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ABSTRACTS

ASSESSMENT OF THE 1986 WINTER WHEAT SCAB EPIDEMIC IN NEW YORK. G. C. Bergstrom, D. W. Kalb, A. M. C. Schilder, W. J. Cox, G. E. Harman, and C. Samimy. Departments of Plant Pathology, Agronomy, and Horticultural Science (NYAES), Cornell University, Ithaca, NY 14853.

An epidemic of scab, incited primarily by *Fusarium graminearum*, caused yield reductions estimated conservatively at 10% of the 1986 New York soft white winter wheat crop. Premature spikelet senescence averaged 9% of spike area with maximum severity of 25% in 32 fields inspected at soft dough stage. None of five fungicides applied at late boot stage gave significant scab control. Deoxynivalenol (DON) at levels up to 15 ppm was detected in a few random grain samples; the extent of DON contamination is unknown. An emergency reduction in germination requirements for certified seed was enacted because many seedlots had reduced germination due to *Fusarium* infection. Several fungicides applied to 1986 scabby seed resulted in significant increases over nontreated seed in stand and yield in 1987.

IMPACT OF IPM ON APPLE DISEASE MANAGEMENT. L.P. Berkett, Department of Plant and Soil Science, University of Vermont, Burlington, VT 05405

A random survey of Vermont apple growers was conducted in 1986 to: (1) gain information on current pest management practices; (2) determine whether these practices have changed since the introduction of IPM programs; and (3) evaluate the impact of IPM on apple pest management practices. Sixty-one orchards were surveyed representing 1594 ha or 89% of the total hectares planted to apples in the State. Ninety percent of those surveyed said that they practiced IPM. Respondents rated apple scab, caused by *Venturia inaequalis* (Cke.) Wint., as the most important pest problem. Eighty-three percent of IPM users collect weather data to determine apple scab infection periods. Forty-one percent of IPM users have seen a decrease in the use of fungicides while 60% reported improved timing of applications since their involvement in IPM.

Genetic diversity among double-stranded RNA (dsRNA) sequences found in isolates from 5 anastomosis groups (AG) of *Rhizoctonia solani*. N. Bharathan and S.M. Tavantzis. Department of Botany and Plant Pathology, University of Maine, Orono, Maine 04469.

The relatedness of dsRNA present in 29 naturally occurring isolates of *R. solani* was examined by Northern blot (RNA-RNA) hybridization. The dsRNA's studied were purified from members of AG 1, AG 2, AG 3, AG 4 and AG 5 differing in virulence and degree of somatic incompatibility. DsRNA's were fractionated on agarose gels, transferred electrophoretically to Hybond membranes and hybridized with ³²P-5'-end-labeled fragments of denatured dsRNA. Probes were individual dsRNA segments selected on the basis of AG, virulence, and somatic incompatibility. The data show that considerable sequence homology exists among dsRNA's within each AG. In contrast no relationship was found among dsRNA species occurring in different AG's. Finally, it appears that sequence homology exists among isolates with varying degrees of somatic incompatibility and of diverse geographic origin.

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HYPOVIRULENCE, DEBILITATION AND DOUBLE-STRANDED RNA IN *SCLEROTINIA SCLEROTIORUM*. G.J. Boland. Department of Environmental Biology, University of Guelph, Guelph, Ontario, Canada. N1G 2W1.

A debilitated isolate of *Sclerotinia sclerotiorum* with a slow growth rate and discolored mycelium was compared with five healthy isolates for virulence and the presence of double-stranded RNA (dsRNA). Lesions caused by the debilitated isolate on celery petioles and bean leaves were 0-25% as wide as lesions caused by healthy isolates. The debilitated isolate contained six dsRNA segments whereas no dsRNA was detected in healthy isolates. Transmission of the disease to healthy isolates by hyphal anastomosis was associated with transmission of the dsRNA segments. Disease and dsRNA also were transmitted by sclerotia.

USE OF HOST RESISTANCE IN MANAGING THE GOLDEN NEMATODE. B. B. Brodie, USDA, ARS, Department of Plant Pathology, Cornell University, Ithaca, NY 14853.

Host resistance was investigated as a management tactic for varying population densities of the golden nematode (GN), *Globodera rostochiensis*. Four different cropping systems utilizing GN resistant and susceptible potato cultivars and a nonhost crop were followed for 3 years. Field plots (9x15 m) naturally infested with GN at densities of <1 eggs/cm³, 1-4 eggs/cm³, 4-15 eggs/cm³, and >15 eggs/cm³ of soil were established for each cropping system. Changes in nematode population densities, were determined from soil samples taken each year after harvest (October). Planting a resistant cultivar in alternate years effectively managed GN when initial nematode densities were <1 egg/cm³ of soil. Initial densities of 1-4 and 4-15 eggs/cm³ of soil required 2 successive years of a resistant cultivar or 2 years of resistance followed by a nonhost, respectively. Initial densities of >15 eggs/cm³ of soil required more than 2 successive years of a resistant cultivar to successfully manage GN. These data indicate that the frequency of host resistance required to manage GN depends upon initial nematode density.

BLUEBERRY STEM CANKER INCIDENCE AND ITS EFFECT ON YIELD IN NEW JERSEY. L.M. Carris and A.W. Stretch, Dept. of Plant Pathology and USDA-ARS, Rutgers University, Blueberry and Cranberry Research Center, Chatsworth, NJ 08019.

During 1986-1987, blueberry stem canker (caused by the fungus *Botryosphaeria corticis*) was found on 13 commercial highbush blueberry cultivars in southern New Jersey. Two fields of cv. Collins surveyed in 1981 had an increase in stem canker incidence in 1987 from 11 and 31% to 94 and 91%, respectively. A cv. Bluecrop field showed a modest increase in stem canker from 5% in 1981 to 18%. Field observations indicate that infected canes are more susceptible to winter kill. A study on the effect of stem canker on winter hardiness, flower number, fruit set and yield was initiated in March, 1987 on cvs. Bluecrop and Collins. Results indicate no significant difference in fruit set and total yield between pairs of cankered and canker-free canes. There was an increase in berry size on cankered canes over canker-free canes in both cultivars, but only cankered Bluecrop canes had a significant reduction in numbers of flowers/bud.

THE RELATION OF INCUBATION TEMPERATURE IN THE DIAGNOSIS OF CRANBERRY FRUIT ROT. F.L. Caruso, Cranberry Experiment Station, University of Massachusetts, East Wareham, MA 02538

At least twelve different fungi are capable of causing field or storage rot in cranberries. Individual berries have occasionally been shown to harbor five separate fungi when plated out on culture media. Proper diagnosis of the primary causal agent is dependent on the temperature at which the sampled berries are incubated. Cranberries (cultivars Early Black and Crowley) with typical rot symptoms were sampled in July, August, September (field collection) and October (while in storage). Individual berries were cut into thirds, surface-sterilized, and placed on three acidified corn meal agar plates. Plates were incubated at 15, 22, and 30 C. Results of this study and their implications to rot diagnosis will be discussed.

EFFECTS OF OXYTETRACYCLINE, PENICILLIN, AND STREPTOMYCIN ON MLO POPULATION IN WHITE ASH TREES. B. Cha and T. A. Tattar. Shade Tree Labs., Dept. of Pl. Path., UMASS, Amherst, MA. 01003.

Forty five white ash (Fraxinus americana) average dbh 30cm naturally infected with ash yellows (AY) MLO were injected in July, 1987 with oxytetracycline, penicillin, and streptomycin using the Maugé system at three dosage levels: average dosages of OTC were 1.0g, 1.3g, and 1.9g, penicillin were 0.08g, 0.1g, and 0.16g, and streptomycin were 0.01g, 0.013g, and 0.019g. Fluctuations of MLO population in AY-MLO infected ash trees were monitored by DAPI staining. Only OTC affected MLO population. In OTC-trees, staining decreased in number and intensity or disappeared entirely one week after injection. At higher dosages, the effect was stronger and lasted about 2 weeks longer. However, OTC-trees showed no difference in MLO population from non-injected trees 1 month later. In 20 non-injected control trees, staining was constant during the study. Yellows agents appeared to be MLO, since the agent was sensitive to OTC but not to penicillin and streptomycin.

DEVELOPMENT OF A GENE PROBE FOR IDENTIFICATION AND DIFFERENTIATION OF SPIROPLASMA CITRI FROM OTHER SPIROPLASMAS IN SEROGROUP I. K. H. Chen and T. A. Chen, Department of Plant Pathology, NJAES, Rutgers University, New Brunswick, NJ 08903.

A library of genomic sequences from S. citri strain C189 was constructed. Hind III partial digestion fragments from S. citri were ligated to plasmid vector pBR322 and used to transform Escherichia coli strain HB101. Recombinants were screened for expression of S. citri antigens by ELISA using polyclonal antiserum raised in mice against strain C189. Of 950 transformants screened, five clones were found positive for expression. The recombinant plasmids in two of the clones contain a 6.7 kb DNA fragment. Dot hybridization, using biotinylated cloned DNA as a probe, shows that this fragment strongly hybridizes with S. citri DNA. In this test, weak hybridization with DNA from two other spiroplasmas from honey bee and corn (Corn Stunt spiroplasma) was evident.

COMPARISON OF POWDERY MILDEW EPIDEMICS ON WHEAT CULTIVARS WITH DIFFERING DISEASE RESISTANCE. B. J. Christ and M. L. Risius. Departments of Plant Pathology and Agronomy, The Pennsylvania State University, University Park, PA 16802.

Five cultivars of wheat were assessed starting at growth stage 10.4 (Feeke's scale, Large 1954) for severity of powdery mildew. Tyler, Redcoat, and Twain are susceptible, partial resistant and resistant cultivars, respectively, while resistance in lines 2550 and 2551 were unknown. Disease progress on 2551 and 2550 followed the pattern of Tyler and Redcoat, respectively. There was no significant difference in mildew severity among these four cultivars. Trace amounts of mildew were found on Twain which indicates that the pathogen population is changing for increased virulence matching the resistance gene in Twain.

TESTING A FIELD TECHNIQUE TO MEASURE APPLE TREE CANOPY DENSITY. G. G. Clarke, K. D. Hickey, and J. W. Travis, Dept. of Plant Pathology, Penn State Univ., University Park, PA 16802

Three tree canopy density levels were established by pruning to approximate heavily pruned, moderately pruned, and unpruned situations in a commercial block of York Imperial apples. Trees were ca. 16 ft high, 24 ft wide with 32 ft between rows and spherical in shape. Each density level was replicated 4 times and canopy density was measured using a light meter on an overcast day. A total of 10 measurements were taken under each tree at a height of ca. 1 meter. Mean percentages of light penetration for heavily, moderately, and unpruned situations were 18.3, 7.5, and 5.2, respectively. The largest

variation in measurements occurred in the heavily pruned situations. Coincident with these measurements was an experiment evaluating tree canopy density and its effects on spray deposition. This technique for measuring canopy density is both simple and reproducible and may be useful in commercial and research applications.

DEVELOPMENT OF AN EXPERT SYSTEM TO DIAGNOSE AND ADVISE TREATMENT FOR APPLE TREE ROOT DISORDERS. D. Cooley, P. Cohen & T. Gruber. Dept. of Plant Pathology, UMASS, Amherst, MA. 01003.

Computer-based decision support systems (DSS) can be a valuable tool for plant disease diagnosticians and agricultural consultants. So-called expert systems are being developed for use in several commodity areas, for use in IPM and other Extension programs. We developed a system which diagnoses and advises treatment for apple root disorders, including diseases and other stresses. Early prototypes were developed on LISP machines (Texas Instruments "Explorer") using Mu, an inference engine and developers interface originally developed for medical diagnostics and treatment recommendations. The knowledge base was then used to develop a microcomputer-based system using the commercial shell, Personal Consultant Plus (Texas Instruments). This system was satisfactorily tested against theoretical problems, and will be tested in the field in 1988. It is anticipated that the root disorder expert system will be part of a microcomputer-based DSS for apple production.

INFLUENCE OF HOST RESISTANCE ON THE INITIAL APPEARANCE OF FOLIAR LATE BLIGHT OF POTATO FROM INFECTED SEED TUBERS. M. A. Doster and W. E. Fry, Dept. of Plant Path., Cornell University, Ithaca, NY 14853.

Seed tubers of susceptible and resistant potato cultivars were inoculated with Phytophthora infestans and planted in fields in New York State during 1983-1987. Plants emerged from only 37% of the infected tubers, but 95% of the noninoculated tubers. Blight was observed first on foliage of susceptible cultivars in 1983 and 1984, but on the resistant cultivar Rosa in 1985. Therefore, at least for some resistant cultivars prediction of the initial appearance of foliar blight may be similar to that for susceptible cultivars. Blight was first observed 5, 6, 9, and 11 days after the cumulation of 18 severity values (as defined by Blitecast). With the use of severity values the initial appearance of foliar blight could be predicted accurately. Only in one year did initial blight occur during the period 7-14 days after the accumulation of 10 rain-favorable days (as predicted by Blitecast).

FUNGI ASSOCIATED WITH A NEEDLE BLIGHT OF PINUS STROBUS IN THE NORTHEAST. T. Dreisbach, W. Merrill, and J. M. Skelly, Dept. of Plant Pathology, Penn State Univ., University Park, PA 16802

Needle blight of Pinus strobus, characterized by tip dieback and necrosis of first- and second-year needles, occurs from WV to ME, and is widespread in Acadia N. P., ME. Symptomatic '86 needles collected in Acadia N. P. in May '87 bore fruiting bodies of the following fungi: Bifusella linearis, Hendersonia pinicola, Septoria sp., Hemiphysalium sp., Leptostroma sp., and Truncatella sp. Symptomatic '86 needles collected in VT, NH, and ME in July '87 yielded these additional species: Lophodermium sp., Cryocaligula sp., Meloderma desmazierii, and Sirococcus strobilinus. Necrotic '87 needles collected in VT, NH, and ME in July '87 yielded H. pinicola, and Septoria sp. Symptomatic needles from WV and PA yielded M. desmazierii. These results indicate that numerous needlecast and needle blight fungi, as well as fungi of unknown pathogenicity, are associated with needle blight of P. strobus in the Northeast. Some of these fungi are established in needles <2 months old.

HETEROTHALLISM AND PATHOGENIC SPECIALIZATION IN UNCINULA NECATOR. David M. Gadoury and Roger C. Pearson, Department of Plant Pathology, Cornell University, Geneva, New York 14456.

At least two mating types occurred in a collection of single-spore isolates of Uncinula necator from 10 Vitis and 2 Parthenocissus species. Isolates from Vitis spp. sporulated within 5-6 days at 20 C on tissue culture plants of the Vitis interspecific hybrid cultivar Chancellor *in vitro*. However, only 16 of 35 grape isolates sporulated on tissue culture plants of Parthenocissus quinifolia, with latent periods of 10 to 41 days. Isolates from P. quinifolia and P. tricuspidata also sporulated in 5-6 days at 20 C on tissue culture plants of P. quinifolia and P. tricuspidata, respectively, but grew poorly or not at all on Chancellor or Vitis labrusca 'Concord'. The pathogenic specialization of grape isolates, although not evident on Chancellor, may be evident on other Vitis cultivars and should be considered in selection of cultivars for resistance to powdery mildew. Further research will involve the selection of differential hosts to determine the nature of pathogenic specialization in U. necator, i.e., whether the specialization is in the form of pathogenic races, *formae speciales*, or both.

SITONA/FUSARIUM/COLD HARDINESS INTERACTION IN ALFALFA. Alan R. Gotlieb, Norman E. Pellett, and Bruce Parker, Plant & Soil Science Dept., University of Vermont, Burlington, VT 05405.

Over the past 10 years, alfalfa stand longevity has decreased in many fields in Vermont from 6 years to 3 years. In 1983 we found several 2-year-old stands in southern Vermont dying out in the fall of the second year. Root examination revealed feeding injury from *Sitona hispidula* which resulted in root infection and severe root rot. The predominating fungus isolated was *Fusarium oxysporum*. *Sitona* injury first appears in June the year after establishment. At first, *Sitona* damage is only to the surface of the root, but by late June 4th and 5th instar larvae penetrate into the root and cause deep feeding wounds (DFW). The number of DFW per root are directly correlated with the severity of root rot which increases through the summer and fall. As DFW and vascular discoloration increase, alfalfa cold hardiness is reduced (measured by electrolyte leakage after laboratory freezing). Alfalfa stand reduction due to the *Sitona/Fusarium* complex has now been found throughout Vermont.

INFESTATION OF WOUNDED ROOTS OF *PINUS STROBUS* BY *BURSAPHELENCHUS XYLOPHILUS* FROM CONTAMINATED WOOD CHIPS MIXED IN SOIL. S. Halik and D.R. Bergdahl. Department of Forestry, The University of Vermont, Burlington, VT 05405

White pine (*Pinus strobus*) wood chips were inoculated with an isolate of *Bursaphelenchus xylophilus* from that host and incubated at 30°C for 8 wks. After incubation, the average wood moisture content (mc) was about 130% based on oven dry weight (ODW) and the nematode population was about 50/g ODW. Uninfested wood chips (130% mc) were used as a control. For each treatment, approximately 150 g of wood chips were mixed with soil in each of 12 one liter pots. Wounds were made at 3 locations on the roots of 24 (12 per treatment) five-year-old white pines by scraping the bark to expose xylem tissue. Seedlings were potted in these chip-soil mixtures and maintained in the greenhouse up to 12 wks at 18-29°C. Seven of 12 seedlings treated with nematode-infested chips wilted and *B. xylophilus* was extracted from roots and stems. Histological studies showed *B. xylophilus* only in tissues of inoculated seedlings.

BEECH BARK DISEASE: ASSOCIATION OF *NECTRIA OCHROLEUCA* IN W. VA., PA., AND ONTARIO. David R. Houston and Eileen M. Mahoney, USDA Forest Service, 51 Mill Pond Road, Hamden, CT and Bruce H. McGauley, Dept. of Parks and Recreation, 2450 McDougall St., Windsor, Ontario N8X 3N6.

Beech bark disease (BBD) occurs when bark, fed upon by the beech scale (*Cryptococcus fagisuga*), is invaded and killed by *Nectria coccinea* var. *faginata* (NCF) and/or *N. galligena* (NGA). In 1986, in several stands on the Allegheny Nat'l Forest in western Pa., the Monongahela Nat'l Forest, W. Va., and in woodlots north of Toronto, Ontario, a third *Nectria*, *N. ochroleuca* (NOL) was found associated with dead trees and dying scale-infested trees. NOL sporodochia and perithecia occurred in abundance, in some stands alone, in others along with NGA. On inoculated dormant beech logs, NOL was significantly less pathogenic than NGA or NCF. Pathogenicity trials on scale-infested trees are underway. This is the first report of (1) NOL associated with trees dying of BBD anywhere, and (2) of NGA associated with BBD in Ontario.

FUSARIUM SPECIES PRESENT IN SOILS OF THE TRANSKEI, SOUTHERN AFRICA. N. Jeschke and P. E. Nelson, University of Massachusetts, Suburban Experiment Station, Waltham, MA 02154; Department of Plant Pathology, The Pennsylvania State University, University Park, PA 16802

While *Fusarium* species present in soils of North America and Europe have been well studied, few studies exist determining the species present in African soils. This study reports the occurrence of *Fusarium* species present in grassland soil collected at different altitudes in the Transkei, Southern Africa. The species most commonly isolated were *F. oxysporum* (32% of 1247 total isolates), *F. equiseti* (26%), *F. nygamai* (9%), *F. semitectum* (9%), *F. solani* (7%), *F. chlamydosporum* (4%), and *F. merismoides* (4%). Fifteen other species, including three unidentified species, accounted for 0.1% to 2% of the total isolates.

PRODUCTION AND CHARACTERIZATION OF MONOCLONAL ANTIBODIES AGAINST THE PEACH EASTERN X-DISEASE AGENT. Y. P. Jiang*, T. A. Chen* and L. N. Chykowski**, *Department of Plant Pathology, NJAES, Rutgers University, New Brunswick, NJ

08903 and **Chemistry and Biology Research Institute, Agriculture Canada, Ottawa, Ontario, KIA 0C6

Monoclonal antibodies (Mabs) against the peach Eastern X-disease agent (EX), a mycoplasma-like organism (MLO), were produced by using a partially purified EX-MLO from infected celery plants as an antigen. Nine hybridomas, secreting Mabs that reacted with EX-MLO in diseased celery, were selected by enzyme-linked immunosorbent assay. The Mabs produced by the nine hybridomas reacted with three different protein bands of EX-MLO in Western blots. Indirect immunofluorescence tests showed that four of the nine Mabs reacted with surface epitopes of EX-MLO. The cell membrane-specific Mabs will be used in affinity chromatography to attempt to highly purify the EX-MLO.

POTENTIAL USE OF BACTERIA FOR BIOCONTROL OF ALFALFA FOLIAR DISEASES. M. E. Jones, F. L. Lukezic, Dept. of Plant Pathology, Penn State Univ., K. T. Leath and R. R. Hill, Jr., ARS-USDA, University Park, PA 16802

Bacteria isolated from greenhouse or field-grown alfalfa, or obtained from other laboratories were tested in vitro for antagonism against the foliar pathogen, *Phoma medicaginis*. Thirty-two isolates reduced conidial germination below 25%. In greenhouse trials, only two of the antagonists consistently reduced the incidence of disease. One of these, a *Flavobacterium* species isolated from alfalfa leaves in the field, reduced *Phoma* leaf spot only slightly in field tests. An antibiotic marked strain of this isolate was tested for survival on alfalfa in the field. Uniform leaf sections sampled at 0, 1, and 12 hours, and also 11 days after inoculation yielded about 1.3×10^4 CFU/ml when plated on antibiotic media. In-vitro antagonism was not a good indicator of efficacy under greenhouse or field conditions. Factors other than survival and antagonism may be limiting in the development of successful antagonists.

NUTRITIONAL DISTURBANCES OF NORWAY SPRUCE IN THREE NORTHEASTERN STATES. J. Ke, J. M. Skelly, and D. Karasevich, Dept. of Plant Pathology, Penn State University, University Park, PA 16802

Twelve major and trace nutrient elements were determined in needles of Norway spruce [*Picea abies* (L.) Karst.] during the 1987 summer. Needles were collected from 7 plots (3 plots in Pennsylvania, and 2 plots each in New York and New Hampshire). Two branches from each of 15 trees in each plot were removed from the upper and lower crown. Needles by yearly internode were washed with CHCl_3 for 1 minute, rinsed with distilled water for 30 seconds, and then immersed 3 times in each of two successive beakers containing Ultrapure, ion-free, organic-free water. Needles were dried, ashed and analysed with a spectrometer. The Mg-content of most of the 2nd to 6th needle year complements, especially for the symptomatic trees, was 0.02% to 0.05%, levels below the deficiency threshold value for this species. The older needles were yellowed while the current needles of the symptomatic trees were green. Mg nutrient content of soil as collected and analysed from under the symptomatic trees was likewise deficient.

EFFECTS OF INOCULUM DENSITY OF *STREPTOMYCES SCABIES* AND POTATO CULTIVAR ON SCAB SEVERITY AND RHIZOSPHERE POPULATION DENSITY. A. P. Keinath and R. Loria, Department of Plant Pathology, Cornell University, Ithaca, NY 14853.

The inoculum density-disease severity relationship for common scab of potato was determined under greenhouse and field conditions. The cultivars Chippewa (scab-susceptible), Superior (scab-resistant), and NY64 (moderately susceptible) were inoculated with 2 rifampin-resistant isolates of *S. scabies*, each at 3 inoculum densities, in 2 greenhouse experiments. Disease severity and rhizosphere population density increased with inoculum level. However, rhizosphere population density was not related to cultivar resistance. NY64 supported a significantly lower rhizosphere population density than the other cultivars in one greenhouse experiment. In a field trial with 7 cultivars, NY64 also had the lowest rhizosphere population density for melanin-producing actinomycetes, a population which includes wild-type *S. scabies*. Disease severity was not consistently related to rhizosphere population density in any experiment.

FUNGICIDES FOR ORANGE RUST CONTROL ON BLACK RASPBERRY. W. C. Kleiner, J. W. Travis, and K. D. Hickey, Dept. of Plant

Pathology, The Pennsylvania State University, University Park, PA 16802

Orange rust of brambles, caused by the long cycled form Arthuromyces peckianus, is a perennial disease affecting commercial black raspberry production in Pennsylvania. Because there are no fungicides known to be effective on orange rust of black raspberries, greenhouse fungicide evaluations were conducted. The fungicides were applied as protectants, before infection occurred, and as eradicants after infection. Used as protectants metiram, flusilazol, and myclobutanil were effective in controlling orange rust. Flusilazol and myclobutanil, two sterol-inhibiting fungicides were effective controlling orange rust after infection. Fungicides have the potential for use in an orange rust management strategy for black raspberry.

INTERACTION BETWEEN ACID RAIN AND DROUGHT STRESS ON FIELD CORN. R. Knittel, E. J. Pell, Dept. of Plant Pathology, and D. P. Knievel, Dept. of Agronomy, The Pennsylvania State University, University Park, PA 16802

An experiment was conducted in 1986 to test the hypothesis that acid rain could predispose field grown Zea mays (cv B73 X Mo17) to drought stress. Mobile greenhouses served to exclude ambient rain and to deliver simulated acid rain (SAR). Plants were treated with 1.5 cm SAR of pH 3.0 or 5.0 twice weekly from 12 June to 30 Sept. A drought was imposed at tasseling by withholding SAR from half of the plants. The drought ended when wilting was observed; a second drought followed one week later. Adaxial leaf conductance was measured in full sun (>900 $\mu\text{E}/\text{m}^2/\text{s}$) and in shade (<100 $\mu\text{E}/\text{m}^2/\text{s}$). At harvest, yield was determined by final stover weight, grain yield, kernel weight and kernel number. Drought, but not pH decreased all yield parameters. A significant drought X rain pH interaction showed more kernels/ear and a lower leaf conductance for plants treated with SAR of pH 3.0 under drought conditions. The experiment has been repeated in 1987.

EFFECTS OF OZONE ON YELLOW BIRCH SEEDLINGS INOCULATED WITH CENOCOCCUM GRANIFORME, LACCARIA LACCATA AND PAXILLUS INVOLUTUS. Dept. Plant Path., Univ. Massachusetts, Amherst, MA. 01003. D. L. Krupczak and W. J. Manning.

Four-week-old yellow birch seedlings (Betula alleghaniensis), grown in a peat-vermiculite medium, were transplanted into twice steamed birch woodland soil and divided into four treatments (40 plants each): (1) non-inoculated soil (NI) (control) and soil broadcast inoculated with mycelium of either (2) Cenococcum graniforme, (3) Laccaria laccata, or (4) Paxillus involutus. All plants were kept in chambers with carbon-filtered air (CF). Half of the seedlings in each treatment received CF plus ozone (O_3) (0.06-0.08 ppm, 8 hr/day, 5 day/week) for 12 weeks. Mycorrhizae increased growth parameters compared with NI plants. C. graniforme had the greatest stimulatory effect on plants in O_3 and CF. Plants mycorrhizal with L. laccata and P. involutus did not differ significantly from one another in O_3 and CF, nor did they differ from NI plants in O_3 . O_3 stimulated growth of NI birch.

EVALUATION OF CHEMICAL SEED TREATMENTS, GERMINATION AND GROWTH TEMPERATURES ON NODULATION AND DISEASE INCIDENCE IN LUPIN. S.S. Leach USDA/ARS, Univ. of Maine, Orono, ME 04469.

Lupins germinated 80% at 13 C and 0% at 7 C. Lupins grown in Phythyum ultimum infested soil in the greenhouse (13-20 C) produced nodules on only 30% of the plants compared to 52% when grown at 13 C. Plants germinated at 7 C and grown at 13-20 C produced nodules on 37.5% of the plants. Seeds inoculated with Rhizobium and grown in P. ultimum infested soil had the poorest stand at all temperatures. Rhizobium also reduced nodulation when Pythyum was present. Apron treated seeds produced the best stands in infested soil and when Rhizobium was applied before Apron. Nodulation was also affected by germination and growth temperatures. There appears to be an interaction between Rhizobium and Pythyum which prohibits nodulation. In other seed treatment tests vitavax and CGA-449 gave the best control against Rhizoctonia solani and Fusarium spp.

ACTIVITY OF FUSARIUM SPECIES IN FEEDING SITES OF CLOVER ROOT CURCULIO LARVAE IN ROOTS OF ALFALFA. K.T. Leath and A.A. Hower. ARS-USDA, Depts. of Plant Pathology and Entomology, Penn State University, University Park, PA 16802.

Larval feeding by the clover root curculio, Sitona hispidulus (F.), causes severe injury to roots of alfalfa. Fusarium species are frequent colonizers of such sites. The fungal populations were characterized in feeding sites in alfalfa roots from the same field during a 3-year period. Fungi were isolated from three sites on each of 100 roots in the spring and fall each year. Isolations were made on acidified water agar following surface sterilization of the root piece. Additional isolations were made from root tissue centripetal to the feeding site to determine the internal spread of the fungi. Fusarium spp. were the fungi most commonly isolated, and F. oxysporum constituted 65% of all fungi isolated. F. solani and F. avenaceum also were frequently isolated. Colonization of root tissue adjacent to the feeding site occurred slowly.

INFECTION OF APPLE PROTOPLASTS WITH TOBACCO MOSAIC VIRUS. X. H. Li, G. N. Agrios and M. E. Walker. Department of Plant Pathology, University of Massachusetts, Amherst, MA. 01003.

Apple protoplasts obtained from callus were inoculated with tobacco mosaic virus (TMV) in the presence of poly-L-ornithine (PLO). Protoplasts were successfully infected with TMV at 10-100ug/ml and PLO at 5-20ug/ml. The best protoplast infection results were obtained when 5×10^5 protoplasts/ml were inoculated with final TMV concentrations ranging from 20 to 50ug/ml while PLO was kept at 10ug/ml. The protoplasts and the inoculum were mixed for 10 minutes. The protoplasts were then washed to remove excess TMV and incubated for 42-72 hrs at 25°C. Inoculation results were monitored by ELISA. An increase of TMV antigen in apple protoplasts could be detected as early as 6 hrs after inoculation and reached a maximum concentration 24-36 hrs after inoculation. A 10-fold increase in ELISA readings (absorbance at 405 nm) was obtained under the above conditions at 24-36 hrs compared to the readings at the completion of inoculation.

STEM AND LEAF RUST ALTER THE RATE AND DURATION OF WHEAT GRAIN GROWTH. M. T. McGrath and S. P. Pennypacker, Dept. of Plant Pathology, Penn State University, University Park, PA 16802

Grain growth of winter wheat infected after anthesis by stem and leaf rust fungi was investigated during the 1987 field season. Disease gradients were established from spreader rows that were artificially inoculated with Puccinia graminis f. sp. tritici and naturally inoculated with P. recondita f. sp. tritici. At 5 day intervals, plants were assessed for disease and grain samples were collected from fungicide-treated and nontreated plots differing in date of disease onset and AUDPC. Piecewise linear regression models fit to square root transformed growth data disclosed that grain dry weight increased linearly (0.19 $\text{mg}^2/\text{grain}/\text{day}$) prior to the influence of rust. From 20 to 25 days after anthesis (growth stage 11.2), growth rates were inversely related to disease pressure and ranged from 0.04 to 0.16 $\text{mg}^2/\text{grain}/\text{day}$. Severe stem rust infection (AUDPC for peduncle >370 percent-days) also reduced the duration of grain growth from 30 to 25 days.

CLONING AND EXPRESSION IN ESCHERICHIA COLI OF AN ERWINIA AMYLOVORA GENE WHICH ENCODES A SPECIES-SPECIFIC ANTIGEN. R. J. McLaughlin*, J. M. Wells*, and T. A. Chen**, *USDA-ARS-NAA, ERRC, Philadelphia, PA 19118 and **Dept. of Plant Pathology, Cook College, Rutgers University, New Brunswick, NJ 08903.

Hind III restriction fragments of chromosomal DNA from E. amylovora strain 477 were ligated into plasmid pBR322 and used to transform E. coli strain HB101. Transformants were screened for the expression of E. amylovora antigens by ELISA using a cocktail of eight species-specific monoclonal antibodies. Of 1300 transformants screened, two clones were found to contain a 5 kb fragment which has a gene that encodes for expression of an E. amylovora antigen. Indirect immunofluorescence microscopy showed that the clones express the antigen on the outer cell surface, as does E. amylovora. Two of the eight monoclonal antibodies used in the initial clonal selection react with the antigen that is expressed by the clone. Each of these monoclonal antibodies are of different sub-isotypes (IgG1 and IgG2b).

CHARACTERIZATION OF MONOCLONAL ANTIBODIES THAT ARE SPECIES-SPECIFIC AGAINST ERWINIA AMYLOVORA ANTIGENS. R. J. McLaughlin*, J. M. Wells*, and T. A. Chen**, *USDA-ARS-NAA, ERRC, Philadelphia, PA 19118, and **Department of Plant Pathology, Cook College, Rutgers University, New Brunswick, NJ 08903.

A total of eight monoclonal antibodies (MA's), specific against *E. amylovora* strains in ELISA tests, were sub-isotyped and characterized as to type of antigen they were against. Three of the MA's were sub-isotyped by ELISA as belonging to group IgG1, four as IgG2b, and one as IgG2a. In ELISA tests with each MA, loss of titer was evident after treatment of whole cell sonicates with Pronase or heat (100 C, 15 min). All of the MA's were against outer cell surface antigens, as shown by indirect immunofluorescence microscopy. Specific reactions were also evident in Western blots of whole cell lysates of *E. amylovora*, which enabled separation of the MA's into four groups. Results of these tests indicate that all of the MA's are directed against outer surface proteins and that at least six of the eight MA's are directed against unique epitopes.

BIOLOGICAL CONTROL OF GRAY MOLD FRUIT ROT OF STRAWBERRY
M.A. McLean and J.C. Sutton. Dept. of Environmental Biology, University of Guelph, Guelph, Ontario. N1G 2W1

Yeasts and bacteria were isolated from the strawberry phylloplane and evaluated in the laboratory for inhibition of *Botrytis cinerea* on strawberry leaf discs. Two yeast isolates (B24C6, G33C5) and one bacterial isolate (B24C4), which significantly suppressed sporulation of *B. cinerea* on the discs, were tested for suppression of the pathogen on strawberry in the field. All isolates were applied at 10⁶ cfu/ml in water with surfactant and the yeasts also were applied in an aqueous nutrient solution (2% sucrose and 0.1% yeast extract) with surfactant. The foliage, flowers and fruit of the strawberry plants were sprayed to runoff with the various suspensions, twice in the autumn of 1986 and 5 to 8 times in the spring of 1987. Isolates B24C4 and G33C5 (in water or nutrient solution) significantly reduced the incidence of *B. cinerea* on both petals and calyxes from 60% to 10% but were ineffective on leaves. We conclude that the biocontrol agents tested suppressed *B. cinerea* when applied to blossoms.

ENDOCRONARTIUM RUST GALLS ON SCOTS PINE PREFERRED FEEDING SITES OF PALES WEEVILS. W. Merrill, Dept. of Plant Pathology, The Pennsylvania State University, University Park, PA 16802

Endocronartium harknessii causes stunting, branch dieback, witches' brooming, and mortality of Scots pine Christmas trees. Pales weevil (*Hyllobius pales*) feeds on bark of young stems and twigs, often girdling them. Pales weevil feeding damage was noted primarily on rust galls on second-year internodes of infected trees. Eight twigs were selected at 1.4 m on each of 10 severely galled (>300 galls/tree) trees 2-2.5 m tall spaced along a 0.25 km transect through the plantation. Lengths and diameters of galled and non-galled portions, and numbers and diameters of pales weevil feeding sites on the second-year internodes were measured. Feeding sites involved 8.4 times more of the surface area of galled than non-galled portions of twigs ($P = .023$). Feeding on some galls girdled the twigs. Branch dieback in galled Scots pine should not be attributed solely to the rust fungus.

NEEDLE BLIGHT OF PINUS STROBUS IN THE NORTHEAST. W. Merrill, T. Dreisbach, R. Hellmann, and J. M. Skelly, Dept. of Plant Pathology, Penn State Univ., University Park, PA 16802

Blighting of first-year needles of *Pinus strobus* (EWP), attributed to ozone or "semi-mature tissue needle blight," has been widespread in Acadia National Park, ME for several years. Surveys in June and July 1987 showed similar-appearing trees at widely separated upland and lowland sites in ME, NH, VT, WV and PA. Affected EWP in all areas showed chlorosis of some first-year needles as early as July followed by necrosis of needle tips or entire needles. Usually, however, not all needles in a single fascicle were affected, as would occur if the blighting was caused by an abiotic agent. Re-examination of plots in Maine in late August 1987 showed only traces or no symptoms of ozone injury on susceptible indicator plants such as *Prunus serotina*, *Rubus allegheniensis*, and *Asclepias syriaca*. These preliminary studies suggest that biotic agents are associated with this needle blight syndrome.

DETECTION OF DOUBLE-STRANDED RNA FROM SQUASH INFECTED WITH TOMATO RINGSPOT VIRUS (TomRSV). S. Mohan and T. A. Chen, Dept. of Plant Pathology, Cook College, Rutgers University, New Brunswick, NJ 08903.

Squash plants (*Cucurbita pepo* var. *melopepo*, cv. 'Elite') were either infected or left uninfected with TomRSV. Fourteen days after inoculation, preparations were made from symptomatic leaves using standard dsRNA isolation techniques. Double-stranded RNA

was eluted from a 10 cm CF-11 cellulose column in STE buffer (0.1 M NaCl, 0.05 M Tris, 1mM EDTA, pH 7.0). Double-stranded RNA species were detected in infected squash plants but not in healthy plants. Isolation of dsRNA required 25 to 50g of plant material to get any detectable amounts of dsRNA. Mini-preparations for the isolation of dsRNA did not result in recovery of detectable dsRNA. Electrophoresis in polyacrylamide and agarose gels showed three dsRNA species. These dsRNA species were resistant to treatments with DNase and RNase A.

ABSENCE OF 3' POLYADENYLATION IN THE RNA OF A TOMATO RINGSPOT VIRUS (TomRSV) ISOLATE. S. Mohan and T. A. Chen, Dept. of Plant Pathology, Cook College, Rutgers University, New Brunswick, NJ 08903

Polyadenylation of tomato ringspot virus and other NEPO viruses was reported as early as 1979 (Mayo et al., J. Gen. Virol. 43:603-610). We report here the unusual absence of a poly(A) tail at the 3' end of the RNA of a TomRSV isolate. After the sucrose density gradient centrifugation, the viral RNA was purified from the nucleic acid-rich middle and bottom components using the SDS-phenol procedure. The RNA was precipitated twice with ice-cold ethanol and the pellet was dissolved in the oligo d(T) loading buffer (10 mM Tris, pH 7.5; 0.5 M NaCl; 1.0 mM EDTA; 0.1% SDS). This RNA was then passed through an oligo d(T) cellulose column pre-equilibrated with loading buffer. After several washings of the column with loading buffer, the bound RNA was eluted out with elution buffer (10 mM Tris, pH 7.5; 1.0 mM EDTA; 0.05% SDS). Most of the viral RNA was eluted from the column in the loading buffer, indicating absence of poly(A) region in the viral genome.

SYMPTOM OCCURRENCE OF VERTICILLIUM DISEASE OF AGARICUS BISPORUS AS RELATED TO INOCULUM CONCENTRATION AND THE STAGE OF SPOROPHORE DEVELOPMENT. L. N. North and P. J. Wuest, Penn State University, University Park, PA 16802.

A disease of the button mushroom, *Agaricus bisporus*, Verticillium spot, caused by *Verticillium fungicola*, is characterized by necrotic lesions on the pileus. Neither the amount of inoculum nor the relationship between inoculum density and time for lesion development is known. Use of a model 4710 Eppendorf pipette allowed quantified amounts of aqueous inoculum to be positioned on pilei at three growth stages: primordium (I), immature sporophore (II), and maturing sporophore (III). Mushroom pilei received 5 µl droplets of inoculum and were observed until a lesion developed. Lesions developed before harvest with inoculum at 10 x 10⁶, and on most stage I and II sporophores when inoculated at 2 x 10⁶. Lesions failed to develop before harvest at 2 x 10⁵, although lesions developed following 12 to 48 hr incubation. The role of inoculum and growth stage on symptom development should be included in epidemiological and crop loss studies with this disease.

DISTRIBUTION OF FUSARIUM SPECIES ON MILLET FROM NIGERIA, LESOTHO AND ZIMBABWE. N. B. Onyike and P. E. Nelson, Dept. of Plant Pathology, Penn State Univ., University Park, PA 16802

Fusarium species cause post-harvest deterioration of cereal grains and, produce mycotoxins that pose serious threats to human health. Seeds of pearl millet, *Pennisetum typhoides*; proso millet, *Panicum milacium* and foxtail millet, *Setaria italica* were collected from Nigeria, Lesotho, and Zimbabwe. The samples were grains sold in markets, left unharvested in the field, or stored in homes. One hundred seed from each sample were placed on Nash medium in petri dishes, the *Fusarium* species isolated from the seed were cultured and identified. *Fusarium* species most frequently recovered from millet seed were *F. moniliforme*, *F. equiseti*, *F. semitectum*, *F. nygamai* and *F. chlamydosporum*. The predominant species on millet seed from Nigeria were *F. nygamai* and *F. moniliforme* while *F. moniliforme*, *F. equiseti* and *F. semitectum* were predominant in Zimbabwe. *F. equiseti* was the only *Fusarium* species associated with millet in Lesotho. Strains of these *Fusarium* species have been reported to be toxigenic.

INCIDENCE OF WHITE PINE BLISTER RUST IN MAINE IN AREAS WITH AND WITHOUT RIBES CONTROL. W.D. Ostrofsky, CFRU, College of Forest Resources, Univ. Maine, Orono 04469, T. Rumpf, D. Struble, and R. Bradbury, Maine Forest Service, Augusta 04333.

Direct control of White Pine Blister Rust in Maine by *Ribes* eradication was initiated in 1917. A statewide survey was conducted in 1987 to assess the long-term impact of this control effort. A total of 100 white pine trees in each of 90

stands was randomly selected and examined for infection by *Cronartium ribicola*. Three age classes (reproduction, sapling, pole), three hazard zones (low, moderate, high) and two levels of *Ribes* control (none, control for more than 50 years) were each represented by five stands. Averaged over all stands, blister rust incidence is 3.8% in the areas with *Ribes* control, and 9.1% in areas with no control. Incidence, averaged within size classes, is lowest in reproduction stands (2.4% with, 7.9% without control) and highest in pole stands (3.9% with, 11.1% without control). Rust incidence did not reflect hazard zone ratings. Results provide a basis for making an economic evaluation of disease impact, and control program adjustments.

EFFECT OF OZONE AND SIMULATED ACID RAIN ON SUGAR AND STARCH IN ROOTS OF RED AND WHITE OAKS. Roy L. Patton, USDA Forest Service, 359 Main Rd., Delaware, OH 43015

One-year-old oak (*Quercus rubra* and *Q. alba*) seedlings were treated with simulated rain solutions of pH 3.0, 3.5, or 4.2 and fumigated with ozone at 0.0, 0.07, or 0.15 $\mu\text{l l}^{-1}$. The seedlings were fumigated with ozone for 8 hr on each of 3 consecutive days and treated with 1.25 cm of rain on the fourth day of each week. This regime was repeated for 18 weeks. Eight seedlings of each species were harvested from each treatment after 6, 12, and 18 weeks for measurement of sugars (anthrone reagent) and starch (enzyme digestion followed by assay for glucose) in the roots. In general, sugar content remained stable and starch content increased in both species with successive harvests. The effects of ozone and rain treatments on root sugar and starch were variable over the harvests.

INCIDENCE AND SEVERITY OF BLACKLEG IN ONTARIO WINTER RAPESEED. R. Peters and R. Hall. Department of Environmental Biology, University of Guelph, Guelph, Ontario, Canada, N1G 2W1.

Blackleg of winter rapeseed, caused by *Leptosphaeria maculans*, is a significant disease in Ontario. In 1986, of 72 fields sampled, 66 (91.7%) had at least some level of blackleg whereas all 49 fields (100.0%) sampled in 1987 had blackleg. The mean incidence of diseased plants was 31.8% in 1986 and 69.1% in 1987. The mean disease severity rating (based on a 0-4 scale) was 0.67 in 1986 and 1.53 in 1987. The mean incidence of severely-cankered plants (category 4) was 8.6% in 1986 and 20.5% in 1987. The most severely diseased fields in 1986 and 1987 had blackleg incidences of 82.5% and 100.0% and contained 50.0% and 75.0% severely-cankered plants respectively. Average losses in yield were estimated to be 5.0% in 1986 and 7.5% in 1987. The most severely diseased fields in 1986 and 1987 suffered yield losses of 29.2% and 27.3% respectively.

IMMUNOSORBENT ELECTRON MICROSCOPY OF A PUTATIVE CARLAVIRUS INFECTING Highbush BLUEBERRIES. E. V. Podleckis and R. F. Davis, Dept. Plant Pathol., Rutgers Univ., New Brunswick, NJ 08903.

Preliminary ELISA and immunosorbent electron microscopy (ISEM) tests suggested that the flexuous rod virus found associated with Sheep Pen Hill disease of highbush blueberries (SPHAV) was serologically related to blueberry scorch virus, a tentative member of the carlavirus group. The serological relationships of SPHAV to ten known members of the carlavirus group was examined by ISEM. Purified virus was applied to grids previously sensitized with the test antibodies diluted 1:200 in Sorensen's buffer. Serological reactions were determined by the presence or absence of decoration of trapped virus particles after treatment with a 1:10 dilution of antibodies and negative staining. The positive reaction of SPHAV with several of the carlavirus antibodies tested supports its tentative placement in the carlavirus group.

PHOMOPSIS FRUIT ROT OF GRAPE RESULTING FROM INFECTIONS AT BLOOM. J. W. Pscheidt and R. C. Pearson. Department of Plant Pathology, NYSAES, Cornell University, Geneva, N.Y., 14456.

A fruit rot of grape in New York, caused by *Phomopsis viticola* Sacc., was associated with heavy rains (>12.7 cm) during bloom. Our goal was to determine if fruit rot resulted from infection at bloom. A suspension of 1×10^7 alpha spores/ml was sprayed onto flowering (50-90% calyptra fall) grape (*Vitis labrusca* 'Concord') clusters on 2 June 1987. Clusters were then enclosed in plastic bags for 24 hours. Inoculated vines were protected from rain during the growing season by plastic tents. Symptoms

first appeared two weeks prior to veraison. One month after veraison, 73% of the clusters had fruit rot and 98% had rachis lesions. Infected fruit showed a brown discoloration that enveloped the stylar or pedicel end of the berry. Berries with advanced symptoms had a rough texture due to subsurface, immature pycnidia. Rachis lesions were characterized by sunken, black areas which caused the rachis to be brittle. Some rachis lesions had girdled portions of the cluster resulting in the dehydration of berries distal to the infection.

WEED RESERVOIRS OF CUCUMBER MOSAIC VIRUS (CMV) AND BROAD BEAN WILT VIRUS (BBWV) AND THEIR ASSOCIATION WITH THE CMV AND BBWV DISEASES OF COMMERCIAL LETTUCE. D. L. Rist and J. W. Lorbeer, Department of Plant Pathology, Cornell University, Ithaca, NY 14853.

Studies during the growing seasons of 1984-87 revealed that the host ranges of CMV and BBWV near commercial lettuce fields in Oswego County, NY, included eighteen and four weed species, respectively. Roots and rhizomes of *Linaria vulgaris* harbored both CMV and BBWV through the winter months. The winter reservoir of CMV also included roots and rhizomes of *Asclepias syriaca*, roots of *Rorippa islandica*, and rosettes of *Barbarea vulgaris*. Both viruses were significantly ($P = 0.05$) more common in weeds growing within 10 m of lettuce fields than in weeds growing between 20 and 30 m from the same fields. Incidences of the two viruses in weeds growing within 10 m of lettuce fields early in the growing season were strongly correlated with incidences of the viruses in lettuce later in the season ($r = 0.93$ for CMV and 0.88 for BBWV).

PHOMA MEDICAGINIS VAR. MEDICAGINIS: A PRIMARY ROOT PATHOGEN OF ALFALFA. Rocio Rodriguez and K. T. Leath. Department of Plant Pathology, The Pennsylvania State University, and U.S. Regional Pasture Research Laboratory, USDA-ARS, Univ. Park, PA 16802.

The role of *Phoma medicaginis* var. *medicaginis* as a root rot pathogen of alfalfa was investigated using inoculations to the roots of plants grown in test tubes, in the slant board soil-less culture method and in the greenhouse. The root system of aseptic plants grown in test tubes showed rot symptoms when inoculated with a spore suspension of the fungus. *Phoma medicaginis* var. *medicaginis* penetrated and caused discoloration and tissue disintegration in roots of plants grown in the slant board system. Wounds were not required for fungal entry, but more extensive rot occurred when roots were wounded. Inoculations to the lateral roots yielded larger lesions than those induced in the main roots. Dry weight of foliage and roots of alfalfa grown in the greenhouse was significantly reduced by infection with this fungus. *Phoma medicaginis* var. *medicaginis* has the ability to act as a primary root pathogen of alfalfa.

POPULATION STUDIES OF PHYTOPHTHORA CINNAMOMI IN CRANBERRY BOGS SUFFERING FROM ROOT ROT. K.A. Rosenberg and F.L. Caruso, Cranberry Experiment Station, University of Massachusetts, East Wareham, MA 02538.

Approximately 12% of Massachusetts' cranberry bogs are infested by the soil-borne fungus *Phytophthora cinnamomi*. Recommendations for those bogs showing small discrete dead areas have been to spot-treat twenty feet outward from these areas with Ridomil 2E. A study was initiated in order to determine whether the fungus was found throughout the bog or whether it was confined to the low spots. Transects were set up in two or three directions from the center of the dead areas. Soil cores (10") were taken at 5, 10, 15, 20 feet outward. Azalea leaf disks were incubated in a soil/water suspension for 5-8 days and plated on PARPH medium. Results of these samplings will be discussed.

APPLICATION OF OXYTETRACYCLINE IN PEACH ORCHARDS USING MAUGET MICROINJECTION. J. Schieffer, T. Tattar, D. Cooley. Shade Tree Labs., Dept. Plant Pathology, UMASS, Amherst, MA. 01003.

Oxytetracycline (OTC) has a history of successfully inducing symptom remission of X-disease in peach. However, methods of injecting the antibiotic tend to be time consuming, cumbersome, or detrimental to tree health. Mauget microinjection, used to deliver chemicals to shade trees with minimum injury, was considered for application of OTC in orchards. In Sept. 1986, peach trees in 4 orchards were rated on a 0-4 scale according to severity of X-disease symptoms. In Oct. 1986, pressurized capsules (one 4 ml capsule/5 cm trunk diameter) were used to deliver 4% OTC to selected trees. In Sept. 1987, symptoms on OTC-treated trees were absent or less severe while untreated

controls either remained unchanged or worse compared to previous year's ratings. Injections were most effective if symptoms occurred on 50% or less of the tree. Mauget OTC microinjection was found to be an effective X-disease therapy in commercial peach orchards.

SURVEY OF NEW YORK WINTER WHEAT FOR FUNGAL LEAF AND SPIKE DISEASES IN 1987. A. M. C. Schilder and G. C. Bergstrom, Department of Plant Pathology, Cornell University, Ithaca, NY 14853.

In 1987, 29 fields of soft white winter wheat in central and western New York were surveyed at three growth stages for the incidence and severity of fungal leaf and spike diseases. Among leaf diseases, powdery mildew (*Erysiphe graminis*) and leaf rust (*Puccinia recondita*) ranged in severity from low to moderate, whereas leaf spots were moderate to severe in 75% of the fields. Based on laboratory identification of associated fungi, *Septoria tritici* was the predominant leaf spotting organism at early and *Stagonospora nodorum* at late growth stages; *Drechslera tritici-repentis* and *Stagonospora avenae* were prevalent in some fields. Three spike diseases, scab (*Fusarium graminearum*), glume blotch (*Stagonospora nodorum*), and loose smut (*Ustilago tritici*), occurred at low levels of severity. Loose smut was detected in 23 fields, indicating widespread seed infection. In addition to fungal diseases, barley yellow dwarf virus infection was widespread and considered to be a major yield reducing factor.

INFECTION OF APPLE PROTOPLASTS WITH APPLE MOSAIC VIRUS BY ELECTROPORATION. P. J. Shiel and G. N. Agrios. Dept. of Plant Pathology, UMASS, Amherst, MA. 01003.

Protoplasts of 'Golden Delicious' and 'Mutsu' apple were inoculated with apple mosaic virus (20 ug/ml) using electroporation. The electroporation device consisted of a series of capacitors powered by a Buchler 3-1500 electrophoresis power supply and an electrode-lined spectrophotometer cuvette. The protoplasts were isolated from cultured apple twig callus by treatment with 2% Cellulysin and 0.5% Macerace and were adjusted to $1-5 \times 10^5$ cells/ml in 0.01M K-PBS buffer pH 7.0 containing 0.7M mannitol and 0.02M 2-mercaptoethanol. Protoplasts were then placed in the cuvette and subjected to electroporation by discharging capacitors of 20 or 100 uF at 400 Volts D.C. Accumulation of virus antigen was detected by ELISA after 24 hrs incubation and was approximately two to three times the level detected in protoplasts immediately after inoculation. Infection was facilitated when virus was added to protoplasts within a few minutes after, rather than during, electroporation.

RHIZOSPHERE COMPETENCE OF *TRICHODERMA HARZIANUM* AND ITS POSSIBLE ROLE IN BIOLOGICAL CONTROL OF *FUSARIUM OXYSPORUM*. A. Sivan and I. Chet, Dept. of Plant Pathol. and Microbiol., The Hebrew Univ. of Jerusalem, Faculty of Agric., Rehovot, 76100 Israel.

Trichoderma harzianum (T-35) applied as a seed coating proliferated successfully in the rhizosphere of melon, cotton and tomato. Population densities were higher at the root base and root tip and lower on the middle segments. When treated seeds were planted in soil infested with *Fusarium oxysporum* f. sp. *melonis* and *F. oxysporum* f. sp. *vasinfectum*, T-35 colonized the rhizosphere and colonization of the roots by *Fusarium* was decreased, especially at the root tip. *Trichoderma* T-35 affected *Fusarium* only in the rhizosphere; when applied either as a seed coating or soil inoculum, T-35 had only minimal effect on *F. oxysporum* survival in natural soil. Root colonization by *T. harzianum* reduced germination of *F. oxysporum* chlamydospores in the rhizosphere soil of melon and cotton.

EVALUATION OF PLANTATION NORWAY SPRUCE IN THREE NORTHEASTERN STATES. J. M. Skelly, J. Ke, and D. Karasevicz, Dept. of Plant Pathology, The Pennsylvania State University, University Park, PA 16802

Fifteen trees within each of seven Norway spruce, [*Picea abies* (L.) Karst.], plantations were evaluated during 1987 with two plantations each in New Hampshire and New York and three in Pennsylvania. Five trees were evaluated in each of three symptom categories (healthy, moderate and severe symptoms) when possible. Foliage discoloration and defoliation ratings were made using the American and West German systems. Both systems indicate that trees are experiencing slight off-coloration and defoliations of >10%. The predominant symptom found on trees in all plantations was yellowing of the upper needle surface; this symptom was not usually in evidence via ground observation and was observed following removal of two branches from the top and mid-point of the live crown. Older needles were most symptomatic. The symptom was most severe in plantations located in the Tug Hill area of New York.

EFFECTS OF LEAF AGE AND INOCULATION METHOD ON SYMPTOM EXPRESSION IN ANGULAR LEAF SCORCH OF GRAPE. Franzine D. Smith and Roger C. Pearson, Department of Plant Pathology, Cornell University, Geneva 14456.

Mature apothecia of *Pseudopeziza tetraspora*, which causes grape angular leaf scorch (ALS), were produced on 2.5% malt agar overlaid with grape leaf pieces after 10-14 days at 20C with 16 h light. Sparse growth and fewer apothecia formed on unamended malt agar. Cultures from single binucleate ascospores produced apothecia, indicating homothallism, or secondary homothallism. Potted vines were inoculated with ascospore suspensions (AS), mature apothecia, agar plugs with mature apothecia (AP) or ascospores released from cultures suspended over vines, held in mist at 20 C for 72 h, and then returned to the greenhouse. The percentages of leaves showing typical symptoms of ALS, 30 days after AS inoculation, beginning at the youngest leaf present at inoculation and proceeding basipetally were 42, 75, 73, 58, 25, 17, and 8% respectively. Only the 7 youngest leaves present at inoculation became infected. *P. tetraspora* was reisolated from symptomatic tissue. Similar results were obtained with other inoculum sources, but AS and AP inoculations resulted in symptoms more typical of ALS in vineyards. This was the first fulfillment of Koch's postulates in ALS and the first report of infectious ascospores in vitro. Phenological susceptibility of leaves explains the distribution of ALS at widely spaced nodes following widely separated periods of wet weather.

EFFECT OF *PYRENOPHORA AVENEA* AND BARLEY YELLOW DWARF VIRUS (BYDV) INFECTIONS, SINGLY AND IN COMBINATION, ON YIELD COMPONENTS OF NOBLE OATS. M. L. Sommerfeld, J. A. Frank and F. E. Gildow, Dept. of Plant Pathology and USDA-ARS, The Pennsylvania State University, University Park, PA 16802.

In field experiments conducted in 1986 and 1987, inoculations with BYDV-PAV-NY were made at growth stages 3 or 7 (Feeke's scale, Large 1954) with viruliferous aphids (*Rhopalosiphum padi*). Inoculations with *P. avenae* were made with a conidial suspension and followed virus inoculations by two weeks. BYDV infections were found to reduce the number of tillers and heads by 14%, the number of seeds/head by 18%, thousand kernel weight by 5% and total yield by 33%, when compared to control plants. Interactions between date of inoculation and BYDV infection occurred for seed/head and total yield only in 1987, with earlier infestations contributing to the greatest reductions in yield. *P. avenae* infections had no significant effects on any components of yield, and no *P. avenae* by BYDV interactions occurred.

INTRASPECIFIC AND INTERSPECIFIC HYBRIDIZATION OF *TRICHODERMA* STRAINS BY PROTOPLAST FUSION. T. E. Stasz, G. E. Harman, and M. C. Matteson, NYSAES, Cornell Univ., Geneva, NY 14456

Auxotrophic mutants of strains of *Trichoderma harzianum*, *T. hamatum*, *T. koningii*, *T. viride*, and *T. virens* (= *Gliocladium virens*) were combined by protoplast fusion. When two different auxotrophs of a single strain were fused, rapidly growing, fully prototrophic, stable hybrids were formed at frequencies of 1 - 10 %, and segregation of parental types by conidiation indicated these were balanced heterokaryons. In contrast, intraspecific and interspecific fusions resulted in various levels of incompatibility. However, prototrophic colonies differing in morphology from the parental strains were obtained at low frequencies. These slowly growing colonies frequently were imbalanced heterokaryons as indicated by both isozyme analysis and segregation of types by conidiation. More rapidly growing, stable, nonparental sectors developed from these. Taxonomic position was not an indication of degree of compatibility; a *T. harzianum* X *T. viride* fusion was among the most compatible tested.

PROTECTION OF DOUGLAS-FIR SEEDLINGS BY *LACCARIA BICOLOR* AGAINST ROOT ROT CAUSED BY *FUSARIUM OXYSPORUM* IS CONDITIONED BY TEMPERATURE AND AGGRESSIVENESS OF THE PATHOGEN. N. E. Strobel and W. A. Sinclair, Department of Plant Pathology, Cornell University, Ithaca, New York 14853.

Douglas-fir (*Pseudotsuga menziesii*) seedlings grown in Petri dishes containing an agar rooting medium were evaluated for incidence and severity of root rot caused by *F. oxysporum* (FO) as conditioned by temperature, aggressiveness of FO isolate, site of inoculation, and prior exposure of the primary roots to the ectomycorrhizal fungus *Laccaria bicolor* (LB). Three isolates of FO displayed differential aggressiveness when inoculated to root tips or to differentiated tissues at 17C, but all three caused extensive decay of roots and hypocotyls at 22C. Prior exposure of roots to LB suppressed the incidence and extent of root colonization by the least aggressive isolate of FO at 17C but not at 22C and did not affect colonization by the other isolates.

Vegetative incompatibility in *Rhizoctonia solani*. T. Syminis, B.P. Bandy and S.M. Tavantzis. Department of Botany and Plant Pathology, University of Maine, Orono, Maine 04469.

The nature of the hyphal interactions among naturally occurring isolates of *R. solani* was studied. Vegetative incompatibility (VI) appears to affect the extent of cytoplasmic exchange and therefore the transmission of hypovirulence-causing agents such as viruses or plasmids. In conjunction with microscopic studies the macroscopic appearance of hyphal interactions of representative pairings were classified into 4 groups. These were: merging (M), merging line (M/L), barrage (B) and barrage line (B/L). Subsequently, eighty-five isolates from 5 anastomosis groups (AG) were paired in all possible combinations and their hyphal interactions were characterized. Depending on the AG, 3-17% of the reactions showed vegetative compatibility (M), whereas the rest of them displayed a varying degree of VI, i.e. 52-91% (M/L), 0-24% (B), and 0-25% (B/L).

CYTOPHOTOMETRIC ANALYSIS OF THE NUCLEAR DNA CONTENT OF 23 ISOLATES OF *PHYTOPHTHORA INFESTANS* FROM THE NETHERLANDS. C. D. Therrien, D. L. Ritch, Dept. of Biology, and B. J. Christ, Dept. of Plant Pathology, The Pennsylvania State University, University Park, PA 16802

Twenty-three isolates of *P. infestans* from The Netherlands were analyzed by Feulgen-DNA (F-DNA) cytophotometry. Of those isolates which bore the A1 mating allele, the distribution of ploidy values (as determined by the analysis of F-DNA content) was 3 diploid, 3 triploid and 5 tetraploid. The distribution of ploidy values for the A2 isolates was 7 diploid, 4 triploid and 1 tetraploid. The mean DNA value for the A1 isolates was 0.821, whereas the mean value for the A2 isolates was 0.711. Analysis of data from mating experiments were consistent with our ploidy estimates from F-DNA cytophotometry. The distribution of mating types and ploidy values may be relative to the evolution and population biology of this species.

RELATIONSHIP OF PRECIPITATION PROBABILITY TO INFECTION POTENTIAL OF *BOTRYTIS SQUAMOSA* ON ONION. P. C. Vincelli & J. W. Lorbeer, Department of Plant Pathology, Cornell University, Ithaca, NY 14853.

An infection index for *B. squamosa* was developed which uses temperature and leaf wetness duration to categorize leaf wetness episodes as insignificant, slight, moderate, or severe potential infection periods, given the presence of inoculum. Using this infection index, it was found that the frequency and severity of infection periods of *B. squamosa* in Orange County, NY increased as the National Weather Service forecast of precipitation probability (PP) increased. Severe infection periods occurred in 0%, 19%, 23%, and 84% of the 36-hr forecast periods in which the maximum PP for the forecast period was <30%, 30-40%, 50-60%, and >70%, respectively. It was concluded that a PP > 30% can be used in combination with a model for forecasting sporulation to forecast severe infection periods of *B. squamosa* up to 36 hr in advance.

TIMING FUNGICIDE SPRAYS FOR CONTROLLING *BOTRYTIS* LEAF BLIGHT OF ONION USING FORECASTS OF SPORULATION AND PRECIPITATION. P. C. Vincelli & J. W. Lorbeer, Department of Plant Pathology, Cornell University, Ithaca, NY 14853.

Onion integrated pest management in New York includes a recommendation to growers to initiate a fungicide program when *B. squamosa* lesions average 1.0 lesion/leaf. A predictive system was developed for timing subsequent fungicide applications to infection periods of *B. squamosa*. The system consists of two components: (1) a model that forecasts the production of conidia of *B. squamosa* based on temperature and relative humidity, and (2) National Weather Service forecasts of precipitation probability, which predict conditions favoring severe infection. In field experiments in 1985-87, acceptable disease control and a savings of 1-3 applications each season compared to a weekly spray program were achieved with the predictive system. In 1987, a model for estimating fungicide weathering was evaluated, which permitted the system to respond to weather favorable for fungicide washoff.

INOCULATION OF SCOTS PINE TO COMPARE TWO INOCULUM SOURCES OF *ENDOCRONARTIUM HARKNESSII*. N. G. Wenner and W. Merrill, Dept. of Plant Pathology, The Pennsylvania State University, University Park, PA 16802

Potted 2-0 Scots pine seedlings were inoculated in May 1986 with *Endocronartium harknessii* spores collected from galls on Scots or ponderosa pine. By August 1987, two different types of symptoms were evident: necrotic stem cracking with or without swelling, or obvious galls. Although inoculations with the two spore sources resulted in equal numbers of infected

trees ($P < 0.25$), the proportions of symptom types differed significantly ($P > .005$). Inoculum from ponderosa pine caused 15% fewer trees to develop obvious galls and 13% more trees to develop stem cracking with or without swelling.

EFFICACY OF BENODANIL IN CONTROLLING *ENDOCRONARTIUM HARKNESSII* ON SCOTS PINE CHRISTMAS TREES. N. G. Wenner and W. Merrill, Dept. of Plant Pathology, The Pennsylvania State University, University Park, PA 16802

Fifty galled trees, 2-2.5 m tall, were selected in a commercial plantation severely infected with *Endocronartium harknessii* in Tioga Co., PA. Half of the trees were sprayed on 23/5/86 with benodanil at the 3.37 kg/ha rate. The study was evaluated on 20/8/87 by determining the ratio of galls/cm on the 1986 internodes, 1.4-1.7 m from the ground, on each of four shoots/tree. Benodanil significantly ($P = .0005$) reduced the average infection ratio on untreated trees from 1 gall/3.4 cm shoot length to 1 gall/14.3 cm on the treated trees. This level of control, however, is not commercially acceptable. Further, 25% of the treated trees held infection ratios not significantly different from those of the checks. These trees probably broke bud after the fungicide had deteriorated. Although benodanil was effective in preventing *E. harknessii* infection, either a higher rate or a second application will be needed to provide adequate control.

DETERIORATION OF ALFALFA SPROUTS BY *PSEUDOMONAS* SPECIES DURING PRODUCTION. R. L. Wick and N. Jeschke, University of Massachusetts, Suburban Experiment Station, 240 Beaver St., Waltham, MA 02154.

Several New England producers of alfalfa sprouts routinely experience bacterial deterioration of sprouts during production. Usually, discreet patches, 1 to 15 cm in diameter, of discolored sprouts occur randomly on sprouting trays. Occasionally, large portions of the sprouts are uniformly affected. Individual discolored sprouts are yellow to brown, appear glassy, and are often stunted. Several different isolates of *Pseudomonas*, most of them fluorescent, have been recovered from diseased sprouts and shown to be pathogenic. Physiological and biochemical tests of the isolates will be discussed.

PSEUDOMONAS SYRINGAE LEAF SPOT OF *PELARGONIUM X HORTORUM*. Robert L. Wick and Karen K. Rane, University of Massachusetts, Suburban Experiment Station, 240 Beaver St., Waltham, MA 02154.

A leaf spot disease of geranium (*Pelargonium X hortorum*) was found in a commercial greenhouse in Massachusetts. Within two weeks, several thousand plants became blighted. The initial symptoms were small, water-soaked lesions, which quickly enlarged to 3 to 5 mm in diameter. Leaves with several spots became entirely chlorotic, then tan, dry and papery. Affected leaves remained attached to the plant. Bacteria associated with the lesions were identified by LOPAT tests as *Pseudomonas syringae* von Hall. Koch's postulates were completed by foliar-spray inoculation. Water-soaked lesions developed in 3 days, and symptom progression occurred as in naturally infected plants.

Evaluation of *Epicoccum purpurascens* for biological control of white mold of bean. Ting Zhou and R. D. Reeleder, Department of Plant Science, Macdonald College of McGill University, Quebec, Canada H9X 1C0.

The ability of *Epicoccum purpurascens* (EP) to control white mold of bean, caused by *Sclerotinia sclerotiorum* (SS), was assessed in two field plots during 1987. Treatments were applied during the flowering period and were followed with one application of ascospores of SS (10^6 spores/ml). In the first trial, treatments of three and five applications of EP (10^9 spores/ml) alone, two applications of EP plus iprodione (IR, 1 kg/ha), and two applications of IR alone (1 kg/ha) significantly reduced disease incidence (DI). DI values for those treatments were 34.8, 31.0, 29.7 and 30.5%, respectively, as compared to 70.2% in control plots (plants inoculated only with ascospores). In the second trial, plots with EP applied four times, EP plus IR (0.5 kg/ha), and IR (1 kg/ha) alone, had significantly lower DI values than control plots.

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