

# **Abstracts of Presentations at the 1987 Annual Meeting**

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# The American Phytopathological Society

## SOUTHERN DIVISION

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### ABSTRACTS

CORRELATION OF FREQUENCY OF APHID TRANSMITTED INFECTION WITH FREQUENCY OF MECHANICALLY TRANSMITTED INFECTION AND SYMPTOM TYPE IN SORGHUM. J.D. Alexander and R.W. Toler, Department of Plant Pathology and Microbiology, Texas A&M University, College Station 77843

Forty-seven sorghum accessions were planted in 6-m rows in a field trial. Half of each row was mechanically inoculated with maize dwarf mosaic virus strain A (MDMV-A) when the plants reached the 3-leaf stage. The second half of each row was left for natural inoculation via aphids. After five weeks, disease incidence and severity were recorded within each treatment and accession. Regression analyses were run comparing levels of infection by natural inoculation with levels of infection due to mechanical inoculation and with disease symptom type within the same accession. With the exception of the accessions with genes for "field resistance", there was a significant correlation ( $P=0.05$ ) between aphid transmitted infection levels and mechanically transmitted infection levels. In addition, the accessions with moderate to severe mosaic symptoms tended to be more easily infected through aphid transmission than those with mild mosaic symptoms or those with necrotic symptoms.

ROOT ROT OF *CAMELLIA SASANQUA* AND *C. OLEIFERA* CAUSED BY *CYLINDROCLADIUM* SP. L. W. Baxter, Jr., A. M. Sprott, S. B. Segars, and S. G. Fagan, Department of Plant Pathology and Physiology, Clemson University, Clemson, SC 29634-0377.

*Camellia sasanqua* and *C. oleifera* plants are used as grafting stock for *C. japonica* because they are resistant to root rot caused by *Phytophthora cinnamomi*. During the past 2 summers many newly transplanted rooted cuttings of *sasanqua* & *oleifera* died 1 to 2 months after transplanting. Isolations from roots and stems of 50 diseased plants yielded a *Cylindrocladium* sp. Inoculations confirmed this fungus as the cause. Wound inoculations on 3-yr-old plants were successful as were inoculations on detached, nonwounded, healthy leaves. The fungus is suppressed completely in culture by benomyl at 10  $\mu\text{g/ml}$  but is not killed. Fungal transplants left for 2 wk on carrot juice agar (CJA) amended with benomyl (1200  $\mu\text{g/ml}$ ) grew when placed on CJA. Captan, triadimefon, PCNB, glycofenne, etridiazol, and chlorothalonil did not give effective control. Scraped 4- to 5-day-old colonies of *Cylindrocladium* formed abundant conidia, and after 7-10 days more it formed fertile perithecia.

PHENOL-OXIDIZING ISOZYME EXPRESSION IN WATERMELON INDUCED BY DIFFERENT RACES OF *FUSARIUM OXYSPORUM* F.SP. *NIVEUM*. C. L. Biles and R. D. Martyn, Department of Plant Pathology and Microbiology, Texas A&M University, College Station, 77843.

Watermelons were protected from a virulent race of *Fusarium oxysporum* f.sp. *niveum* when previously inoculated (induced) with an avirulent race. Horizontal IEF-PAGE was used to examine differences in three phenol-oxidizing enzymes [peroxidase (PER), polyphenol-oxidase (PPO), and shikimate dehydrogenase (SDH)] in compatible, noncompatible, and induced-resistant reactions. Isozyme patterns differed with the tissue examined (root, stem, leaves). The PER loci apparently recognized the avirulent race 12 hr after induction but did not recognize the virulent one. PPO loci responded similarly to both the virulent and avirulent races. Additional PPO isozymes were expressed in the induced treatments 24 hr after challenge with the virulent race but not in the compatible treatments. SDH isozyme patterns were similar at each time in the compatible, noncompatible, and induced-resistant reactions.

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POSSIBLE DISSEMINATION OF TELIOSPORES OF *TILLETIA INDICA* BY THE PRACTICE OF BURNING WHEAT STUBBLE. M. R. Bonde, USDA-ARS, Frederick, MD 21701; J. M. Prescott, CIMMYT, Mexico 06600, D.F. Mexico; T. T. Matsumoto, CDFA, Sacramento, CA 95814; and G. L. Peterson, USDA-ARS, Frederick, MD 21701

*Tilletia indica*, causal agent of Karnal bunt of wheat, has been found in the Yaqui and Mayo Valleys, major wheat growing areas of Mexico. In the state of Sonora, Mexico, wheat stubble is burned in the field following harvest. To determine if *T. indica* teliospores were present above a burning field, a Cessna 210 airplane was flown through a smoke plume at 300, 1500, and 3000 m elevations. Dustbuster<sup>®</sup> vacuum cleaner bags were placed over air intake vents and three samples collected at each elevation. At 300 m, an average of 4.5 teliospores were trapped per min of flight, whereas at 1500 and 3000 m elevations, 3.3 and 0.5 teliospores were trapped per min, respectively. At least 50% of the teliospores were viable. These results suggest the possibility for spread of the pathogen over long distances by air currents.

IN VIVO DICARBOXIMIDE RESISTANCE IN *SCLEROTINIA MINOR* FROM PEANUT. T. B. Brenneman, Plant Pathology Dept., Univ. of GA, Coastal Plain Station, Tifton, GA 31793, P. M. Phipps and R. J. Stipes, Plant Pathology Dept., VPI & SU, Blacksburg, VA 24061.

One isolate of *Sclerotinia minor* with *in vivo* resistance to dicarboximide fungicides was recovered from a field micro-plot of peanut infested two years earlier with a fungicide-sensitive strain. Six total applications of iprodione (1.12 kg/ha) had been applied. Resistance was detected on medium amended with iprodione (2  $\mu\text{g/ml}$ ), and verified on fungicide-treated excised peanut stems. Stem colonization by the resistant isolate (R-2iv) was unaffected by 40  $\mu\text{g/ml}$  of iprodione, a concentration lethal to sensitive isolates as well as those with previously induced *in vitro* resistance. R-2iv was highly resistant to dicloran and vinclozolin which also have good activity against *S. minor*. Although *in vitro* dicarboximide resistance occurs readily in *S. minor*, this is the first report of field resistance.

SPATIAL PATTERN OF *MACROPHOMINA PHASEOLINA* IN TEN FIELDS IN NORTH CAROLINA. C. Lee Campbell, Department of Plant Pathology, North Carolina State University, Raleigh 27695.

Propagules of *Macrophomina phaseolina* are usually aggregated in field soils. To quantify propagule aggregation and to ascertain whether soil texture influences spatial pattern of *M. phaseolina*, a total of 10 fields were studied. In each field one core sample (2.5X10-12 cm) was removed from each of 150 6.1X6.1 m contiguous quadrats and a 10 g subsample of soil was assayed for *M. phaseolina*. Mean inoculum density (ID) ranged from 3.3-77.8 and 11.8-42.2 propagules per 10 g soil in Edgecombe and Wayne County fields, respectively. Values of Morisita's index ranged from 1.17-3.09 indicating low to moderate aggregation of propagules. Soil surface texture, determined for ten 15-quadrat blocks in each field, was generally silt loam, loamy sand, or sand. Mean ID of the 15-quadrat blocks of *M. phaseolina* was not generally correlated significantly with percentage sand, silt, or clay. Thus other factors must account for propagule aggregation of *M. phaseolina* within the fields examined.

*Protomyces gravidus* as a potential mycoherbicide of giant ragweed, *Ambrosia trifida*. R. D. Cartwright and G. E. Templeton, Department of Plant Pathology, University of

An indigenous fungal pathogen, Protomyces gravidus, is being considered for biological control of giant ragweed. It causes large stem galls permeated with mycelium and resting spores. Pure cultures were isolated by germination of overwintered resting spores. On solid media or in liquid culture, it grew as a yeast at constant temperature between 12-28°C, optimum at 20°C. Seedlings were sprayed with washed cells ( $1 \times 10^7$ ) of P. gravidus in the greenhouse. Maximum infection occurred after incubation at 20°C and 48 hrs 100% RH. Stem and leaf galls were produced 2-4 weeks after inoculation. A number of seedlings (2 leaf stage) were killed, but older seedlings (4-6 leaf stage) developed non-lethal infections. Only giant and common ragweed, Ambrosia artemisiifolia, were susceptible in host range studies. Low virulence is a major factor limiting potential of P. gravidus as a mycoherbicide.

Effect of fertilizer level and cultivar on susceptibility of Calatheas to Bipolaris setariae. A. R. Chase, University of Florida, IFAS, Agricultural Research and Education Center, Apopka, FL 32703.

Calathea species and cultivars were grown for 2 mo in a steam treated potting medium top-dressed with Osmocote 19:6:12 at one of the following rates: 2, 5, 8, 11, 14, and 17 g/15-cm pot. The recommended rate is approximately 4 g/15-cm every 3 mo. Plants were then inoculated with a conidial suspension ( $1 \times 10^5$  conidia/ml) of Bipolaris setariae and placed in plastic bags for 3 days. Plants received intermittent misting (5 sec/30 min, 12 hr/day) starting 24 hr before inoculation and continuing until test completion. Rate of fertilizer affected plant quality, number of leaves, height, and leachate soluble salts but did not affect susceptibility to the pathogen. Calathea argentea 'Silver Portrait' and 'Vandenheckei' were most susceptible with C. insignis also susceptible. Calathea makoyana was moderately resistant and C. louisae and C. roseopicta were highly resistant.

Effect of fertilizer rate on susceptibility of Ficus lyrata to Pseudomonas cichorii. A. R. Chase, University of Florida, IFAS, Agricultural Research and Education Center, Apopka, FL 32703.

The effect of fertilizer rate on severity of Pseudomonas leaf spot of Ficus lyrata was tested using a strain of P. cichorii isolated from that plant. Plants were grown in a Canadian peat and pine bark mix (50-50) top-dressed with various rates of Osmocote 19:6:12 for 2 mo prior to inoculation. The rates were 1, 4, 7, 10, 13, and 16 g/12.5-cm pot; 4 g/12.5-cm pot is the recommended rate. Plants were misted (5 sec/30 min, 12 hr/day) starting 24 hr prior to inoculation and continuing until test completion. Plants were sprayed with a bacterial suspension ( $1 \times 10^8$  cfu/ml in 0.01 M  $MgSO_4$ ) and placed in plastic bags for 3 days. Height, number of leaves, and foliage quality were affected quadratically by fertilizer rate with optimal values at rates between 4 and 13 g/pot. The mean percentage of foliage area with symptoms was least at the 1 g/pot rate and highest at the 4 g/pot rate. At rates above 4 g/pot, a linear decrease in disease severity occurred as fertilizer rate increased. This test was performed twice between June and September, 1986.

POWDERY MILDEW RESISTANCE AMONG NATIVE POPULATIONS OF CEDAR ELM. P. F. Colbaugh, S. L. Fields, and B. J. Simpson. Texas Agricultural Experiment Station, Texas A&M University Research and Extension Center, Dallas, Texas 75252

Cedar elm (Ulmus crassifolia Nutt.) is widely used as a landscape tree in North Central Texas. Nurserymen obtain their trees from native stands that grow along streams or on dry limestone hills. While the tree is valued for its beauty and adaptation to local growing conditions, susceptibility to powdery mildew is a common problem. Field investigations over a 2-year period determined the severity of powdery mildew on cedar elm trees on Dallas area landscapes. Observations of 247 trees during October, 1986, indicated 237 trees had slight to severe symptoms of the disease while 10 trees showed no visible symptoms. Variations in seed production were also noted among the tree population. Of trees observed during the fall seeding season, 42% produced moderate or abundant seed while 58% produced low levels of seed. These observations indicate selections of cedar elm can be used to overcome problems of powdery mildew susceptibility and heavy seed production.

COMPARISON OF CULTURAL AND FUNGICIDAL CONTROLS FOR CERCOSPORA BLIGHT OF ASPARAGUS. K. E. Conway<sup>1</sup>, J. E. Motes<sup>2</sup>, B. Bostian<sup>2</sup> and C. J. Foor<sup>1</sup>, Department of Plant Pathology<sup>1</sup> and Department

of Horticulture and L.A., Oklahoma State University, Stillwater, OK 74078-0285.

Control of Cercospora asparagi on asparagus was compared by burning or soil incorporation of fern residue, and a fungicide. Ferns were mowed (March) and left as residue on surface of 16 blocks of asparagus. Residue was roto-tilled into soil in 4 blocks and burned in 4 blocks prior to spear production in April. Spears were allowed to grow after harvest to produce ferns. Chlorothalonil (1.75 kg (a.i.)/ha) was applied to ferns of 4 blocks on 9, 24 July and 12 August. Untreated blocks were controls. Disease severity was assessed weekly (July-October). Area under disease progress curve values were significantly less ( $P=0.01$ ) on ferns in fungicide protected blocks compared to other treatments. Burning the residue also significantly reduced disease ( $P=0.05$ ) compared to soil incorporation of residue and controls.

RESISTANCE TO PEANUT STRIPE VIRUS IN ARACHIS GERM PLASM. J. N. Culver, J. L. Sherwood, and H. A. Melouk<sup>1</sup>, Department of Plant Pathology, Oklahoma State University and USDA-ARS<sup>1</sup>, Stillwater, OK 74078-0285.

Peanut accessions of the Arachis section; A. diogeni (PI 468141 and PI 468142), A. helodes (PI 468144), Arachis sp. (PI 468345 and PI 468169), and of the Rhizomatosa section (PI 468174, PI 468363, and PI 468366), were evaluated for resistance to peanut stripe virus (PStV). These entries and a susceptible cultivar Argentine were mechanically inoculated with PStV. Three to 4 weeks after inoculation, leaves from each entry were tested for PStV infection. Infection was determined by symptomatology, local-lesion assay on Chenopodium amaranticolor, enzyme-linked immunosorbent assay, and electron microscopy. All entries except for PI 468169 and the susceptible cultivar Argentine were negative for virus infection. To our knowledge, this is the first report of resistance to PStV in Arachis.

FORMATION OF HYBRID CITRUS RINGSPOT VIRUS ISOLATES BY COMPONENT MIXING. J. V. da Graca and R. F. Lee, University of Florida, CREC, Lake Alfred 33850.

The top and bottom components of two isolates of citrus ringspot virus (CRSV), one causing bark lesions (6B1), the other not (4E), were separated by sucrose density gradient centrifugation. The top component of each was mixed with the bottom component of the other and inoculated onto Chenopodium quinoa, a local lesion host which reacts differently to 4E and 6B1 in terms of lesion appearance and number. The 4E bottom component enhanced the infectivity of the 6B1 top component to give lesion counts intermediate between the two type isolates, while the reverse combination did not significantly alter lesion formation. Single lesions of the two hybrid CRSV isolates were inoculated onto C. quinoa, and then back to citrus to determine if either retains the ability to form bark lesions. Results of this are not yet available.

SPREAD OF DIAPORTHE PHASEOLORUM VAR. CAULIVORA IN A SOYBEAN FIELD FROM AN INOCULUM POINT SOURCE. J.P. Damicone, G.T. Berggren, and J.P. Snow, Dept. of Plant Pathology & Crop Physiology, Louisiana State University, Baton Rouge, LA 70803.

Oat kernels colonized by mycelium of Diaporthe phaseolorum var. caulivora (DPC) were placed in the center quadrat (.75 m<sup>2</sup>) of plots planted with Wilstar 550 or Deltapine 105 soybean cultivars. Ascospores and conidia were produced in perithecia and pycnidia, respectively, formed on the kernels in the field. The number of lesions and/or cankers per plant, proportion of plants infected, and proportion of plants dead were quantified on 4 dates beginning at the R<sub>1</sub> stage and yield was measured in quadrates radiating from the inoculum. Cultivar had no effect on disease measures and disease progress curves for each were monocyclic. Disease measures on both cultivars and yield loss of Wilstar 550 declined significantly with distance from inoculum. Although symptomatic plants were detected up to 4.5 m from the inoculum, incidence was low past 1.5 m. Environmental variables in relation to DPC spread will be discussed.

A SEARCH FOR COMMON GENE PRODUCTS AMONG FLUORESCENT PSEUDOMONAS AND BACILLUS SPECIES ANTAGONISTIC TO SEPTORIA TRITICI. H. M. El-Nashaar and F. J. Gough. USDA-ARS, P.O. Box 1029, Stillwater, OK 74078-0285

Soluble proteins from two cultures of Pseudomonas fluorescens

and one culture each of *Bacillus subtilis* and *B. pumilus* were compared using tube cell polyacrylamide gel electrophoresis. One *E. fluorescens* isolate was obtained from Texas (C. Howell), the remaining cultures were from Oklahoma (F. Mehdizadegan). Each culture suppressed *in vitro* growth of *Septoria tritici* (= *Mycosphaerella graminicola*) and development of *Septoria tritici* blotch. Bacterial cells were ultrasonically disrupted and centrifuged at 45,000 g for 30 min. The supernatant was used as the soluble protein fractions. Although the four cultures differed in quantity and quality of their protein, protein banding at  $R_f$  values of 0.05, 0.21, and 0.65 was common for all isolates. These common proteins may be involved in antibiosis of *S. tritici*; but further investigation is required.

COMMON GENE PRODUCTS AMONG PSEUDOMONAS AND ACINETOBACTER ISOLATES ANTAGONISTIC TO *GAEUMANNOMYCES GRAMINIS* VAR. *TRITICI*. E. M. El-Nashaar<sup>1</sup>, E. E. Wagih<sup>2</sup>, and F. J. Gough<sup>1</sup>. USDA-ARS Plant Science and Water Conservation Lab., P.O. Box 1029, Stillwater, OK 74078-0285, and Plant Pathology Dept., Alexandria Univ., Egypt.

Soluble protein fractions from one nonfluorescent and six fluorescent *Pseudomonas* and an *Acinetobacter* sp., that were suppressive to take-all disease of wheat (caused by *Gaeumannomyces graminis* var. *tritici*, Ggt) and which inhibited growth of Ggt *in vitro*, were compared using native disc-polyacrylamide gel electrophoresis. Ultrasonically disrupted cells were centrifuged at 45,000 g for 30 min. Soluble protein fractions in the supernatant separated on 10% polyacrylamide gel revealed both qualitative and quantitative differences. Proteins banding at  $R_f$  values of 0.02, 0.05, 0.07, 0.19, 0.21, 0.45, and 0.57 were common among the eight isolates. The possible involvement of one or more of these proteins in the antagonistic mechanism is being investigated.

A VIRUS DISEASE OF SORGHUM x SUDANGRASS HYBRID IN TEXAS. L.M. Giorda, R.W. Toler, and G. Odvody. Dept. of Plant Path. and Microbiol., Tx. Agr. Exp. Sta., College Station, TX 77843.

Disease symptoms developed 20-25 days after virus inoculation of 'Sudax' (sorghum x sudangrass hybrid) from field infected plants. Symptoms included yellow streaks and bands in half of the leaf, followed by chlorosis, necrosis, and death of the plant. Isometric particles, 22-26 nm in diameter, were observed in embedded tissue of sorghum 'Sudax' and sweet corn 'Silver Queen'. The virus was not transmitted by *Schizaphis graminum* or *Rhopalosiphum maidis* but was mechanically transmitted to 2-10% of inoculated 'Sudax'. Twenty two species and cultivars of mono- and dicotyledonous plants were inoculated with the virus. Symptoms appeared only in sweet corn, sorghum, and in the commercial jumbo Italian bush bean (NK). Although similar isometric particles were observed in bean, the virus was not recovered when back-inoculated to 'Sudax'. Infected sap from sorghum and corn were tested against PMV, SAD, BrMV, CMV, MCMV antisera with negative results.

REFRACTIVE QUALITY OF BACTERIAL COLONIES AS A MEANS TO DIFFERENTIATE *XANTHOMONAS CAMPESTRIS* PV. *PRUNI* FROM OTHER YELLOW-PIGMENTED BACTERIA. R. Gitaitis, J. Hamm, and P. Bertrand. Department of Plant Pathology, Coastal Plain Experiment Station, University of Georgia, Tifton, GA 31793.

Populations of *Xanthomonas campestris* pv. *pruni* (XPR) were monitored on peach leaves by spreading 0.1 ml samples from leaf washings on to the surface of nutrient agar plates. Colonies were counted after incubation at 30C for 48-72 hr. Identifications were based on the patterns in individual colonies when plates were held 15 cm above a clear templet that contained horizontal black lines spaced 3 mm apart. The templet was placed on the translucent surface of a light-box that was subilluminated with two 45.7 cm white fluorescent lamps (20 joules/sec). The clarity of XPR colonies created an undistorted view of discrete straight lines when the templet was viewed through the colony. Most other yellow colonies contained various distorted patterns or were opaque. Initial identifications made by using the straight-line templet exceeded 98 percent accuracy.

REDUCTION OF CROWN GALL ON MUSCADINE GRAPES. C.H. Graves, Jr., R.P. Vine and C.P. Hegwood, Jr. Depts. of Plant Path. and Weed Sci., Food Sci. and Human Nutri., Miss. State, MS 39762, and Truck Crops Branch Expt. Sta., Crystal Springs, MS 39059.

*Agrobacterium tumefaciens* (AT) has not been generally consid-

ered a significant pathogen on muscadine (*Vitis rotundifolia*), though AT biovar 3 is common and serious on *V. vinifera* and other *Vitis* spp. In a recent planting of muscadines, a serious incidence of apparent crown gall was found on Georgia 15-5-3 and Georgia 23-45 selections. Similar occurrences have since been noted on Doreen, Magnolia, Sugargate, Carlos, and other cultivars. Galls were usually located near the soil line, and occasionally on aerial portions of plants. When severe, aerial portions died. *Agrobacterium* spp. were isolated from both *V. rotundifolia*, and *V. vinifera* galls, and pathogenicity indicated. Extensive sampling of symptomless muscadine cultivars from several vineyards (where vascular juices were extracted and plated on RS and NKS media) suggested a high percentage of cultivated muscadines infested with *Agrobacterium* spp.

COMPARISON OF VIRULENCE OF TOMATO AND PEPPER ISOLATES OF *COLLETOTRICHUM* SPP. J. F. Hadden and L. L. Black, Dept. of Plant Path. and Crop Physiol., La. Agric. Expt. Sta., La. State Univ. Agric. Ctr., Baton Rouge, LA 70803

Detached fruit of pepper (cayenne and Yolo Wonder) and tomato (Heinz 1350 and Roma F021) were inoculated with twenty-two isolates of *Colletotrichum* from pepper and tomato representing *C. acutatum*, *C. capsici*, *C. coccodes*, and *C. gloeosporioides*. Fruit were wound inoculated with a spore suspension of  $10^6$  spores/ml using a hypodermic syringe and held at room temperature. Percent fruit showing lesion development and lesion diameter were recorded after 9 days. Only 43% of *C. gloeosporioides*-inoculated fruit showed lesion development compared to 87%, 74%, and 75%, for *C. acutatum*, *C. capsici*, and *C. coccodes*, respectively. Average lesion diameter caused by each species was similar (*C. gloeosporioides*, 18.7mm; *C. acutatum*, 24.6mm; *C. capsici*, 21mm; and *C. coccodes*, 21mm).

XYLEM-LIMITED BACTERIA CAUSE BLIGHT SYMPTOMS IN CITRUS. D. L. Hopkins, Agricultural Research and Education Center, IFAS, University of Florida, Leesburg, FL 32749-0388

Xylem-limited, Gram-negative bacteria (XLB) isolated from various hosts were used to inoculate seedlings of rough lemon, the citrus rootstock that is most susceptible to blight. After 2 years, stunt and dieback symptoms were observed in seedlings inoculated with XLB isolates from grapevine, peach, oak, blackberry, and goldenrod. Three isolates of the Pierce's disease of grapevine bacterium and two isolates of an XLB obtained from citrus with blight were used to inoculate rough lemon, rangpur lime, and sweet orange citrus seedlings. One citrus XLB isolate produced stunt and dieback symptoms in all three rootstocks, with more severe symptoms occurring in rough lemon. These inoculated seedlings also had reduced water conductivity in stem sections and elevated zinc levels in trunk wood and phloem, which are diagnostic tests for blight. Three sweet orange trees on rough lemon rootstock inoculated with XLB also developed symptoms.

INDUCTION OF SYNCHRONIZED ASEQUAL DEVELOPMENT OF *ASPERGILLUS PARASITICUS* IN LIQUID CULTURE. S. T. Kendall and D. M. Wilson, Department of Plant Pathology, University of Georgia, Coastal Plain Experiment Station, Tifton, GA 31793.

A temperature mediated shake culture method was developed which synchronized conidial production in *A. parasiticus* (NRRL 2999). Glass culture tubes (150 x 24 mm) containing five ml of a defined liquid medium (pH 4.5) were prewarmed to 41C and inoculated with a washed conidial suspension ( $5 \times 10^4$  conidia/ml) of *A. parasiticus*. The tubes were incubated for 20 hr at 41C followed by 28 hr at 30C. During the 41C incubation floating conidia swelled two times their original size, germinated, and formed a loose mat. Continued incubation at 30C resulted in synchronized asexual development and by 10 hr at 30C conidogenesis was observed. Rapid spore production followed which leveled off after about 20 hr as determined by spore counts. Aflatoxin synthesis occurred in this system at 30C. Addition of beta-ione to cultures resulted in altered aflatoxin synthesis and atypical conidial development.

REDUCTION OF LESIONS CAUSED BY RHIZOCTONIA SP. ON STEMS OF JUVENILE SOYBEAN AND BEAN PLANTS WITH A PREEMERGENT SPRAY OF SN 84364 (FLUTONANIL) ON THE SOIL. T. A. Kucharek and R. E. Cullen. Plant Pathology Dept., University of Florida, Gainesville, 32611.

In separate field tests on soybeans and beans, a preemergent, banded

(.25-.31m) spray on the soil along the row center with SN 84364 (50WP at 1.12 kg/ha) reduced the number of lesions caused by *Rhizoctonia* sp. on stems by 49 and 63%, respectively. The addition of metalaxyl (ZEC at 1.2 l/ha) to the spray further reduced lesions on soybeans but not on beans. In two additional field tests on soybeans where SN 84364 was tank mixed with metalaxyl, lesions were reduced by 47 and 24% and the metalaxyl by itself reduced lesions by 34% in the former test but not the other. Spray volume was 187 and 74 l/ha for the bean and soybean tests, respectively, but spray pressure was identical (2.1kg/cm<sup>2</sup>).

ANALYSIS OF LATE LEAF SPOT (*CERCOSPORIDIUM PERSONATUM*) DISEASE COMPONENTS TO EXPLAIN THE RATE-REDUCING EFFECTS OF A PROTECTANT AND A STEROL INHIBITING FUNGICIDE. J. Labrinos, F.W. Nutter, Jr., and S.C. Alderman, Dept. Plant Pathology, University of Georgia, Athens 30602.

Analysis of disease components can be used to explain how fungicides reduce the infection rate 'r'. To differentially reduce the rate of infection, HWG 1608 (sterol inhibitor) and chlorothalonil (protectant) fungicides were applied at different levels of active ingredient (a.i.) to field plots of peanut (*Arachis hypogea* 'Florunner'). Sprays were initiated when *Cercosporidium personatum* reached the 1% level of infection. Although both fungicides reduced 'r' as a.i. was increased, HWG 1608 reduced 'r' to a much greater extent than chlorothalonil. Analysis of disease components showed that reduction in 'r' was largely attributed to fungicidal effects on sporulation and lesion number. The regression coefficient relating a.i. to the log of number of spores produced per lesion was -0.474 for HWG 1608 and -0.213 for chlorothalonil. The level of a.i. did not affect lesion size.

BIOLOGICAL CONTROL OF RHIZOCTONIA SOLANI ON COTTON BY LAETISARIA ARVALIS AND A MYCOPHAGOUS INSECT, PROISOTOMA MINUTA. Robert Lartey, E. A. Curl, and Curt M. Peterson, Dept. of Plant Pathology, and Dept. of Botany and Microbiology, Auburn University, AL 36849.

Biological control of *Rhizoctonia solani* on seedling cotton by a fungal agent, *Laetisaria arvalis*, and a mycophagous microarthropod, *Proisotoma minuta* (Insecta: Collembola), was assessed in sterilized and non-sterilized soil infested with *Rhizoctonia* inoculum densities of 0.01 to 0.15 g/kg soil. *L. arvalis* applied to the seed reduced disease severity more effectively than when applied to the soil; in sterilized soil this fungus alone caused minor root injury. Collembola at 1000/kg soil suppressed disease without causing root injury. The two agents were compatible and, when applied together, the disease control benefit was significantly greater than for either used alone. Seedling emergence and root and shoot dry weights also varied according to the single agent or combination used. Overall, *P. minuta* was the more effective of the two agents.

EFFECTS OF POWDERY MILDEW, TRIADIMENOL SEED TREATMENTS, AND TRIADIMEFON FOLIAR SPRAYS ON YIELD OF WINTER WHEAT IN NORTH CAROLINA. S. Leath, USDA-ARS, Department of Plant Pathology, North Carolina State University, Raleigh, NC 27695-7616.

Wheat plots were established in central and eastern North Carolina in the fall of 1985 to determine yield reduction caused by *Erysiphe graminis* f. sp. *tritici* on wheat varieties Saluda and Coker 983. The efficacy of triadimenol applied as a seed treatment with and without different triadimefon foliar spray schedules also was evaluated for the control of powdery mildew. Plots at both locations were 2.4 m<sup>2</sup>, bordered by 1.2 m of barley and arranged in a randomized complete block design with five replications. Yields for Saluda in the untreated plots were 79% of the full controls, whereas yields in plots treated with triadimenol were 89% of the full controls. Treatment differences ( $p=0.05$ ) for mildew severity were observed in both Saluda and the resistant variety, Coker 983. No clear differences existed for test weight or kernel weight. Seed treatment may provide acceptable and economical control of powdery mildew in certain circumstances.

INFLUENCE OF CHLOROTHALONIL APPLIED IN IRRIGATION WATER ON YIELD AND FOLIAGE RESIDUE. Robert H. Littrell.

A quadrant in .4 ha center-pivot system was used to establish four-row plots 4.3 x 9.1 m to apply chlorothalonil with (1) conventional ground sprayer, (2) irrigation water (no traffic), and (3) irrigation water (with traffic). Fungicide was applied seven times in 4 mm of water or 96 l of spray per ha using 1.24 kg a.i.

chlorothalonil/ha. Pod yields were increased and leafspot diseases were reduced in all fungicide treated plots. There was an estimated 675 kg/ha increase in pod yields in two versus three (approximately \$480 increase in return per ha). Residue was significantly greater from ground spray application. These results tend to explain the increase in peanut yield when fungicides are applied in the irrigation water.

CERCOSPORIN PRODUCTION AND PATHOGENICITY OF *CERCOSPORA ARACHIDICOLA* ISOLATES. H. A. Melouk and W. Schuh. USDA-ARS, Plant Pathology Dept., Oklahoma State University, Stillwater, OK 74078-0285.

Four isolates of *C. arachidicola* (CA) obtained from diseased peanut grown in Oklahoma were maintained on peanut-oatmeal agar (POA). Two isolates were classified as "Pink" because cercosporin was detected in POA by thin layer chromatography, and two were classified as "Black" because cercosporin was not detected. Differences in parasitic fitness parameters (lesions/leaf, necrotic area/leaf, conidia/mm<sup>2</sup> necrotic area, and percent necrotic area) were found between isolates on the cv. Tannut 74. However, no relation between cercosporin production and the parasitic fitness parameters was observed. Thus, cercosporin production does not appear to be a factor in determining the pathogenicity of the "Black" and "Pink" isolates of CA.

INHERITANCE OF RESISTANCE TO VIRUSES IN COWPEAS. A. Melton, W. L. Ogle, O. W. Barnett, and J. D. Caldwell. Department of Horticulture, Clemson University, Clemson, SC 29634.

*Vigna unguiculata* subsp. *unguiculata* populations were inoculated with southern bean mosaic virus-cowpea strain (SBMV-C), blackeye cowpea mosaic virus (BICMV), cowpea severe mosaic virus (CSMV) and cowpea chlorotic mottle virus (CCMV). Populations were Mississippi Silver (MS) and California #5 Blackeye, their F<sub>1</sub>, and reciprocal F<sub>1</sub>, backcross to each parent and F<sub>2</sub> progenies. Sensitive or tolerant plant responses were rated by symptom expression. Resistant or susceptible plant responses were rated by detection of virus with enzyme-linked immunosorbent assay (ELISA). Two pairs of recessive genes (sbc-1 and sbc-2) controlled resistance to SBMV-C movement in MS. Tolerance to SBMV-C in MS was controlled by two recessive genes. One recessive gene pair in MS controlled resistance to infection by BICMV. MS and all subsequent generations having MS as a parent were infected by CSMV but were rated as tolerant due to reduced symptom severity. MS contained no resistance or tolerance to CCMV.

A ROT OF ONION BULBS CAUSED BY GEOTRICHUM SP. M. E. Miller, Texas Agricultural Experiment Station, T. H. Camp, USDA-ARS, Weslaco, TX 78596, R. A. Taber, and L. M. Pike, Texas A&M University, College Station, TX 77843.

An undescribed bulb rot caused by *Geotrichum* sp. was found on Texas Grano 1015Y (TG 1015Y) onions in south Texas in 1986. TG 1015Y bulbs inoculated with 0.5 ml of a 30,000 conidia ml<sup>-1</sup> aqueous suspension of the fungus developed small, watery, translucent lesions after 3 days incubation at 20C. Lesions increased to 4-6 cm after 7 days. Differences in disease severity occurred among 12 onion lines. TG 1015Y and 91438 had significantly higher ( $p = 0.05$ ) disease severity ratings while TG 1030Y and 91486 had significantly lower ratings than the other lines. There was a linear relationship ( $Y = -2.25 + 0.23X$ ,  $R^2 = 0.8$ ) between disease severity and temperature from 10-30C.

THE EFFECTS OF RING NEMATODE, CRICONEMELLA ORNATA, ON THE NUTRIENT CONTENT OF CENTIPEDEGRASS. M. R. NEWNAM AND L. T. LUCAS, PLANT PATHOLOGY DEPARTMENT, NORTH CAROLINA STATE UNIVERSITY, RALEIGH, NC 27695-7616.

Changes in nutrient content were detected in centipedegrass that was grown in soil infested with different initial population (P<sub>i</sub>) levels of *Criconemella ornata*. Nitrogen, potassium, and iron content decreased, whereas, phosphorus, calcium, manganese and zinc levels increased in the shoot tissue of parasitized plants. Nitrogen, potassium, sulfur, iron, manganese, and zinc content decreased, whereas, phosphorus, calcium, magnesium, and copper levels increased in the nematode-parasitized roots. Significant negative

correlations were obtained in the shoot tissue analysis between  $P_i$  and nitrogen, potassium, iron and molybdenum in the shoots, and between shoot nitrogen and phosphorus, iron and molybdenum in the shoots. These changes in nutrient levels may result in plants having lower levels of stress tolerance to drought and cold weather.

DETECTION OF PLANT DISEASE GRADIENTS USING A HAND-HELD, MULTISPECTRAL RADIOMETER. F. W. Nutter, Jr., Department of Plant Pathology, University of Georgia, Athens 30602.

A multispectral radiometer was used to determine if plant disease gradients could be detected by measuring the amount and quality of sunlight reflected from peanut (*Arachis hypogaea*) canopies. Reflectance measurements (500 to 850 nm wavelength range) and visual assessments of disease severity were taken within and across plant rows at various distances from peanut rust (*Puccinia arachidis*) or late leafspot (*Cercosporidium personatum*) disease foci. Reflectance measurements and visual assessments were highly correlated for all gradients measured. Reflectance in the 800 nm wavelength band increased and visual disease severity decreased, with increasing distance from disease foci. Although disease gradients were detected with either method, the reflectance method provided data twenty times faster. The development of models to describe disease gradients, based upon reflectance data, may provide a standardized and objective method to detect and quantify plant disease gradients in other crops.

THE NATURE OF ICE NUCLEATION-ACTIVE BACTERIA ASSOCIATED WITH APPLE AND PEACH TREES IN GEORGIA AND INFLUENCE OF VARIOUS CHEMICALS ON THEIR ICE NUCLEATION ACTIVITY. J. W. Olive and S. M. McCarter, Dept. Plant Pathology, University of Georgia, Athens, GA 30602.

When 286 strains of ice nucleation-active bacteria from 20 apple and 12 peach orchards in Georgia were tested, all produced fluorescent pigments and were negative for oxidase and arginine dihydrolase. Most strains resembled *Pseudomonas syringae* pv. *syringae* in that they utilized erythritol, DL-lactate, and sucrose but did not cause pitting of polypectate media or soft rot of potato. Eighty-four percent produced syringomycin. All except one strain produced a hypersensitive reaction on tobacco. The strains were diverse in pathogenicity and virulence on green tomato fruit, green bean pods, and peach seedlings. Streptomycin resistance among strains was correlated with a history of streptomycin use in orchards. Of 54 pesticides tested *in vitro*, dicofol, dinocap, metalaxyl, and triforine were most active in inhibiting ice nucleation.

EFFECT OF DISEASE RESISTANCE ON TOBACCO ETCH VIRUS EPIDEMICS IN BELL PEPPER. B.G. Padgett, F.W. Nutter, Jr., and C.W. Kuhn, Dept. Plant Pathology, Univ. of Georgia, Athens 30602.

Incidence of TEV in bell pepper usually approaches 100% by time of harvest in Northeast Georgia, resulting in significant losses. Although pepper genotypes have been developed that differ in disease reaction to TEV, the effect of these genotypes on the rate of infection and yield has not been determined. Yolo Wonder B (YWB), Tamber 2 (TAM), and an Asgrow line (susceptible, moderately resistant, and resistant, respectively) were selected to quantify the effect of resistance on TEV epidemics. Disease incidence, assessed visually and by ELISA, was plotted with respect to time; the infection rate, relative area under the disease progress curve (RAUDPC), and yield recorded. Epidemics progressed fastest on YWB (RAUDPC=1.0) and slowest on Asgrow (RAUDPC=0.33). Tam was intermediate with a RAUDPC of 0.48. Asgrow and Tam increased yield by 32 and 12%, respectively, indicating that resistant genotypes offer a potential means of managing TEV in Georgia.

GROWTH AND SURVIVAL OF ARROWLEAF CLOVER INOCULATED WITH BEAN YELLOW MOSAIC VIRUS AT DIFFERENT AGES. Indre J. Pemberton and G. R. Smith, Texas Agricultural Experiment Station, Drawer E, Overton, TX 75684.

Arrowleaf clover (*Trifolium vesiculosum* Savi.) plants were inoculated with BYMV at five different ages and evaluated for growth and survival. Eight plants each of arrowleaf breeding line 64 and variety 'Yuchi' were inoculated at 35, 63, 91, 119 or 147 days. Uninoculated control plants were maintained under identical conditions. All plants were clipped and dry matter measured four times at monthly intervals, beginning on

day 105. Total dry matter production was not significantly different between line 64 and 'Yuchi'; however, overall survival rate of inoculated plants was 94% for line 64 compared to 55% for 'Yuchi'. Age of plants at inoculation significantly affected total dry matter production ( $P=.01$ ), with greatest reductions occurring the earlier the plant was inoculated. Current work is underway to identify other such 'tolerant' lines and evaluate their progeny for virus resistance.

SCREENING FOR RESISTANCE TO PHYTOPHTHORA ROOT ROT IN CRIMSON CLOVER. R. G. Pratt and W. E. Knight, USDA, ARS, Forage Research Unit, P.O. Box 5367, Mississippi State, MS 39762

Cultivars and inbred lines of crimson clover (*Trifolium incarnatum* L.) were screened for resistance to root rot caused by a *Phytophthora* sp. in greenhouse tests for 5 years. Potentially resistant plants from cultivars were selfed, and their progeny were further screened and selfed for up to four additional generations. Inbred lines were compared with parental cultivars and with each other on the basis of scores for severity of root disease symptoms and mortality. Five of 18  $S_2$  lines, and 7 of 18  $S_3$  lines, manifested significant resistance in a final severe test. Segregation for resistance within  $S_2$  through  $S_4$  generations was suggested by differences in disease scores of related  $S_2$  to  $S_5$  lines. Results suggest that high levels of resistance to *Phytophthora* root rot may not be present within cultivars of crimson clover. However, moderate levels of resistance can be obtained that enable plants to survive under prolonged conditions favorable for disease.

Greenhouse Evaluation of Fungicides for Control of Strawberry Anthracnose-Crown Rot. Barbara J. Smith, USDA-ARS Small Fruit Research Station Poplarville, MS 39470

Three fungicides were tested on 4 strawberry cultivars for their efficacy in controlling anthracnose-crown rot. The fungicides were applied weekly for 10 weeks at the following rates (g a.i./l water): benomyl, 1.3, 2.7, 3.6; captafol, 19.2, 38.4, 76.8; and propiconazole, 0.3, 0.6, 1.2. After 4 fungicide applications, the plants were spray inoculated with a conidial suspension ( $1.5 \times 10^6$  conidia/ml) of *Colletotrichum fragariae*. The mean disease severity rating (DSR) of each fungicide treatment was significantly less than that for untreated controls (2.7). Plants treated with propiconazole had a significantly lower DSR (1.6) than those treated with either captafol (2.2) or benomyl (2.4). Plants inoculated with isolate MS-9 had a significantly higher DSR (2.2) than those inoculated with isolate CF-4 (1.8). No significant effect of cultivars, fungicide rates, or treatment interaction existed.

SEEDLING DISEASES OF VEGETABLES ASSOCIATED WITH CONSERVATION TILLAGE AND FLUID DRILLING. Donald R. Sumner, Suhas R. Ghatge, and Sharad C. Phatak. Coastal Plain Experiment Station, Tifton, GA 31793-0748.

Corn, okra, cucumber, cowpea, soybean, and tomato seeds (intact or pre-germinated) were planted with fluid drilling into no-till or disked rye, on Bonifay sand and Tifton loamy sand, in March and April of 1985. Rows were drenched with pencycuron plus metalaxyl, or nontreated, and irrigated immediately after planting. Plant stands were increased 65% and 20% with fungicides in the first and second plantings, respectively, but plant stands were increased 49% without fungicides when planting in warmer soils in April compared with March. In 1986, plantings of cucumber, cowpea, and okra were made in no-till, disked, or plowed rye in April and May. Fungicides increased plant stands 40% in Tifton loamy sand and 15% in Bonifay sand. There were no significant differences in plant stands among tillage treatments.

SCLEROTIUM ROLFSSII ON APPLE ROOTSTOCK: OVERWINTER SURVIVAL OF MYCELIUM AND HISTOLOGY OF INFECTION. S. F. Tomasino and K. E. Conway, Oklahoma State University, Stillwater, OK 74078-0285.

Domestic apple rootstock used for graft propagation of apple and crabapple cultivars is an important host plant of *Sclerotium rolfsii* (SR). A histological study of the infection process on apple seedlings and rootstocks inoculated with sclerotia revealed aggregates of mycelium (infection cushions) in the crevices of bark that aid hyphal penetration into host tissue. Mycelium ramified within phloem and xylem, resulting in vascular girdling 7 to 9 days after inoculation. SR mycelium was observed and isolated from tissue samples

taken in early spring from dead rootstock killed at various dates the previous year. This indicates that SR can overwinter as mycelium. SR was readily isolated from trees killed late in the growing season while those killed from early-season infections lacked active mycelium.

'TAM RIO GRANDE GOLD-SWEET' - A NEW MULTIPLE VIRUS-RESISTANT, YELLOW WAX PEPPER CULTIVAR. B. Villalon, Texas Agricultural Experiment Station, 2415 East Highway 83, Weslaco, Texas.

The Texas Agricultural Experiment Station at Weslaco has released a new multiple virus-resistant (MVR) pepper cultivar. 'TAM Rio Grande Gold-Sweet' (TRGG) is a MVR, small-yellow wax, nonpungent, pickling-type pepper. This high yielding, conical, diamond shaped, 'Caloro' type sets early concentrated fruit on a compact plant with thick foliage. 'TRGG' possesses genetic resistance to tobacco etch virus (TEV), potato virus Y (PVY), pepper mottle virus (PeMV) and tobacco mosaic virus (TMV). The sweet, yellow fruit are well-suited for fresh market consumption in salads, or as a processed, pickled, whole product. Extensive performance trials in Texas and other areas indicated 'TRGG' has a wide range of adaptability.

ASSOCIATION BETWEEN AMBIENT INOCULUM DENSITY OF TWO ALFALFA LEAFSPOT PATHOGENS AND MICROENVIRONMENTAL FACTORS. K. Von Chong, C. Lee Campbell and E. Echandi. Dept. Plant Pathology, North Carolina State University, Raleigh 27695.

Spore density of Leptosphaerulina briosiana and Pleospora herbarum (Stemphylium botryosum) was monitored in or above the

alfalfa canopy with a Burkard 7-day spore trap and temperature, relative humidity, leaf wetness and rainfall were monitored in the canopy using a datalogger and electronic sensors at one site in 1985. During the seven 1-wk periods examined, quantities of L. briosiana ascospores and S. botryosum conidia were positively correlated ( $P=0.23$ ). When quantity of inoculum obtained for each fungus each week was related to environmental conditions during the previous 7 days, spore density per  $m^3$  for both fungi was correlated negatively with mean maximum temperature ( $P<0.05$ ) and mean rainfall ( $P<0.12$ ), and positively ( $P<0.20$ ) with mean leaf wetness duration. These possible associations indicate the potential importance of environmental factors in ambient inoculum density during epidemics of alfalfa leafspot.

YIELD RESPONSE OF ANNUAL CLOVERS TO MELOIDOGYNE INCOGNITA UNDER FIELD CONDITIONS. G. L. Windham and G. A. Pederson, USDA, ARS, Forage Research Unit, P. O. Box 5367, Mississippi State, MS 39762

The effect of Meloidogyne incognita on 'Bigbee' berseem clover, 'Yuchi' arrowleaf clover, and 'Chief' and 'Tibbee' crimson clovers was determined by comparing yields in infested and noninfested plots. M. incognita was increased in the nematode-infested plots by growing infected 'Floridel' tomato prior to planting the clovers. Uninoculated tomato plants were grown in check plots. The mean initial nematode populations at planting for Bigbee, Yuchi, Chief, and Tibbee were 1227, 940, 1188, and 832, juveniles/500  $cm^3$  of soil, respectively. Plots were 2.4 x 4.8 meters and bordered by fescue sod to minimize nematode movement. Forage was harvested four times from the Bigbee and Yuchi plot starting in February, 1986 and once from the crimson clover plots in April. Yield losses for total yields of Bigbee, Yuchi, and Chief were 11%, 3%, and 10%, respectively. Tibbee was unaffected by M. incognita.