**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 The Index is outdated because it was based primarily on pre-1950 information.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 pathogenic fungi, their synonyms, geographic distributions, and host plants.

**LIMTED SUSCEPTIBILITY OF SAFFLOWER AND CENTAUREA SPP. TO Puccinia Jaceae FROM TURKEY. B. J. CHRIST, Department of Plant Pathology, Univ. of British Columbia, Vancouver, B.C.**

F. *jaceae* Oth., 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. athami*, an endemic rust fungus of NA, had 31 times as many pustules/cm² leaf area than safflower inoculated with *P. jaceae* (means = 3.1 vs. 0.1, respectively). YST inoculated with *P. jaceae* had 2.7 pustules/cm²; 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 TERTIBAFINE (SF-86327) ON GROWTH AND LIPID BIOSYNTHESIS IN Ustilago Maydis. A.M. BUCHMAN AND R.N. DAVIS, Laboratory Division, University of Maryland, College Park, Maryland 20742.**

Tertibafine, an antimycotic agent of the allylamine class [(E)-(N-(6-dimethyl-l-hepten-4-y)-l-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 10⁶/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 tertibafine in *U. maydis*, as in other fungi, appears to be inhibition of squalene epoxidase activity.


The enzyme-linked immunosorbent assay (ELISA) was adapted for the detection of TSWV in individual thrips. TSWV was detected in 19 of 41 *Frankliniella occidentalis* and 23 of 41 E. *schultzei* laboratory-grown adult thrips fed previously on infected plants as larvae. In reciprocal tests, 6 of 19 *F. occidentalis* and 8 of 22 E. *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 titer based on A405nm values 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
higher incidence of scab than Monona and Norchip, while Kennecott was intermediate. Incidence ranged from 92.2% on Rosa to 66.4% on Kennebec was intermediate. Incidence ranged from 92.2% on Norchip. Few of the uninoculated plants given excessive fertilization died and none of the plants given the lowest level of 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 Booth, 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 potatoes, tomatoes, 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 isolates grew on NA. One-month old tobacco plants were inoculated 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 Department, 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 inoculated or inoculated with Fusarium graminearum Schwabe at approximately the same stage of the development 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. Kratovich. 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 zinc 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 FLUSILOZAL. M. J. Henry, Du Pont Company, Expt. Station, Ag Products Dept., Wilmington, DE 19898

The recently discovered triazole fungicide flusilazole (DPX-6573) is being developed to control a variety of plant diseases. Flusilazole at 0.01 μg/ml inhibits growth of Ustilago maydis sporidia approximately 90% in liquid media. The incorporation of 14C- acetate into ergosterol in U. maydis sporidia is completely inhibited by 0.01 μg flusilazole/ml. Reduced C-ergosterol levels correspond to an accumulation of 14C- eburicol as determined by radio-hplc analysis and LC-MS identification. The 14α-demethylation of DHS is blocked in cell free preparations of either U. maydis or Saccharomyces cerevisiae. A concentration of 0.025 μg Flusilozaol/ml (0.06 μM) inhibits the 14α-demethylation of DHS in microsomes of S. cerevisiae. The fungicide interacts with...
gal cytochrome P-450 to produce a typical type II binding spectrum. The estimated dissociation constant (Kd) is 0.006 μg/ml (0.02 μM). The data indicate flusilazol inhibits fungal growth and controls plant disease by inhibiting sterol 14α-demethylase in ergosterol biosynthesis.

ROSE ROSETTE ON MULTIFLORA ROSE IN SOUTHERN INDIANA. D. P. 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 easternmost location was near Aberdeen, Indiana about fifteen miles west of the Ohio state line. The eriophyid mite Phyllocopetes fructiphilus, implicated as vector of the rosette agent was present, often in high populations, on symptomatic material. Successful transmission of the disease 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, R.C. Schuurink, T.P. Denny, G.J. Baker, M.M. Atkinson, S.W. Huchtonon, and A. Collier. 'Dept. of Botany, Univ. of Maryland, College Park, MD 20742, 'Dept. of Plant Pathology, University of Georgia, Athens, GA 30602, and 'Microbiological and Plant Pathology Laboratory, USDA/ARS, Beltsville, MD 20705.

Six P. syringae pv. syringae (Pers.) 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 Pers DNA was constructed in cosmid plasmids and probes from leaky EcoRI fragments from one of the mutants. Eight cosmid clones with homology to the terium was obtained at 25 ppm with an exposure of 20 min while virus was fixed and stained to produce a visual mobility. Virus was fixed and stained to produce a visual mobility.

RECOVERY OF CYLINDROCLOIDAL 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 Cylindrocloidal 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 various amendments and C. scoparium was often found. The best results occurred when lactose, 80 mg, oxalil, 40 mg and aureomycin, 5.0 mg were used.

TITRATION CURVES OF ISOMERIC PLANT VIRUSES IN AGAROSE SLAB GEL ELECTrophoresis. S. Ruttt and J. S. Favett*. USDA-ARS, PGGI, Glenn Dale, MD 20769 and *NichRD, NIH, Bethesda, MD 20793.

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 (8% 20.1 cm) of 0.6-0.8% agarose (Invitrogen), 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, 8-9X1.1 cm trench. Gels were electrofocused 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 μg) 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 indicated the stability, heterogeneity, and pH 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. O. D. HIngings, V. D. Damstette, and W. N. Dowler, USDA, ARS, Frederick, MD 21701.

Three strains of OMKV from Nigeria (NG-OK2, NG-H1, and NG-OK1) and two strains from the Ivory Coast (IC-OK1, and IC-H1) were compared biologically on selected hosts. In general, as the geographical distance between the area where the strains were isolated increased, differences in symptoms on indicator hosts also increased. Nigerian strains, isolated from hibiscus (H1) and from okra (OK1) have a very wide host range, are severe, and killed by partial control on selected hosts. The Ivory Coast OK and H1 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. A certain host to the reaction of NG-OK1 was intermediate between the NG and IC strains, suggesting a geographical continuum of biological reactions to OMKV strains in Sub-Saharan Africa.

EFFECT OF TWO BACTERICIDES ON EHRINIA AMILYVORA SURVIVAL IN VITRO AND IN VIVO ON APPLES. W. J. Sanislowicz and T. Van Der Zet, USDA, ARS, Appalachian Fruit Research Station, Kearneyville, VA 25340.

An aqueous suspension of E. amylovora (10^6 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 greatly 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 of the concentration of the bactericide was 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 dissolvied in 0.2% Ortho X-77, EC 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 500 ppm.

PATHOGENICITY OF 7 VIRGINIA ISOLATES OF THELAVIOSIS 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 1:1:5 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.K. Hackley, P.W. Derriggede, and A. Nagano, 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 amended with 0 to 100 µg 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. Roth and T. H. Barkadale. 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 F2 and 12 plants for F3 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 F2 and F3 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 g/l a.i. ± 250 ppm Fe) applied weekly 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 Pathology, 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 the time of initial inoculation to the first symptoms. The effect of stem rust, grain dry weight increased linearly at 1.08 mg/g day/days. The rates 18 days after anthesis were 56, 75, 68, 88, 56, 75, 96, 1.1, 1.03-1.25, 1.17-1.49, and 1.39-1.58 mg/day for stems, with slight inoculation initiated at: 1 week before flowering, at flowering, 2 weeks after flowering, and at the first sign of disease. Duration of growth was about 34 days for plants with the rust severity not decreased, whereas grain growth ceased within 13 days after anthesis when plants were more severely diseased. AUDPC for these epidemics were 1025, 972, 668, 253, 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 DECOMPOSING FUNGI. J. A. Micalis and T. L. Highley. U.S. Forest Products Laboratory, Madison, WI 53707.

The brown-rot fungi, Postia placenta, Gloeophyllum sapmarium and Gloeophyllum trabeum, are economically important decomposers 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 possible mechanism that could be working in conjunction with cellulose, "is responsible. The in vitro production of H2O2 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. sapmarium. The ability of nondegradative isolates to produce H2O2 suggests that additional mechanisms may be involved in brown-rot decay.


A program at Du Pont to examine the utility of organosilicon compounds as agrochemicals has produced a new class of sterol-inhibiting fungicides, the stylymethyliplagias, which 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.

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

Hyphal 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 hyphal and conidia of hv strains, but not in cv or in single conidial wall fragments 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, and F. L. Lukezic. Dept. of Plant Pathology, Penn State Univ., Univ. Park, PA 16802.

Tomato seedlings were spray-inoculated on the axial and abaxial sides of leaves, with a suspension of 2.3x10⁶ CUF/ml of Pseudomonas syringae pv. tomato. Seedlings were exposed to 1) 12 h systemic exposure to high pressure sodium light for five days following inoculation, and 2) a greenhouse environment without supplementary light. Sections (ca. 25 mm) were removed from inoculated and control leaves at 1 h intervals after inoculation. Sections viewed under SEM displayed small and large congregations of bacteria on the leaf surface within 1 h 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 wall of plant leaf tissues by plant pathogenic bacteria.

OVERTWINTERING 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, leaves and stems of tomato seedlings that were infected 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, cyctochrome 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. samsun plants were inoculated with TMV (ATCC FPV 221) 15-20 days before use. Chloroplasts, isolated from chlorotic and "green island" regions of leaves exhibiting mosaic symptoms, were delipitated and the Triton X-100 extracts of 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 CO2 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 effectiveness of a control rotation program. The number of cysts and larvae per root system was determined at 39, 50, and 69 days after planting. Field experiments indicated the following: (a) 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, *vFisicor* 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 Kernal or partial bunt of wheat, has been investigated by transmission electron microscopy (TEM) and Feulgen-DNA (F-DNA) cytomterometry. Numerous post-metelic mitotic divisions occurred within the telosporae, with the telosporae 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, of approx. 0.455 units. We "split" the F-DNA content of the post-fusion nuclei being 0.455 units. We "split" the F-DNA content of the post-fusion nuclei being 0.455 units.

**Development of Rust Resistant Green and Wax Bean Germplasm.** J. R. Stavely and J. Steiwe, USDA, ARS, MPP, 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: 339-364) 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*$_s$ or *F*$s$ were made with various commercial cvs. Resistance evaluation was done with multiple race inoculations of each plant (Phytopathology 73:676-679). Upon maturation, resistant *F*$_s$ or *F*$s$ lines were field selected at Bridgeton for horticultural desirability. All our releases (*F*$_s$ or *F*$s$) are not expected to carry genes for common mosaic virus resistance, but retain some horticultural variability to permit selection by breeders.

**Prediction of Apple Fire Blight Infection in Maryland.** 1984 to 1986. P. W. Steiner and R. 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 moisture above 18.5°C from the last freeze or 3-day period of sub-18.3°C temperatures after the first wetting event in the above sequence; (c) a wetting event as rain or dew. These parameters are similar to those reported for apple and pear blight in wisconsin (S. T. Stavely, 1964). By using a combination of bacteriological and meteorological data, we developed a system by which the occurrence of blossom blight and canker blight could be predicted. The system was evaluated in 1986, and predicted that blossoms blight occurred in the orchards in 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 Department, 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-
Comparative translocation patterns of Arbotect (thiabendazole hypophosphite) in large American elms, 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 uninucleated seed 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.

Superior cultivars, precision planting, split and/or increased nitrogen application increase the 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 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) yearly, 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.

Deepest days (DD) above 12.7°C (minimum for Erwinia amylovora multiplication) from green tip for the two 2-day periods was 156 + 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 patterns of Arbotect (thiabendazole hypophosphite) in large American elms on Melrose Avenue, Roanoke, VA and S. E. Crane, Rohm & Haas Co., Fort Washington, PA 19034.

Superior cultivars, precision planting, split and/or increased nitrogen application increase the 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 defense, fungicides may be justified to attain economically higher yields. A plot design to assess fungicide efficiency 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) yearly, 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 stiipe union about 2 cm from 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 fire blight infection. Ten blighted fruit from diseased trees and 10 non-infected fruit from symptomless trees served as controls. Each fruit was assessed 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 62% 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 suspending 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 pv syringae and pisi. Inhibitors of bacterial DNA and protein synthesis, rifampicin, streptomycin, and tetraacyline, 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.

**INCOMPATIBLE P. SYRINGAE PATHOVAR SYRINGAE INDUCE AN IONIC RESPONSE (IR) OF NICOTIANA TABACUM SUSPENDING 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 PV SYRINGAE AND PISI. INHIBITORS OF BACTERIAL DNA AND PROTEIN SYNTHESIS, RIFAMPICIN, STREPTOMYCIN, AND TETRAACYCLINE, 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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