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ABSTRACTS

CALCIUM OXALATE IN AMERICAN CHESTNUT BARK INFECTED BY ENDOTHIA PARASITICA. A.R. BENNETT AND D.F. HINDAL, Plant Path. & Agr. Micro., 401 Brooks Hall, West Virginia Univ. Morgantown, WV 26506

American chestnut bark infected by virulent or hypovirulent strains of Endothia parasitica was assayed for oxalic acid and calcium oxalate content. Tissues (0.5g) were excised from within the canker, at the canker margin, and from uninfected tissues beyond the canker margin, ground to a fine powder, oven dried, and the oxalate and free oxalic acid content measured by gas chromatography. Oxalate content in healthy bark and at the canker margin was significantly higher than in the inner canker regions and no significant differences were found among tissues infected by virulent or hypovirulent strains. Prismatic crystals of calcium oxalate were observed in healthy bark by scanning electron microscopy in small cubical cells of the phloem; each cell contained one large crystal. The cells occurred in regular rows and were connected with one another. These data indicate that calcium oxalate is a natural component of healthy chestnut bark, and exists at lower concentrations in infected bark.

FUNGI ON PLANTS AND PLANT PRODUCTS IN THE UNITED STATES - A SOURCEBOOK FOR PLANT PATHOGENIC FUNGI. G.F. Bills, G.P. Chamuris, & D.F. Farr. Systematic Botany, Mycology, and Nematology Laboratory, Agricultural Research Service, Beltsville, MD 20705.

The "Index of Plant Diseases in the United States" (Agr. Handb. No. 165) has been the most comprehensive reference documenting fungi in this country. The Index is outdated because it was based primarily on pre-1950 information. Our laboratory is producing a new book, "Fungi on Plants and Plant Products in the United States." This book has been designed to: 1) provide host distribution data for plant pathogenic fungi; 2) aid in the identification of fungi on plants and plant products; and 3) serve as a source of accepted names and synonyms of these fungi. The construction of this book involves 3 major tasks: 1) searching the pathological and mycological literature for incidences of plant disease; 2) revising the nomenclature and taxonomy of the host plants; and 3) revising the nomenclature, taxonomy, and geographic distributions of the fungal pathogens. The first part of the new book lists the host plants with their associated fungi and state localities. The second part will be a compilation of pathogens, their synonyms, geographic distributions, and host plants.

LIMITED SUSCEPTIBILITY OF SAFFLOWER AND CENTAUREA SPP. TO PUCCINIA JACEAE FROM TURKEY. Bruckart, W. L., USDA-FDWSRU, Fort Detrick, Bldg. 1301, Frederick, MD 21701

P. jaceae Otth., evaluated for biological control of C. solstitialis L. (yellow starthistle = YST) in North America (NA), caused limited infection of five other Centaurea spp. and eight commercial safflower (Carthamus tinctorius L.) cultivars. The maximum amount of infection on susceptible non-target Centaurea spp. was 5 pustules/plant, and pustules were very small, indicating a resistant reaction. Infection amounts and reaction types were less on the safflower cultivars than on the Centaurea spp. Safflower inoculated with P. carthami, an endemic rust fungus of NA, had 31 times as many pustules/cm^2 leaf area than safflower inoculated with P. jaceae (means = 3.1 vs. 0.1, respectively). YST inoculated with P. jaceae had 2.7 pustules/cm^2; and pustule type indicated a very susceptible reaction. These results suggest that P. jaceae would not be a threat to non-target Centaurea spp. or safflower if introduced into NA for biological control of YST.

EFFECT OF THE ANTIMYCOTIC AGENT TERBINAFINE (SF-86327) ON GROWTH AND LIPID BIOSYNTHESIS IN USTILAGO MAYDIS. Ann M. Buchman and Hugh D. Sisler, Department of Botany, University of Maryland, College Park, Maryland 20742.

Terbinafine, an antimycotic agent of the allylamine class {(E)-N(6,6-dimethyl-L-hepten-4-ynyl)-N-methyl-1-naphthalene-methanamine}, strongly inhibited growth of U. maydis. Colony forming ability of U. maydis sporidia was prevented when 2 µg/ml or more of the fungicide was incorporated into agar medium. Colony forming ability was only 6% of that of non-treated control after sporidia (2.4 x 10^6/ml) were grown for 12 hours in liquid medium with 1 µg/ml of the fungicide. Gas liquid chromatography (GLC) of lipid fractions revealed a marked accumulation of squalene, no net increase of ergosterol or other sterols, and a 50% decrease in phospholipid fatty acids in sporidia incubated for 12 hours with 2 µg/ml of the fungicide. The primary action of terbinafine in U. maydis, as in other fungi, appears to be inhibition of squalene epoxidase activity.

DETECTION OF THE TOMATO SPOTTED WILT VIRUS (TSWV) IN INDIVIDUAL THRIPS VIA ELISA. J.J. Cho, R.F.L. Mau, R.T. Hamasaki and D. Gonsalves. Dept Plant Pathology & Entomology, Univ of Hawaii, Kula, HI 96790, & Honolulu, HI 96822, and Dept Plant Pathology, N.Y. Agr. Exp. Stn., Cornell Univ., Geneva, NY 14456.

The enzyme-linked immunosorbent assay (ELISA) was adapted for the detection of TSWV in individual thrips.TSWV was detected in 23 of 41 Frankliniella occidentalis and 23 of 48 F. schultzei laboratory-grown adult thrips fed previously on infected plants as larvae. In reciprocal tests, 6 of 19 F.occidentalis and 8 of 22 F. schultzei transmitted TSWV. TSWV was detected in thrips removed from TSWV-infected lettuce plants obtained from 3 farms. On Farm 1, 7 of 82 adult and 63 of 174 larval thrips were TSWV-positive; on Farm 2, 6 of 48 adult and 63 of 187 larval thrips were TSWV-positive; and on Farm 3, 9 of 146 adult and 55 of 165 larval thrips were TSWV-positive. Virus titers based on A405nm valves varied between individuals. Initial tests suggested that TSWV may replicate in thrips. TSWV titers and percentage of TSWV positive thrips based on A405nm values decreased approximately 4 and 10 days but increased 19 days after TSWV acquisition.

INCIDENCE AND SEVERITY OF POWDERY SCAB ON FIVE POTATO CULTIVARS. B. J. Christ. Department of Plant Pathology, The Pennsylvania State University, University Park, PA 16802.

Five potato cultivars were evaluated for disease reaction to powdery scab in a field trial with a split plot design. The main plots were assigned to two planting dates and the subplots were comprised of cultivars. Progress of disease was assessed by destructive sampling with four assessment periods following tuber initiation. Planting date effect was significant at each assessment except for severity on the fourth assessment. Severity and incidence was higher for the first planting. Cultivar effects were significant. Rosa and Katahdin had

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higher incidence of scab than Monona and Norchip, while Kennebec was intermediate. Incidence ranged from 92.2 % on Rosa to 66.4 % on Norchip. Severity and incidence at the third assessment were highly correlated with area under the disease progress curve.

THREE-YEAR FIELD EVALUATION OF SEED TREATMENTS ON WINTER WHEAT. S.E. Crane and E.L. Stromberg, Rohm and Haas, Ft. Washington,PA 19034, and Dept. of Plant Pathology, Physiology, and Weed Science, VPI & SU, Blacksburg, VA 24061.

Loose smut at levels of 5-15% is not uncommon in plantings of treated Foundation grade seed. A safe and effective seed treatment is needed by the Atlantic region producers to protect against yield losses due to loose smut (Ustilago tritici). Smutted seed was treated in 10 kg batches in a rotating metal drum. Seed was planted during November of all three years in Accomac Co., Va. in a Bojac fine sandy loam in 10.5 cm rows at a seeding rate of 67-74 seeds per row meter. Plot size was 2.7 x 60 m. Registered and experimental fungicides were compared to non-treated controls for: emergence, plant height, tiller number, phytotoxicity, loose smut, powdery mildew (Erysiphe graminis tritici), and yields. The ergosterol biosynethesis inhibiting (EBI) fungicides were superior to Vitavax in the control of loose smut. Some EBI's were also effective in controlling or suppressing powdery mildew 150 days after treatments.

ENHANCED BIODEGRADATION OF METALAXYL (RIDOMIL) FUNGICIDE IN "HISTORY" APPLING LOAM SOIL IN VIRGINIA. R. M. Cu, R. J. Stipes, & M. J. Weaver, Dept. Plant Pathol., Physiol. & Weed Science, Virginia Tech, Blacksburg, VA 24061.

Enhanced biodegradation of metalaxyl (Ridomil) fungicide was evaluated in "history" (treated) vs. "non-history" (non-treated) Appling sandy loam from southcentral Virginia. Soil samples amended with metalaxyl at 0, 100 and 1,000 µg/gm were incubated at 21 C and sampled at 0, 7, 14, 21 and 55 days after treatment (DAT). Metalaxyl residues were extracted by sonicating soil subsamples in methanol and bioassayed in agar using Phytophthora boehmeriae as the test organism. The fungus exhibited growth at a 100-fold greater dilution of extract from "history" than from "non-history" soil at 7 DAT at both concentrations, indicating accelerated degradation of metalaxyl in "history" soil. There were ten-fold more bacteria and ten-fold less fungi in "history" than "non-history" soil. The large population of bacteria may be responsible for enhanced biodegradation.

A SURVEY OF BARLEY YELLOW DWARF VIRUS AND APHID VECTORS IN SMALL GRAINS OF PENNSYLVANIA. F. Gildow and J. Frank, Dept. of Plant Pathology, Penn State Univ., Univ. Park, PA 16802; and D. Bingaman and C. Powell, Bureau of Plant Industry, Pennsylvania Dept. of Agriculture, Harrisburg, PA 17110.

Isolates of BYDV infecting barley, oats, and wheat were collected in 1984-86 from 8 counties representing 3 environmentally distinct cereal management areas. Enzyme immunosorbent assay and vector-specificity were used to compare these isolates to 4 characterized New York isolates (MAV,PAV,RMV,RPV). BYDV was recovered from 300 of 376 plants selected for testing based on symptom expression. The percentage of plants infected with Pennsylvania isolates similar to RPV,RMV,MAV, and PAV were 19, 4, 9, and 82%, respectively. Isolates similar to SGV were not detected. Of the 300 infected plants, 16% were infected with more than 1 isolate. Of 329 aphids collected in 3 counties from symptomless plants, 5% were found to be viruliferous for BYDV. No difference was detected in vector-specificity among clones of New York and Pennsylvania BYDV aphid vectors.

GERANIUM MORTALITY DUE TO PYTHIUM ROOT ROT ASSOCIATED WITH HIGH LEVELS OF NUTRIENT SALTS. L. Gladstone and G. Moorman. Dept. of Plant Pathology, Penn State Univ., Univ. Park, PA 16802.

The relation of nutrition to Pythium root rot development in seedling geranium plants grown in soilless media under greenhouse conditions was studied. Seven-week-old seedling geraniums of the cultivar Showgirl received soluble fertilizer with each irrigation. A complete base fertilizer was amended to supply phosphorus, nitrate nitrogen, or ammonium nitrogen in suboptimum, optimum, or excessive concentrations. Base fertilizer was amended with sodium chloride to establish a range in the electrical conductivity of the fertilizer solution. Half of the plants in each treatment were inoculated with Pythium ultimum. Few of the uninoculated plants given excessive fertilization died and none of the plants given the lowest level of fertilization died even when inoculated with Pythium. Mortality of the inoculated plants increased as the concentration of nitrogen or phosphorus increased. Mortality does not appear to be associated merely with increased electrical conductivity of the potting medium.

INTERACTIONS AMONG PLANT ALLELOCHEMICALS, PLANT PATHOGENS, AND INSECT HERBIVORES. Dr. Robert Goth, USDA-ARS Vegetable Laboratory, Beltsville, MD 20705; Dr. Vera Aber Krischik and Dr. Pedro Barbosa, Dept. of Entomology, University of Maryland, College Park, MD 20742, respectively.

Two plant allelochemicals, the alkaloid nicotine and the flavonoid rutin are found in the plant family Solanaceae which includes potato, tomato, and tobacco. To study their effects on the growth of five Pseudomonas spp., nicotine and rutin were incorporated into nutrient agar (NA) at levels ranging from 0 to 1% wet weight. Above 0.5% nicotine, none of the five Pseudomonas spp. grew, however, some of the isolates grew on NA 1.0% rutin. One-month old tobacco plants were injected with P. solanacearum and after two weeks the leaves were fed to larvae of Manduca sexta (Sphingidae). Leaves injected with P. solanacearum reduced feeding and growth rates of the larvae. Research on the effects of P. solanacearum on nitrogen and allelochemical concentrations in leaves and the affects on insect herbivores is in progress.

MANAGING SCAB OF WINTER WHEAT WITH MIXED HOST POPULATIONS. A. P. Grybauskas, Botany Dept. University of Maryland, College Park, 20742

Two different pairs of two scab-susceptible winter wheat cultivars, differing primarily in relative maturity as expressed by head dates, were grown as pure lines and as mixtures of 1:1, 1:3 and 3:1. All plots were either uninoculated or inoculated with Fusarium graminearum Schwabe at approximately the mid-flower stage of development of the earliest of the four cultivars. Under disease conducive conditions, scab was most severe in pure lines that were at peak susceptibility when inoculated, and was significantly reduced in mixtures of 1:1. Results indicate that in the absence of resistance, population variance in degree of susceptibility, generated through mixed flowering times, can be utilized to reduce scab incidence.

FERTILITY MANAGEMENT FOR POWDERY MILDEW CONTROL IN WINTER WHEAT. A.P. Grybauskas, D.J. Sammons and R.J. Kratochvil. Depts of Botany and Agronomy, University of Maryland, College Park 20742

Three cultivars of winter wheat, varying in degree of resistance to powdery mildew caused by Erysiphe graminis f. sp. tritici, were grown in a multi-factored experiment to evaluate the effect of nitrogen and potassium fertilizers on disease development. The treatments included: two levels of nitrogen, two levels of potassium, and two sources of potassium (either muriate or sulfate). Disease assessments were made visually at four different canopy levels on 4 dates. Dry hot weather in late spring severely suppressed mildew development in all treatments. Under these environmental conditions, high nitrogen levels increased mildew at the upper canopy level; but potassium, especially the muriate source, reduced mildew development at the lower canopy levels.

MODE OF ACTION OF FLUSILAZOL. M. J. Henry, Du Pont Company, Expt. Station, Ag Products Dept., Wilmington, DE 19898

The recently discovered triazole fungicide flusilazol (DPX-H6573) is being developed to control a variety of plant diseases. Flusilazol at 0.01 µg/ml inhibits growth of Ustilago maydis sporidia approximately 90% in liquid media. The incorporation of ^{14}C- acetate into ergosterol in U. maydis sporidia is completely inhibited by 0.01 µg flusilazol/ml. Reduced ^{14}C-ergosterol levels correspond to an accumulation of ^{14}C-eburicol as determined by radio-hplc analysis and LC-MS identification. The 14 α-demethylation of ^{3}H-dihydrolanosterol (DHL) is blocked in cell free preparations of either U. maydis or Saccharomyces cerevisiae. A concentration of 0.025 µg flusilazol/ml (0.08 µM) inhibits the 14 α-demethylation of DHL 50% in microsomes of S. cerevisiae. The fungicide interacts with fun-

gal cytochrome P-450 to produce a typical type II binding spectrum. The estimated dissociation contant (KD) is 0.006 µg/ml (0.02 µM). The data indicate flusilazol inhibits fungal growth and controls plant disease by inhibiting sterol 14 α-demethylase in ergosterol biosynthesis.

ROSE ROSETTE ON MULTIFLORA ROSE IN SOUTHERN INDIANA. D. F. Hindal and J. W. Amrine. Division of Plant and Soil Sciences. West Virginia University, Morgantown, WV 26506.

Rosa multiflora with symptoms of rose rosette disease were observed in Daviess, Floyd, Jefferson, Lawrence, Martin, Ohio, Scott, and Switzerland counties in Indiana. The eastern most location was near Aberdeen, Indiana about fifteen miles west of the Ohio state line. The eriophyid mite Phyllocoptes fructiphilus, implicated as vector of the rosette agent was present, often in high populations, on symptomatic material. Successful transmission of the disease agent from symptomatic tissues collected in Indiana was accomplished by grafting and by transferring P. fructiphilus that was present on these tissues to healthy plants. This is the first report that rose rosette is established on multiflora rose as far east as Indiana.

MOLECULAR CLONING OF PSEUDOMONAS SYRINGAE PV. SYRINGAE GENES THAT COMPLEMENT MUTATIONS AFFECTING HYPERSENSITIVE AND IONIC RESPONSES IN TOBACCO. **H.-C. Huang[1], R.C. Schuurink[1], T.P. Denny[2], C.J. Baker[3], M.M. Atkinson[3], S.W. Hutcheson[1], and A. Collmer[1], [1]Dept. of Botany, Univ. of Maryland, College Park, MD 20742, [2]Dept. of Plant Pathology, University of Georgia, Athens, GA 30602, and [3]Microbiology and Plant Pathology Laboratory, USDA/ARS, Beltsville, MD 20705.**

Six P. syringae pv. syringae (Pss) Tn5 mutants, unable to cause a hypersensitive response (HR) in tobacco leaves or an ionic response (K^+ efflux/ H^+ influx) in suspension-cultured tobacco cells, were subjected to Southern blot analysis. Most of the mutations were independent and resulted from single Tn5 insertions. A library of Pss DNA was constructed in cosmid pLAFR3 and probed with a cloned Tn5-containing EcoRI fragment from one of the mutants. Eight cosmids with homology to the probe were mobilized to the mutants in triparental matings. Five of the cosmids complemented three of the mutants; two complemented all of the mutants; and one also caused P. syringae pv. tabaci to elicit the HR in tobacco leaves.

RECOVERY OF CYLINDROCLADIUM SCOPARIUM FROM NURSERY SOILS CONTAINING LOW DENSITY POPULATIONS. B. B. Hunter, Wang Chengguo and B. Towers. Department of Biological Sciences, California University of PA, California, PA 15419 and PA Bureau of Forestry, Middletown, PA 17057.

Geranium baiting was employed to recover Cylindrocladium scoparium from various parts of the PA Bureau of Forestry Nursery at Spring Mills, PA. In areas where there were 10-25 propagules per gram of soil (determined by a wet-sieving procedure), C. scoparium was observed and/or recovered in 90 % of the soil samples. However, in soils possessing 2 or less propagules per gram of soil, the fungus was rarely found. Numerous amendments (bacterial antibiotics, sugars, nitrogen sources and other chemicals) were added singly and in various combinations to natural and experimental geranium baited soils to ascertain whether C. scoparium could be detected. More than 1000 soil samples (low density populations) were investigated with the amendments and C. scoparium was often found. The best results occurred when lactose, 80 mg, oxgall, 40 mg and aureomycin, 5.0 mg were used.

TITRATION CURVES OF ISOMETRIC PLANT VIRUSES IN AGAROSE SLAB GEL ELECTROPHORESIS. S. Hurtt and J. S. Fawcett*. USDA-ARS, PGGI, Glenn Dale, MD 20769 and *NICHHD, NIH, Bethesda, MD 20783.

An electrophoretic titration curve is produced by a rapid and simple 2-dimensional technique that displays the mobility of a component as a function of pH. We adapted the technique to isometric plant viruses. Slab gels (ca 18X12X0.1 cm) of 0.6-0.8% agarose (Isogel, Marine Colloids), 10% d-sorbitol, and 2.5% carrier ampholyte were cast on Gel Bond films and a slot former was inserted to make a central, 8-9X0.1 cm trench. Gels were elctrofocused at 300 V (regulated) for 2 hr on a water-cooled horizontal electrophoresis apparatus. Electrodes were then placed perpendicular to the pH gradient and virus (75 ug) was flowed into the trench. Electrophoresis in the second dimension was conducted at 10 V/cm for ca 90 min. The pH of points in the gel were measured with a contact pH electrode. Virus was fixed and stained to produce a visual mobility profile. Titration curves were unique and indicative of the stability, heterogeneity, and pI for each of six viruses.

DIFFERENTIATION OF NIGERIAN AND IVORY COAST STRAINS OF OKRA MOSAIC VIRUS. E. C. K. Igwegbe, Univ. of Nigeria, Nsukka, and A. D. Hewings, V. D. Damsteegt, and W. M. Dowler, USDA, ARS, Frederick, MD 21701

Three strains of OkMV from Nigeria (NG-OK2, NG-HI1, and NG-OK1) and two strains from the Ivory Coast (IC-OK1, and IC-HI1) were compared biologically on selected hosts. In general, as the geographical distance between the areas where strains were isolated increased, differences in symptoms on indicator hosts also increased. Nigerian strains, isolated from hibiscus (HI) and from okra (OK) have a very wide host range, are severe, and can be differentiated by symptomatology on selected hosts. The Ivory Coast OK and HI strains react similarly but are usually less severe. Nigerian and Ivory Coast strains were more closely related by geography rather than by host of origin. On certain hosts the reaction of NG-OK1 was intermediate between the NG and IC strains, suggesting a geographical continuum of biological reactions to OkMV strains in Sub-Saharan Africa.

EFFECT OF TWO BACTERICIDES ON ERWINIA AMYLOVORA SURVIVAL IN VITRO AND IN VIVO ON APPLES. W. J. Janisiewicz and T. van der Zwet, USDA, ARS, Appalachian Fruit Research Station, Kearneysville, WV 25430.

An aqueous suspension of E. amylovora (10^8 CFU/ml) was totally killed with benzalkonium chloride (BC) at 250 ppm and sodium hypochlorite (SH) at 10 ppm after 5 min exposure in vitro. BC was also effective at 125 and 62 ppm when exposure time was extended to 10 and 20 min, respectively. The effect of extended exposure to SH was clearly visible after the chemical was mixed with the wetting agent Ortho X-77. Complete kill of the bacterium was obtained at 25 ppm with an exposure of 20 min while partial control was obtained with 5 and 10 min treatments. Further increase in the concentration of this bactericide allowed for reduced exposure time to obtain complete kill. When 'Rome Beauty' apples, artificially infested with E. amylovora, were exposed for 10 min to these two bactericides dissolved in 0.25% Ortho X-77, BC was effective at 2000 ppm but not at 1000 ppm and below. No bacteria were detected using traditional recovery methods following treatment with SH at 500ppm.

PATHOGENICITY OF 7 VIRGINIA ISOLATES OF THIELAVIOPSIS BASICOLA ON SELECTED BURLEY AND FLUE-CURED TOBACCO CULTIVARS. C.S. Johnson, Virginia Polytechnic Institute and State University, Southern Piedmont Agricultural Experiment Station, P.O. Box 448, Blackstone, VA 23824

Seven isolates of Thielaviopsis basicola were tested in the greenhouse for pathogenicity on 4 burley and 4 flue-cured tobacco cultivars varying in resistance to the pathogen. Month-old seedlings were transplanted into vermiculite saturated with a 1:15 dilution of a mycelial suspension of each isolate. Plants were rated for vigor and root rot 3 wks after inoculation. Differences in vigor and root rot among isolates and cultivars were highly significant. Isolate by cultivar interactions were detected for vigor among flue-cured tobacco cultivars. Cultivar by isolate interactions were found for root rot among both burley and flue-cured tobacco cultivars.

IN VITRO GROWTH AND FIELD OBSERVATIONS OF BASIDIOMYCETES ASSOCIATED WITH SUPERFICIAL FAIRY RINGS IN BENTGRASS. K.E. Kackley*, P.H. Dernoeden** and A.P. Grybauskas*, Depts of Botany* and Agronomy**, University of Maryland, College Park, MD 20742.

Superficial fairy ring (SFR) is primarily a disease of Agrostis palustris Huds. (white patch) and is incited by several, mostly unidentified, basidiomycetes. According to the literature, SFR occurrence has been associated with the use of benomyl. Observations at three Maryland and one Delaware sites revealed that SFR developed in the absence of fungicide usage in bentgrass. Two basidiomycete isolates, exhibiting identical colony characteristics, were obtained from SFR's where benomyl was either

not used or was used extensively. The isolates were grown on PDA ammended with 0 to 100 ug ai/ml of benomyl, carbendazim or iprodione at 25°C. Growth of the isolates was not stimulated by any fungicide treatment. In vitro growth data and field observations do not support the premise that benomyl predisposes bentgrass to this disease by stimulating the growth of all SFR fungi.

INCREASED TOLERANCE TO BACTERIAL WILT IN EGGPLANT. H. P. Li, Department of Plant Protection, Huazhong Agricultural University, Wuhan, Peoples Republic of China, and R. W. Goth and T. H. Barksdale, Vegetable Laboratory, USDA, ARS, Beltsville, MD 20705

Previous evaluation of eggplant, Solanum melongena, germplasm in the USDA Plant Introduction collection showed several accessions with tolerance to Pseudomonas solanacearum (Phytopath. 76:563, 1986). Some of these tolerant P.I. lines were intercrossed and 6 sets of populations were developed. Twenty-day-old seedlings were root-dip-inoculated with a mixture of 3 isolates, transplanted in soil in 10-cm pots, and kept in a greenhouse at 32 C ± 3 C. There were 3 replications each of 24 plants for parent and F_1 and 128 plants for F_2 populations. Data in terms of survivors, or of number of days to 50% wilted or 50% dead, showed a genetic advance in the level of tolerance in the F_1 and F_2 of 2 crosses: P.I. 176761 x P.I. 169663 and P.I. 173106 x P.I. 220120.

THE EFFECT OF VARIOUS FUNGICIDE SCHEDULES AND INOCULUM LEVELS ON EARLY BLIGHT SEVERITY AND YIELD OF POTATO. S. A. Maczuga and B. J. Christ. Dept. of Plant Pathology, The Pennsylvania State University, University Park, PA 16802.

The potato cultivar 'Norchip' was used to evaluate 5 fungicide application schedules on disease development under 4 inoculum levels of Alternaria solani. A nested factorial design was used to assign inoculum level (main effects) and spray schedules (treatment effects). Fungicide schedules included mancozeb (1.8 Kg/ha a.i.) applied weekly and initiated at: 1 week before flowering, at flowering, 2 weeks after flowering, and at the first sign of disease. A no-spray treatment also was included. Assessments of severity and incidence were made throughout the growing season. Severity and incidence increased with increasing inoculum levels. Lowest incidence and highest yield of US #1 tubers occurred in plots with low inoculum density and plots where fungicide treatments were initiated before flowering.

RATE AND DURATION OF WHEAT GRAIN GROWTH AS AFFECTED BY STEM RUST. M.T. McGrath and S.P. Pennypacker. Dept. of Plant Path. Pennsylvania State University, University Park, PA, 16802.

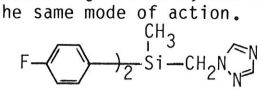
Grain growth in wheat infected by Puccinia graminis f. sp. tritici after anthesis was examined under field conditions during the 1986 growing season. Six epidemics differing in date of onset and AUDPC were established at various distances from artificially inoculated rows. Prior to the influence of stem rust, grain dry weight increased linearly at 1.08 mg/grain/day. The rates 18 days after anthesis were .56-.75, .68-.88, .96-1.12, 1.03-1.25, 1.12-1.49, and 1.39-1.58 mg/grain/day for main stems with average rust severities on the peduncle at that time of 16.25, 16.25, 8.8, 1.5, 2.7, and 1.0%, respectively. Duration of growth was about 34 days for plants with the lowest rust severity, whereas grain growth ceased within 23 days after anthesis when plants were more severely diseased. AUDPC for these epidemics were 1025, 972, 668, 635, 519, and 223 percent-days, respectively. Mature grain weights were 16.9, 18.4, 20.0, 22.1, 23.4, and 29.3 mg, respectively.

IN VITRO PRODUCTION OF HYDROGEN PEROXIDE BY DEGRADATIVE AND NONDEGRADATIVE ISOLATES OF BROWN-ROT WOOD DECAY FUNGI. J.A. Micales and T.L. Highley. U.S. Forest Products Laboratory, Madison, WI 53707.

The brown-rot fungi, Postia placenta, Gloeophyllum saepiarium and Gloeophyllum trabeum, are economically important degraders of wood. These fungi rapidly metabolize the cellulose and hemicellulose, but not the lignin, of woody tissues. The mechanisms involved in cellulose depolymerization are not well understood. One hypothesis is that a H_2O_2/Fe^{++} system, working in conjunction with cellulases, is responsible. The in vitro production of H_2O_2 was estimated under nitrogen limiting conditions for nondegradative isolates, which have lost their ability to decay wood, and degradative isolates of these species. Hydrogen peroxide was produced by all isolates of P. placenta and by certain degradative and nondegradative isolates of G. trabeum and G. saepiarium. The ability of nondegradative isolates to produce H_2O_2 suggests that additional mechanisms may be involved in brown-rot decay.

BIOLOGICALLY ACTIVE ORGANOSILICON COMPOUNDS: SILICON-CONTAINING TRIAZOLE FUNGICIDES. William K. Moberg, Gregory S. Basarab, John Cuomo, and Paul H. Liang, Agricultural Products Department, Experimental Station, Building 402, E. I. du Pont de Nemours and Co., Inc., Wilmington, DE 19898, USA

A program at Du Pont to examine the utility of organosilicon compounds as agrichemicals has produced a new class of sterol-inhibiting fungicides, the silylmethyltriazoles. This poster describes the discovery, synthesis, optimization, and field performance of these compounds. A member of this class, DPX-H6573, is currently under development worldwide as a broad spectrum foliar fungicide. DPX-H6573 establishes the utility of silicon compounds in agriculture, and offers advantages over known agents of the same mode of action.



DPX-H6573

A TRANSMISSION ELECTRON MICROSCOPIC STUDY OF VIRULENT AND HYPOVIRULENT STRAINS OF ENDOTHIA PARASITICA. J. R. Newhouse and W. L. MacDonald, Dept. of Plant Pathology and Ag. Micro., West Virginia University, Morgantown, WV 26506.

Hyphae and conidia of virulent (v) and hypovirulent (hv) strains of the chestnut blight fungus, Endothia parasitica, were preserved using freeze-substitution. The major cytoplasmic features of both types of strains were similar, except for the presence of spherical, membrane-bounded virus-like particles (VLPs) in hv strains. The VLPs measured 50-90 nm in diameter, possessed an electron dense core, and usually occurred in aggregates surrounded by rough endoplasmic reticulum. Unique Golgi bodies seemed to be associated with particle formation. Correlative studies revealed VLPs in hyphae and conidia of hv strains, but not in ds-RNA-free single conidial v isolates obtained from them. Differential staining and cytochemical studies showed that individual particles consisted of RNA surrounded by a lipid membrane. The results of this study suggest a role for VLPs in hypovirulence of E. parasitica.

DIRECT PENETRATION OF TOMATO LEAVES BY PSEUDOMONAS SYRINGAE PV. TOMATO. J. M. Perez, S. P. Pennypacker, & F. L. Lukezic. Dept. of Plant Pathology, Penn State Univ., Univ. Park, PA 16802.

Tomato seedlings were spray-inoculated on the axial and abaxial side of leaves, with a suspension of $2.3x10^8$ CUF/ml of Pseudomonas syringae pv. tomato. Seedlings were exposed to 1) 12 h photoperiod of high pressure sodium light for five days following inoculation, and 2) a greenhouse environment without supplementary light. Sections (ca. 2x5 mm) were removed from inoculated and control leaves at 1 h intervals after inoculation. Sections viewed under SEM displayed small and large congragations of bacteria on the leaf surface within 1 hr after inoculation. Direct bacterial penetration of the epidermis occurred within 2 h following inoculation. Evidence of enzymatic degradation was suggested by the presence of minute cell wall residues around areas of dissolved cell walls. Similar observations were noted with tomato seedlings grown in the greenhouse; however, direct penetration required 4 h. This is the first known report of direct penetration of the cell wallof plant leaf tissues by plant pathogenic bacteria.

OVERWINTERING OF PSEUDOMONAS SYRINGAE PV. TOMATO IN PENNSYLVANIA. J. M. Perez, S. P. Pennypacker, and F. L. Lukezic. Dept. of Plant Pathology, Penn State Univ., Univ. Park, PA 16802.

Individual samples of non-sterile soil, sterile soil, and roots, stems, seeds, and leaves of tomato seedlings that were infested or inoculated with P. syringae pv. tomato were placed in nylon mesh bags. On 27 November 1984 and 9 November 1985 the samples were exposed to environmental conditions at 0, 5, and 10 cm depths in field sites following the production of tomatoes. Samples were taken at 23 day intervals and 1 g specimens were

serially diluted on a selective medium. The positive recovery of P. syringae pv. tomato was based upon colony color and morphology, cytochrome oxidase reaction, hypersensitive reaction, and pathogenicity tests. The bacteria survived 46, 69, and 69 days, respectively, in non-sterile soil, sterile soil, and roots, and 207 days in the stems, seeds, and leaves. Bacteria therefore survived in tomato debris under the 1984/85 and 1985/86 winter conditions that existed in Pennsylvania and were present to serve as primary inoculum when plants were established for the following growing season.

FUNCTIONAL PROPERTIES OF CHLOROPLASTS FROM TOBACCO MOSAIC VIRUS-INFECTED TISSUE. B.C. Ramirez and S.W. Hutcheson, Dept. of Botany, University of Maryland, College Park, MD 20742

Tobacco mosaic virus (TMV) infection causes a loss in photosynthetic capacity (PC) of leaves that exhibit mosaic symptoms. To determine the mechanisms by which TMV infection affects PC, we have investigated TMV effects on chloroplast function. Nicotiana tabacum var samsún plants were inoculated with TMV (ATCC #PV 221) 15-20 days before use. Chloroplasts, isolated from chlorotic and "green island" regions of leaves exhibiting mosaic symptoms, were indistinguishable from their counterparts isolated from equivalent leaves of sham-inoculated plants in density, constituent proteins, chlorophyll content, chlorophyll a/b ratios, and their capacity to carry out photosynthetic electron transport and CO_2 assimilation. The results indicate that the diminished PC of TMV-infected leaves showing mosaic symptoms can be attributed to a reduction in the number of physiologically normal chloroplasts in the tissue.

DIFFERENT ASPECTS OF THE HOST RANGE OF Heterodera glycines. L. Rivera and D.F. Crossan; Department of Plant Science, Univ. of Delaware, Newark, DE. 19717-1303

Field and greenhouse experiments were conducted for two years to determine whether or not Heterodera glycines race 3 could infect and reproduce on common weeds present in soybean fields as well as the susceptibility of different commercially grown bean varieties in Delaware (baby lima beans, snap beans and kidney beans). Studies were also initiated to determine whether other leguminous species could maintain a population of the nematode significant enough to influence the effectiviness of a crop rotation program. The number of cysts and larvae per root system was determined at 39,50, and 69 days after planting, for each plant species tested. The number of cysts that developed on snap beans was not significantly different from the susceptible soybean variety Essex. Under field conditions, cysts developed in low numbers on baby lima beans, alfalfa, lambsquarter, tall morning-glory, cocklebur, jimsonweed and velvetleaf.

THE NUCLEAR CYTOLOGY OF TILLETIA INDICA. M. H. Royer and C. D. Therrien. USDA, ARS, Frederick, MD 21701, and Dept. of Biology, The Pennsylvania State Univ., Univ. Park, PA 16802.

The nuclear cytology of Tilletia indica, the incitant of Karnal or partial bunt of wheat, has been investigated by transmission electron microscopy (TEM) and Feulgen-DNA (F-DNA) cytophotometry. Numerous post-meiotic mitotic divisions occurred within the teliospores, with the teliospores remaining multinucleate at the time of promycelium formation. The mean F-DNA content of the primary sporidia was found to be 0.115 units, whereas that of the secondary sporidia was 0.175 units. The nuclear F-DNA content of the individual nuclei of binucleate teliospore initials was found to be 0.230 units, with that of the post-fusion nuclei being 0.455 units. We hypothesize that DNA replication in the binucleate teliospore initials occurs prior to nuclear fusion. Ultrastructural investigations of the teliospore initials showed that fusion nuclei were initially binucleolate, becoming uninucleolate prior to teliospore development.

YIELD REDUCTIONS IN FIELD CORN ASSOCIATED WITH GRAY LEAF SPOT UNDER CONDITIONS OF MINIMUM AND CONVENTIONAL TILLAGE AND DIFFERENTIAL HYBRID RESISTANCE. K. L. Smith, A. P. Grybauskas, and P. R. Thomison, USDA-ARS-SNECL, BARC-West, Bldg. 007, Beltsville, MD 20705, and Dept. of Botany, and Dept. of Agronomy, University of Maryland, College Park, MD 20742

Grain yield losses associated with gray leaf spot, caused by Cercospora zeae-maydis, were investigated in a 2-yr field study using a susceptible corn hybrid (S), Pioneer Brand 3184, and a resistant corn hybrid (R), Pioneer Brand 3192, grown in minimum tillage (MT) and conventional tillage (CT). Natural inoculum levels were relied upon for infection. Control plots were sprayed biweekly with benomyl at 2.24 kg ai/ha. In 1985, grain yield reductions were 51.5% (63.3 q/ha) for S-MT, 14.5% (13.8 q/ha) for R-MT, 46.8% (45.2 q/ha) for S-CT, and 24.5% (22.0 q/ha) for R-CT. In 1986, an exceptionally dry growing season, grain yield reductions were 27.8% (27.3 q/ha) for S-MT, 13.5% (11.1 q/ha) for R-MT, 22.1% (12.9 q/ha) for S-CT, and 8.3% (4.4 q/ha) for R-CT.

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

A greenhouse experiment was conducted in 1986 to investigate the effects of barley yellow dwarf virus (BYDV) and Pyrenophora avenea infections, singly and in combination, on yield of spring oats. Plants receiving virus treatments were infested with viruliferous aphids (Rhopalosiphum padi, PAV-NY) for 24 hr, at three, six or nine weeks after planting. Fungal inoculations followed virus inoculations by two weeks. Upon maturity, yield and its components were calculated. BYDV infections reduced all components of yield, except seeds/panicle. Date of infestation had an effect on all components of yield, except seeds/panicle, with the early infestations contributing to the greatest reductions in yield. P. avenea infections had significant effects only on number of seeds/panicle. P. avenea by BYDV interactions were detected for all yield components.

DEVELOPMMENT OF RUST RESISTANT GREEN AND WAX BEAN GERMPLASM. J. R. Stavely and J. Steinke. USDA, ARS, MPPL, Beltsville, MD 20705 and Rutgers Res. and Dev. Center, Bridgeton, NJ 08302

We have released 11 green and four wax, edible-podded Phaseolus vulgaris germplasm lines that are resistant to the 31 available races of Uromyces appendiculatus. All 15 lines combine resistance genes for 25 races from Puerto Rican dry bean line B-190 (Phytopathology 74: 339-344) with genes for 12 races from commercial cvs. Following the cross of an edible podded cv. with B-190, 3-8 successive backcrosses of F_1s or F_2s were made with various commercial cvs. Resistance evaluation was done with multiple race inoculation of each plant (Phytopathology 73:676-679). After the last backcross, homozygous resistant F_4 or F_5 lines were field selected at Bridgeton for horticultural desirability. All our releases (F_5s or F_6s) are homozygous for the I gene for common mosaic virus resistance, but retain some horticultural variability to permit selection by breeders.

PREDICTION OF APPLE FIRE BLIGHT BLOSSOM INFECTIONS IN MARYLAND, 1984 TO 1986. Paul W. Steiner and Richard Heflebower, Botany Department, University of Maryland, College Park, MD 20742.

Primary fire blight of apples in Maryland can be separated into two distinct types: blossom blight and canker blight. Each type develops independently from different inoculum sources and in response to different factors. Blossom blight appears to develop from epiphytic populations of Erwinia amylovora. It occurs following the sequence: (a) blossom opening; (b) accumulation of approx. 110 degree hours above 18.3°C from the last freeze or from a 3-day period of sub-18.3°C temperatures after the pink stage; and (c) a wetting event as rain or dew. These parameters are similar to those reported for apple and pear blight in western U.S. [S.V. Thomson (1986), Phytopathol. 76:476 and B.C. Zoller, et al. (1976), Amer. Phytopathol. Soc. Proc.3:322] but adequately describe the occurrence or lack of blossom infections in Maryland in 1984, 1985 and 1986. Streptomycin applied 1 day before the first wetting event in the above sequence in 1986, completely prevented blossom blight but not canker blight in orchards with a history of severe fire blight.

PREDICTION OF APPLE FIRE BLIGHT OVERWINTERING CANKER ACTIVITY IN MARYLAND, 1984 TO 1986. P. W. Steiner and R. Heflebower, Botany Dept., University of Maryland, College Park, MD 20742.

Using on-site weather data and observations on the appearance of fire blight symptoms on apples in 1984 and 1985, we identified a 2-day period in each year when overwintering canker activity (OCA)was probably initiated. The average accumulated de-

gree days (DD) above 12.7°C (minimum for Erwinia amylovora multiplication) from green tip for the two 2-day periods was 136 ± 6 DD. The onset of OCA in 1986 was predicted using this estimate and confirmed visually by cutting across canker margins regularly during the early season. A diffuse browning which extended 1-2 mm into healthy tissues from canker margins was evident on 8 May (157 DD) but not on 5 May (111 DD), indicating that OCA probably commenced on 6-7 May (131-148 DD) in 1986. In 1984 and 1986, OCA began after petal fall and could not have provided inoculum for blossom infections. In 1985, OCA began just after full bloom and was coincident with conditions favorable for blossom infection and may have contributed to a severe fire blight epidemic that year.

COMPARATIVE TRANSLOCATION OF ARBOTECT INJECTED VIA ROOT FLARES OR SHALLOW BOLE PITS IN LARGE AMERICAN ELMS. R. J. Stipes, R. Cu, J. L. Ratliff, T. D. Myers, T. B. Brenneman, B. J. Stipes, R. L. Fralin and S. V. Overton. Dept. Plant Pathol., Physiol. & Weed Science, Virginia Tech, Blacksburg, VA 24061.

Comparative translocation patterns of Arbotect (thiabendazole hypophosphite) in large American elms on Melrose Avenue, Roanoke, VA were monitored and evaluated during the summer, 1986. Two injection methods and Arbotect concentrations were employed: (A) root flare (2 oz./5 in. DBH=diam. at breast height), (B) shallow bole pit (2 oz./5 in. DBH) or (C) root flare (12 oz./5 in. DBH). Six randomly selected trees per method were used. For fungicide detection, wood disks from at least 100 crown stems per tree were observed for relative degrees of fungal inhibition following placement on Ceratocystis ulmi-seeded agar. By A, B and C methods, 59%, 64% and 94% of the stems, respectively, showed activity, while the highest levels of activity were in the C stems. Method C holds the best promise for controlling Dutch elm disease.

PLOT DESIGN FOR EVALUATION OF EFFICACY AND TIMING OF FOLIARLY-APPLIED FUNGICIDES IN WHEAT AND BARLEY. E. L. Stromberg, Pl. Path., Phys. & Weed Sci., VPI & SU, Blacksburg, VA 24061 and S. E. Crane, Rohm & Haas Co., Fort Washington, PA 19034.

Superior cultivars, precision planting, split and/or increased nitrogen application increases yield potential of wheat and barley in Mid-Atlantic States and coincides with increases in losses due to diseases. Although resistance is the first line of disease defense, fungicides may be justified to attain economically higher yields. A plot design to assess fungicide efficacy and application timing includes randomized complete blocks with treatment areas delimited by tramlines and sub-divided into thirds. First fungicide application is made over the front two-thirds; the second over the back two-thirds. Three application timings result: 1)early, 2)early and late, and 3) late. Ease of management makes this a useful design. Disease ratings and yields are determined for each timing within a treatment and statistical comparisons are made among and within treatments.

OCCURRENCE OF SEVERE FIRE BLIGHT IN MALLING 26 ROOTSTOCK. T. van der Zwet and S. S. Miller, USDA, ARS, Appalachian Fruit Research Station, Kearneysville, WV 25430

Two orchard blocks with 3-year-old trees of various apple cultivars, with no previous record of fire blight, became severely infected in May 1985. In Block 1, three resistant cultivars on M26 were compared with Red Yorking on M7A. In Block 2, Red Stayman on M26 was compared with three resistant cultivars on M7A. Of 476 trees on M26, 81 (17%) showed rootstock symptoms and the trees were dying. Only one of 417 trees on M7A showed rootstock blight. Most infected trees showed the scion union about 2-5 cm above the soil line. Erwinia amylovora was recovered from infected tissues. Attempts to isolate the bacterium from healthy tissues and soil adjacent to the rootstock were negative. These observations indicate that epiphytic populations of E. amylovora developed on the surface of the previously symptomless trees and that the bacterium apparently entered the M26 rootstock (no root suckers present) directly through the bark. The high degree of resistance of M7A rootstock to fire blight was confirmed.

DETECTION AND RECOVERY OF ERWINIA AMYLOVORA IN MATURE PEAR FRUIT THROUGH MONOCLONAL ANTIBODIES. T. van der Zwet and J. C. Walter, USDA, ARS Appalachian Fruit Research Station, Kearneysville, WV 25430 and C. P. Lin, Dept. of Plant Pathology, Rutgers University, New Brunswick, NJ 08903

Recovery of Erwinia amylovora from the surface and internal parts of mature pear fruit on fire blight-infected trees was tested through the application of monoclonal antibodies and epifluorescent microscopy. Ten fruit each of 'Bartlett' and 'Starkrimson' cultivars were collected from branches at 3 distances (0, 15, and 60 cm) from fresh blight infections. Ten blighted fruit from diseased trees and 10 non-infected fruit from symptomless trees served as controls. Each fruit was evaluated for the presence of E. amylovora on the surface and in 3 parts (upper, central and lower) of the core. The bacterium was recovered from the surface of 42% of all fruit of both cultivars. Recovery of bacteria from internal tissues was 11% (upper), 12% (central), and 9% (lower) from core sections of fruit from blighted trees. E. amylovora was not recovered from the core sections of any healthy pear fruit.

INDUCTION OF THE IONIC RESPONSE OF TOBACCO SUSPENSION CULTURE CELLS BY PSEUDOMONAS SYRINGAE. I. Yucel and S.W. Hutcheson, Dept. of Botany, University of Maryland, College Park, MD 20742

Incompatible P. syringae pathovars induce an ionic response (IR) of Nicotiana tabacum suspension culture cells in which there is a tobacco cell-dependent K^+ efflux and alkaline pH shift of the assay medium beginning 2h after inoculation. In an effort to elucidate the biochemical signals involved in the elicitation of host defense mechanisms, we have investigated the IR induction by P. syringae pvs syringae and pisi. Inhibitors of bacterial RNA and protein synthesis, rifampicin, streptomycin, and tetracyline, inhibit IR induction by antibiotic sensitive strains when added during the first 2h after inoculation, but had no effect when resistant strains were used. IR induction was insensitive to nalidixic acid, an inhibitor of DNA replication. Induction of IR, therefore, requires de novo protein synthesis during a 2h induction stage.

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