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ELISA FOR THE DETECTION OF VENTURIA INAEQUALIS. L.P. Berkett, A.R. Gotlieb, and J.A. Bergdahl. Department of Plant & Soil Science, University of Vermont, Burlington, VT 05405.

Polyclonal antisera to V. inaequalis were produced by immunizing rabbits with conidia/mycelium suspensions. Antigen production involved culturing the fungus on laboratory inoculated apple twigs. The reactivity of the antisera was evaluated by using standard ELISA procedures. It reacted strongly with the original isolate used for its production and with isolates from 7 states and 1 Canadian province. Preliminary screening of 79 fungal isolates which co-inhabit apple leaves detected some cross-reactivity, but in all cases, V. inaequalis had a much higher reactivity to the antisera. Currently, techniques to increase the sensitivity of ELISA are being investigated.

USE OF PROTEIN A -GOLD TECHNIQUE FOR ULTRASTRUCTURAL LOCALIZATION OF ABSCISIC ACID IN DISEASED AND HEALTHY ROOTS OF TOMATO PLANTS. Bertrand S, Benhamou N. Département de phytologie, Université Laval. Québec, Canada. G1K 7P4

Abscisic acid (ABA) has often been associated with stress reactions in plants. The exact relationship of this hormone with pathological responses has not yet been investigated. In this study, roots from healthy or *F.oxysporum* f. sp. *radicis-lycopersici* -infected tomato plant were used to investigate the implication of ABA in that host-pathogen interaction. Ultrathin sections of healthy and diseased roots were incubated with anti-ABA antibodies followed by gold labelled protein A. Differences in ABA distribution were found : healthy tissue showed an important accumulation of ABA in the root cap cells and in the cells surrounding the columnella. Labelling was lighter in the latter structure. Differences in root cap cells of diseased plants were also observed .External walls lacked labelling and their structure was more fibrous. Their cytoplasm was disorganized and few gold particles were observed in a scattered pattern.

PRODUCTION AND USE OF A MONOCLONAL ANTIBODY SPECIFIC TO AGROBACTERIUM TUMEFACIENS BIOVAR 3. T.J. Burr, A.L. Bishop, V.L. Mittak, and B.H. Katz, Department of Plant Pathology, Cornell University, New York State Agricultural Experiment Station, Geneva, NY 14456.

A murine monoclonal antibody, AbF21-1D3G7C8 (isotype IgG1) was produced that is specific for Agrobacterium tumefaciens biovar 3 (AT3), the causal agent of grape crown gall. All 35 tumorigenic and nontumorigenic AT3 strains from North America, Europe, Asia and Australia reacted in microELISA with the antibody. Other agrobacteria, related genera, and saprophytic bacteria from grape did not react with the antibody. It was purified from ascities fluid and culture supernatant using a protein A column. Activity saturation in microELISA was reached at about 1 ug/ml. The antibody was used in an immunoblot procedure to identify strains of AT3 from symptomless dormant grape cuttings from New York, California and Washington State. With microELISA the antibody detected as few as 2.3×10^4 cells/well and with immunoblot about 10^5 cells/ 4 ul spottings.

ISOLATION AND CHARACTERIZATION OF RHIZOCTONIA SOLANI AND BINUCLEATE R. SOLANI-LIKE FUNGI FROM HERBACEOUS AND WOODY ORNAMENTALS IN NEW JERSEY. T. D. Cavileer and J. L. Peterson. Plant Pathology Dept., Rutgers Univ., New Brunswick, NJ 08903

Forty-seven Rhizoctonia solani and R. solani-like fungi were isolated from diseased plants representing eight herbaceous, eight woody, two turf and various ornamental genera. Thirty isolates were multinucleate and 17 binucleate using trypan blue and DAPI staining techniques. Fifty-three percent of the binucleate isolates were from woody ornamentals with the remaining 47% belonging to one herbaceous genus. Seventy-seven percent of the multinucleate isolates were from herbaceous ornamentals, seven percent from woody ornamentals and 16% from turf. When paired with tester isolates (AG 1,2-1, 2-2,3,4,5,6,8, and 9) three anastomosed with AG-1, four with AG-4, and the rest failed to anastomose. Mycelium of the multinucleate isolates were whitish to tan initially, turning brown with age. Two isolates were thiamine auxotrophic.

PRELIMINARY SURVEY OF WHEAT POWDERY MILDEW VIRULENCE GENES IN PENNSYLVANIA. B. J. Christ and M. L. Risius, Depts. of Plant Pathology and Agronomy, Penn State University, University Park, PA 16802.

Wheat cultivars Chancellor, Transec, Kavkaz, Normanie, Amigo and 14 near isogenic lines containing different resistance genes to wheat powdery mildew fungus, Erysiphe graminis f. sp. tritici were planted Fall 1987 at Rock Springs, PA, while only 9 were tested at Landisville, PA. At Rock Springs virulence was detected to all resistance genes including Pm1, Pm2, Pm2+, Pm3a, Pm3b, Pm3c, Pm4, Pm5, Pm7, Pm8, Pm9, a gene from Michigan Amber, and 6 unnamed genes. In Landisville where only 9 genes were tested, virulence was detected to Pm2, Pm2+, Pm3a, Pm3c, Pm4, Pm5 and a gene from Michigan Amber but not for Pm1 and Pm3a. These data indicate that the powdery mildew population has virulence genes to many of the common resistance genes. These data are useful in deciding what resistance should be used in the wheat breeding program.

CHARACTERIZATION OF PATHOGENESIS-RELATED PROTEINS FROM STRESSED CUCUMBER COTYLEDONS. Côté, F., Letarte, J., Benhamou, N. and Asselin, A. Département de phytologie, Université Laval, Québec, Canada, G1K 7P4.

Starch lesions are produced on tobacco mosaic virus (TMV)-infected cucumber cotyledons without necrosis. The accumulation of extracellular pathogenesis-related (PR) proteins was studied in such tissue with intercellular fluid (IF) subjected to various polyacrylamide gel electrophoretic systems for protein and enzyme analysis. PR proteins were also induced in tissue floated on serine (1mM), thiamine-HCl (1mM) or $AgNO_3$ (50 µM) for 3 days. Nuclease, peroxidase and ß-1,3-glucanase activities were detected in IF

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extracts of stressed tissues. Nuclease activity was associated with two acidic proteins of approximately 15 Kd and 17 Kd. Four acidic peroxidases between 35 Kd and 37 Kd were found. One acidic ß-1,3-glucanase was detected in polyacrylamide gels. The *in vitro* association of some PR proteins with starch granules was observed by ultrastructural studies involving gold-labeled PR proteins.

FAILURE TO TRANSMIT BARLEY YELLOW DWARF VIRUS BY DIURAPHIS NOXIA IN THE UNITED STATES. V. D. Damsteegt, USDA-ARS, Frederick, MD 21701 and F. E. Gildow, Dept. Plant Pathology, Pennsylvania State University, University Park, PA 16802

Diuraphis noxia Mordw. (Russian wheat aphid) (RWA) has been implicated as a vector of barley yellow dwarf virus (BYDV) in S. Africa. Since the introduction of the RWA into the U.S. in 1986, there has been concern about its potential to transmit cereal viruses. We attempted to transmit Rochow's RPV, RMV, MAV, PAV, and SGV strains of BYDV by allowing D. noxia a 7-day acquisition feeding on infected oats or barley followed by a 7-day inoculation feeding on oat or barley seedlings; 20 to 50 aphids/seedling. Visual symptoms and ELISA were used to evaluate transmission. At least three experiments were conducted with each D. noxia/BYDV strain combination. No BYDV symptoms were noted in 625 plants with any D. noxia transmission attempt and all 169 ELISA samples from these plants were negative. Among positive controls inoculated with known vectors, 129 out of 182 plants showed symptoms and 45 out of 67 ELISA samples from these plants were positive.

INFLUENCE OF OZONE AND/OR ACIDIC PRECIPITATION ON POTTED SEEDLINGS OF EIGHT TREE SPECIES. D. D. Davis and J. M. Skelly, 211 Buckhout Lab., University Park, PA 16802

Potted seedlings of 8 tree species were exposed to 0, 75, or 150 ppb ozone in controlled environment chambers for 6 h/day on 2 consecutive days weekly for 12 weeks in 1987. On the third day, seedlings were exposed to simulated acidic precipitation at pH 3.0 or 4.2 in a greenhouse. Seedlings were maintained in a non-filtered greenhouse during days 4-7. Foliar symptoms were evaluated at 4, 8, and 12 weeks and a destructive harvest was conducted at 12 weeks. A dark adaxial stipple, induced by the ozone component, was most severe on black cherry, followed by sweet gum, yellow-poplar, white ash, red maple and yellow birch. Red oak and white oak did not exhibit stipple. Ozone had a slight, variable effect on biomass depending upon dosage, species, and parameter measured. There were no consistent significant effects due to pH 3.0 vs pH 4.2 acidic precipitation. Four of the 8 species are being exposed to ozone and/or acidic precipitation in 1988 utilizing CSTR chambers.

MODIFIED TISSUE CULTURE METHOD FOR RAPID PRODUCTION OF ROOTED PLANTLETS OF WILD STRAWBERRY CLONES FOR USE IN PATHOGENICITY STUDIES WITH BINUCLEATE RHIZOCTONIA SPP. J. L. Drozdowski and W. J. Manning, Dept. of Plant Pathology, Fernald Hall, UMASS, Amherst, MA. 01003.

Large scale production of aseptic, well-rooted wild strawberry plantlets for pathogenicity studies with binucleate Rhizoctonia spp. is quite difficult, using conventional tissue culture methods. Non-rooted plantlets on filter paper wicks in liquid culture tubes containing strawberry rooting medium (Boxus, 1974), rooted poorly, or not at all, and meristem multiplication increased. Abundant production of primary perennial roots and transient rootlets with root hairs occurred when GA (0.29 µM) and activated charcoal (2g/l) were added to the medium and sucrose was decreased by 50%.

PATHOGENICITY OF BINUCLEATE RHIZOCTONIA SPP. AND RHIZOCTONIA SOLANI FROM STRAWBERRY TO ASPARAGUS. J. L. Drozdowski and W. J. Manning, Dept. of Plant Pathology, Fernald Hall, UMASS, Amherst, MA 01003.

Binucleate Rhizoctonia spp. and R. solani were obtained from roots of commercial and wild strawberry plants. Aseptic seedlings of asparagus (Asparagus offinalis L. 'Mary Washington') were grown in liquid culture system containing Hoagland's solution. Three plants were inoculated with an agar plug of the fungal isolate in the crown region and incubated at 24°C for 6 weeks. Binucleate Rhizoctonia, typed to AG-A and AG-I induced transient rootlet necrosis that progressed into primary perennial roots resulting in poor growth and/or plant death. Mycelial growth extended along the root surface, heavily colonizing the root cap, and formed infection cushions in the meristematic region. AG-G isolates induced lesions on primary perennial roots but plants appeared healthy. All isolates of R. solani were highly virulent inducing necrosis of the entire root system.

THE EFFECTS OF NITROGEN FERTILIZERS AND CHLORIDE SALTS ON ASPARAGUS GROWTH AND FUSARIUM CROWN AND ROOT ROT. W. H. Elmer, CT Agric. Expt. Sta., Box 1106, New Haven, CT 06504.

Greenhouse-grown asparagus plants (cv. Mary Wash.) were transplanted into autoclaved soil or autoclaved soil artificially infested with Fusarium oxysporum f. sp. asparagi (FOA) or F. moniliforme (FM). Soils had been amended with $(NH_4)_2SO_4$, NH_4NO_3, $Ca(NO_3)_2$ or KNO_3 at equal rates of N (0.18 mg/cc soil). Each N-amended soil was supplemented with KCl or NaCl (1.8 mg/cc soil) or no Cl^-. Plant weights, root length, and fungal root colonization were recorded after 10 wk. Plants grown in infested soils had higher weights in NH_4NO_3-amended soil than in other N treatments. Plants grown in Cl^--amended soil showed less root colonization by FOA and by FM, and increased root weight and length as compared to plants in soil without Cl^-. Responses were greater for NaCl than for KCl. These studies suggest manipulation of N and Cl^- nutrition may suppress Fusarium crown and root rot of asparagus.

ALLOZYME VARIATION IN THE WHITE ROT FUNGUS, LENTINULA EDODES. C. G. Fisher, D. J. Royse and B. May*, Dept. of Plant Pathology, Penn State University, University Park, PA 16802, and *Ecol. and Evol. Genetics, Cornell University, Ithaca, NY 14850.

Lentinula edodes is an edible white rot fungus native to the subtropical regions of eastern Asia. Sporocarps are highly prized for both their culinary and medicinal properties. Shiitake mushroom production is increasing rapidly in the U.S. and is currently a major agricultural industry in Japan and China. Most U.S. production is on sawdust-based substrates while production in Asia is on natural logs. Our current studies are directed toward genetic improvement of genotypes for production on sawdust. These studies include assessment of genetic variability and its inheritance. Ten L. edodes lines were examined for allozyme variation using starch gel electrophoresis. Of 56 structural loci examined, 25 were polymorphic. The greatest number of alleles were observed for Ada, Dia-4, Mdh-1 and Pep-1gg-2. Assessment of allelic variability of shiitake is being used for line identification and registration, linkage analysis and breeding strategies.

THE USE OF DORMANT SEASON ERADICANT SPRAYS TO CONTROL GRAPE POWDERY MILDEW. David M. Gadoury and Roger C. Pearson, Department of Plant Pathology, Cornell University, New York State Agricultural Experiment Station, Geneva 14456.

Cleistothecia on the bark of the vine were recently shown to be the principal source of primary inoculum for grape powdery mildew in New York. Our objective was to determine the effect of reducing the size of the pathogen population on the subsequent development of powdery mildew epidemics. In laboratory assays, copper sulfate, lime sulfur, bordeaux mixture, and dinocap reduced the number of viable ascospores in overwintering cleistothecia by 80, 60, 39, and 26% within 14 days of application, whereas benomyl and triadimefon had no significant effect. In 4 years of vineyard trials, single dormant over-the-trellis sprays of lime sulfur at a rate of 337 L/ha delayed mildew epidemics by 3-4 weeks, and reduced fruit infection to 14% on the highly susceptible *Vitis* interspecific hybrid cultivar Rosette and to 1.2% on the more resistant *Vitis labrusca* cultivar Concord. Untreated vines bore 43% and 30% infected fruit, respectively. Eradication of cleistothecia of *Uncinula necator* may delay epidemics of grape powdery mildew until fruit become naturally resistant to infection in early August.

SEED MYCOFLORA OF PEARL MILLET FROM NIGER. Ganbobo, M.S., and D. Dostaler, Departement de phytologie, Universite Laval, QUEBEC (Quebec), Canada, G1K 7P4.

Over 30 fungal species were isolated from 8 seed samples of Pearl millet (Pennisetum typhoides) collected by ACRISAT center from different farms around Niamey in Niger. Circularia lunata, C. pallescens, Aspergillus niger, A. nidulans and Rhizoctonia solani were the most prevalent species and were widely distributed among the seed samples.

EXPERIMENTAL CROSSING OF SELECTED ISOLATES OF BURSAPHELENCHUS XYLOPHILUS AND B. MUCRONATUS. P. T. Hajdukiewicz, and R. F. Myers, Plant Pathology Department, Rutgers University, Cook College, New Brunswick, NJ 08903.

Crossing experiments were conducted among isolates of

Bursaphelenchus xylophilus obtained from Canada (C-2), France (F-1), Japan (J-6), and the United States (US-1), and B. mucronatus obtained from Japan (J-13 & J-14). Immature individuals were reared to adults, sexed, and crossed reciprocally to determine if fertile hybrids were produced. Intrabreeding resulted in high frequencies of sexual encounters accompanied by high rates of reproduction. Reciprocal crosses of F-1 in combination with C-2, J-6, J-14, and US-1 resulted in a limited number of hybrids after a two week period. Reciprocal crosses of F-1 with J-13 resulted in high fecundity. C-2 interbred freely with US-1, J-6, and J-14, but not with J-13. Crosses between US-1 or J-6 with J-14 resulted in viable progeny. Crosses between US-1 or J-14 with J-13 resulted in negligible hybridization.

VARIATION IN RESISTANCE OF CUTTING-PROPAGATED GERANIUMS TO LEAF BLIGHT CAUSED BY BOTRYTIS CINEREA. M. K. Hausbeck and S. P. Pennypacker, Plant Pathology, 211 Buckhout Lab., Penn State University, University Park, PA 16802.

Five cutting-propagated geranium (Pelargonium x hortorum) cultivars and two ivy geranium (Pelargonium peltatum) cultivars were evaluated for resistance to leaf blight caused by Botrytis cinerea. Rooted cuttings were placed in a settling tower and inoculated with dry conidia from cultures transferred from a B. cinerea isolate collected from a commercial propagation greenhouse. Inoculated and noninoculated cuttings were placed in a 15 C dew chamber and evaluated using a plant quality rating and measurement of percent leaf area infected. In addition, these and other cultivars were evaluated for resistance to naturally occurring leaf blight in a commercial propagation greenhouse. Although immunity to B. cinerea was not identified in the cultivars evaluated, several nonvariegated P. x hortorum cultivars appeared to be more resistant than the P. peltatum cultivars.

EFFECTS ON THE FUNGI FUSARIUM OXYSPORUM RADICIS-LYCOPERSICI, PYRENOCHAETA LYCOPERSICI AND GLOMUS INTRARADICES ON YIELD AND ROOT INFECTION OF GREENHOUSE TOMATO. J.C. Hecquet, and D. Dostaler, Département de phytologie, Université Laval, Québec, Québec, Canada G1K 7P4

The interaction between Glomus intraradices, a vesicular-arbuscular mycorrhizal fungus, Fusarium oxysporum radicis-lycopersici and Pyrenochaeta lycopersici and its effect on tomato plants was investigated over a 20-week period. The presence of Glomus decreased root necrosis caused by Fusarium and Pyrenochaeta by 22%. Yield, total phosphorus in stems and leaves, dry mass of top plant and weight of healthy roots were increased when Glomus was inoculated. The establishment of G. intraradices in the soil and the roots was sufficient to cause a reduction in weight of diseased roots and of root rot and brown rot intensity.

POST-INFECTION AND ANTISPORULANT ACTIVITY OF SBI FUNGICIDES AGAINST VENTURIA INAEQUALIS ON APPLE LEAVES. K. D. Hickey and G. G. Clarke, The Pennsylvania State University, Fruit Research Lab., P.O. Box 309, Biglerville, PA 17307-0309.

Six sterol biosynthesis inhibitor (SBI) fungicides applied in post-infection (PI) sprays were variable in preventing lesion development and suppression of conidia production of Venturia inaequalis in 4 field tests. Effectiveness of the fungicides diniconazole, fenarimol, flusilazole, myclobutanil, pyrifenox, and terbutrazole, applied in single or multiple applications, was determined for specific infection periods. Level of activity was rate-specific and varied with PI application interval, number of applications, and cultivar. Acceptable control of scab on 'Rome Beauty' was obtained when 3 or more PI applications were made. Single PI sprays against specific infections were significantly ($P = 0.05$) less effective than when a second application followed 7 days later. Two or 3 sprays reduced conidial production on lesions but failed to prevent recurrent sporulation after treatments were continued.

IMMUNOLOGICAL CHARACTERIZATION OF WOOD DEGRADATION. Jody Jellison, Barry Goodell, Dept. Forest Biology, Univ. Maine, Orono, ME 04469, and G. Daniel, Swedish Inst. Agri. Sci., Uppsala, Sweden

The mechanisms by which white and brown rot fungi penetrate and degrade wood cell walls are still incompletely understood. Polyclonal antisera have been used to identify extracellular fungal metabolites in degraded wood using ELISA and immuno-EM. In addition, monoclonal antibodies are being used to differentiate between ligninase and cellulase, two glycosylated extracellular degradative enzymes, and to help distinguish their individual roles in attacking complex lignocellulose substrates. Differential localization of monoclonals produced to enzymes has been demonstrated using gold labeled TEM sections of degraded wood. Immunolocalization of degradative enzymes should allow us to better assess the role of individual fungal enzymes in wood biodegradation.

RESPONSE OF MYCORRHIZAL AND NONMYCORRHIZAL YELLOW BIRCH SEEDLINGS TO TWO OZONE CONCENTRATIONS. D. L. Krupczak and W. J. Manning, Dept. of Plant Pathology, Univ. of Massachusetts, Amherst, MA 01003

Yellow birch seedlings (Betula alleghaniensis) inoculated with Cenococcum geophilum, or not inoculated, were exposed to ozone (O_3) at 0.01-0.02 ppm (low O_3) or 0.06-0.08 ppm (high O_3), for eight hours/day, five days/week for 10 weeks. Seedlings were removed and evaluated every two weeks. Height of mycorrhizal seedlings in high O_3 was greater from week two to week eight. In the low O_3 treatment, inoculated seedlings were taller from week four to week ten. Significant differences were not detected in root dry wt, shoot dry wt, and leaf dry wt due to ozone concentration. Mycorrhizal treatment increased total leaf number. The rate of mycorrhizal infection was greater in the low O_3 treatment between weeks four and eight. After eight weeks, the rate of mycorrhizal infection was greater in the high O_3 treatment.

HOST RANGE AND HOST INVOLVEMENT IN REPLICATION OF TURNIP CRINKLE VIRUS AND ITS SATELLITE RNAS. X.H. Li and A.E. Simon, Department of Plant Pathology, University of Massachusetts, Amherst, MA 01003.

Turnip crinkle virus (TCV) supports the replication of a small family of satellite RNAs. Sat-RNA C (355 b) exacerbates the symptoms of TCV on turnip while sat-RNA D (194 b) and sat-RNA F (230 b) are avirulent. We are working to elucidate the interaction between the sat-RNAs, TCV and the host which are responsible for symptom intensification. We have tested the symptoms expression and replicative ability of TCV and its satellites on over 20 varieties of plants from 4 species of crucifers. Our results indicate that sat-RNA C is virulent on some, but not all, mustard and cabbage varieties. Sat-RNA C was also found to intensify symptoms on all varieties of *Arabidopsis* tested. We also noted differential accumulation of TCV satellites in *Arabidopsis*. RNA F in particular did not accumulate to the level observed in turnip and other hosts. This indicates a probable involvement of factors other than simply the viral replicase in satellite RNA accumulation.

UTILIZATION OF METHIONINE AND ACC (1-AMINOCYCLOPROPANE-1-CARBOXYLIC ACID) BY ECTOMYCORRHIZAL FUNGI FOR ETHYLENE PRODUCTION. William H. Livingston, Dept. of Botany and Plant Path., Univ. Maine, Orono, ME 04469

Effects of methionine and ACC, known precursors of ethylene production in higher plants, on ethylene production by 5 isolates of *Laccaria* spp. and an unknown ectomycorrhizal isolate were investigated. Fungal cultures were grown on 10 ml MMN liquid for 6 weeks, filtered, and placed in 23 ml tubes containing 10 ml MMN plus 2.5mM methionine or ACC. After incubating 90 hr at 20 C, a 1 cm^3 gas sample was withdrawn and analyzed for ethylene using a gas chromatograph. Ethylene production of the cultures was sampled weekly for 4 weeks. Cultures were flushed with air 90 hr before each sampling. ACC failed to stimulate ethylene production in any of the samples. Methionine stimulated ethylene production (highest avg. = 12.4 ppm/mg dry wt), but values were significant ($P<0.01$) for only 2 *Laccaria* isolates. Ethylene values increased with successive sample periods. Ethylene synthesis pathways in higher plants and ectomycorrhizal fungi are probably different.

OCCURRENCE OF *ARMILLARIA* SPECIES IN MAINE ON HARDWOOD BRUSH AFTER HERBICIDE TREATMENT AND ON PLANTED CONIFERS. William H. Livingston, Dept. of Botany and Plant Path., and Jody Jellison, Dept. Forest Biology, Univ. Maine, Orono, ME 04469

In 1986, 27 plantations of *Picea mariana* and *P. glauca* were surveyed for trees dying from root diseases. Fungal isolates were obtained from 85 trees in 20 plots and were compatible with *Armillaria ostoyae* (biological species I) haploid cultures. Fourteen clones were identified. In 1987, another stand consisting predominantly of hardwood brush (*Acer* spp. and

Betula spp.) was examined for occurrence of *Armillaria* spp. in woody stems treated one year previously with Garlon™ (triclopyr). *Armillaria* spp. were present in 22% of the stems, and culture pairings are in progress for species identification. *Armillaria* root disease is present in forest stands managed for regeneration, and a quick method for species identification is needed for future studies. Therefore, proteins extracted from *Armillaria* cultures are being evaluated using SDS-PAGE for potential use in immunological identification of *Armillaria* spp.

ETIOLOGY OF POTATO SCAB IN WISCONSIN. R. Loria, J. R. Wilde and S. A. Slack. Department of Plant Pathology, Cornell University, Ithaca NY 14853-5980.

Tubers with potato scab symptoms, representing 31 location/cultivar combinations and various lesion types, were collected throughout Wisconsin during 1987. Approximately 60 streptomycete-like isolates were recovered from lesions using several isolation methods. Isolates were tested for pathogenicity on tubers produced from stem cuttings. Pathogenic isolates were recovered from most tuber samples and were evaluated based on morphological and physiological characteristics. Isolates characteristic of Streptomyces scabies were obtained from russet lesions, slightly raised/slightly pitted lesions and deeply pitted lesions. Though most pathogenic isolates were typical of S. scabies, several were distinctly different from this pathogen, and are similar to an acid-tolerant Streptomyces sp. which has been found in New York and Maine. These isolates usually were recovered from russet lesions.

PROPICONAZOLE TO CONTROL CLAVICEPS PURPUREA IN SPRING BARLEY. A. Ould El Ghaouth Magary, and D. Dostaler, Département de phytologie, Université Laval, Québec, Québec, Canada G1K 7P4.

In vitro tests showed that prochloraz (ED_{50}< 0.1 ppm) was the most effective fungicide in reducing radial growth of C. purpurea followed by propiconazole (ED_{50}= 0.2 ppm). At 10 ppm, propiconazole was the most effective ingredient in reducing ergot on barley cv. Bruce in greenhouse tests. A single application of propiconazole (100 ppm) five days before inoculation (first awns visible) reduced the infection by 75% while benomyl did not. Propiconazole had an eradicant effect when applied two hours before inoculation.

INHIBITION OF BOTRYTIS CINEREA BY AN ANTIFUNGAL SUBSTANCE FROM PSEUDOMONAS GLADIOLI AND ITS PREVENTION BY STEROLS. G. H. Mao and R. A. Cappellini, Department of Plant Pathology, Rutgers University, New brunswick, NJ 08903

A new antifungal substance from Pseudomonas gladioli has been identified as a polypeptide with a molecular weight of 41.5 kd. In vitro tests this substance affected the morphology, growth rate and spore germination of Botrytis cinerea. At lower concentrations (0.5-0.8 units/ml), the hyphae were degenerated with increased branching. Germinated spores produced short, branched, gnarled germ tubes. Fungus growth and spore germination were inhibited at higher concentrations (1-2 units/ml). Spores appeared shriveled and plasmolyzed. Additions of cholesterol, ergosterol and stigmasterol neutralized the antifungal activity. In the presence of cholesterol (40-50 ug/ml), the inhibitory activity was completely prevented and the spores germinated normally. The effect of stigmasterol and ergosterol was weaker in comparison to the protection by cholesterol.

STUDIES ON THE MODE OF ACTION OF AN ANTIFUNGAL SUBSTANCE FROM PSEUDOMONAS GLADIOLI ON BOTRYTIS CINEREA SPORES. G. H. Mao and R. A. Cappellini, Department of Plant Pathology, Rutgers University, New Jersey 08903

The effect of an antifungal substance (AFS) from Pseudomonas gladioli on metabolic activities of Botrytis cinerea was tested. ATPase, glucose-6-phosphatase and succinate dehydrogenase were demonstrated in spores and term tubes of B. cinerea using modification of the lead and Nitro BT methods. Spores were suspended in an egg white-agar solution and applied to glass coverlips. The AFS was then applied to the spore film, covered with a cellophane film and incubated at 21-23 C. There was no detectable ATPase, glucose-6-phosphatase or succinate hydrogenase in the fungal cells when spore germination was completely inhibited. On the other hand, these enzymes were detectable in low levels of AFS which did not inhibit spore germination although the germ tubes became abnormal.

TREE HEALTH RELATED TO SOIL PROPERTIES IN RED SPRUCE STANDS IN MASSACHUSETTS. Melinda A. McCall, Gretchen C. Smith, Dept. of Forestry and Wildlife Management, University of Massachusetts, Amherst, MA 01003

An investigation of soil properties at six high elevation red spruce (Picea rubens) stands in western Massachusetts was undertaken to address the question; "Can the degree of spruce decline be related to soil properties?" Soil properties examined (exchangeable Ca, Mg, K, Al, Pb, Zn, Cu; pH; exchangeable acidity) are those which may be affected by acid deposition, and which have been theorized to contribute to forest decline. These properties are related statistically to tree health parameters such as vigor, needle retention, needle discoloration, and branch dieback. A second phase of the study compares soil from around healthy and declining trees to relate the soil directly to a particular tree. This phase could determine if site variability accounts for the occurance of patches of declining spruce among healthier spruce.

ASSESSMENT OF THE OCCURRENCE AND IMPACT OF VIRAL DISEASES OF WINTER WHEAT IN NEW YORK STATE IN 1988. N. R. Miller, G. C. Bergstrom, and S. M. Gray. Department of Plant Pathology, Cornell University, Ithaca, NY 14853.

Sixty-five randomly selected winter wheat fields were surveyed for four virus diseases using symptom expression and various enzyme-linked immunosorbent assay (ELISA) techniques as a basis for assessment. Symptoms associated with wheat spindle streak mosaic virus (WSSMV) were severe at stem elongation with susceptible cultivars showing an average incidence of 36% tillers diseased. The cultivar Geneva incurred only trace levels of WSSMV infection in commercial fields as well as in replicated field trials where its resistance proved comparable to that of Hart and Harrow HG-5. Barley yellow dwarf virus (BYDV) was present in many fields at stem elongation and spike emergence; BYDV incidence statewide averaged only 1.4% of tillers infected. Wheat streak mosaic virus was detected at trace levels in one field. Soilborne wheat mosaic virus was not detected. Fungal foliar diseases were of minor significance in 1988, though foot rot was severe in many fields.

ANTHRACNOSE STALK ROT DEVELOPMENT AS INFLUENCED BY WOUND PREDISPOSITION, AND MAIZE GENOTYPE AND ONTOGENY. A. Muimba-Kankolongo and G. C. Bergstrom, Department of Plant Pathology, Cornell University, Ithaca, NY 14853.

Stalks of maize hybrids Cornell 281 and B37xLB31, susceptible and resistant to anthracnose stalk rot (ASR), respectively, were inoculated (into a wound in the internode above the brace roots) with Colletotrichum graminicola at four host stages at intervals of 0, 1, 2, 6, and 12 hours between wounding and inoculation. ASR severity was inversely proportional to the interval between wounding and inoculation in both hybrids at all host stages. Inoculations at vegetative (mid- and late-whorl) and at reproductive (anthesis and kernel soft dough) stages resulted in internode-restricted and systemic ASR, respectively. Within each inoculation regime, the most severe ASR occurred in Cornell 281. Resistance associated with maize genotype, ontogenic stage, and "wound healing" each may contribute in an additive manner to ASR reduction.

COLLECTION AND SYMPTOM EVALUATION OF OAK AND MAPLE LEAVES IN PENNSYLVANIA. B. L. Nash, D. M. Karasevicz, J. M. Skelly, and D. D. Davis, Dept. of Plant Pathology, The Pennsylvania State University, University Park, PA 16802.

In order to assess tree health along a 110-mile SO_4 deposition gradient in northcentral PA, three methods of leaf collection were evaluated including: tree climber and pole pruner, climber and pole pruner/muslin basket, and shotgun sampling. White oak, red oak, and red maple were sampled at four sites along the gradient (11 trees total per species). A subsample of over 7,000 randomly-selected oak and maple leaves were evaluated for biotic and abiotic injury by two trained technicians. Presence of specific causal agents and symptom severity were recorded. These data were summarized by tree species and statistically analyzed for significant effects due to collection technique, cardinal direction of sampled branch, and leaf evaluator. Insect feeding and insect galls were the most common types of injury. The first method provided good sample material with greatest ease of procurement.

CHEMICAL CONTROL OF SCALD (RHYNCHOSPORIUM SECALIS) IN SPRING BARLEY (HORDEUM VULGARE). N.

Nekouam and D. Dostaler, Département de phytologie, Université Laval, Québec, Québec, Canada G1K 7P4

Foliar applications of ethyltrianol, prochloraz and propiconazole significantly reduced scald lesioning (-15%) on top 3 leaves and increased yield (+1,2 t/ha) of barley cv. Cadette in field plots. But no significant effect was observed with seed treatments with ethyltrianol and triadimenol. Disease progression was reduced on three barley lines, Cadette, Laurier and Sophie by a combination of a seed treatment (triadimenol) and foliar treatments (triadimefon, 125 g.a.i./ha).

ACREMONIUM TYPHINUM, A SYSTEMIC FUNGAL ENDOPHYTE OF FESTUCA GLAUCA LAM. P. J. Newton and P. M. Halisky, Department of Plant Pathology, Rutgers University, New Brunswick, N. J. 08903, and J. F. White, Jr., Department of Biology, Auburn University, Montgomery, AL 36193.

Blue fescue (Festuca glauca Lam.) is an attractive, fine-leaved fescue currently being evaluated for turf usage. Acremonium-like endophytes are present in several species of fine fescue (Saha et al., Plant Dis. 71:1021-1024). Acremonium typhinum was isolated from leaf sheath tissues of blue fescue and a hybrid fescue (F. ovina x F. glauca). The isolates contained vegetative mycelium (1.5-3µ dia.), reniform to ellipsoidal conidia (4-6 x 2-3µ) and short (11-24µ) conidiogenous cells, some with a septum at the base. The fungus grew relatively slowly on Difco PDA, the colony measuring 24 mm in diameter after 14 days at 25°C. The fungus was compared with other isolates of A. typhinum as well as with other Acremonium species. This report establishes blue fescue as a new host for Acremonium typhinum.

CROWN ANALYSIS OF HIGH ELEVATION RED SPRUCE ON WHITEFACE MTN, NEW YORK. C.W. Olson, D.R. Bergdahl, School of Natural Resources, UVM, Burlington, VT 05405; P.M. Wargo, USDA Forest Service, Hamden, CT 06514; and D.R. Tobi, UVM

Plots above and below cloud-base on wind and leeward sides of Whiteface Mt, NY were located in stands of 60-120 yr old Picea rubens. Four plots each consisted of 9 healthy and 9 declining trees (0-10 and 11-50% crown dieback). Crowns were divided into quadrants and one branch was removed from each. No. of brooms, % dieback, oven-dry wt and length were determined for the 1st 10 internodes of each branch. Variables were different ($p<.03$) between health classes. Internode length (avg '83-87) increased ($p<.01$) from above to below cloud-base; differences were greatest on windward plots. Internode wt (avg '78-87) increased ($p<.01$) from wind to leeward. Percent dieback increased ($p<.05$) from below to above cloud-base. No. of brooms increased ($p<.009$) from wind to leeward plots; differences were greatest on below cloud-base plots. Healthy trees had more brooms than declining trees ($p<.03$). Internode length was greatest on healthy trees and health classes differed most below cloud-base ($p<.05$).

Distribution of Fusarium species on sorghum seeds from Nigeria, Lesotho, and Zimbabwe. Nwanma B. Onyike and Paul E. Nelson, Dept. of Plant Pathology, The Pennsylvania State University.

Sorghum (Sorghum bicolor Moench) is grown for human consumption in semi-arid countries of Asia and Africa. Postharvest deterioration by Fusarium species limits the availability of this crop and constitutes a danger to human and animal health because of the mycotoxins produced. Samples of sorghum grain sold in the market, left unharvested in the field, or stored in homes were collected from Nigeria, Lesotho, and Zimbabwe. From each sample 100 seed were cultured on a selective medium and incubated for 7 d with a 12 h photoperiod. Fusarium colonies from infected seed were transferred individually to carnation leaf agar plates, potato dextrose agar slants, and incubated for 10 d with 12 h photoperiod. The most prevalent Fusarium species recovered from the seed were Fusarium moniliforme (64.5%), F. equiseti (8.8%), F. semitectum (8.3%), and F. graminearum (3.7%). F. moniliforme was the predominant species recovered from the seed from all three African countries.

THE STABILITY OF VERTICILLIUM WILT RESISTANCE IN ALFALFA UNDER DROUGHT STRESS. B.W. Pennypacker and K.T. Leath, Penn State University and USDA-ARS, University Park, PA 16802.

Two Verticillium wilt resistant alfalfa clones were grown in the greenhouse in 0.03-m^3 cylinders that allowed simulation of field drought stress. After 6-wk plants were stubble inoculated with V. albo-atrum. Plants grew 6 more wk before consecutive drought episodes were imposed during the next two growing periods. Plant response to combined stresses of drought and V. albo-atrum was assessed at harvest during the first drought episode and weekly during the second droughting. Plant height, stem diameter, leaf area, leaf and stem dry weight, and aerial biomass were significantly ($p=0.01$) reduced by the drought treatment during both drought episodes. Verticillium albo-atrum significantly ($p=0.01$) reduced the height and stem diameter of all inoculated plants. There was no significant drought x pathogen interaction in either growing period, an indication that resistance to V. albo-atrum was stable under drought stress.

RHIZOCTONIA SPP. ASSOCIATED WITH GOLF COURSE TURFGRASS IN SOUTHERN NEW JERSEY K. A. Plumley, Agri-Diagnostics Associates, 2611 Branch Pike, Cinnaminson, New Jersey, 08077.

Three New Jersey golf courses were monitored for the presence of Rhizoctonia spp. in 1987. The monitoring sites were fairways and greens with or without a history of Brown Patch. Leaf samples were collected weekly in May and September and twice weekly in June, July and August. Individual blades were plated on selective media and Rhizoctonia-like fungi were selected and subcultured. Isolates were classified by colony morphology, nuclear condition, and pathogenicity on turfgrass. Approximately 50% of the isolates recovered were pathogenic isolates of R. solani, 25% were pathogenic isolates of R. zeae and 25% were non-pathogenic binucleate Rhizoctonia-like fungi. The R. solani and R. zeae isolates were recovered from greens and fairways with or without Brown Patch symptoms. Most of the binucleate isolates were recovered from asymptomatic turfgrass.

ENHANCED PRODUCTION OF SCLEROTIA OF TYPHULA ISHIKARIENSIS IN AMENDED V-8 JUICE MEDIUM. S. Pouleur, L. Couture and D. Dostaler. Département de phytologie, Université Laval, Québec (Québec), Canada G1K 7P4; and Station de recherches, Agriculture Canada, Sainte-Foy (Québec), Canada G1V 2J3.

In preliminary studies, it was determined that V-8 juice agar medium (V-8 juice 200 mL, $CaCO_3$ 3 g, agar 15 g/L) was more satisfying than a range of commonly used mycological media to support growth of Typhula ishikariensis, causal agent of speckled snow mould in winter cereals. Selected supplements to the medium were tested to enhance production of sclerotia. Production of sclerotia increased with concentration of mannose (2.5 to 20 g/L) or ground cereal leaves (5 to 20 g/L) in the medium. Combinations of mannose and cereal leaves were somewhat better than mannose or cereal leaves alone. The best combination (10 g each of mannose and cereal leaves) yielded 290 mg sclerotia/Petri dish after a 6-week incubation at 9°C, as opposed to 100 mg in plain V-8 juice agar. Mycelial growth did not follow the same pattern.

METALAXYL RESISTANCE FREQUENCY IN OVERWINTERING POPULATIONS OF PYTHIUM APHANIDERMATUM FROM METALAXYL CONTROL FAILURE SITES. P. L. Sanders and M. D. Soika, Department of Plant Pathology, Penn State University, University Park, PA 16802.

Soil samples are collected in late fall each year from metalaxyl-control-failure sites to monitor fluctuations in metalaxyl resistance frequency in populations of Pythium aphanidermatum. Soil samples are homogenized in water, serially diluted, and plated on a selective medium, non-amended & amended with metalaxyl, to partition the population into metalaxyl-resistant & -sensitive components. Immediately following a metalaxyl control failure, the pathogen population is typically 100% resistant to 100ug/ml metalaxyl. In the absence of metalaxyl selection pressure, resistance levels have remained high for up to three years following metalaxyl control failure. On a golf course, where sampling has been carried out for five years after a control failure, the resistance frequency declined to 10%, stabilized, and has not returned to the 0% detection frequency typical of a pre-selection condition.

DETECTION OF VIRUS INFECTED PROTOPLASTS IN SUSPENSION BY FLUORESCENT ANTIBODY STAINING. Shiel, P.J., Le, X.H., Agrios, G. N., and Thomas, M. E., Dept. of Plant Pathology, Univ. of Mass., Amherst, MA. 01003.

A simple procedure was developed to detect apple mosaic virus (ApMV) and tobacco mosaic virus (TMV) in protoplasts still in suspension. Healthy and virus infected protoplasts from apple callus tissue and from tobacco mesophyll were fixed by suspending concentrated protoplasts in 100% ethanol for four minutes. Virus-specific antisera and anti-antibody FITC conjugate were added to the protoplasts in phosphate-buffered

mannitol and were each incubated at 37°C for two hours. An average of 6.0% of treated, suspended apple protoplasts, obtained from twig callus of ApMV infected trees in February and March, fluoresced brightly. However, 35.5% of apple protoplasts fluoresced when the callus was obtained from twigs collected from the same trees in May. Protoplasts produced from healthy trees at either time did not fluoresce. This procedure was also successful in detecting TMV infected tobacco mesophyll protoplasts in suspension.

ISOZYME POLYMORPHISMS DIFFERENTIATE ISOLATES OF LEPTOSPHAERIA MACULANS VIRULENT AND WEAKLY VIRULENT TO BRASSICA NAPUS. D.W. Sippell[1], R.S-C. Wong[1] and R. Hall[2]. [1]Allelix Inc., Research Farm, Georgetown, Ontario L7G 4S7 and [2]University of Guelph, Guelph, Ontario N1G 2W1.

Of 43 isolates of Leptosphaeria maculans from oilseed rape (Brassica napus) from Canada, West Germany, Sweden and the United Kingdom, 22 were virulent and 21 were weakly virulent to B. napus. Isozyme polymorphisms of glucose phosphate isomerase and malate dehydrogenase were identified by a starch gel electrophoresis procedure used to differentiate canola cultivars. For each enzyme there were two isozyme patterns, one consistently associated with virulent isolates, the other with weakly virulent isolates. In contrast, pigment production, measured as optical density of the spent medium, and pH of the spent medium did not consistently differentiate virulent from weakly virulent isolates.

The Response of Two "SNB Symptomatic" Eastern White Pine Clones Taken from Acadia National Park to Ozone. J. M. Skelly, K. R. Snyder, and W. Merrill. Department of Plant Pathology, Pennsylvania State University, University Park, PA 16802

Semi-mature tissue needle blight (SNB) of Pinus strobus was studied via exposure of two ramets derived from "SNB symptomatic" ortets in Acadia National Park, ME to four ozone treatments. Clones C-6, C-13 and wild-type seedlings were exposed 7 h/d from May 31 to August 11 in Continuously Stirred Tank Reactors to ozone at 1) 15-30 ppb; 2) 40-70 ppb; 3) 40-70 ppb with an early season (June 9) 90 ppb 1h spike; and 4) 40-70 ppb with both a 90 ppb early season spike and an additional (June 30) 160 ppb 1h spike. SNB-like symptoms developed only on clone C-13. Banding and tip necrosis were first noticed in treatments 3 and 4 following the first spike exposure. SNB symptoms became more intense involving additional tissues following the second spike. Exposures to low doses in treatment 2 induced SNB-like symptoms late in the exposure period. Treatment 1 trees remained asymptomatic as did the wild-type and C-6 ramet.

GROWTH AND STEROL CONTENT OF STRAINS OF *USTILAGO AVENAE* RESISTANT AND SENSITIVE TO TRIADIMENOL. Franzine D. Smith and Wolfram Koeller, Department of Plant Pathology, Cornell University, New York State Agricultural Experiment Station, Geneva 14456.

A strain (sen) of *Ustilago avenae* sensitive to triadimenol and a chemically mutated resistant strain (r1) of sen were treated in liquid culture with triadimenol at 2 mg/L. Sporidia/ml was determined every 2 hr from 4 to 14 hr and at 24 hr. Growth of r1was inhibited 98.9 % by triadimenol between 4 and 6 hr, but inhibition decreased to 9 % between 14 and 24 hr. Inhibition of the sen cultures occurred later than in r1 and reached 99.5 % between 6 and 10 hr and then decreased to 90.9 % for hours 14 to 24. Abnormal branching, clustering and filamentous growth of sporidia occurred in both sen and r1 cultures. It continued to increase in sen cultures from 6 to 24 hr and was present in the r1 cultures from 8 to 14 hr, but had disappeared from the r1 cultures by 24 hr. Ergosterol was the major sterol in treated r1 cultures, in control r1, and in control sen cultures. Ergosterol precursors were the major sterols in treated sen cultures. The results suggest that resistance to triadimenol is due to a biochemical process induced by exposure to triadimenol and not a pre-existing physical exclusion of triadimenol from the target site.

LIMITED REPLICATION AND MOVEMENT OF TOMATO MOSAIC VIRUS (ToMV) IN RESISTANT TOMATO SOMACLONES. S. Schiller Smith, Dept. of Botany & Plant Pathology, Univ. of Maine, Orono, ME 04469 and H.H. Murakishi, Dept. of Botany and Plant Pathology, Michigan State Univ,, East Lansing, MI 48824-1312.

Six tomato somaclones, regenerated from a fully ToMV-susceptible line (GCRI-26), were selected for resistance to ToMV. The inheritance of this resistance appears to be complex, involving multiple nuclear genes and a maternally inherited factor in each case. Somaclonal resistance has been characterized for temperature sensitivity, virus strain response, and response to other viruses. To gain a better understanding of the role of resistance in systemic movement of virus, plant grafting experiments were done using resistant and susceptible plants. Detection of virus in protoplasts after release from inoculated plants has helped to elucidate the resistance mechanism, which appears to involve limited virus replication and movement.

CONTROL OF PHYTOPHTHORA ROOT AND CROWN ROT OF APPLE SEEDLINGS BY *TRICHODERMA* SPP. V. L. Smith, W. F. Wilcox, and G. E. Harman, Depts. of Plant Pathology and Hort. Sci., N. Y. State Agr. Exp. Sta., Cornell Univ., Geneva, 14456

Phytophthora root and crown rots of apple seedlings were controlled in greenhouse trials by selected isolates of *Trichoderma*. Forty-four isolates from local orchard and *Aphanomyces*-suppressive pea field soils were selected for the ability to grow and sporulate at 10 C, for evidence of antibiotic production against *Phytophthora cactorum*, and for tolerance to metalaxyl in vitro. In greenhouse trials, apple seedlings were planted into soil mix artificially infested with *P. cactorum*, with and without the addition of individual *Trichoderma* isolates (ca 10^6 CFU/g). After ca. 2 weeks in the greenhouse, pots containing seedlings were flooded for 72 hr to induce zoospore discharge and subsequent infection by *P. cactorum*. Significant (P=0.01) increases in plant weight and reductions in root rot severity were obtained with the addition of 8 different isolates of *Trichoderma* spp.; the remaining isolates provided moderate or no control. These results suggest the potential for identifying isolates of *Trichoderma* spp. useful as biocontrol components of a program for managing *P. cactorum* on apple.

THE NUCLEAR DNA CONTENT AND PLOIDY OF PHYTOPHTHORA INFESTANS. C. D. Therrien, D. L. Ritch, and L. J. Spielman, Dept. of Plant Pathology, The Pennsylvania State University, University Park, PA 16802, and Dept. of Plant Pathology, Cornell University, Ithaca, NY 14853.

Because of previous reports that polyploidy observed in P. infestans may be the result of extended laboratory cultivation, we have analyzed the nuclear DNA content of five isolates collected in the field in New York and Maine during 1987 and processed immediately thereafter. The mean DNA values for the three isolates from New York were 0.98, 1.14 and 0.90 arbitrary units (a.u.). For the two Maine isolates the values were 0.61 and 0.73 a.u. These values indicate that the New York isolates are tetraploid. The two isolates from Maine are diploid and triploid respectively. The results of these studies demonstrate that the polyploidy observed in these isolates cannot be the result of extended laboratory cultivation. Furthermore, we have for the first time reported a diploid isolate in The New World which has not been isolated in Mexico, nor is of recent Mexican origin.

QUANTIFYING RHIZOMORPHS OF ARMILLARIA IN SOIL AROUND STUMPS IN FOREST STANDS. Philip M. Wargo, USDA Forest Service, Hamden, CT 06514.

Rhizomorphs of Armillaria species were quantified in the soil around stumps, created by cutting different numbers of years ago, in 16 mixed oak stands in south-central Pennsylvania. Rhizomorphs were detected by 3 independent methods: (1) directly by removing 3 blocks of soil (15x15 cm) down to the B horizon and measuring the lengths (cm) of rhizomorphs in the soil or indirectly (2) by driving 6 stakes (20-35 cm) of red oak saplings or (3) by burying 6 potatoes into the soil in a 3x2 30 cm sq. grid and counting the number colonized by Armillaria after 35-40 and 120 days for potatoes and stakes respectively. Rhizomorph density (cm/cc soil) increased with time since cutting and was low in stands not recently disturbed. On a stand basis, % plots (stumps) with stakes and tubers colonized, and % stakes and tubers colonized were positively correlated ($r = 0.52$ to 0.78 $\alpha=0.05$) with average rhizomorph density, and % plots and % stumps with rhizomorphs.

CROWN AND ROOT RELATIONSHIPS IN DECLINING RED SPRUCE (PICEA RUBENS SARG.) TREES. P.M. Wargo, USDA Forest Service, Hamden, CT 06514, D.R. Bergdahl, C.W. Olson and D.R. Tobi, School of Natural Resources, Univ. of Vermont, Burlington, VT 05405.

Crown and root vitality of healthy and declining (<10% and 10 to 50% crown dieback respectively) red spruce growing above 900 m were compared. Crown vitality was measured by visual estimate and by actual measurements of a branch removed above mid crown from each of four quadrants. Three woody root systems with fine roots attached from each tree were judged living or dead by color and texture; mycorrhizae were also counted. Crown dieback increased as the number of fine roots per unit length decreased and percentage of dead fine roots and length of dead 4th order woody roots increased. Crown deterioration occurred prior to substantial woody root death. Decreased shoot elongation and dry weight of the internodes for years 1986--1982 were also

correlated with both woody and fine root deterioration but correlations were higher with the fine roots. Crown vitality was highly and most closely correlated with numbers of mycorrhizae/unit length of nonwoody-fine root, from 4th order woody roots.

CYCLANEUSMA MINUS INFECTION CONTROLLED USING BRAVO 720 SPRAY SCHEDULES. Nancy G. Wenner and William Merrill, The Pennsylvania State University, University Park, PA 16802.

Needlecast caused by Cyclaneusma minus limits production of Scots pine (Pinus sylvestris) Christmas trees in Pa. Two treatment schedules successfully controlled infection of 0.5-2.0 m tall Scots pine in a commercial planting in Clearfield Co., Pa. Bravo 720 was applied periodically by backpack mist blower from June 1987 to May 1988 to protect the 1987 needle complement. Efficacy was monitored by direct isolation of the fungus from 40 needles collected from each of 10 permanent sample trees per treatment block. On 6/2/88 infection levels in the unsprayed checks were 88%; in contrast, five sprays at 3.2 l f.p./ha applied 6/8, 8/18, 10/14/87, and 3/23 and 5/10/88 held infection to 2.0%. Two applications, 12.9 l f.p./ha applied on 6/8/87 with a second spray at 3.2 l f.p./ha applied on 5/10/88, held infection to 17.0%. Both treatments significantly differed from the checks $P < 0.0005$, and from each other $P = 0.002$. The five spray schedule is now the recommended treatment in Pa.

DOUBLE-STRANDED RNA IN HEALTHY BARSOY BARLEY. I. A. Zabalgogeazcoa and F. E. Gildow. Dept. of Plant Pathology, The Pennsylvania State University, University Park, PA 16802

A high molecular weight (≈12 MD) ds-RNA was isolated by cellulose chromatography and gel electrophoresis from greenhouse grown 21-day old barley cv. Barsoy grown from seed obtained from 5 sources in 4 states. The foundation seed also contained ds-RNA. No viral particles were detected in the tissue by electron microscopy or sucrose density gradients. The parental lines of Barsoy, Dayton and Aizu-7, contained a similar ds-RNA. Barley cultivars Post, Pennco, Pennrad, Hudson, Luther, and Maury tested negative for ds-RNA. Crosses of Barsoy with other ds-RNA free cultivars demonstrated that the ds-RNA is paternally and maternally transmitted to the progeny. The origin of this molecule is under investigation.