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ABSTRACTS

CHARACTERISTICS OF NONMYCORRHIZAL FESCUE, CORN, RED CLOVER, BLACK LOCUST, AND APPLE RELATED TO MYCORRHIZAL DEPENDENCY. M. J. Adelman and J. B. Morton, WVU Plant Path. and Ag. Micro., P.O. Box 6057, Morgantown, WV 26506-6057.

Five plant species were grown for 12 weeks in an Appalachian soil equilibrated at five solution P levels (0.03 to 0.24 mg P/kg). Mycorrhizal dependency of all hosts was calculated (shoot dry weight of mycorrhizal plants/shoot dry weight of nonmycorrhizal plants) at each P level. The rate of increase in shoot and root dry weight of nonmycorrhizal plants predicted relative differences in mycorrhizal dependency among host species. For example, mycorrhizal dependency was greatest for apple and least for fescue. Shoot and root dry weights of nonmycorrhizal apple did not increase appreciably at any P level. Dry weights of nonmycorrhizal fescue shoots and roots increased rapidly up to a P level of 0.06 mg/kg, where shoot dry weight of mycorrhizal and nonmycorrhizal plants were equivalent. At higher P levels, there was little increase in root and shoot dry weight of nonmycorrhizal fescue.

NATIVE VA MYCORRHIZAL FUNGI IN DIFFERENT HOST-SOIL COMBINATIONS: RELATIONSHIP BETWEEN MPN ESTIMATES AND PERCENTAGE ROOT COLONIZATION. M. J. Adelman and J. B. Morton, WVU Plant Path. and Ag. Micro., P.O. Box 6057, Morgantown, WV 26506-6057.

Most probable number (MPN) estimates of native vesicular-arbuscular mycorrhizal fungi from four different habitats were related to percentage mycorrhizal colonization of assay hosts in the lowest MPN dilutions. Both measures of propagule infectivity varied with host and type of soil diluent used in each MPN test. Despite these differences, percentage colonization was directly proportional to MPN estimates when values of both were low. Maximum limits of mycorrhizal infection varied with plant species when infectivity of inocula was high, causing the relationship to plateau. A quadratic regression provided the best fit ($r = 0.89$, $p = 0.0001$) when the full range of values were plotted. Possibly, a linear model can be constructed that will predict MPN values based on estimates of percentage colonization in a single assay host.

HISTOLOGY OF INFECTION OF PHOTINIA LEAVES BY ENTOMOSPORIUM MACULATUM. A.B.A.M. Baudoin, Dept. of Plant Pathology, Physiology & Weed Science, VPI&SU, Blacksburg, VA 24061.

Infection of Photinia X fraseri leaves by Entomosporium maculatum was studied by light microscopy. Leaf tissue, inoculated with drops of conidial suspension, was cleared and stained with trypan blue, or embedded in paraffin and sectioned. Spores germinated within 6 hours at similar rates on either side of expanding, susceptible leaves and mature, relatively resistant leaves. Appressoria, consisting of rounded and sometimes slightly swollen germ tube apices, developed without apparent preference above anticlinal walls, lumina of epidermal cells, and stomata. Penetration was detected 12 hours after inoculation. Hyphae often grew under the cuticle in the outer epidermal wall for some distance before penetrating the cell lumen. On young leaves, the abaxial side was about twice as susceptible as the adaxial side and stomatal penetration was uncommon. On mature leaves penetrations were rare, and most occurred on the abaxial side, through guard cells or stomata.

NATURAL OCCURRENCE OF MACROCYCLIC TRICHOHECENES IN BACCHARIS SPP. PLANTS AND THEIR PROBABLE ORIGIN. C. A. Bean, Department of Botany, University of Maryland, College Park, MD 20742 and

T. Kommedahl, Department of Plant Pathology, University of Minnesota, St. Paul, MN 44108.

Two *Baccharis* spp. plants collected in Brazil were analyzed for macrocyclic trichothecene mycotoxins by HPLC. *B. megapopotomica* can absorb, translocate, and metabolize microbially produced trichothecenes under greenhouse conditions; *B. coridifolia*, when fed to livestock, causes histopathological changes suggesting mycotoxin contamination. In *B. megapopotomica* high concentrations of baccharanoids (metabolized trichothecenes) were found, and tissue of *B. coridifolia* contained high levels of non-metabolized trichothecenes and low levels of baccharanoids. Trichothecene-producing fungi could not be isolated from root tissue, and *Baccharis* spp. plants grown in greenhouse soil contained no trichothecenes. These studies suggest that the origin of trichothecenes in *Baccharis* spp. may be the result of a plant/soil fungi interaction.

PERSISTENCE OF DICLORAN, IPRADIONE AND VINCLIZOLIN ON PEANUT VINES UNDER FIELD CONDITIONS. T. B. Breneman, P. M. Phipps and R. J. Stipes, Dept. of Plant Pathology, Physiology and Weed Science, VPI&SU, Blacksburg, VA 24061*

Suspensions of dicloran (D), iprodione (Ip) and vinclozolin (V) were applied to peanut vines until runoff at concentrations of 10, 3.3 and 2.5 mg/ml, respectively. Weekly bioassays of excised stems were used to measure fungicide persistence for 4 wks. Wounded stems were inoculated with *Sclerotinia minor*, and lesion development monitored. All three compounds were fungicidal in assays of stems collected immediately after treatment; D, Ip and V gave 88, 75 and 100% inhibition of lesion development at 2 wks, and 41, 30 and 45% inhibition at 4 wks after treatment, respectively. Accumulated rainfall at weekly intervals following treatment was 0, 2.44, 5.82 and 6.09 cm, and accumulated solar radiation was 3498, 6179, 9305 and 12,292 langleyes. Time, rainfall and solar radiation were each correlated ($P=0.01$) with reduced levels of inhibition by all three fungicides.

THE EFFECT OF THE LESSER PEACHTREE BORER ON THE EXPANSION OF CYTOSPORA CANKER ON PEACH TREES. D. I. Breth, J. W. Travis, and L. A. Hull, Depts. of Plant Pathology and Entomology, The Pennsylvania State University, University Park, Pa. 16802

In October, 1983, *Prunus persica* 'Loring' were inoculated with an isolate of *Cytospora* sp. obtained from an orchard in Adams Co., Pa. In July, 1984, the induced cankers were infested with 0, 5, or 10 of the first generation neonate larvae of *Synanthedon pictipes* G. & R. per canker. The uninfested cankers served as controls. The effect of the borer larvae on canker expansion was examined by measuring the length, width, and total area of the cankers in October, 1984, through destructive sampling. Preliminary studies suggest a direct positive relationship between the number of larvae developing within the diseased tissue and the resulting total area of the canker.

REDUCTION IN YELLOW NUTSEDGE STAND AND TUBER SET BY PUCCINIA CANALICULATA AND BENTAZON HERBICIDE. W. L. Bruckart¹, D. R. Johnson¹, and J. Ray Frank², ¹USDA-Plant Dis. Res. Lab., and ²USDA-Weed Sci. Res. Lab., Ft. Detrick, Bldg. 1301, Frederick, MD 21701.

Puccinia canaliculata was evaluated in the absence of crop effects for potential in biological control of yellow nutsedge (*Cyperus esculentus*) on the Delmarva Peninsula. A 2 x 3 factorial experiment was conducted which integrated two sublethal rates of bentazon herbicide with the pathogen. One application of the rust fungus was made on June 13, along with initiation of weekly fungicide controls. Herbicide applications at 0.28 and 0.56 kg/ha were made June 27. Combination of rust and

* = Student Paper Competition

herbicide (0.56 kg/ha) resulted in a 33% reduction (=600 plants/m²) in nutsedge stand compared with untreated controls. Herbicide or rust alone accounted for reductions of 14% and 8%, respectively. Tuber set also was reduced by 33, 21 and 45% (=4300/m³) because of the rust, herbicide (0.56 kg/ha) and combined treatments, respectively.

ELM SURVIVAL AFTER 50 YEARS OF DUTCH ELM DISEASE. R.J. Campana and R.J. Stipes. Dept. Botany & Plant Pathology, Univ. of Maine Orono, ME 04469 and Dept. Plant Pathology, VPI & State Univ., Blacksburg, VA 24061

Massive decimation of urban elm populations in Eastern North America from Dutch elm disease poses questions on extinction of *Ulmus americana* as a landscape tree. A survey was made in 1983-84 of 14 sites in eight of the United States where the disease occurred 50 years ago. Each site was examined for data on: (1) presence of disease-free elms; (2) trees of seed bearing size; (3) large trees surviving population decimation; (4) recent elm seedlings; and (5) size, structure and distribution of new elm populations. Healthy elms were observed at every site including: numerous trees of seed-bearing size; some large trees surviving early epidemics; thousands of new seedlings; and trees of varied age and size in new elm populations. The data indicate clearly the continued survival of sufficient large trees to provide seed for new elm populations and continued survival of *U. americana* despite serious losses.

YELLOW-POPLAR SEEDLING GROWTH RESPONSE TO OZONE AND SIMULATED ACIDIC RAIN. A. H. Chappelka, B. I. Chevone and T. E. Burk, Dept. Plant Pathology, Physiology & Weed Science and Dept. Forestry, VPI&SU, Blacksburg, VA 24061*

Half-sib, 9 wk-old, yellow-poplar were exposed to O₃ (0.00, 0.05, 0.10, and 0.15 ppm, 4h/d, 5d/wk) with simulated rain (pH 3.0, 4.3 or 5.6 1h/d, 2d/wk at 0.75 cm/h) for six weeks. Across rain treatments, there was a significant linear increase in root/shoot ratio and specific leaf area (leaf area/leaf weight) with increasing concentrations of O₃. A significant linear reduction in cumulative height growth was observed with increasing rain acidity across all O₃ exposures. A significant O₃ x rain interaction occurred with leaf and stem dry weights. Leaf dry weight decreased linearly with decreasing pH only in seedlings exposed to 0.05 ppm O₃. Stem dry weight also decreased linearly with decreasing pH, but only in plants fumigated with 0.05 and 0.10 ppm O₃.

THE POTENTIAL SPREAD OF PEACH ROSETTE MOSAIC VIRUS (PRMV) IN CONCORD GRAPE VINEYARDS USING INFECTED PULP AND SEED AS MULCH. A. M. Childress and D. C. Ramsdell, Dept. Plant Pathol., Physiol. and Weed Sci., VPI&SU, Blacksburg, VA 24061 and Dept. Botany and Plant Pathol., Michigan State Univ., East Lansing, MI 48824, respectively.

The nepovirus, peach rosette mosaic virus (PRMV) causes a serious disease of cv. Concord grapevines in Michigan. The mean yield of infected vines was reduced by more than 40%. Sources of the virus include infected grapevines and weeds. Seed and pulp residue, obtained after commercial heat processing of grapes for juice, is often returned to some vineyards as mulch. The role of mulch containing infected seed and seedlings as an additional source of PRMV was investigated. A high percentage of seed sampled at timed intervals from processed and unprocessed fruit contained PRMV. The virus was detected in 14.3% of the seedlings from unprocessed seed lots but was not detected in seedlings from heat processed seed. Although PRMV was detected in only a few of the seedlings, the potential for establishing new infection sites exists.

OZONE INJURY ON NATIVE VEGETATION IN FOUR MID-ATLANTIC NATIONAL PARK SERVICE AREAS. D. D. Davis. 211 Buckhout Lab., University Park, PA 16802

During 21-31 August 1984, foliar ozone injury was evaluated on native, broadleaved bioindicator species in four mid-Atlantic National Park Service areas: Hampton National Historic Site near Baltimore, MD; Gettysburg, PA; Fredericksburg-Spotsylvania Court House, VA; and Petersburg, VA. Severity of injury on each plant was rated from 0 (no symptoms) to 4 (severe symptoms), and incidence of individuals exhibiting symptoms was calculated (0-100%). The number of plants exhibiting ozone injury, regardless of severity, as compared to the total number of individuals examined was: *Asclepias syriaca* 86/121; *Cercis canadensis* 8/15; *Cornus florida* 121/287; *Fraxinus* spp. 20/244; *Hamamelis virginiana* 6/13; *Liriodendron tulipifera* 125/215; *Prunus serotina* 70/324; *Sassafras albidum* 5/272; and *Vitis* spp. 64/118.

FOLIAR INJURY TO PINE SEEDLINGS EXPOSED TO SULFUR DIOXIDE. D. D. Davis and A. R. Biggs. 211 Buckhout Lab., University Park, PA 16802.

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Five *Pinus* species seedlings growing on a strip mine near a coal-fired power plant were evaluated for susceptibility to sulfur dioxide. The seedlings had been exposed to acute dosages of sulfur dioxide twice during the summer, and were evaluated the following spring. Five plots ranging in size from 0.5 to 1.0 acre were established at distances 1.0 to 3.0 miles from the power plant. The terminal shoot of each plant evaluated was assigned a visible injury rating of 0, 5, 20, 40, 60, 80, 95, or 100%. Number of plants evaluated, percentage of plants exhibiting symptoms, and mean severity rating, respectively, for each species were as follows: *P. strobus* - 377, 100%, 91.1; *P. virginiana* - 286, 96%, 16.1; *P. nigra* - 354, 83%, 7.2; *P. ponderosa* - 107, 53%, 2.8; and *P. resinosa* - 409, 42%, 3.8. Tip necrosis was the most common symptom caused by sulfur dioxide. *P. nigra* needles also had a very distinctive banding symptom.

WATER RELATIONS OF GEOTRICHUM CANDIDUM: GROWTH AND POLYGALACTURONASE PRODUCTION AND ACTION IN VITRO. L. L. Davis and A.B.A.M. Baudoin, Dept. Plant Pathology, Physiology & Weed Sci., VPI&SU, Blacksburg, VA 24061

Susceptibility of lemons to sour rot, caused by *Geotrichum candidum*, is influenced by fruit water potential (Baudoin and Eckert 1982, *Phytopathology* 72:1592-1597). In liquid media amended with either mannitol or polyethylene glycol 400 as osmotica, osmotic potentials (ψ_s) from -5 to -25 bars had little effect on growth of *G. candidum*, whereas KCl at -25 bars reduced growth to 5% of that at -5 bars. With all three osmotica, production of extracellular polygalacturonase (PG) was strongly affected by ψ_s ; at -25 bars PG production was only 1% of that at -5 bars. PG activity in assay mixtures amended with mannitol, sucrose or glycerol as osmotica decreased slowly as the ψ_s decreased from -5 to -25 bars. We conclude that ψ_s exerts a major effect on extracellular PG production, a minor effect on PG activity and little or no effect on fungal growth. The effect on PG production correlates well with the influence of water potential on lemon susceptibility to sour rot.

THE EFFECT OF PYRENOPHORA TERES AND TWO ISOLATES OF BARLEY YELLOW DWARF VIRUS (BYDV) ON THE FREEZING RESISTANCE OF WINTER BARLEY. L. M. Delserone and J. A. Frank, Dept. of Plant Pathology, Pennsylvania State University and USDA-ARS, Univ. Park, PA 16802*

The winter barley cultivar Pennrad was planted in a specific medium in black plastic tubes, and grown for three weeks under metal halide lamps. Plants were treated with either an RMV or PAV isolate of BYDV, *Pyrenophora teres*, combinations of *P. teres* with each of the isolates, or non-viruliferous aphids. After three weeks, the plants were grown at cold-hardening temperatures for one week. Excised crowns then were exposed to a freezing temperature of -3.8 C for 8 hr, and were scored for survival. Compared with shoot and root regrowth of healthy frozen control plants, infection by *P. teres* resulted in an 8.7% decrease in regrowth, feeding by non-viruliferous aphids decreased regrowth up to 10.5%, while infection by either BYDV isolate decreased regrowth up to 21.3%. Combinations of *P. teres* with either RMV or PAV further reduced regrowth up to 27.1%.

SPORE MOVEMENT IN VESSELS OF ELM SUSCEPTIBLE OR RESISTANT TO DUTCH ELM DISEASE. M.R. Dietz and R.J. Campana. Dept. of Botany & Plant Pathology, Univ. of Maine, Orono, ME 04469

Since large vessel size in elms indicates resistance to Dutch elm disease, downward rate of spore movement in susceptible(S) and resistant(R) elm species (*Ulmus americana*; *procera*; *hollandica*; *parvifolia*; and *pumila*) was evaluated. Ten trees of each species received four inoculations of conidial suspensions in water (5x10⁴ sp/ml). Inoculated stems were severed 40 cm below inoculation points (IPs) after 24 hrs, debarked, cut into 1 cm discs, and placed on water agar plates containing 1 mg/l pyridoxine. Discs were incubated at 22°C and observed for coremia and/or mycelial characteristics. Mean distance of conidial movement was greater in *americana*(S) and *procera*(I) than in *hollandica*(I), *parvifolia*(R) and *pumila*(R). The data indicate that spores of *C. ulmi* move farther in the same time period in susceptible than in resistant elms.

DOUBLE-STRANDED RNA ASSOCIATED WITH THE NATURAL POPULATION OF ENDOTHIA PARASITICA IN WEST VIRGINIA. M. L. Double, W. L. MacDonald, and R. L. Willey, WVU Plant Path. and Ag. Micro., 401 Brooks Hall, P.O. Box 6057, Morgantown, WV 26506-6057.

Naturally occurring hypovirulent (hv) isolates of *Endothia parasitica* that contain double-stranded (ds) RNA have been found in Europe and Michigan and occasionally on old surviving American chestnut trees in the eastern US. This study was initiated to determine if hv isolates are common in the natural *E. parasitica* population. Twenty actively growing cankers on American chestnut sprouts were sampled at each of 15 sites in seven WV counties. Of over 1000 isolates, the majority produced typical *E. parasitica* colonies. Many isolates, however, exhibited abnormal morphology. Twenty-one abnormal isolates

were examined for dsRNA using polyacrylamide gel electrophoresis and nine yielded dsRNA bands. This survey indicates that dsRNA may be common in the natural population of *E. parasitica*.

COMPARISON OF SPORULATION OF PERONOSCLEROSPORA SORGHI, P. SACCHARI, AND P. PHILIPPINENSIS FROM SEVERAL AREAS OF THE WORLD. N. B. Duck, M. R. Bonde, and G. L. Peterson. Plant Disease Res. Lab., USDA-ARS, Bldg. 1301, Ft. Detrick, Frederick, MD 21701.

Seven isolates of *Peronosclerospora sorghi*, three of *P. sacchari* and four of *P. philippinensis* were compared as to the number of conidia produced per cm² surface of infected corn leaves. At 21 days after inoculation, eight plants for each isolate were placed in dew chambers. At the time of maximum sporulation, conidia were collected from each plant and counted with a particle counter. The surface of the infected portion of leaves was measured. All *P. sorghi* isolates produced 3.0×10^3 conidia/cm² infected leaf surface except an isolate from Thailand that produced 1.5×10^4 conidia/cm². *P. sacchari* and *P. philippinensis* produced 4.0×10^3 - 1.0×10^4 spores per cm² infected leaf area. Besides having epidemiological significance, these results support previous studies on host ranges and morphology which indicate that *P. sorghi* from Thailand is a separate species from typical *P. sorghi*; and that *P. sacchari* and *P. philippinensis* may be a single species.

METABOLITE PRODUCED BY TALAROMYCES FLAVUS REDUCES VIABILITY OF MICROCLEROTIA OF VERTICILLIUM DAHLIAE IN VITRO AND IN SOIL. D. R. Fravel, C. J. Baker, USDA-ARS, Beltsville, MD 20705 and J. B. Ristaino, University of California, Davis, 95616.

Culture filtrates of *Talaromyces flavus* grown in shake culture for up to 5 days or sterile culture medium were dialyzed and were incorporated into Czapek-Dox agar at 5 dilution rates. Aqueous suspensions of microclerotia (ms) of *V. dahliae* or agar plugs of agar with *V. dahliae* were placed on the agar surface. The culture filtrate prevented germination of the ms and was fungistatic to mycelium of *V. dahliae*. Metabolite titre increased during the incubation period and was lost when dialyzed with tubing of greater than 6-8 x 10³ molecular weight cut-off (mwco). To determine the effect of the metabolite on ms in soil, ms were embedded in nylon mesh and buried 4 cm deep in each of two field soils or sterile sand. Soils were treated with water or dialyzed fractions of filtrate or medium and the nylon pieces were recovered after 24 hr. In all soils there was a significant loss in viability of ms treated with the 3.5 x 10³ mwco dialyzed filtrate, compared to all other treatments.

EFFECT OF SODIUM HYPOCHLORITE ON ENGLISH BOXWOOD, AZALEA AND PHYTOPHTHORA SPP. Melinda M. Gates, Robert C. Lambe and George H. Lacy, Dept. Plant Pathol., Physiol. and Weed Sci., VPI&SU, Blacksburg, VA 24061.

Clonal greenhouse grown English boxwood (*Buxus sempervirens* var. *suffruticosa*) and azaleas (*Rhododendron*) were drenched daily for ten days every three months during one year with 420, 105, 14 and 0 ppm NaClO. Phytotoxicity and plant growth index (g.i.) were evaluated quarterly. There was no significant effect of NaClO at any concentration on boxwood g.i., whereas g.i. of azalea was significantly less than the control at the 105 and 420 ppm concentrations. In boxwood, NaClO at the 420 and 105 ppm concentrations produced significant phytotoxicity; however, in azaleas, no phytotoxicity was observed at any concentration. Chlamydospores of *Phytophthora parasitica* and mycelial fragments of *P. cinnamomi* were exposed for 60 sec to NaClO at 420, 42, 4.2, 0.42, and 0 ppm. Viability was reduced only at 420 ppm NaClO for *P. parasitica* but at 4.2 ppm for *P. cinnamomi*.

RESISTANCE TO POTATO VIRUS S IN SOLANUM TUBEROSUM

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Potato Virus S (PVS) is a widely distributed latent virus of potato *Solanum tuberosum*. The prevalence of this virus in potato is due primarily to the lack of genetic sources of PVS resistance that can be readily transferred into developing germplasm. We used ELISA to assay 206 *S. tuberosum* cultivars and 39 advanced breeding lines for PVS and other potato viruses. Only B6603-12 was not naturally infected with PVS. Further, we were unable to infect plants of this line with PVS either by mechanical inoculations or by approach grafting a PVS infected scion to its root stocks. B6603-12 is a selection from a cross between B5063-4 and 5141-6. Because it flowers well and is cross compatible with numerous potato breeding lines under greenhouse conditions, this clone is useful as a parent in germplasm developmental programs.

A LABORATORY STUDY OF AGE- AND CULTIVAR-DEPENDENT RESISTANCE OF CORN TO CERCO-SPORA ZEA-MAYDIS AND OF SENSITIVITY TO CERCO-SPORIN. K. D. GWINN, NC State University, Raleigh, NC 27695,

D. A. Stelzig, J. L. Brooks, WV University, Morgantown, WV 26506, and F. M. Latterell, USDA-ARS, Frederick, MD 21701.

The relationship between plant age and susceptibility to *Cercospora zea-maydis* was examined with three corn cultivars differing in degrees of resistance. Leaf discs from 1-, 2-, and 3-mo-old plants were dipped into a mycelial suspension (0.25 mg dry wt/ml) and incubated on water agar for 6-8 da at 28 C. Percentage of stomates penetrated by the fungus was linearly related to plant age with values ranging from 3.5% (1 mo) to 37.7% (3 mo). Differences among varieties were not significant. Ion leakage from leaf discs induced by incubation with cercosporin (1.2 uM) in the light, however, showed an age-dependent linear decrease in sensitivity to the toxin. Varietal differences were not significant. Results suggested that apparent resistance of young plants may be due to lack of fungal penetration rather than cercosporin insensitivity.

Effects of Fungicide DPX-H6573 on Sterol Biosynthesis in Fungi. M. J. Henry. E. I. du Pont de Nemours & Co., Inc., Agricultural Chemicals Dept., Experimental Station, Wilmington, DE 19898.

The experimental fungicide DPX-H6573 at a concentration of 0.1 ug/ml inhibited the increase in dry weight of *Ustilago maydis* or of *Cercospora beticola* in liquid culture. Following treatment with DPX-H6573, lipid extracts had reduced levels of demethylsterols and increased levels of 14 α -methylsterols. Sterols were analyzed by gas chromatography and mass spectroscopy. Results indicated a reduction in the amount of primary sterols; ergosterol in *Ustilago* and ergosta-5,7-dienol in *Cercospora*, while both species accumulated eburicol and obtusifolliol. The 14 α -demethylation of ³H-dihydrolanosterol was also inhibited by DPX-H6573 in cell free preparations of *U. maydis* microsomes. Spectral binding studies with microsomes from *Saccharomyces cerevisiae* showed a type II binding of the fungicides to cytochrome P-450. The present study demonstrates that the primary mode of action of DPX-H6573 is inhibition of 14 α -demethylation in sterol biosynthesis.

A Comparison of Fungicide Resistance Between Benzimidazole and Ergosterol Biosynthesis Inhibiting (EBI) Fungicides in a *Cercospora beticola* Model System. M. J. Henry and A. E. Davis. E. I. du Pont de Nemours & Co., Inc., Agricultural Chemicals Department, Experimental Station, Wilmington, DE 19898.

The sugar beet/*C. beticola* combination was used to determine the probability of developing resistance to EBI fungicides and to directly compare these results with resistance to benzimidazole fungicides. Mutants were selected on fungicide amended medium after treatment with N-methyl-N-nitrosoguanidine. Mutants resistant to an inhibitor of sterol 14 α -demethylation were cross-resistant to all fungicides with that specific mode of action, but were not resistant to the morpholine-based EBI fungicides. A comparison of disease caused by mutant strains under greenhouse conditions showed that levels of EBI resistance and virulence varied widely. In contrast, all strains resistant to MBC in culture were both highly virulent and resistant when tested on sugar beets. These results indicate that EBI fungicide resistance can occur but at a markedly lower frequency than resistance to benzimidazole fungicides.

COLONIZATION PATTERNS OF VERTICILLADIELLA PROCERA IN SCOTS AND EASTERN WHITE PINE. W. Elliott Horner, Kathy J. Lewis and S. A. Alexander, Dept. of Plant Pathology, Physiology and Weed Science, VPI&SU, Blacksburg, VA 24061.

The colonization pattern of *V. procera* in diseased pines was studied by making tissue platings onto both general and selective media. A systematic sampling procedure was repeated on 10 *Pinus sylvestris* and four *P. strobus* Christmas trees (5-9 yr old) with symptoms of White pine root disease. Sampling points were at pre-determined positions up the stem (4 points on each of two sides), around the root collar (8 points) and along each major root. Root collar positions consistently yielded the fungus in high frequencies (~80%) that were equally distributed $P(X^2>3.54)=0.83$. Isolations along roots declined rapidly acropetally and fit a negative exponential distribution $P(X^2>8.48)=0.29$. Recovery frequency along the stem decreased acropetally, but the trend was not statistically significant. This recovery pattern suggests that *V. procera* colonization involves initial establishment at the root collar with subsequent acropetal development.

ECTOMYCORRHIZAL ASSOCIATIONS OF POPULUS GRANDIDENTATA COLONIZING COAL MINE REFUSE. A. Iskra and D. F. Hindal, WVU Plant Path. and Ag. Micro., P.O. Box 6057, Morgantown, WV 26506-6057.

Populus grandidentata, big tooth aspen, naturally colonizes abandoned coal mine refuse in West Virginia. Surveys for the basidiomycetous fungi in 5 volunteer stands were conducted and the mycorrhizae associated with the sporocarps examined. *Amanita muscaria*, *Scleroderma citrinum*, *Pisolithus tinctorius*

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and a *Russula* sp. were most common in 4 stands whereas *Leccinum insigne*, *A. muscaria* and *S. citrinum* predominated in the other. The presence of clamps and the amount and branching of the extramatrical hyphae, as well as the color, texture, thickness, and density of the mantle varied with the fungus associated with the mycorrhizae. Characteristics of the mycorrhizae and the extramatrical hyphae may be useful for identifying the symbionts in the absence of the sporocarps.

"DISTRIBUTION AND STABILITY OF AGGRESSIVENESS IN *CERATOCYSTIS ULMI*." R.J. Iuli and R.J. Campana, Department of Botany and Plant Pathology, University of Maine, Orono, ME 04469.

Since the occurrence of intermediate strains of *C. ulmi* between aggressive or non-aggressive is controversial, 113 fresh, and 121 older isolates of *C. ulmi* were evaluated for aggressiveness *in vitro*. Isolates were evaluated for radial growth rate at 20 and 33°C, aerial mycelium, radial striation and diurnal zonation. Results yielded a skewed frequency distribution of fresh isolates into aggressive or non-aggressive groups, with 90% being aggressive. There were no intermediate types, confirming earlier studies by Brasier, et al (1981). Ninety seven percent of the isolates determined by others as aggressive, maintained aggressiveness following aging *in vitro*, and 65% of those typed as non-aggressive remained the same. Two distinct groups (aggressive and non-aggressive), with a predominance of aggressive isolates, were found in natural populations of *C. ulmi*.

EFFECT OF GAMMA IRRADIATION ON SURVIVAL OF *ERWINIA AMYLOVORA* W. J. Janisiewicz and T. van der Zwet, USDA, Appalachian Fruit Research Station, Kearneysville, WV 25430 and P. B. Jahrling, USAMRIID, Ft. Detrick, MD 21701.

Isolates of *Erwinia amylovora* (NY 273 and MD 9), maintained on nutrient-yeast-dextrose agar (NYDA), were exposed in phosphate buffer (10⁶ cells/ml) to various doses of gamma (cobalt 60) irradiation. Both isolates proved highly susceptible with no survival at 60 Krads. A dose of 80 Krads was required to eliminate these isolates from the surface of nearly mature Rome Beauty apples and Bartlett pears, artificially infested in a suspension of 10⁶ cells/ml. When naturally infested apples were irradiated, doses as high as 140 Krads were not sufficient to eradicate the bacterium. Isolates obtained from surviving colonies were still pathogenic on artificially inoculated green pears. Degree of resistance to irradiation was reduced to doses below fruit damaging level after treatment with sensitizing agent N-methylmaleimide. These isolates also became very susceptible to lower doses of irradiation following several laboratory transfers on NYDA.

RESPONSE OF STRAWBERRY PLANTS GROWN IN METHYL BROMIDE TREATED SOIL INFESTED WITH MYCORRHIZAL FUNGI. J. W. Jett and D. F. Hindal, WVU Plant Path. and Ag. Micro., P.O. Box 6057, Morgantown, WV 26506-6057.

A greenhouse study was conducted to test the effect of a mixed inoculum containing *Glomus mosseae* and *G. fasciculatum* on growth of strawberry (var. *Mourdan*). Mycorrhiza-free plantlets were grown in infested and noninfested methyl bromide sterilized (MBS) (896 kg/ha for 10 days) or methyl bromide fumigated (MBF) (448 kg/ha for 2 days) soil for 4 months. Two phosphorus (P) levels (56 or 560 kg/ha) were compared in the infested and noninfested MBS soil. Shoot dry weight of mycorrhizal plants in the low P MBF soil was 247% and 43% greater than nonmycorrhizal plants grown in the low P MBS or MBF soil, respectively. However, mycorrhizal plants produced 25% less dry matter than nonmycorrhizal plants in the high P MBS soil. These results indicate mycorrhizae improved growth only at the low P level.

HYPOXYLON SPECIES: PIONEER SAPWOOD DECAY FUNGI ON DEAD RED OAKS IN PENNSYLVANIA. D. Karasevicz and W. Merrill, Dept. of Plant Pathology, The Pennsylvania State University, University Park, PA 16802.

Hypoxyylon species were found to be pioneer decay fungi in the succession of microorganisms involved in the biodeterioration of northern red oak (*Quercus rubra*) which died following defoliation by the gypsy moth (*Lymantria dispar*). Oaks dead one growing season had stained sapwood with small, widely scattered pockets of white rot. Sapwood of oaks dead two growing seasons sustained more extensive white rot. *Hypoxyylon stromata* were found on 75% of these trees. Basidiomycetes replace *Hypoxyylon* species between 2 and 6 years after tree death. The occurrence of *Hypoxyylon* species as pioneer decay organisms in oaks which die following gypsy moth defoliation in PA parallels reports of the activities of these fungi on oaks stressed or killed by other agents in the southern U.S.

ASSOCIATION OF PHYTOPHTHORA CRYPTOGEA WITH PEACH COLLAR ROT IN PENNSYLVANIA. S. H. Kim, J. F. D'Amico, and B. A. Jaffee. Pennsylvania Department of Agriculture, Harrisburg, PA 17110 and Fruit Research Laboratory, Biglerville, PA 17037.

In July of 1984, isolations were made from the discolored area on below-ground trunks of three 2-year-old declining peach trees that had been deeply planted i.e. graft unions were 2cm below soil line. *Phytophthora cryptogea*(A¹; opt temp 22C; 0.6 mm on corn meal agar/24hr at 35C; elongated sporangia rare) was isolated only from the lower 2/3 of the discolored area of one tree; attempts to isolate the fungus from either roots or the upper 1/3 of the discolored area failed. The virulence of *P. cryptogea* and a pathogenic cherry isolate of *P. megasperma* were compared by adapting the excised twig assay for apple trees (Plant Disease 65:823-825). The current year's twigs of 34 cultivars were used for the assay at 20C, and the assay was repeated monthly from August to December. The results indicated that *P. cryptogea* was more virulent than *P. megasperma* on twigs collected in August, September and November, but the virulence of the two fungi was similar in October and December.

SYMPTOMLESS TRANSPLANTS ASSOCIATED WITH AN OUTBREAK OF BACTERIAL SPOT ON TOMATOES IN PENNSYLVANIA. S. H. Kim, K.L. Reed and L. B. Forer, PA Dept of Agr, Harrisburg, PA 17110.

Over the last few years attempts to prevent the introduction of bacterial spot into PA by inspection of transplants have failed because either plants with symptoms were too few to be detected, or symptomless plants carried epiphytic or resident *Xanthomonas campestris pv vesicatoria*(Xcv). In 1984, 2% of a transplant lot grown in southern state greenhouses was inspected and a 0.5% random sample of the inspected symptomless-plants (SLP) in addition to the disease suspects were tested for the presence of Xcv. Xcv was isolated only from the SLP after inducing the disease symptoms by wounding potted SLP with wet cheese cloth and placing each pot in polyethylene bag at 27C. The fields planted with the inspected SLP lots carrying Xcv resulted in trace to over 50% fruit infection. A survey limited to green-pack cultivars of Count II, 674, 908 and Mt. Pride covering 794 acres indicated that 673 and 121 acres produced trace-9% and over 10% fruit infection, respectively.

A PREDICTIVE SIMULATION MODEL FOR PEANUT LEAFSPOT. Guy R. Knudsen, Harvey W. Spurr, Jr., USDA-ARS Tobacco Research Lab., Oxford, NC 27565, and Jack E. Bailey, Dept. of Plant Pathology, N.C. State University, Raleigh, NC 27695

A microcomputer simulation model was developed to predict the seasonal progression of *Cercospora leafspot* of peanuts; it was derived in part from an advisory model used for fungicide scheduling and in part from other published and unpublished data. Infection rate (new lesions per sporulating lesion per day) is a function of temperature, hours of relative humidity >95%, available uninfected tissue, and control agent residues. Latent and infectious periods are modeled as distributed delays. A submodel determines plant growth as a function of time, with a feedback function relating growth rate to disease. Predictions of disease progression closely fit field observations in validation tests. The model is being used to explore system sensitivity to weather, latent and infectious periods, fungicide or biocontrol agent characteristics, and other variables.

SELECTION FOR BENOMYL-RESISTANT *VENTURIA INAEQUALIS*: EFFICACY OF BENOMYL AND MANCOZEB IN MIXTURES AND THE EFFECT OF THE INITIAL PROPORTION OF RESISTANCE.

N. Lalancette, K. D. Hickey, and H. Cole. The Pennsylvania State University Fruit Research Lab, Biglerville, PA 17307

In 1983 and 1984, a block of 72 'Rome Beauty' apple trees was inoculated with benomyl-sensitive and resistant strains of *Venturia inaequalis*. Different concentrations of benomyl and mancozeb were then applied as mixtures to the trees. In both years, selection for the resistant strains increased rapidly with an increase in concentration of benomyl in the mixture. An increase in the mancozeb concentration tended to decrease or delay the selection process. In 1983, 98.7% of the initial population was sensitive, and mixtures containing high benomyl rates provided adequate control. However, in 1984, when only 69% of the initial population was sensitive, disease increased rapidly and no mixture provided adequate control. The mancozeb concentrations were apparently too low for maintaining control of the large resistant subpopulation.

A COMPARISON OF RAINFALL AND THROUGHFALL CHEMISTRY ON TWO FORESTED SITES DIFFERING MARKEDLY IN SOIL FERTILITY. I. Leininger and W. Winner, Dept. of Plant Pathology, Physiology and Weed Science, VPI&SU, Blacksburg, VA 24061.

Rainfall and throughfall chemistry was compared to determine the capacity of red oak foliage to alter rainfall chemistry. Samples were collected weekly during the summer of 1984. Col-

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lections were made at Shenandoah National Park (SNP) and Fernow Experimental Forest (FEF) sites with low and high soil fertility, respectively. Collected samples were analyzed for pH, conductivity, SO₄, NO₃, Ca⁺⁺, Na, NH₄, K⁺, and heavy metals. Rainfall was generally more acidic and higher in SO₄ and NO₃ concentration at FEF than at SNP. Throughfall analysis showed red oak canopies at FEF tended to make rainfall more alkaline, whereas canopies at SNP tended to make rainfall slightly more acidic or to have no effect on pH. Alteration of rainfall chemistry at both sites involved the retention of some ions and the loss of others from the foliage. Work is underway to further clarify the role of soil fertility in these processes.

MYCOPARASITISM OF RHIZOCTONIA SOLANI (Rs) BY TRICHODERMA AND GLIOCLADIUM IN NATURAL SOIL. J. A. Lewis and G. C. Papavizas, USDA, ARS, Beltsville, MD 20705.

Coiling around *R. solani* (Rs) by *T. viride* (T-1-R4), *T. hamatum* (TRI-4), *T. harzianum* (WT-6-24), and *G. virens* (GI-21) occurred when the pathogen and antagonist were placed in natural soil. Mycelial strands of Rs grew from pathogen-infested beet seed into soil and enmeshed on nylon screen (100 µm-mesh) placed in soil. Screens with Rs mycelium were covered with soils containing antagonists as conidia, fermentor biomass (FB), or 3-day-old mycelial-bran preparations (MP). Periodically, screens were removed, washed and examined by light microscopy or SEM. The extent of coiling or contact between hyphae of antagonists and pathogen was then determined. FB and MP of isolates (GI-21, TRI-4) effective in reducing disease caused by Rs interacted with 50-80% of Rs hyphae within 48 hr, whereas less effective isolates (WT-6-24, T-1-R4) interacted only with 10% of the Rs hyphae. Staining with acridine orange and lectin-PITC indicated the extent and type of mycoparasitism. This is one of the first demonstrations of interaction between pathogen and antagonist hyphae in natural soil.

SOIL-BORNE PROPAGULES OF VERTICILLADIELLA PROCERA: THEIR DENSITY, DISTRIBUTION AND ASSOCIATION WITH COLONIZED ROOTS OF CHRISTMAS TREES. Kathy J. Lewis, W. Elliott Horner and S. A. Alexander, Dept. Plant Pathology, Physiology & Weed Science, VPI&SU, Blacksburg, VA 24061.*

Quantitative sampling for soil-borne propagules of *Verticilladiella procera* by dilution plating revealed higher densities around diseased trees. The mean number of propagules from soil samples adjacent to roots was greatest at the root collar (6000/gm soil), decreasing exponentially toward the root tip (11/gm soil at 30 cm). Propagule density also decreased with distance from the rhizoplane. Samples of root tissue and adjacent soil were taken systematically along 2 roots per tree. Successful isolation of *V. procera* from both tissue and soil samples per site decreased toward the root tip. These results suggest that high levels of soil-borne propagules are present in association with root colonization and that colonization originates at the root collar.

TREE-RING ANALYSIS OF FOREST GROWTH RESPONSE TO ENVIRONMENTAL STRESS. R. Long and D. D. Davis, The Pennsylvania State University, University Park, PA 16802.

The effects of anthropogenic stresses on forest tree growth are being evaluated with tree-ring analysis. As a preliminary study to account for climatic effects, two mature forest stands (>50 yrs.) with contrasting good and poor site quality were selected based on soil characteristics and similarities in species composition. Tree-ring chronologies for chestnut oak (*Quercus prinus*) and eastern hemlock (*Tsuga canadensis*) were developed at each site. Crossdated ring widths were standardized using a cubic spline to remove age effects. Comparisons of competitive status showed greater species diversity and higher basal area on the better site. Response function analysis using total monthly precipitation and mean monthly temperature as predictors of tree-ring indices showed a decrease in ring-width variance accounted for by climate in *Q. prinus* at both sites during the past 50 years. Hemlock showed an increase in ring-width variance accounted for by climate on the poor site.

THE DIFFERENTIATION OF ENDOTHIA AND CRYPHONECTRIA SPECIES BY CYCLOHEXIMIDE SENSITIVITY AND ESTERASE ACTIVITY. J. A. Nicales and R. J. Stipes, Dept. Plant Pathology, Physiology and Weed Science, VPI & SU, Blacksburg, VA 24061.

The genus *Endothia* was recently divided into the genera *Endothia* and *Cryphonectria* due to morphological differences. These fungi frequently fail to produce the perfect stage, and their proper identification is often difficult. Polyacrylamide gel electrophoresis was used to detect alpha- and beta-esterase activity from buffer-soluble extracts of mycelial acetone powders. Banding patterns were species specific and could be used to identify unknown isolates. Cycloheximide sensitivity was

determined by radial growth on cycloheximide-amended potato-dextrose agar. Isolates of *Endothia gyrosa*, *E. singularis* and *Cryphonectria havanensis* were extremely sensitive to this compound (ED₅₀ < 0.1 µg/ml), while isolates of *C. gyrosa*, *C. parasitica*, *C. radicalis*, *C. eugeniae*, *C. cubensis*, *C. japonica*, *C. macrospora*, *C. coccobolii* and *E. viridistroma* were more resistant (ED₅₀ > 0.1 µg/ml). Such biochemical data are useful adjuncts to morphology.

THE EFFECTS OF AMBIENT OZONE ON FIELD-GROWN BLACK CHERRY (*PRUNUS SEROTINA* EHRH.) SEEDLINGS. R. Long and D. D. Davis, Dept. of Plant Pathology, The Pennsylvania State University, University Park, PA 16802.

The effects of ambient ozone on growth of black cherry seedlings was investigated using foliar applications of the anti-oxidant ethylenediurea (EDU). Nine replications with 44 1-year-old seedlings per replication were established in May 1983. Trees received one of three treatments: 1000 ppm EDU+surfactant+water, surfactant+water, or water. Six sprays were applied at 10-day intervals from late June to early September in 1983 and 1984. Evaluation of total height and diameter growth of 328 trees in October 1984 showed a significant (P=0.0049) treatment effect on diameter growth. A significant interaction prevented evaluation of treatment effects on height growth. Diameter growth of non-EDU treated trees was 11% less than diameter growth of EDU treated trees. Significant differences were not detectable for fresh weight or dry weight of stem and/or root biomass of a destructive subsample.

AMINOPEPTIDASE ACTIVITY OF PERONOSCLEROSPORA SORGHII, P. SACCHARI AND P. PHILIPPINENSIS. J. A. Nicales^a, D. M. Huber^b, M. R. Bonde^c, G. L. Peterson^c and W. E. Fry^a. ^aCornell University, Ithaca, NY 14853; ^bPurdue University, West Lafayette, IN 47907; ^cU.S.D.A. Plant Disease Research Laboratory, Frederick, MD 21701.

The relationships of *Peronosclerospora sorghii*, *P. sacchari* and *P. philippinensis* were examined by their aminopeptidase activities. Beta-naphthylamide derivatives of 22 amino acids were incubated with a concentrated conidial suspension. Fluorescence, produced by enzymatically cleaved beta-naphthylamine, provides a quantitative estimate of specific aminopeptidase activity. Two isolates of *P. sacchari*, three isolates of *P. philippinensis* and one *P. sorghii* isolate from Taiwan produced similar aminopeptidase profiles suggesting close phylogenetic relationships. The aminopeptidase activity of an Honduran isolate of *P. sorghii* was low and did not correspond with that of the other isolates. The results of this study suggest that the production of aminopeptidase profiles may be a highly sensitive technique for identifying species of *Peronosclerospora*.

COMPUTER AIDED 2-D GEL ELECTROPHORETIC ANALYSIS OF GEOTRICHUM CANDIDUM PROTEINS. N. U. Nwachuku, W. R. Hruschka, R. High and H. E. Moline, Department of Microbiology, George Washington University, Washington, D.C. and U.S. Department of Agriculture, ARS, HSI, Beltsville, Maryland.*

Some recent taxonomic studies of microorganisms rely on two-dimensional gel electrophoretic analysis (PAGE) of cellular proteins. The classification of *G. candidum* strains has been questioned; there are currently over 50 synonyms for this fungus. 2-D page patterns of total proteins of 30 strains of *G. candidum* isolated from humans, plants, and animals were studied. The electrophoretograms contained from 400 to 500 polypeptide spots. Their molecular weights ranged from 14,000 daltons to 92,000 daltons. The isoelectric points of a majority of the proteins was less than 7. An analysis of quantitative differences in the proteins was accomplished with a Hewlett-Packard 1000F computer. While the protein patterns varied greatly, the human isolates showed more similarity than the plant isolates.

THE EFFECT OF CONCURRENT OZONE AND ACID RAIN TREATMENTS ON RADISH GROWTH. PRELIMINARY RESULTS. R. L. Olson, Jr., W. E. Winner and L. D. Moore, Dept. of Plant Pathology, Physiology and Weed Science, VPI&SU, Blacksburg, VA 24061.

Radishes (*Raphanus sativus* L.) were subjected to acid rain and ozone, alone and in combination. The experiment consisted of 4 groups of 22 plants each (A,B,C and D), and treatments began on day 10 following emergence. Groups A and B received filtered air and 0.1 ppm ozone, respectively, and simulated rain (pH 5.6). Groups C and D received clean air and ozone, respectively, and simulated acid rain (pH 3.5). Rain treatments were 1 hr/day, 3 days/wk at 1 cm/hr. The ozone treatment was 0.1 ppm, 4 hr/day, 3 days/wk. On day 30, the plants were harvested, and dry weights of roots, hypocotyl and shoots were obtained along with leaf area. Acid rain produced lesions on leaves, but neither it nor ozone had significant effect on dry weights. Ozone was found to increase leaf area and specific leaf area (p = 0.05) and decrease root-shoot ratio (p = .076).

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ULTRASTRUCTURAL OBSERVATIONS OF LEAVES OF RED DELICIOUS NATURALLY INFECTED BY *SPILOCAEA POMI*. Santford V. Overton, Orson K. Miller and Laurence D. Moore, Dept. of Plant Path., Physiol. & Weed Sci. and Dept. of Biology, VPI&SU, Blacksburg, VA 24061.*

Infection of Red Delicious apple leaves by *Spilocaea pomi* was examined at the fine structural level. Fungal hyphae encased within a slime layer were observed adjacent to the cuticle. There appears to be enzymatic degradation of both the cuticle and epidermal cell walls. Mechanical separation may also be involved due to the irregular appearance of the lower surface of the cuticle and the upper surface of the epidermal cells where gaps occur. Extensive granulation of fungal cytoplasm was evident during degradation of the cuticle and cell walls. This may have resulted from the accumulation of phenolic compounds and their oxidative products. Formation of osmiophilic droplets and fibrillar material previously described by K. M. Maeda (1970) were found in parenchyma cells proximal to the invading fungus. Within these cells chloroplasts lose their integrity as discrete organelles and coalesce into disorganized masses.

THE VIRGINIA PEANUT LEAFSPOT ADVISORY PROGRAM: IMPROVEMENTS AND PERFORMANCE IN 1984. P. M. Phipps and J. L. Steele, Tidewater Res. Ctr., VPI&SU and USDA, ARS, Suffolk, VA 23437.

Three computerized weather stations provided ambient temperature and dew point data for processing into leafspot advisories by a central computer at the Tidewater Res. Ctr. Weather stations were ca 48 km apart and served farms within a 24 km radius or collectively ca 85% of the VA production area (40,000 ha). Growers made 3415 telephone calls to obtain advisories from a code-a-phone between Jun 10 and Sep 30. Advisories were also broadcast daily by three radio stations and one television station. Using guidelines for fungicide application (Phytopathology 74:1189-1193), growers applied four sprays in two regions and three in the other. Grower testimonials and results of test demonstrations indicated good to excellent leafspot control was obtained with the program in all regions. The potential benefit of the advisory to the Virginia peanut industry was \$2.5 million in 1984.

TRANSFORMATION OF HYPOPODES OF *RHIZOGLYPHUS ROBINI* CLAPAREDE (ACARI:STIGMATA:ACARIDAE) ON CULTURES OF THREE FUNGAL PATHOGENS OF BULBS. M. H. Rhoades, S. L. Poe (Dept. Entomology) and R. J. Stipes (Dept. Plant Pathol., Physiol. & Weed Sci.), VPI & SU, Blacksburg, VA 24061).

Three fungal pathogens of bulbs were tested for their influence on transformation of the bulb mite, *Rhizoglyphus robini*, from the non-feeding stage (hypopode) to the feeding stage (tritynymph). Hypopodes were placed on potato-dextrose agar (PDA) and PDA cultures of *Botrytis gladiolorum*, *Curvularia trifolii* f. sp. *gladioli* and *Fusarium oxysporum*. Transformation to the tritynymph stage began on the third day, and the pattern was similar for all treatments. After 9 days, 87-100% of hypopodes had transformed. Differences among fungi, and between fungi and PDA were not significant. These fungi are important food bases for the bulb mite.

PROBLEMS ASSOCIATED WITH GENETICS OF REACTIONS TO VIRUSES IN FIELD STUDIES. C. W. Roane, S. A. Tolin, G. R. Buss and H. S. Aycock, Dept. of Plant Pathology, Physiol. and Weed Sci. and Dept. of Agronomy, VPI&SU, Blacksburg, VA 24061.

A classical model for genetics of host-parasite interactions utilizes rust, in which reactions are based on several uredia per inoculation. With some hosts, several cultures may be inoculated onto a single leaf or host plant. With viruses, there is usually but one interaction per plant that can be scored, infection or no infection. Thus, F_3 are essential for studies with two strains or two viruses. If F_2 of soybean are inoculated, virus may cause sterility or top necrosis resulting in no seed. Hence, seed must be produced on uninoculated F_2 and their genotype deduced from F_3 behavior. In maize, reactions of inoculated F_2 are not always correlated with F_3 behavior; thus, F_2 genotypes can be only tentatively determined from F_3 data. Therefore, the genetics of virus reactions is distinctly more difficult than that of rusts or other local lesion diseases.

INHERITANCE OF REACTION TO PEANUT MOTTLE VIRUS IN SOYBEAN P.I. 96983. C. W. Roane, S. A. Tolin and G. R. Buss, Dept. of Plant Pathol., Physiol. and Weed Sci. and Dept. of Agronomy, VPI&SU, Blacksburg, VA 24061

The soybean plant introduction (P.I.) 96983 has the *Rsv* gene conditioning resistance to soybean mosaic virus and is resis-

tant to peanut mottle virus (PMV). The mode of inheritance of PMV resistance was determined by studying crosses of P.I. 96983 with 'Essex', a susceptible cultivar, and with two resistant cultivars, 'York' and 'Shore', both of which have the *Rpv1* gene conditioning PMV resistance. The F_3 were obtained by harvesting seeds of individual F_2 plants and planting samples of these seed in progeny rows. Primary leaves of the F_3 plants were air-brush inoculated with PMV isolate V74S/473. Plants were classified as infected (susceptible) or healthy (resistant). Rows were homozygous resistant, homozygous susceptible, or segregating. From the data obtained, F_2 genotypes were determined. Resistance to PMV in P.I. 96983 is conditioned by one gene which is allelic with the *Rpv1* in York and Shore.

NEW HOSTS FOR FUNGI FOUND ON GRASSES IN VIRGINIA. M. K. Roane and C. W. Roane, Dept. of Plant Pathology, Physiology and Weed Science, VPI&SU, Blacksburg, VA 24061.

In our grass collections, we have again found a number of fungi on new Virginia hosts. They are *Ascochyta sorghina* and *Gloeocercospora sorghi* on *Sorghum halepense*, *Daruca filum* and *Puccinia coronata* var. *gibberosa* on *Agrostis perennans*, *Curvularia geniculata* on *Paspalum floridanum*, *Helminthosporium tritici-repentis* on *Secale cereale*, *Kabatiella zeae* on *Zea mays*, *Phyllachora graminis* on *Agropyron repens*, *Phyllosticta sorghina* on roots of *Avena sativa*, and *Ustilago syntherismae* on *Digitaria ischaemum*. These fungus-host associations have not been reported previously in Virginia.

CLONING *ERWINIA CAROTOVORA* SUBSP. *CAROTOVORA* DNA FRAGMENTS MEDIATING THE PRODUCTION OF CELLULASES, PROTEASE, AND PECTOLYTIC ENZYMES. D. P. Roberts, C. Allen, and G. H. Lacy, Dept. Plant Pathol., Physiol. & Weed Sci., VPI&SU, Blacksburg, VA 24061.*

Erwinia carotovora subsp. *carotovora* strain EC14 DNA was cloned to study the genetics of pathogenicity. Partial BamHI digests of chromosomal DNA were ligated into the plasmid pBR322. The resultant chimeric plasmids were transformed into *Escherichia coli* strain HB101. Three colonies producing pectolytic enzymes, 15 producing cellulases, and two producing proteases were detected on selective media. All three chromosomal DNA inserts mediating the production of pectolytic enzymes are different based on restriction endonuclease analyses from each other and from a 3.4 kb PstI fragment cloned previously that mediates the production of at least two endo-pectate lyases. In the same manner, genes encoding two different cellulases and one protease were detected among other clones.

CORRELATION BETWEEN HUMIDITY PERIODS AND SOOTY BLOTCH AND FLY-SPECK INCIDENCE IN VIRGINIA APPLE ORCHARDS. W. L. Sharp and K. S. Yoder, Dept. Plant Pathol., Physiol. & Weed Sci., VPI & SU Fruit Research Laboratory, Winchester, VA 22601.*

In a 2-yr study in three commercial Virginia orchards, the summer fungicide spray schedule on selected Golden Delicious trees was terminated on successive dates. Sooty blotch and flyspeck disease incidences on fruit were recorded in mid-August and at harvest. The fruit was kept in cold storage for 3 mo and rot incidence was recorded. For each test group, hrs of 95% or greater relative humidity (RH) was recorded, beginning 3 wk (the approximate effective life of the fungicides used) after the last spray application. There was a high positive linear correlation between accumulated hr of high humidity and sooty blotch incidence, and 50 - 100 hr of high RH accumulated before the appearance of sooty blotch symptoms. Flyspeck required a longer accumulated period of high RH than sooty blotch for disease expression. No correlation between sooty blotch and rot levels was evident.

DETECTION OF *CRONARTIUM QUERCUM* F. SP. *FUSIFORME* IN *PINUS TAEDA* EMBRYOS USING THE ENZYME LINKED IMMUNOSORBENT ASSAY. P. Spaine, H. Amerson and J. Moyer. Dept. of Botany, North Carolina State University, Raleigh, N.C. 27695-7612.

The indirect (ID) and indirect preabsorption (IPA) ELISAs were compared for the detection of axenic homogenates of *Cronartium quercum* f. sp. *fusiforme* (C.q.f.). The ID ELISA detected C.q.f. homogenate as low as 20 ug/ml of fungal fresh weight. When healthy pine homogenates (HP) were mixed with C.q.f., fungal binding to the ELISA plate was reduced. The IPA ELISA eliminated HP interference and was capable of detecting C.q.f. diluted in HP and C.q.f. homogenates alone as low as 10 ug/ml fungal fresh weight. *Pinus taeda* embryos were examined using the IPA ELISA from 3-8 weeks after inoculation *in vitro* with C.q.f. basidiospores. C.q.f. infection in the embryos appeared to decrease over time relative to the rate of embryo growth. Future development of this technique will be for its application as a disease resistance screening assay.

* = Student Paper Competition

A NEW SELECTIVE MEDIUM THAT ASSAYS LOW POPULATIONS OF *THIELAVIOPSIS BASICOLA* IN TOBACCO FIELD SOILS. Lawrence P. Specht and G. J. Griffin, Dept. Plant Pathology, Physiology and Weed Science, VPI&SU, Blacksburg, VA 24061.*

Thielaviopsis basicola is a slow-growing fungus that has been difficult to isolate from tobacco field soils using previously reported selective media (VDYA-PCNB and TBM). A new selective medium (TB-CEN) is described that can be used, in combination with a pour-plate technique, for isolating *T. basicola* when 10^1 or lower soil dilutions are required. The most important components of TB-CEN are raw (unautoclaved) carrot extract, etridiazol (added as Terrazole 35WP) and nystatin. Other components and procedures critical for the success of the medium will be discussed. The results of critical performance tests indicate that TB-CEN is superior to all other described media for quantitatively isolating *T. basicola* from naturally infested tobacco field soils containing 10^1 to 10^2 propagules per gram.

EVALUATION OF GRAY LEAF SPOT RESISTANCE IN SELECTED CORN HYBRIDS IN VIRGINIA, 1982-84. E. L. Stromberg, Dept. of Plant Path., Physiol. & Weed Sci., VPI&SU, Blacksburg, VA 24061.

Gray leaf spot of corn, caused by *Cercospora zeae-maydis*, has increased in prevalence and severity within the past decade in the Eastern United States. Much of this increase has been associated with continuous no-till corn production. In each of the three years since 1982, public and/or commercial hybrids have been evaluated for their reaction to *C. zeae-maydis* under heavy disease pressure at one or more farm locations in western Virginia. Hybrids were scored two or three times each season on a leaf blight index of 0 (resistant) to 5 (susceptible). Grain yield, moisture, and stalk lodging were recorded at harvest. In 1984, seven of 19 commercial hybrids tested had significant resistance ($P = 0.05$); while in 1983, five of 22 were resistant; and in 1982, six of 24 were resistant.

STAND LOSSES CAUSED BY SCLEROTINIA CROWN AND STEM ROT IN FALL, NO-TILL PLANTED ALFALFA IN VIRGINIA. E. L. Stromberg and S. W. Van Scoyoc, Dept. of Plant Path., Physiol. & Weed Sci. and Dept. of Agronomy, VPI&SU, Blacksburg, VA 24061.

Sclerotinia crown and stem rot (SCSR) caused by *Sclerotinia trifoliorum* incited numerous, severe stand reductions and failures in fall, no-till planted alfalfa in Virginia in 1983 and 1984. From a survey conducted in March, 1984, 28% of all fields planted no-till in fall 1983 were found to have stand losses ranging from 51-100%. This represents 614 ha with a value of \$303,400 at \$494/ha establishment cost. Fall, no-till planting into sods is likely to increase disease pressure as these sods usually contain several plant species, including clovers, that are hosts for *S. trifoliorum*. In no-till planting sclerotia produced on clover within the sods remain at or near the soil surface, well positioned as inoculum for the alfalfa planting.

ISOLATIONS FROM VIRULENT *ENDOTHIA PARASITICA* CANKERS AFTER EXPOSURE TO VIRULENT AND HYPOVIRULENT INOCULUM FOR ONE YEAR. C. R. Spolt, D. L. Hobbins, and W. L. MacDonald, Glenville State College, Glenville, WV 26351; and WVU Plant Path. and Ag. Micro., P.O. Box 6057, Morgantown, WV 26506-6057.

Brown pigmented virulent strains of *Endothia parasitica* were used to initiate cankers on American chestnut to study their interaction with orange hypovirulent (hv) and v inoculum. After 8-wk growth, cankers were exposed for 1-yr to vegetatively compatible or incompatible orange inoculum growing on bark pieces placed 10 cm above the canker. Over 95% of the isolates retrieved from cankers exposed to compatible hv inoculum resembled the orange hv strain in growth habit but were pigmented light brown, indicating their conversion from v to hv. Cankers exposed to vegetatively incompatible hv inoculum yielded 30% converted brown isolates. Most isolates from the compatible or incompatible v combinations resembled the original brown v strains. Vegetative incompatibility appears to seriously limit interaction under forest conditions.

IDENTIFICATION OF SEED-BORNE SQUASH MOSAIC VIRUS IN MUSKMELON. S. A. Tolin, R. C. Lambe and B. I. Chevone, Dept. Plant Pathology, Physiology and Weed Science, VPI&SU, Blacksburg, VA 24061

Squash mosaic virus (SqMV) was seed-borne in a seed lot of muskmelon, *Cucumis melo*. An average of 10% of the seedlings expressed symptoms of stunting and primary leaf distortion and mosaic, or reacted positively with SqMV antisera when leaf discs punched from cotyledons were used in agar gel diffusion tests. In field tests, virus spread rapidly from initially

infected plants. Transmission of SqMV through seed from nine ripe muskmelon fruit from infected vines was 0-58% with a mean of 25%. Seed transmission was poorly correlated with fruit weight or severity of symptoms. Germination of seed from infected fruit averaged 91% compared with 95% from noninfected fruit. Of a total of over 600 emerged seedlings, 85% of those having an abnormal appearance were positive serologically for SqMV. The intensity of the precipitation band for cotyledons was generally correlated with the severity of symptoms that developed on the true leaves.

OCCURRENCE OF PEANUT STRIPE VIRUS IN VIRGINIA. S. A. Tolin and N. A. Rechcigl, Dept. of Plant Pathology, Physiology & Weed Science, VPI&SU, Blacksburg, VA 24061

A virus isolated in 1983 from peanut 'NC7' in research plots near germplasm introduced from the Peoples Republic of China had host range and symptomatology typical of peanut stripe virus (PStV). This isolate reacted strongly with zucchini yellow mosaic virus antisera and weakly with PStV antisera in SDS immunodiffusion tests. It failed to infect the potential weed hosts *Cassia fasciculata* and *C. tora*. Large groups of pinwheel and scroll inclusion bodies were observed adjacent to nuclei in palisade cells of infected 'Floriant' peanut. Seed-borne PStV was not found in over 300 seeds of China PI1420334/433348, PI433349, or PI420335 grown in Virginia in 1983, or in 'VA81B' from adjacent rows. Peanut mottle virus was identified from most symptomatic peanut plants sampled in research plots near the Chinese germplasm.

QUANTITATIVE RECOVERY OF *CYLINDROCLADIUM SCOPARIUM* FROM NURSERY SOILS IN PENNSYLVANIA. Tyka, G. L. and B. B. Hunter, Department of Biological and Environmental Sciences, California University of Pennsylvania, California, PA 15419.

A wet-sieving procedure in conjunction with a selective agar medium was used to recover and quantify *Cylindrocladium scoparium* from soils in two Pennsylvania Bureau of Forestry nurseries. A geranium baiting soil bioassay was initially employed to detect *C. scoparium*. Soils were wet-sieved through 500-, 150- and 45-um sieves and then treated with a 5% chlorox solution. Partial contents of the two smaller mesh sieves were ultimately pipetted onto Petri plates containing glucose-lima bean agar medium (100:23:15 g/l) supplemented with antibiotics and varying amounts of rose bengal. In 4-7 days numerous colonies of *C. scoparium* were evident; some colonies of unwanted fungi were also found. The greatest number of *Cylindrocladium* propagules per gram of moist soil (28.0 average) was recovered in the medium containing 250 mg/l of rose bengal.

SIGNIFICANCE OF APPLE TISSUE INJURY TO ARTIFICIAL INFECTION BY *ERWINIA AMYLOVORA*. T. van der Zwet (USDA) and J. C. Walter (WVU), Appalachian Fruit Research Station, Kearneysville, WV 25430

In August and September, 400 Rome Beauty and Red Delicious apples were collected from the orchard and washed with soap and water. Fruit were dip-inoculated for 1 min in a buffered bacterial suspension of 10^8 cells/ml of *E. amylovora* and incubated in plastic trays at 21-27°C and 80-90% R.H. At intervals of 0, 24, 48, and 96 hr before or after inoculation, fruit were bruised or injured mechanically. The highest percent infection appeared on fruit bruised at inoculation time, followed by those injured with the large puncture. More fruit became infected when they were injured before than after inoculation. When fruit of both cultivars were injured and immediately dipped in inoculum for 5 or 10 min, 77% of Red Delicious and 94% of Rome Beauty fruit became infected. When noninjured fruit were dip-inoculated for 10 min, none of the Red Delicious but 41% of the Rome Beauty fruit became infected through the stem or calyx end.

THE EFFECTS OF ERGOSTEROL DEFICIENCY ON MITOCHONDRIAL FUNCTION IN *USTILAGO MAYDIS*. W. F. Waterfield and H. D. Sisler. Univ. of MD, Dept. of Botany, College Park, MD 20742.

Responses of an ergosterol deficient mutant of *U. maydis* (erg-40) or of the wild type (WT) cells treated with the ergosterol biosynthesis inhibitor, fenarimol, indicated mitochondrial impairment. The P/O ratio with a pyruvate-malate substrate was 1.4, 1.7 and 2.5 for mitochondria of erg-40, fenarimol treated WT and WT cells, respectively. Mitochondrial membrane potential was examined with Safranin O, a lipophilic cationic dye which moves across the membranes in response to the electrical potential generated by electron transport. Mitochondria from the WT cells maintained an optical density difference (ΔOD) of 0.13. The erg-40 maintained a ΔOD of 0.7, indicating a lower membrane potential than in the WT. These studies suggest that the slow growth rate of the erg-40 and fenarimol treated WT cells is partly due to a reduced mitochondrial membrane potential and a lowered mitochondrial ATP syn-

* = Student Paper Competition

thesis. This is thought to be due to sterol changes in mitochondria which lead to increased permeability to protons.

A NEW TWIG CANCKER OF FRASER FIR. N. G. Wenner and W. Merrill. Dept. of Plant Pathology, The Pennsylvania State University, University Park, PA 16802

A previously undescribed twig canker was found in July 1983 on 0.5-2 m tall *Abies fraseri* Christmas trees in Schuylkill Co., PA. Cankers 0.5-2 cm long form on the undersides of the twigs, at the bases of elongating current year shoots. Young succulent shoots up to 10 cm long usually are girdled completely and killed. These dead, brown shoots remain hanging within the tree. Older shoots up to 20 cm long often are partially girdled and bend down at a 90° angle, but survive and remain green. The most conspicuous symptom is the exposure of the whitish-silver abaxial surface of the needles on the drooping cankered shoots. In PA the cankers develop in late June-early July. Trees which break bud later appear to be more severely affected. Numerous isolations have found an undescribed species of *Phomopsis* consistently associated with the cankers. Pathogenicity studies are in progress.

PATHOGENICITY OF *BOTRYOSPHAERIA DOTHIDEA* TO RHODODENDRON CV. NOVA ZEMBLA. W. H. Wills and R. C. Lambe, Dept. Plant Pathology, Physiology and Weed Science, VPI&SU, Blacksburg, VA 24061

Single spore (SS) cultures were made from two mass isolates of *Botryosphaeria dothidea* selected for fast and slow growth rates in vitro. In screens of 18 SS cultures from the slow-growing mass isolate and 22 SS cultures of the fast-growing mass isolate, by wound inoculation into excised stems of *Rhododendron* cv Nova Zembla with agar discs of the respective cultures, there was a wide but similar range in extent and especially rate of lesion development. In similar wound inoculation of intact plants in the greenhouse with a single mass isolate, extensive and rapid colonization of woody stems followed initial infection of young tissue which ultimately could result in death of plants. In experiments with wounded and non-wounded excised stem sections, infection of young tissue by mycelium occurred only through wounds.

POTENTIAL FOR FUNGICIDAL CONTROL OF DIEBACK CAUSED BY *BOTRYOSPHAERIA DOTHIDEA* ON RHODODENDRON. W. H. Wills and R. C. Lambe, Dept. Plant Pathology, Physiology & Weed Science, VPI&SU, Blacksburg, VA 24061

Eight fungicides, each at three concentrations were incorporated into PDA and tested for inhibition of a single isolate of *Botryosphaeria dothidea*. Four fungicides were tested similarly against eight isolates of *B. dothidea* at 10 µg/ml concentration. Benlate®, Topsin M® and Ornalin® were inhibitory at 10 µg/ml and Topsin M and Benlate at 1 µg/ml. Stem lesion development was measured after wound inoculation with *B. dothidea* following 18 hour uptake of four fungicides (100 µg/ml) singly through cut ends of excised stems in the laboratory. All four fungicides, especially Benlate, reduced lesion development. Benlate, sprayed at the label rate for other *Rhododendron* pathogens, prevented lesion formation on wounded, inoculated stems of intact plants in the greenhouse when applied at time of inoculation but not when applied four days after inoculation. This treatment shows potential only for prevention of dieback.

IN VITRO EFFECT OF METALAXYL ON RADIAL GROWTH, RELEASE AND GERMINATION OF ZOOSPORES OF 17 *PHYTOPHTHORA INFESTANS* ISOLATES. Luis Zoquier and R. J. Young, WVU Plant Pathology & Ag. Micro., 401 Brooks Hall, P.O. Box 6057, Morgantown, WV 26506-6057.

Seventeen isolates of *P. infestans* were tested in vitro for sensitivity to metalaxyl. Radial growth was measured on clear lima bean agar with 8 concentrations of metalaxyl ranging from 0.001 to 5.0 µg ai/ml. Release and germination of zoospores were studied in liquid preparations with concentrations ranging from 10 to 150 µg ai/ml. Radial growth of all isolates was sensitive to metalaxyl at 0.001 µg ai/ml, with inhibition ranging from 4.3 to 40%. ED50 values ranged from 0.005 to 0.13 µg ai/ml. The processes of zoospore release and germination were less sensitive to metalaxyl with ED50 values ranging from 6.0 to 96 µg ai/ml and 33.5 to 139 µg ai/ml, respectively. Results show a strong variability to metalaxyl among 17 isolates of *P. infestans* having no previous exposure to the fungicide. Such variability could partially explain the rapid appearance of resistant strains of the pathogens in vivo.

TIMING AND NUMBER OF APPLICATIONS OF METALAXYL/MANCOZEB MIXTURES IN THE CONTROL OF POTATO LATE BLIGHT. Luis Zoquier and R. J. Young, WVU Plant Pathology and Ag. Micro., 401 Brooks Hall, P.O. Box 6057, Morgantown, WV 26506-6057.

Field control of foliar potato late blight (*P. infestans*) was studied using the cv. Katahdin in 1983 and 84. Two inoculum source rows, planted between test plots, were inoculated with race 1,4 producing a season-long inoculum source. Moderate to heavy disease developed in 1984 only. Fungicides were applied at 250 psi with a tractor mounted boom with 12 fogging nozzles. Treatments included early, mid and late season applications. Two or 3 treatments of metalaxyl applied in combination with mancozeb as a tank mix or prepack (MZ58), controlled foliar late blight. Only the earliest treatment failed to protect plants. Three mid-to-late season tank mix treatments were superior to 2 with MZ58 regardless of timing and were similar to 8 standard 2 lb treatments of mancozeb. All fungicide treated plants produced tuber yields statistically superior to inoculated unprotected plants.

TRANSLOCATION OF METALAXYL IN GREENHOUSE-GROWN TOMATO PLANTS. L. Zoquier and R. J. Young, WVU Plant Pathology and Ag. Micro., 401 Brooks Hall, P.O. Box 6057, Morgantown, WV 26506-6057.

Systemic fungicide activity, inhibitory to *P. infestans*, was detected in bottom leaves of 45-day-old tomato plants using leaf disks that were inoculated with a filter paper disk dipped in inoculum containing 25,000 zoospores/ml. Disks were incubated at 20 C under a 12-hr photoperiod. A reduction in necrosis but not in sporulation was noted 24 hr after top leaves were treated with a 1000 µg ai/ml solution of metalaxyl. Basipetal translocation continued through the 96-hr test reducing necrosis by 57% and sporulation to trace levels, compared to the control. Additional applications of metalaxyl at 24-hr intervals showed similar patterns of activity except the effect on necrosis and sporulation was greater. Three treatments prevented sporulation. When middle leaves were treated with 1000 µg ai/ml metalaxyl, it moved acropetally and basipetally. Movement in acropetal direction was more rapid, but inhibitory activity also was detected in bottom leaves.