospores of sunflower rust (*Puccinia helianthi*) in early work germinated after storage for 3 months in a refrigerator or 4 years in a domestic freezer. As longevity of spores produced in a greenhouse and in growth cabinets for current work is much shorter we are investigating storage in a mechanical freezer at -75°C. Spores stored 1 and 4 weeks in vials without pretreatment; after air drying; drying with silica gel; air drying and rehydration; or with silica gel in the vials germinated on water agar over 90% for one race and 70 to 80% for another regardless of pretreatment. Spores from storage were tested without treatment; after temperature shock at 40°C; or after rehydration. Percent germination was similar for all treatments. Infectivity of stored spores measured as pustules per cm² on inoculated leaves was less consistent than germination. Requirements for successful low temperature storage of *P. helianthi* appear less stringent than for cereal rusts.

DIFFUSION OF POTATO ROOT DIFFUSATE THROUGH SOIL. Denise Rawsthorne and B. B. Brodie, Department of Plant Pathology and USDA, ARS, Cornell University, Ithaca, NY 14853.

Encysted eggs of the golden nematode, *Globodera rostochiensis*, hatch primarily in response to an unknown factor present in potato root diffusate (PRD). Nematode population decline in the field midway between potato rows that were 90 cm apart where no root growth occurred suggested diffusion of PRD through the soil. Movement of PRD through soil was examined in the greenhouse using the hatch of eggs from *G. rostochiensis* cysts as an indicator. Bags containing cysts were placed at increasing distances and depths from potato roots whose growth was restricted by nylon mesh. Significantly greater hatch than that observed in fallow soil occurred up to 50 cm laterally away from the root zone. Hatch that occurred beyond 5 weeks after plant emergence was not attributed to PRD. These results suggest that narrower row spacings and/or the use of potato trap cropping may be used effectively to manage *G. rostochiensis*.

LESION DEVELOPMENT AND POPULATION GROWTH OF *XANTHOMONAS CAMPESTRIS* PV. *PHASEOLI* ON THE LEAF SURFACE OF BEAN PLANTS EXPOSED TO HYDROGEN FLUORIDE. K. L. Reynolds and J. A. Laurence. Dept. Plant Pathology, Cornell U., Ithaca, NY 14853.

Four week old *Phaseolus vulgaris* cv. 'California Light Red Kidney' plants were exposed continuously to 0 or 1 $\mu\text{gF m}^{-3}$ for 15 days or 3 $\mu\text{gF m}^{-3}$ for 5 days or 5 $\mu\text{gF m}^{-3}$ for 3 days immediately following inoculation with *X. campestris* pv. *phaseoli*. Bacterial suspensions were sprayed on each plant to establish a leaf-surface population on the first trifoliolate leaf and a lesion on a second trifoliolate leaflet. Lesion diameters were measured when first visible and again 15 days after inoculation. At 0, 3, 5 and 15 days after inoculation leaves were collected, measured for leaf area and washed. Washings were serially diluted and plated to estimate leaf-surface populations of the bacterium. Leaves were harvested on the same days to determine F accumulation. The development of lesions and leaf-surface populations of the pathogen were not affected by the concentration of fluoride, the exposure regime or the concentration of fluoride in foliar tissue.

DETECTION OF CUCUMBER MOSAIC VIRUS IN WEED HOSTS IN AREAS OF COMMERCIAL LETTUCE PRODUCTION USING POLYCLONAL AND MONOCLONAL ANTIBODIES IN AN ELISA PROCEDURE. D. L. Rist and J. W. Lorbeer. Department of Plant Pathology, Cornell University, Ithaca, NY 14853.

Reservoirs of Cucumber Mosaic Virus (CMV) near lettuce fields in NY were identified by indexing weeds for the presence of CMV using polyclonal antibodies in an ELISA procedure. The winter reservoir included rhizomes and roots of *Asclepias syriaca*, roots of *Rorippa islandica*, and rosettes of *Barbarea vulgaris*. Lettuce growing adjacent to stands of infected *A. syriaca* or *R. islandica* was severely damaged by CMV in several instances. The summer reservoir included *Echinocystis lobata*, *Galinsoga parviflora*, *Solanum dulcamara*, *Linaria vulgaris*, *Capsella bursa-pastoris*, *Thlaspi arvense*, and *Lepidium virginicum*. Monoclonal antibodies were used to differentiate isolates of CMV into the lettuce related strains L1 and L2. No strict strain host specificity was detected, although L1 was most commonly isolated from *B. vulgaris*.

PATHOGENICITY OF ROOT AND BUTT ROT FUNGI ON RED SPRUCE AND BALSAM FIR. D.M. Rizzo and T.C. Harrington, Dept. of Botany and Plant Pathology, Univ. of New Hampshire, Durham, 03824.

Six root and butt rot fungi were wound-inoculated into roots of mature red spruce (*Picea rubens*) and balsam fir (*Abies balsamea*). After 13 mo., host reaction (xylem discoloration and resinosis or wetwood) was more intense and limited to a smaller volume in spruce roots than in fir roots. The inoculated fungi were reisolated less often from spruce roots than from fir roots. In both spruce and fir, large roots inoculated near the root collar reacted less strongly than did smaller (1-3 cm diam.) roots. Also, the pathogens survived better and caused more decay in large roots than in small roots. *Scytinostroma galactinum* induced up to 45 and 60 cm of discoloration in small roots of spruce and fir, respectively. *Resinicium* (*Odontia*) *bicolor* and *Polyporus borealis* induced less discoloration, but the extent of discoloration was significantly greater than in the control wounds. *Poria subacida*, *Serpula himantioides*, and *Armillaria* sp. induced more extensive zones of discoloration than did controls in fir but not in spruce.

SYNERGISTIC INTERACTION BETWEEN STEROL-INHIBITOR AND PROTECTANT FUNGICIDES IN THE TREATMENT OF *VENTURIA INAEQUALIS*. K.A. Rosenberg, F.L. Caruso and M.G. Zuck, Department of Botany and Plant Pathology, University of Maine, Orono, ME 04469.

Laboratory investigations subjected *Venturia inaequalis* conidia to the sterol-inhibiting fungicides bitertanol and CGA-71818 (.01, .005, and .0025 ppm) and the protectant fungicides Captan and mancozeb (.1, .05, and .025 ppm). Conidia were also subjected to the paired combinations of bitertanol-Captan and CGA-71818-mancozeb. Fungicides were incorporated into malt extract agar. Conidia were sampled at 24 and 48 hours and measured using a camera lucida and digitizer tablet. Mean hyphal length showed significant reductions in the paired combinations. Greenhouse evaluations involved inoculating McIntosh seedlings with a 10^5 conidia/ml suspension of *V. inaequalis* and placing them in a mist chamber for 44 hours. The individual fungicides (1/20 field rate) and their respective combinations were sprayed at 1 day before inoculation and 1,2,3,4,5,7, and 9 days after inoculation. Scab development ratings showed increased disease control with the paired fungicides.

SINGLE AND JOINT SEGREGATION OF ISOZYME LOCI IN THE PADDY STRAW MUSHROOM, *VOLVARELLA VOLVACEA*. D. J. Royse¹, M. H. Jodon¹,

G. G. Antoun², and B. May³. ¹Penn State University, ²Agricultural Research Center, Giza, Egypt, and ³Cornell University.

Single-spore derived breeding stocks from two lines of *Volvarella volvacea* were crossed to produce F_1 hybrids. The resulting hybrids were confirmed by isozyme electrophoresis (presence of heteromers for multimeric systems) and were heterozygous at five loci. To determine single and joint segregation of the five isozyme loci (Ada, Gpt, Mpi, Np, and Pep-PAP), 77 single-spore isolates were obtained from an F_1 sporocarp. The single-spore derived offspring were grown in potato-dextrose yeast-extract broth for 2 to 3 wk. Samples were harvested, processed and subjected to starch gel isozyme electrophoresis. Chi-square tests were performed on the data to determine goodness of fit to expected 1:1 single locus segregation ratios. Loci segregated in expected 1:1 ratios. One linkage (Gpt with Np; $r = 0.115$) was found among 10 pairwise comparisons for joint segregation.

PRODUCTION OF MONOCLONAL ANTIBODIES AGAINST HONEY BEE SPIROPLASMA AS-576. W.S. Sheng and T.A. Chen, Department of Plant Pathology, Rutgers University-NJAES, New Brunswick, NJ 08903.

Three stable hybridoma monoclones secreting specific antibodies against a strain of honeybee spiroplasma (HB) (AS-576) were obtained by fusing spleen cells of AS-576-immunized mice with NS-1/1-Ag4-1 myeloma cells. Two monoclonal antibodies (MA), isotypic to be IgG1 and IgG2b, reacted specifically with AS-576 and 20 other isolates of HB from different geographical areas. The third MA, an IgG1 isotype, cross reacted with three plant pathogenic spiroplasmas belonging to serogroup I: *Spiroplasma citri*, corn stunt spiroplasma and P-40. None of these MAs reacted with other spiroplasma strains belonging to the 18 other serogroups. The MAs also found to have positive serological reactions in the deformation and growth inhibition tests.

SCREENING FOR MONOCLONAL ANTIBODIES AGAINST STRAINS OF THE FASTIDIOUS BACTERIUM CAUSING PIERCE'S DISEASE OF GRAPE. C. L. Shi, J. M. Wells and T. A. Chen, USDA, ARS and Dept. of Plant Pathology, Rutgers Univ. New Brunswick, NJ 08903

Antibodies from 6 monoclonal hybridomas react with strain PCB-R (ATCC 35876) of the Pierce's disease bacterium but not with two other closely-related strains of fastidious, Gram-negative, xylem-limited bacteria: PWT-100 (ATCC 35880) from periwinkle (*Verica minor*) and PLM-G83 (ATCC 35871) from plum (*Prunus domestica*). The hybridomas were produced from fusion of mouse spleen cells immunized with strain PCB-R and NS-1 murine myeloma cells. Over 100 hybridomas were screened by ELISA against the three strains of bacteria in a search for antibodies specific to the Pierce's disease bacterium. Optical density readings from reactions of purified immunoglobulins from culture supernatants with strain PCB-R ranged from 0.155 to 0.202, compared to readings of zero for strains PWT-100 and PLM-G83. Cloning of the hybridomas and further characterization of specificity is in progress.

AN INFECTION SAC IN GERMINATING ASCOSPORES OF *VENTURIA INAEQUALIS* DURING PENETRATION OF APPLE LEAVES. Karen J. Smereka and W. E. MacHardy, Department of Botany and Plant Pathology, University of New Hampshire, Durham, NH 03824.

Ultrastructural observation of germinating ascospores of *Venturia inaequalis* revealed the presence of an infection sac in the ascospore or appressorium prior to and during penetration of the leaf cuticle. Ascospore suspensions were applied to matured apple leaves and incubated for 16 h. Germination occurred from either cell of the two-celled spore, and penetration was either with or without the formation of a germ tube and appressorium. A fibrous, mucilaginous substance was associated with the attachment of the spore to the leaf surface and around the appressorium at the site of penetration. A membrane-bound infection sac was appressed to the leaf cuticle at the site of penetration. A similar structure was reported in conidia of *V. inaequalis* during the infection process (Maeda, K. 1970. M.S. Thesis, Purdue Univ.) but had not been reported in ascospores.

VINCA MINOR, A POSSIBLE RESERVOIR HOST FOR CUCUMBER MOSAIC VIRUS. Diane B. Smith and Robert F. Davis, Dept. of Plant Pathol., Cook College, New Jersey Agr. Expt. Sta., Rutgers University, New Brunswick, NJ 08903

Vinca plants with mild mosaic symptoms were growing in close proximity to eight other ornamental plants with virus-like symptoms ranging from mild to severe mosaic. Host range and serology confirmed the identity of the virus in all symptomatic plants as cucumber mosaic virus (CMV). The vinca isolate of CMV was purified and used to produce antibodies in

mice. Crude anti-ascites fluid or purified IgG was used in indirect ELISA to detect CMV. Aphid transmission using Myzus persicae was accomplished from the infected vinca plants to Cucurbita pepo 'Multiplik' with 10% efficiency. In addition, up to 27% of the Cucurbita pepo bait plants placed next to the infected vinca acquired CMV within one week as determined by symptomatology and ELISA. The data suggests that Vinca minor may serve as a source of CMV which is transmitted to surrounding plants by aphids.

EXPRESSION OF CLONED ERWINIA CAROTOVORA PV. CAROTOVORA PECTOLYTIC ENZYME GENES IN ESCHERICHIA COLI AND ERWINIA HERBICOLA. Franzine D. Smith, Phyllis M. Berman, M. S. Mount, Tony M. Masuck, Dept. of Plant Pathology, Univ. of Mass., Amherst, MA, 01003.

Hybrid pBR322 plasmids containing Erwinia carotovora pv. carotovora pectic enzyme genes were transformed into two isolates of Escherichia coli and two of Erwinia herbicola. Isolated plasmids from all pectolytic transformants appeared identical on agarose gels. However, indicator zones around colonies on a polygalacturonic acid screening medium varied significantly in size between the two bacterial genera and between the strains within each genus. Differences in synthesis, regulation, production levels, or transport of the E. carotovora enzymes were indicated. Detection of pectic enzyme activity on ultrathin polyacrylamide isoelectric focusing gels revealed some differences in enzyme profiles among the isolates. Pathogenicity of the transformants was also tested.

INFLUENCE OF ANTIOXIDANT TREATMENT ON SOYBEAN PHYSIOLOGY AND YIELD. Smith, G. and E. Brennan, Department of Plant Pathology, Cook College-NJAES, Rutgers University, New Brunswick, NJ 08903.

The antioxidant EDU was used to evaluate the response of 4 soybean cultivars to ambient O₃ concentrations over a 3-yr period. Field plots were arranged in a split-plot design with 4 replications. At regular intervals throughout the growing season, plants with and without antioxidant protection were examined for differences in foliar injury, plant growth, and physiological response. At maturity, EDU effects on seed weight, size, and quality were evaluated. EDU was shown to reduce visible O₃ injury and chlorophyll loss but had no consistent effect on leaf nitrate reductase-activity. Root nodule nitrogenase activity was enhanced with EDU treatment and total plant nitrogen content increased accordingly. There was no measurable effect of EDU on plant growth or development or on final seed yield. On certain occasions, seed size and quality were reduced in the unprotected plants. New Jersey Agricultural Experiment Station, Publication Number K-11151-3-85.

QUANTIFICATION OF ENVIRONMENTAL FAVORABILITY TO EPIDEMICS OF SEPTORIA NODORUM. V. J. Spadafora, J. A. Frank and H. Cole, Jr. Dept. of Plant Pathology and USDA-ARS, The Pennsylvania State University, University Park, PA 16802.*

A technique to quantify environmental favorability to S. nodorum leaf and glume blotch was developed from results of growth chamber experiments and verified under field conditions. Two winter wheat cultivars were inoculated and subjected to different durations of leaf wetness (DLW). Sigmoid relationships between disease severity and DLW were observed. Indices were developed relating the predicted severity of infection to the DLW following rainfall. Environmental conditions in field plots were varied by sprinkler irrigation. Foliar disease severity was curvilinearly related to the total number of infection units accumulated between GS 7-11.1. The effects of host resistance were underestimated, indicating that resistance components, in addition to infection efficiency, should be incorporated into the index. Glume blotch severity was linearly related to the total number of infection units.

ISOZYME POLYMORPHISM IN BIOCONTROL SPECIES OF TRICHODERMA AND GLIOCLADIUM. T. E. Stasz, N. F. Weeden, and G. E. Harman, Department of Horticultural Sciences, Cornell University, NYSAES, Geneva, NY 14456.

A high degree of isozyme polymorphism was detected among 27 isolates of Trichoderma hamatum, T. harzianum, T. koningii, T. polysporum, T. viride and Gliocladium virens by horizontal starch gel electrophoresis with polymorphism greater between species than within. Polymorphism was detected in 27 of 32 enzyme systems studied. Most enzyme systems, including aspartate aminotransferase, glutamate pyruvate transaminase, leucine aminotransferase, glutamate pyruvate transaminase, leucine aminopeptidase, glucose phosphate isomerase, and triose phosphate isomerase, exhibited at least 5 variants.

Many of the enzyme systems were homozygous in spite of considerable intraspecific polymorphism. Eleven enzyme systems were especially useful because bands were clearly resolved for most isolates. Thus, a large number of markers are available in these fungi for taxonomic, genetic, or population studies.

EFFECTS OF ACID RAIN ON RETENTION OF FUNGICIDES AND CONTROL OF LATE BLIGHT ON POTATO LEAVES. A.H.C. van Bruggen, J.F. Osmelowski and J.S. Jacobson. Boyce Thompson Inst., Ithaca, N.Y. 14853.

In a series of factorial experiments we investigated the effect of 2 pH levels of simulated acid rain (2.8 and 4.6) on retention of 5 fungicides (wetttable powders and flowables) on 3 potato cultivars (Norchip, Monona and Katahdin). Wash-off of triphenyltin hydroxide (TPTH) and cupric hydroxide was significantly increased by rain at pH 2.8 compared to rain at pH 4.6, regardless of fungicide formulation or potato cultivar. Retention of maneb, mancozeb and chlorothalonil was not affected by pH of simulated rain. The percent wash-off of chlorothalonil and cupric hydroxide was higher as wetttable powder than as flowable. Despite considerable reductions in fungicide concentrations by simulated rain, control of late blight (Phytophthora infestans) was still significant. Infection by P. infestans of leaves sprayed with TPTH was higher after acid rain treatment at pH 2.8 than at pH 4.6, but this was ascribed to enhanced susceptibility to late blight after application of rain at pH 2.8 rather than increased fungicide wash-off.

DISTRIBUTION OF RHIZOMORPHS OF ARMILLARIA IN SOILS FROM DECLINING RED SPRUCE STANDS IN THREE FOREST TYPES. P.M. Wargo¹, A.C. Carey², G.T. Geballe², W.H. Smith². ¹USFS, 51 Mill Pond Road, Hamden, CT 06514 and ²School of Forestry, Yale University, New Haven, CT 06520.

Our studies on red spruce decline in the Northeast showed that incidence and severity of Armillaria root disease at a given elevation increased with severity of decline symptoms but decreased with elevation. In this study the distribution of rhizomorphs in the forest floor in stands of declining red spruce was determined in hardwood, transition, and montane boreal forest types. Rhizomorph frequency and density was significantly lower in the higher elevation transition and montane boreal forest types. These data indicate that reduced colonization of declining red spruce at high elevations is due to reduced inoculum of Armillaria. Increased lead (Pb) concentrations and decreased pH of forest floors of higher elevation stands were correlated with inoculum reduction but do not explain completely the variation in distribution of the fungus.

EXPERIMENTAL CONTROL OF CYCLANEUSMA NEEDLECAST OF SCOTS PINE. N. G. Wenner and W. Merrill, Dept. of Plant Pathology, Penn State University, University Park, PA 16802

Scots pines (Pinus sylvestris) 0.5-2.0 m tall growing in a commercial Christmas tree plantation in Clearfield Co., Pa. were treated with chlorothalonil (Daconil 2787F) to prevent infection by Cyclaneusma minus. The fungicide was applied up to three times (6/14/84, 8/8/84, 11/5/84) with a backpack mist blower at rates of 4.7, 9.4, and 18.8 l f.p./ha to protect the 1984 needle complement. Efficacy was determined by periodic direct isolation of the fungus from 40 needles from each of 10 permanently labelled sample trees per treatment block. Three applications at 4.7 l f.p./ha or one application at 18.8 l f.p./ha gave equal protection until January 1985 with 6.5% and 7.0% infection, respectively, compared to 28.5% infection on unsprayed trees. The efficacy of these applications deteriorated rapidly from late winter through spring 1985 indicating the need for additional fungicide applications prior to the second growing season.

ACTIVITY OF THE HERBICIDE ORYZALIN AGAINST 4 PHYTOPHTHORA SPP. IN VITRO. W.F. Wilcox, Dept. of Plant Pathology, N.Y.S. Agr. Experiment Station, Cornell University, Geneva, NY 14456.

Oryzalin (active ingredient in the herbicide Surflan) was examined for activity *in vitro* against Phytophthora cactorum, P. megasperma, P. cryptogea, and P. cambivora at 7 concentrations from 0.06-4.0 mg/L. Relative to non-amended soil extract, production of sporangia in soil extract amended with 0.06, 1.0, and 4.0 mg/L oryzalin was reduced by 58-84%, 68-100%, and 97-100%, respectively, depending on species. Colony growth on corn meal agar amended with 0.06, 1.0, and 4.0 mg/L oryzalin was reduced by 0-2%, 5-40%, and 56-82%, respectively. P. cambivora was the species most inhibited, P. cactorum the least inhibited. These results suggest that oryzalin concentrations likely to occur in soils treated herbicidally at labeled rates may have a beneficial non-target effect by interfering with the biology of several Phytophthora species that cause crown rot on deciduous fruit trees.

* = Student Paper Competition

FIELD PERFORMANCE OF NUSTARTM FUNGICIDE (FORMERLY DPX H6573).
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Wilmington, DE 19898.

NUSTARTM, a new ergosterol biosynthesis inhibiting fungicide, has been extensively evaluated in orchard trials in the Eastern apple growing region. Data taken over the past several years indicates effective preventive and post-infection activity for control of apple scab, powdery mildew, and cedar apple rust.

PATHOGENESIS OF VENTURIA INAEQUALIS ON IN VITRO- AND
GREENHOUSE-GROWN APPLE CULTIVARS WITH DIFFERENT LEVELS OF RE-

SISTANCE. L.M. Yepes and H.S. Aldwinckle, Plant Pathology
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Four apple (Malus pumila) cultivars with different levels of resistance to Venturia inaequalis, the incitant of apple scab, were grown in vitro and in the greenhouse. Young leaves were inoculated by spraying an aqueous suspension of V. inaequalis conidia. Development of the fungus during the early events of pathogenesis, and concurrent host responses were followed by fluorescent and scanning electron microscopy. On in vitro leaves, V. inaequalis did not form visible lesions on any cultivar. Microscopic examination revealed that conidia germinated, but only limited mycelial development occurred. On greenhouse leaves, germination, appressorium formation, and penetration occurred at similar rates on all cultivars. However, subcuticular stromata were formed only on susceptible cultivars. Reasons for the failure of V. inaequalis to develop on in vitro-grown apple leaves and prospects for the use of modified in vitro screening techniques are discussed.