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ABSTRACTS

Alphabetized by first author's last name.

ISOLATION OF DOUBLE-STRANDED RNA FROM TILLETIA INDICA. R. J. Beck, J. R. Newhouse, O. P. Smith, G. L. Peterson, and M. R. Bonde. USDA-ARS, FDWSRU, Fort Detrick, Frederick, MD 21701

Tilletia indica is the fungal causal organism of Karnal bunt of wheat, not known to be present in the U.S. Isolates of the fungus from Mexico (4), India (3), and Pakistan (1) were sampled for the presence of double-stranded (ds) RNA. Using column chromatography and polyacrylamide gel electrophoresis, dsRNA was detected in all four Asian isolates and in one of the four Mexican isolates. The isolated nucleic acids were resistant to DNase I and S_1 nuclease, and sensitive to RNase A in low salt buffer. All dsRNA-containing isolates exhibited two dsRNA bands that were estimated to be 3400 and 3200 base pairs in size. The dsRNA-containing Mexican isolate originated from the Toluca Valley, an area of the country in which the fungus had not been found previously. The three dsRNA-free Mexican isolates were obtained from the Sonora region where Karnal bunt disease is widespread. These findings could have important epidemiological implications.

RESISTANCE TO *LYCOPERSICON* SPECIES TO THE TOMATO LEAF CURL VIRUS VECTOR *BEMISIA TABACI*. Channarayappa, G. Shivashankar, V. Muniyappa, and R. H. Frist. University of Agricultural Sciences, Bangalore-65, India and Biology Department, West Virginia University, Morgantown, WV 26506.

More than 1200 cultivars, breeding lines, and wild species of *Lycopersicon* were screened for resistance to the tomato leaf curl virus (TLCV). All accessions of *L. esculentum* were susceptible to TLCV under field conditions. Three lines of *L. hirsutum* and one line of *L. peruvianum*,both wild species, showed resistance to TLCV due to failure of virus transmission by the whitefly, *Bemisia tabaci*. Analyses of leaf surfaces by light and scanning electron microscopy showed different types of trichomes of varying proportions on both abaxial and adaxial surfaces of different tomato species. Higher densities of non-glandular trichomes deterred whiteflies from feeding, but they did not prevent transmission of the virus. Resistant lines of *L. hirsutum* were distinguished by presence of type VIc glandular trichomes. Whiteflies became trapped in the exudate of the trichome glands. Field tests with cages showed a high correlation between whitefly preference and the morphology of leaf surfaces. The whiteflies preferred those lines which appeared to be resistant to TLCV. Thus, use of plants bred for glandular trichomes (type VIc) should control TLCV transmission

A PATHOGEN GROWTH RESPONSE MODEL FOR FUNGICIDE APPLICATION TO CONTROL CERCOSPORA LEAFSPOT OF PEANUT. R. M. Cu, P. M. Phipps, and R. J. Stipes, Tidewater Agr. Exp. Sta., Suffolk, and Dept. Plant Pathol., Physiol. & Weed Sci., VPI&SU, Blacksburg, Va 24061.

A new advisory program was developed for efficient use of fungicides to control early leafspot of peanut. Conditions conducive for sporulation, germination and infection (RH≥95% and temperature ≥16C and ≤30C) were assigned weighted time-duration values (TDV) on the basis of growth responses of Cercospora arachidicola. Cumulative thresholds with TDV=48, 72, 96 and 120 for fungicide application were compared to the 1981 advisory and a 14-day schedule in field tests (1987-89). Chlorothalonil (1.26 kg/ha) and peanut cv. Florigiant were used each year. The spray threshold of TDV=48 was similar to the 1981 advisory in that the number of spray applications were one to three fewer than a 14-day program. The TDV=48 program suppressed disease incidence to levels similar to a 14-day program, and significantly better than the 1981 advisory program. Evaluations of the TDV=48 model in simulated disease environments based on historical weather data (1983-86) gave similar results.

OCCURRENCE OF THE A^2 MATING TYPE OF *PHYTOPHTHORA INFESTANS* IN POTATO FIELDS IN THE UNITED STATES AND CANADA. K.L. Deahl, R.W. Goth, R. Young, S.L. Sinden, and M.E. Gallegly, USDA:ARS:Vegetable Laboratory, Beltsville, MD 20705.

Ten isolates of *P. infestans* collected from blighted potato fields during the years 1983-1989 were tested for mating type on lima bean, oatmeal, and rye grain media. Two of the ten isolates produced oospores in 15 days when cultured together with known A^1 mating types from the USA, Mexico, and Europe, showing they belong to the A^2 mating type. When cultured singly or with known A^2 isolates, the newly isolated A^2 mating types did not produce oospores even after 6 weeks of culture. Pathogenicity tests showed that potato foliage and stems were blighted by both organisms, and there appeared to be no difference between the A^2 and the A^1 isolates in virulence. Inoculations with a mixture of A^1+ A^2 sporangia also produced oospores in host tissues.

EFFECTS OF NATIVE dsRNA ON THE PATHOGENICITY OF *ENDOTHIA PARASITICA* ISOLATES FOUND IN WEST VIRGINIA. S. A. Enebak and W. L. MacDonald. West Virginia University, Division of Plant and Soil Sciences, 401 Brooks Hall, Morgantown, WV 26506.

Virulence levels were measured in eighty-nine dsRNA-containing isolates of *Endothia parasitica* after inoculation into dormant American chestnut stems. Virulence ranged from a level comparable to a dsRNA-containing hypovirulent control to a level significantly greater than a dsRNA-free virulent control. To determine the effect of the presence or absence of dsRNA on virulence, several of the isolates and their single conidial progeny (lacking all, or a portion of, dsRNA) were inoculated into 'Golden Delicious' apples; an assay for virulence based on relative lesion size. Of the six strains tested, only BS2, SR2, and the single-banded progeny of isolate C-18 (a multiple-banded isolate) showed a significant ($P = 0.05$) increase (2, 3, and 7 cm^2, respectively) in lesion size. While the remaining three parents and their dsRNA-free progeny did not differ significantly in lesion size, the parent isolates tended to be smaller in size than their respective progeny.

EFFECT OF SUBLETHAL METHAM SODIUM TREATMENTS ON MICROSCLEROTIA OF VERTICILLIUM DAHLIAE. D. R. Fravel. Biocontrol of Plant Diseases Laboratory, USDA-ARS, Beltsville, MD 20705.

To determine parameters useful in assessing impaired functioning of microsclerotia of V. dahliae, microsclerotia

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were embedded in 0.5 cm^2-pieces of nylon mesh, buried in nonsterile field soil, and treated with 100, 10, 2, or 1.33 % of the recommended rate of metham sodium or with water. Meshes were retrieved after 24 h and placed on Czapek agar. Colony diam. was recorded at 4-day intervals for 3 wk. All rates of metham sodium significantly reduced the growth rate of V. dahliae. Growth rate decreased linearly with increasing rates of metham sodium. Field soil, infested with microsclerotia of V. dahliae, was treated with various rates of metham sodium as above. Six-wk-old eggplants were transplanted into this soil and pathogenicity was assessed by symptom development and stem isolation. Incidence in the 10 and 100 % rates was not significantly different from the healthy control. Incidence was inversely related to rate. This information will be used to integrate sublethal rates of fumigants with biocontrol.

PHYTOPHTHORA MEGASPERMA ISOLATED FROM BLEEDING CANKER OF FLOWERING DOGWOOD. M. E. Gallegly and W. L. MacDonald, West Virginia University, Morgantown, WV 26506-6057.

Isolation from bleeding canker of flowering dogwood (*Cornus florida*) on the campus of WVU yielded *Phytophthora megasperma* Drechsler. Only *P. cactorum* has been associated with this disease prior to this report of the association of another *Phytophthora* sp. The isolate is homothallic with paragynous antheridia; amphigynous antheridia are rare. On half-strength cleared lima bean agar, diameters of oogonia averaged 46.2 μm (40-55 μm), oospores 39.7 μm, oospore walls 3.7 μm, and antheridia 14 μm (mostly spherical and usually only one applied near the oogonial stalk). Sporangium-shaped bodies appeared as hyphal swellings, as if direct germination had occurred, when discs from 3-day-old cultures were in deionized water under cool white light for 24 hr at 25 C. Typical sporangia that liberated zoospores were formed at 16 C; both bodies were formed at 20 C. Sporangia at 20 C were nonpapillate, and ovoid, obpyriform or ellipsoid. They averaged 62.0 x 38.4 μm with l/b ratios 1.5-1.9. Zoospores were 10-13 μm. This isolate is a large-oogonium form similar to some of those from other woody plants in the Pacific Northwest.

PESTICIDE USE DATA FOR IPM EVALUATION. Leonard P. Gianessi, Resources for the Future, Inc., 1616 P Street, N.W., Washington, D.C. 20036

Pesticides have an important role in most successful IPM programs. Currently, there are a great many regulatory initiatives concerning pesticides. Many products that may be withdrawn from production have important roles in IPM programs. A systematic determination of which pesticides are important in IPM programs needs to be completed. Thus, policymakers would be aware of the potential impacts on IPM programs of potential regulations. The withdrawal of Alar has resulted in reduced thresholds for spraying of certain apple insects. The withdrawal of phosalone has disrupted California's IPM program for walnuts. Herbicide usage is often taken for granted in IPM programs targeted to insect or disease control. Many herbicide registrations for fruit and vegetable crops are being withdrawn. Systematic pesticide use data for IPM programs would indicate how often use has to be increased due to unusual weather or pest pressures.

IN VITRO SCREENING OF CORN CYST NEMATODE TO CORN BREEDING LINES. **G. Hashmi, R. N. Huettel, and L. R. Krusberg. USDA ARS, BARC-W, Beltsville, MD 20705 and Dept. Botany, UM, College Park, MD 20740.**

An in vitro screening method was developed to determine the pathogenicity of the corn cyst nematode, Heterodera zeae (CCN) to 25 lines of Zea mays. Isolates of H. zeae from Maryland were established in vitro and maintained on corn root explants (cv. IO Chief) on Gamborgs B5 medium. All tests were conducted in petri plates containing Gamborgs B5. The rate of germination and growth of corn roots from the 25 lines was determined in vitro. All lines exhibited growth equal to the control, cv. IO Chief. For screening of lines to nematodes, 2 roots per line were inoculated with 5 in vitro propagated CCN mature cysts. Each line, replicated 3X, was incubated at 28 C in the dark. Visual observations for nematode development were made at 10, 12, 15, and 35 days. Results indicated that this screening method allowed for categorizing corn lines as resistant or susceptible to CCN based on number of nematodes that develop.

ISOZYME DETECTION AND VARIATION IN USTILAGO HORDEI. R. Hellmann and B. J. Christ, Department of Plant Pathology, Penn State University, University Park, PA. 16802

Haploid isolates of the smut fungus, Ustilago hordei (Pers.) Lagerh., were examined for enzyme variation by starch gel electrophoresis. Fifty-five isolates from North Dakota but representing different virulence genotypes were tested. An additional eight isolates from Ethiopia were also tested. Activity was detected for nine enzymes. No variation was detected for four enzymes (PEP, G-6-PDH, ACO, AK). For the remaining five enzymes (6-PGD, PGI, PGM, IDH, MDH), only a few isolates deviated from the predominant banding pattern. Only two to three different banding patterns were observed. Based upon these preliminary results, the limited variation observed would make it difficult to use isozymes as genetic markers in future studies of U. hordei.

PRESENCE OF GENTISIC ACID AND ASSOCIATION WITH FOLIAR SYMPTOMS OF GREENING INFECTED CITRUS. M. E. Hooker & E. L. Civerolo, USDA, Beltsville, MD 20705; R. F. Lee & R. H. Brlansky, Univ. of FL, Lake Alfred 33850

A method for hydrolyzing gentisoyl-B-D-glucose to gentisic acid was modified for use in microcentrifuge tubes. After extraction and thin layer chromatography on silica gel plates, the presence of gentisic acid was indicated as a fluorescent marker. The intensity of the gentisic acid fluorescent areas was highly correlated with the severity of foliar symptoms of greening. Extracts of older bark tissue had significantly greater gentisic acid than similar extracts from young bark. This method appears to be reliable for diagnosis of citrus greening disease based on greenhouse evaluations.

SURVIVAL OF *CYLINDROCLADIUM SCOPARIUM* IN NURSERY SOILS IN WEST VIRGINIA AND PENNSYLVANIA. B. B. HUNTER, AND M. P. REILLY. DEPARTMENT OF BIOLOGICAL SCIENCES, CALIFORNIA UNIVERSITY OF PENNSYLVANIA, CALIFORNIA, PA 15419

A modified geranium leaf baiting soil-bioassay was used to determine whether *Cylindrocladium scoparium* survived in nursery soils. Nurseries in PA have been monitored since 1982, and one in WV has been investigated the past 3 years. Fungal identification was made from the hyphae/conidiophores on the leaf surface. Isolates of *C. scoparium* were recovered from nursery soils in PA and WV. Movement of infested soils to non-infested soils resulted in the permanent establishment of the pathogen. Some soils in PA are suspected of having cylindrocladia for at least 17 years. At a former forest seedling nursery in WV, a flood of several years ago deposited soil and debris of nearly 20 inches over the nursery. In the summer and fall of 1988 and 1989, *C. scoparium* was isolated from the nursery soils (flood soil and debris removed) and from flood debris soils which were planted with conifer and hardwood nursery seedlings. Once infested, these soils and others were always positive.

BIOCONTROL OF BLUE MOLD AND GRAY MOLD AND SURVIVAL OF BIOCONTROL AGENT ON VARIOUS PEAR CULTIVARS IN STORAGE. W. Janisiewicz and A. Marchi USDA, ARS, Appalachian Fruit Research Station, Kearneysville, WV 25430, and CRIOF, University of Bologna, 20200 Bologna, Italy.

Control of blue mold (incited by Penicillium expansum) and gray mold (incited by Botrytis cinerea) was achieved using antagonistic Pseudomonas syringae pv lachrymans on wounded pear fruit cultivars Bosc (BC), Red Bartlett (RB), Bartlett (BR), and Anjou (AJ) at 1 C and 18 C storage. Blue mold was easiest to control on AJ pears, followed by BR, RB, and BC. Best control of gray mold was achieved on BR pears, followed by RB, AJ, and BC. Rots were easier to control on fruit with smooth wounds made with a sharp instrument, than on fruit with similar size rough wounds made by piercing the tissue with a nail. The antagonist populations increased 10 to 100-fold at the wound site during the 30 day storage at 1 C. The population increases did not follow the disease pattern on two types of wounds. Higher populations of the antagonist were recovered from nail than from smooth wounds.

BAND VS BROADCAST APPLICATION OF CONTACT NEMATICIDES FOR CONTROL OF TOBACCO CYST NEMATODES IN VIRGINIA. C. S. Johnson, VPI & SU, Southern Piedmont Agricultural Experiment Station, P.O. Box 448, Blackstone, VA 23824.

Fenamiphos (6.7 kg a.i./ha) and tank-mixes of 4.4 kg a.i./ha fenamiphos with 2.2 kg a.i./ha chlorpyrifos or 3.4 kg a.i./ha fenamiphos with 6.7 kg a.i./ha ethoprop were tested for control of Globodera tabacum subsp. solanacearum (Gts) on two Virginia farms in 1989. Numbers of Gts eggs in mid-season were reduced

at location 2 by application of 6.7 kg a.i./ha of fenamiphos in a 50.8 cm band centered over the row. Other differences in Gts egg population densities were not significant at either location. Nematicide use increased flue-cured tobacco yield at both locations, but increases in yield and gross economic return from band application of nematicides were not significantly greater than the control at location 1, where initial Gts populations were highest. Yield and gross economic return were similar across all nematicide treatments at location 2.

DETECTION OF PLANT VIRUSES AND A MYCOPLASMA-LIKE ORGANISM BY DIRECT TISSUE BLOTTINGS ON NITROCELLULOSE MEMBRANES. N. S. Lin, Y. H. Hsu, and H. T. Hsu. Academia Sinica, Taipei; National Chung-Hsing University, Taichung; and U. S. Department of Agriculture, Maryland, respectively.

A technique of tissue blotting on nitrocellulose membranes was described for detection of plant viruses and a mycoplasma-like organism in infected plants. Tissue blots were made by pressing firmly and gently the freshly cut tissue surface on nitrocellulose membranes. Antigens in tissue blots were detected by enzyme-labelled immunological probes. In indirect methods, the blots were reacted with antigen-specific antibodies and detected with enzyme-labelled species specific second antibodies. Alternatively, the blots were reacted with antigen-specific biotinylated antibodies and detected with avidin-enzyme conjugates. In direct methods, the blots were reacted and detected with enzyme-labelled antigen-specific antibodies. The tissue blotting technique was applied to detect viruses in cucumovirus, luteovirus, potexvirus, potyvirus and tomato spotted wilt virus groups and a mycoplasma-like organism.

EFFECT OF EDAPHIC FACTORS AND TIME ON GLIOCLADIUM BIOCONTROL OF PYTHIUM AND RHIZOCTONIA DAMPING-OFF OF ZINNIA. R. D. Lumsden and J. C. Locke USDA, ARS, Beltsville, MD 20705.

Gliocladium virens was added (0.1% w/v) as an alginate-bran prill formulation (W. R. Grace & Co., Columbia, MD) to peat-vermiculite soilless mix and moistened with 20-10-20 fertilizer. After 1 wk, or variable incubation periods, zinnia seeds were planted in infested mix and incubated at 20 C for Pythium and 28 C for Rhizoctonia. Pythium was controlled best with preincubation temperatures of 6-20 C and Rhizoctonia of 15-30 C. Moisture and pH content did not adversely affect biocontrol of either pathogen except when very wet (-30 K Pa) or alkaline (pH 7.9). Control of both pathogens was best with a preincubation of 1-2 days, but was still somewhat effective after 1 mo. Zero time was ineffective. Thus, G. virens biocontrol is effective over a broad range of conditions, with time of preincubation before use having the most effect. This suggests the importance of actively growing mycelium of G. virens in the biocontrol mechanism.

THE POLYMYXA GRAMINIS-WHEAT SOIL-BORNE MOSAIC VIRUS RELATIONSHIP ON A SUBCELLULAR LEVEL. Mary S. Mayes and R. L. Grayson, Dept. of Plant Path., Phys., and Weed Science, VPI & SU, Blacksburg, VA 24061

The effects of various fixatives on viral suspensions, the progress of wheat soil-borne mosaic virus (WSBMV) through Florida 302 wheat, and its relationship to Polymyxa graminis were studied on the subcellular level. The utilization of electron immunocytochemical techniques using gold-labelled antibodies on viral suspensions and thin sections confirmed that (1) paraformaldehyde provided the best preservation of viral morphology, viral concentration, and antigenicity, (2) P. graminis is the actual vector of the virus, and (3) the labelling pattern of the fungal structures and plant chloroplasts seems to suggest that they play a role in the synthesis of some viral proteins.

INVESTIGATIONS OF MICROBEAL POPULATIONS ON SELECTED LIGHTLY PROCESSED PRODUCTS. Harold E. Moline, USDA, ARS, Hort. Crops Quality Lab, BARC, Beltsville, Md. 20705

With the recent increase in marketing of lightly processed products, there has been an accompanying concern about product quality. Broccoli, cauliflower, green pepper, chopped celery, lettuce, and carrots were randomly sampled at local markets. Serial dilutions of microbes from produce were made at day of sampling, two, and four days later to determine bacterial, yeast, and fungal populations. Representative bacterial colonies were also tested for pectolytic activity. Fungal populations were low in all samples; yeast populations were highest on minced carrot (10x7 cfu/ml), sliced pepper (10x5 cfu/ml), and chopped celery (10x7 cfu/ml). Total bacterial populations increased significantly with time after processing (10x2 cfu/ml to 10x7 cfu/ml) in all lightly processed produce except cauliflower. Pectolytic bacterial populations increased from 10% of the total colonies at initial sampling to 50% of the total two days later.

EVALUATION OF ALTERNARIA SOLANI AND A. ALTERNATA FROM POTATOES AND TOMATOES BY ISOZYME ANALYSIS. D.M. Petrunak and B.J. Christ, Department of Plant Pathology, The Pennsylvania State University, University Park, PA 16802.

Isolates of Alternaria solani Sorauer, the causal agent of early blight on potato and tomato, and isolates of A. alternata (Fr.) Keissler, also associated with early blight, were examined for isozyme variability using starch gel electrophoresis. Differences in electrophoretic patterns for three enzymes (MDH, IDH, ACO) separated the isolates according to species. Variability for seven other enzymes (G6PD, PGM, PEP, MPI, 6PGD, MPD, PGI) was detected between and within species. For these seven enzymes, a minimum of three to five banding patterns were detected. The two species can be distinguished by some enzymes, but there are common bands between the species in other enzymes suggesting that the species may be closely related.

DEVELOPMENT OF GRAY LEAF SPOT OF FIELD CORN CAUSED BY CERCOSPORA ZEAE-MAYDIS. C.E. Ringer and A. Grybauskas, Dept. of Botany, University of Maryland, College Park, MD 20742.

Development of gray leaf spot of corn (causal agent Cercospora zeae-maydis) was compared on two field corn hybrids representing the extremes of available resistance in commercial hybrids as determined by initial field trials. Area under the disease progress curve, rate of disease increase, infection efficiency, latent period (days from infection to sporulation) and spores per cm^2 lesion were compared on Pioneer 3184 (highly susceptible) and Pioneer 3192 (moderately resistant) in the field and in the greenhouse using artificially inoculated plants. Pioneer 3184 had greater area under the disease progress curve, rate of disease increase, infection efficiency, and sporulation than Pioneer 3192. No differences were observed in latent period.

RESISTANCE TO BEAN RUST IN THE PHASEOLUS VULGARIS PLANT INTRODUCTION COLLECTION. J.R. Stavely, Microbiology & Plant Pathology Laboratory, ARS, USDA, Beltsville, MD 20705

In the late summer to early fall of 1987, 1988, and 1989, respectively, 1,136, 1,192, and 1,104 Phaseolus vulgaris plant introductions (PIs) were exposed to field epidemics of rust at Beltsville that were initiated by inoculation of susceptible spreaders with races 38, 39, 40, 41 and 43 of Uromyces appendiculatus. In the respective years, 67, 168, and 164 of the PIs were rust resistant. All others had susceptible reactions, but some had reduced infection intensities. All field resistant PIs were tested for reactions to 33 pathogenic races of U. appendiculatus in the greenhouse (GH). Many of the PIs were mixed so that some plants were resistant and others susceptible to specific races. All plants of 3, 13, and 19 of the PIs tested in the GH in each year were resistant to all races. These included 24 from Guatemala, 5 from Mexico, 3 from Columbia, and one each from Bolivia, Chile, and Hondorus.

THE RELATIONSHIP BETWEEN LEAF BLIGHTING CAUSED BY *CERCOSPORA ZEAE-MAYDIS* AND CORN YIELD. E. L. Stromberg, Dept. of Pl. Path., Phys. and Weed Sci., VPI&SU, Blacksburg, VA 24061-0331

Gray leaf spot (GLS) caused by *Cercospora zeae-maydis* is an important disease of maize in the mid-Atlantic and Eastern Corn Belt regions of the country with significant yield losses in some years and locations. All commercially available hybrids are susceptible to this disease to some degree. A block of the hybrid Pioneer Brand 3320 was no-till planted into corn debris naturally infested with *C. zeae-maydis*. The corn block consisted of 25-ft, 4-row plots, in a randomized complete block with four replications; one of nine fungicide or control treatments were applied to the center two rows. By late June GLS lesions were visible. Treated rows were rated for blighting (0-5

scale) six times during the season and harvested for grain. Yields were reduced by as much as 45 bu/A where blighting (4.58 on 14 Aug) was most severe. Grain yield reached a maximum of 115.2 bu/A with a treatment providing the least degree and duration of blighting (3.10 on 14 Aug).

THE EFFECT OF PHOTOSYNTHATES ON THE SUSCEPTIBILITY OF APPLE SHOOTS TO FIRE BLIGHT. Patrice Suleman and Paul W. Steiner, Botany Dept., University of Maryland, College Park, MD 20742.

Apple shoot apices of fire blight resistant (Red Delicious) and susceptible (Jonathan) cultivars were multiplied in vitro on solid, modified Murashige and Skoog (MS) medium amended with 3% or 6% sorbitol as a carbon source and supplemented with BAP, IAA and GA_3. Shoots were then subcultured on MS medium without phytohormones under light and dark conditions and inoculated with *Erwinia amylovora* (10^6 cells/ml) 3 weeks later using a hypodermic needle. Both cultivars were susceptible and symptoms were similar to those observed in the field. Within 48 hours after inoculation, brown to reddish lesions were apparent on the etiolated but not light grown shoots. After 2 weeks, all Jonathan and a few Delicious shoots showed symptoms. Light-grown, but not dark-grown shoots showed significant differences in symptom severity. The combination of light/dark and 3%/6% sorbitol in the medium suggests that fire blight resistance may be influenced by both the nutritional and osmotic aspects of apple photosynthates.

ANTAGONISM OF LACTIC ACID BACTERIA AGAINST ERWINIA AMYLOVORA. T. van der Zwet and J.C. Walter. USDA, ARS, Appalachian Fruit Research Station, Kearneysville, WV 25430

A variety of lactic acid bacteria, obtained from the American Type Culture Collection, Rockville, MD, were found to be antagonistic to virulent strains of Erwinia amylovora (Ea). Plugs of 15 lactobacilli, representing L. amylovorus, L. brevis, L. confusus, L. casei, L. fructosus, L. plantarum, L. sake, and L. yamanashiensis, grown on MRS medium (pH 6.6), were placed on NYDA (pH 6.8) plates seeded with Ea 48 hr earlier. After an incubation period of 36 hr at 25 C, the diameter of growth inhibition zones was measured. All Lactobacillus spp. inhibited growth of virulent isolates of Ea, but were not effective against avirulent, streptomycin resistant strains. In vivo tests were performed by placing 50 ul of 10^8 CFU of each Lactobacillus on an injured leaf surface (60-pin cushion in 2 cm diam.), challenged 2 hr later with 50 ul of 10^8 CFU of Ea. On a scale of 1 (no inhibition) to 4, inhibition of leaf symptoms ranged 2.2 - 3.7 for all lactobacilli.

EVALUATION OF BINUCLEATE RHIZOCTONIA-LIKE FUNGI FOR BIOLOGICAL CONTROL OF SORE SHIN CAUSED BY RHIZOCTONIA SOLANI ON TOBACCO (NICOTIANA TABACUM L.). S.K. Walker, C.S. Johnson, and E.L. Stromberg, Dept. of Pl Path, Phys and Weed Sci, VPI & SU, Blacksburg, VA 24061.

Binucleate Rhizoctonia-like fungi (BNR) have been shown to be effective biocontrol agents against brown patch disease of creeping bentgrass (Agrostis palustris) and Rhizoctonia root rot of bean (Phaseolus vulgaris). Six isolates of BNR shown to be effective biocontrol agents in previous studies (Echandi,E.E. and S.K. Walker, unpubl) were tested for pathogenicity on tobacco (Nicotiana tabacum L.) cv. McNair 944 in greenhouse experiments. No BNR isolates produced lesions comparable to lesions produced by two pathogenic isolates of R. solani used as controls. Four BNR isolates produced small reddish-brown lesions on some seedlings. Two BNR isolates that rarely produced lesions on tobacco seedlings were chosen for evaluation as biocontrol agents. Tobacco seedlings (4-6 wk old) were inoculated by placing 3 oat kernels colonized by BNR adjacent to the stem at the soil line; 12 h later the same plants were inoculated with 3 oat kernels colonized by R. solani. Analysis of variance indicated that isolate 1N1-4 reduced disease severity on tobacco seedlings.

ANALYSIS AND MODELING OF SOYBEAN RUST EPIDEMICS. X. B Yang, M. H. Royer, A. T. Tschanz, and B. Y. Tsai. LSU, Baton Rouge, LA 70830; USDA-ARS, Frederick, MD 21701; USDA-APHIS, Hyattsville, MD 20782; and Asian Veg. Res. Dev. Ctr., Taiwan

Effects of plant age and weather on epidemics of soybean rust (Phakopsora pachyrhizi) were studied by planting soybean at weekly intervals during 1980-81 in Taiwan. Disease was first observed at soybean growth stages V2-V3, indicating the presence of inoculum near the time of each planting. On the autumn-seeded crop, disease developed quickly and reached the maximum level 60 days after planting. On the summer-seeded crop, disease was initiated later and had a longer epidemic period. A model was developed to predict disease development using physiological days as biological times for both the soybean plant and the rust pathogen. The regression model predicted disease development with R^2 from 0.66 (n=400) to 0.82 (n=217). Defoliation was highly correlated with disease severity, and relative area under the disease progress curve was a good predictor of yield loss.

REACTION OF LEAF PROTOPLASTS OF *SOLANUM TUBEROSUM* TO GERMINATED CYSTOSPORES OF *PHYTOPHTHORA INFESTANS*. U-Tai Roongruangsree, R. J. Young, K. L. Deahl, and S. L. Sinden. Dept. of Plant Pathology, West Virginia University, Morgantown, WV 26506-6057, USDA-ARS BARC-WEST, Beltsville, MD 20705.

Protoplasts of *S. tuberosum*, and cystospores of *P. infestans* were co-cultured in 1.0% SeaPrep® Agarose on microscope slides at 20 C to observe cellular interactions. After 20 hr, hyphal growth was random and failed to recognize compatible cell systems. The addition of lima bean broth did not alter the growth patterns. After 40 hr incubation, incompatible hyphae failed to recognize protoplasts as potential host cells, but a few protoplasts were penetrated. When this occurred, hyphae coiled inside but did not exit the cell and later showed signs of degeneration. In the compatible interaction, hyphae penetrated many cells, branched within and exited to penetrate other cells. Fluorescein diacetate stain indicated protoplasts to be viable after 70 hr in co-culture. The method described indicates that recognition of compatible and incompatible cell systems occurs at the single cell level and may be useful for studying interactions.

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FERMENTA ASC CORPORATION, Mentor, OH

FERRY MORSE SEED CO., San Juan Bautista, CA

FUNK SEEDS INTERNATIONAL, INC., Bloomington, IL

GREAT LAKES CHEMICAL CORPORATION, West Lafayette, IN

GRIFFIN CORPORATION, Fresno, CA

GUSTAFSON, INC., Des Moines, IA

HARRIS MORAN SEED CO., Hayward, CA

H. J. HEINZ CO., Bowling Green, OH

HOECHST ROUSSEL AGRI. VET. CO., Somerville, NJ

ICI AMERICAS, INC., Mountain View, CA

ICI AMERICAS, INC., Richmond, CA

ILLINOIS CROP IMPROVEMENT ASSOCIATION, Urbana, IL

ILLINOIS FOUNDATION SEEDS, INC., Champaign, IL

ISTITUTO DI FITOVIROLOGIA, Torino, Italy

JANSSEN PHARMACEUTICA, Piscataway, NJ

LANDIS INTERNATIONAL, Valdosta, GA

MERCK & CO., INC., Rahway, NJ

MOBAY CORPORATION, Kansas City, MO

MONSANTO CO., St. Louis, MO

NOR-AM CHEMICAL CO., Wilmington, DE

NORTHRUP KING CO., Woodland, CA

PEST PROS, INC., Plainfield, WI

PETOSEED CO., INC., Woodland, CA

PFIZER, INC.-TEKCHEM, Chem. Div., New York, NY

RHONE-POULENC AG COMPANY, Research Triangle Park, NC

RICERCA, INC., Painesville, OH

RJR NABISCO INC., Winston-Salem, NC

ROHM & HAAS CO., Philadelphia, PA

SAKATA SEED AMERICA, INC., Salinas, CA

SANDOZ CROP PROTECTION CORP., Des Plaines, IL

O. M. SCOTT & SONS, Marysville, OH

TWYFORD INTERNATIONAL, INC., Sebring, FL

UNIROYAL CHEMICAL CROP PROT. R&D, Bethany, CT

UNOCAL CHEMICALS, West Sacramento, CA

W-L RESEARCH, INC., Evansville, WI