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ABSTRACTS

SUGARCANE SMUT IN FLORIDA. S. A. Alfieri, Jr., C. P. Seymour, and J. W. Miller. Florida Department of Agriculture and Consumer Services, Division of Plant Industry, P. O. Box 1269, Gainesville, FL 32602.

Sugarcane smut, caused by *Ustilago scitaminea*, is one of the most serious diseases of sugarcane, *Saccharum officinarum*, in all cane-growing areas of the world, with losses ranging from negligible to total loss. Known since 1877 from South Africa, the disease appeared for the first time in the continental United States on June 28, 1978, 4.5 miles (7 km) southeast of Clewiston in the major cane-producing area of Florida. The disease, concentrated in a 7 x 8-mile area, is characterized by a black, pencil-thin, whip-like appendage at the apex of the stalk, stools with spindly (grassy) shoots, multiple distorted buds, and LaLas (pale-green, spindly adventitious stems). Susceptible varieties constitute 32 percent of the planted cane in Florida. Research includes testing cultivars for resistance or susceptibility, existence of races, and development of resistant cultivars. Sugarcane smut can be controlled with the use of resistant cultivars.

VARIATION IN VIRULENCE OF DIVERSE SOURCES OF *FUSARIUM MONILIFORME* VAR. *SUBGLUTINANS* ON VIRGINIA AND LOBLOLLY PINE. Jane Barrows-Broadus and L. D. Dwinell. USDA For. Ser., For. Sci. Lab, Carlton St., Athens, GA 30602

Twenty-five isolates of *Fusarium moniliforme* var. *subglutinans* (FMS), were tested for virulence on greenhouse-grown, Virginia and loblolly pine seedlings. Fourteen of the isolates came from pitch cankers on 6 southern pine species, 2 from loblolly shoots damaged by tip moth, 2 from midge lesions on needles and 4 from sporodochia on slash pine, 1 each from seed orchard and plantation soil, and 1 from a deodar weevil pupa. The isolates from deodar weevil and plantation soil were avirulent on both pine species. The mean percent shoot mortality of the 23 virulent isolates was 36% on loblolly, and 90% on Virginia pine. The range on loblolly was 13-73% and on Virginia pine 48-100%. The coefficient of variation on loblolly pine was 46% and on Virginia pine, 17%. Virulence of the cultures was not strongly associated with the source of isolates. This confirms previous observations that Virginia pine is more susceptible to pitch canker than loblolly pine.

AN ACTINOMYCETE-LIKE ORGANISM ANTAGONISTIC TO THE PINE PITCH CANKER FUNGUS, *FUSARIUM MONILIFORME* VAR. *SUBGLUTINANS*. Jane Barrows-Broadus and T. J. Kerr. USDA For. Serv., For. Sci. Lab., Carlton St., Athens, GA, Dept. Microbiol. Univer. of GA. Athens, 30602.

An Actinomycete-like organism producing a clear interference zone was discovered as a contaminant in a culture of *Fusarium moniliforme* var. *subglutinans* (FMS), the cause of pine pitch canker. Hyphae of FMS growing near the edge of the zone were greatly distorted producing many vesicles. The Actinomycete-like organism was isolated and tested for its antagonistic action against FMS. It maintained an average interference zone diameter of 4.0 cm against FMS for over 30 days on several media. On PDA amended with 1000 ug/ml streptomycin sulfate and 120 ug/ml neomycin sulfate, it was completely inhibited. It was not sensitive to the fungicides, benomyl, pentachloro-nitrobenzene, or chloroneb. Attempts are being made to identify this organism which shows promise as a possible biological control agent for the pitch canker fungus.

RHODODENDRON DIEBACK CAUSED BY *PHYTOPHTHORA HEVEAE*. D. M. Benson, Dept. Plant Path., N. C. State Univ., Raleigh, 27650.

Phytophthora heveae was isolated from dieback tissue on a hybrid rhododendron growing in a western North Carolina nursery. Axillary buds on terminal shoots of hybrids, 'Catawbiense Album' and 'Roseum Elegans' were removed and a 3-mm agar disk containing *P. heveae* was placed on the wound. Shoots were enclosed in plastic bags for 30 hr. Wound-inoculated shoots developed a brown discoloration that progressed into buds, petioles, and leaves. Rate of spread in stems of current growth was about 13 mm/day, but spread was slower in older stems. Mature leaves infected through the petiole abscised when touched. Shoot infection did not occur through intact axillary buds. In a second test, nonwounded plants with expanding shoots and/or expanding axillary buds on mature stems were inoculated by spraying with a zoospore suspension to runoff. Plants were misted intermittently (4 sec/6 min) for 2.5 days. Infection occurred on expanding stems, leaves, and buds but not on mature tissue. Oospores were observed in infected leaf tissue.

ENVIRONMENTAL FACTORS AFFECTING GERMINATION, INFECTION, AND DEVELOPMENT OF ANTHRACNOSE ON WINGED WATERPRIMROSE UNDER CONTROLLED ENVIRONMENTS. J.M. Brumley and D.O. TeBeest. Department of Plant Pathology, 217 Plant Science Building, University of Arkansas, Fayetteville, AR 72701.

Colletotrichum gloeosporioides f. sp. *jussiaea* causes anthracnose of winged waterprimrose. Plants inoculated with spore concentrations of 1, 2, and 4 x 10⁶ spores/ml had 97, 96, and 99% leaf area blighted, respectively, 120 hr after inoculation. Disease developed more rapidly on plants held in dew chambers (100% RH) for 16-32 hr at 28 or 32 C than on plants held at 20 or 24 C for the same periods. Percentage leaf infection was equal if dew periods were 28 hr or greater regardless of temperature (20-32 C). By 120 hr leaf infection exceeded 90% on plants incubated at 24, 28, or 32 C in controlled growth chambers but was 13% on plants at 20 C. No disease developed on plants incubated at 16 C. When day/night incubation temperatures alternated (32/24 C), disease severity was less than that at 28/28 or 28/20 C. Spore germination on the leaf surface was significantly affected by dew time and temperature.

EFFECTS OF THE SOUTHERN CHINCH BUG (*BLISSUS INSULARIS*) AND THE ST. AUGUSTINE DECLINE STRAIN OF PANICUM MOSAIC VIRUS (PMV-SAD) ON SEVENTEEN ACCESSIONS AND TWO CULTIVARS OF ST. AUGUSTINE-GRASS. B.D. Bruton, J.A. Reinert, and R.W. Toler, Texas A&M Univ, Univ of Florida, IFAS Agri Res Center, Ft. Lauderdale, Florida 33314, and Texas A&M Univ, College Station, TX 77843.

Stenotaphrum secundatum (Walt.) Kuntze accessions and cultivars were evaluated for resistance to chinch bugs, PMV-SAD, and combined resistance to both. Under laboratory conditions, mortality of adult chinch bugs after 4 days feeding ranged from 8.3% on Florida Common to 61.7% on Floratam. Chinch bug population means over a five month period for the two cultivars in the field ranged from 12.9 to 0.3 adults/sq ft respectively. Maximum insect population counts were 97 on Florida Common and two on Floratam. Disease reaction of the material following two airgun inoculations with PMV-SAD ranged from 1 (no symptom development) to 3.8 (severe mottling). Ten of the 17 accessions and Floratam failed to develop symptoms. FA-38, FA-217, and FA-236 were symptomless carriers of PMV-SAD as demonstrated by bio-assay on German Strain-R millet. Florida accessions

FA-108, FA-118, FA-46, FA-243, FA-121, FA-64, and FA-82 exhibited combined resistance equal to or approaching that of Floratam.

BACTERIOCIN PRODUCTION IN ERWINIA CAROTOVORA. Patricia Campbell and Eddie Echandi, Department of Plant Pathology, North Carolina State University, Raleigh 27650.*

Erwinia carotovora var. carotovora and E. carotovora var. atroseptica produced bacteriocins spontaneously in natural media. Treatment of cells with UV irradiation and mitomycin C increased the number of bacteriocinogenic strains and titre of bacteriocins. Small (≤ 3 mm diam) and large (> 3 mm diam) inhibition zones were produced in solid medium. Bacteriocins were precipitated with ammonium sulfate, sedimented by high-speed centrifugation, and semi-purified by sucrose density gradient fractionation. A bacteriocin from a strain producing large inhibition zones could not be sedimented by high-speed centrifugation. Bacteriocin particles from strains producing small inhibition zones were rod-shaped and contractile similar to phage tails. Soft rot of Irish potato slices inoculated with E. carotovora was controlled in the laboratory with semi-purified bacteriocin preparations from E. carotovora. However, the same preparations did not control soft rot of whole naturally infested potato tubers.

SURFACE ROT AND PROXIMAL END ROT OF SWEET POTATO CAUSED BY FUSARIUM SOLANI. C. A. Clark, Dept. Plant Pathol. and Crop Physiol., LSU Agric. Expt. Sta., Baton Rouge, LA 70803.

Fusarium solani was isolated from sweet potatoes with surface rot symptoms and from sweet potatoes with a dry rot at the proximal end. When roots with proximal end rot were bedded, some sprouts developed black sunken cankers from which F. solani was also isolated. All isolates produced typical surface rot symptoms when inoculated onto wounded 'Centennial' or 'Jasper' sweet potatoes. Proximal end rot symptoms developed following inoculation of freshly cut proximal ends with isolates of F. solani. Inoculated cuttings planted in the greenhouse, developed slight discoloration at the cut end and in callus tissue which developed at the leaf scars. Growth of the cuttings was not affected and the necrosis that occurred was very limited and apparently localized. F. solani was reisolated following all three types of inoculation. Sprout necrosis was not observed in a commercial seed bed planted with proximal end rot-affected 'Jasper' mother roots.

EXTRACTION OF RENIFORM NEMATODE EGGS FOR INOCULUM OR ESTIMATION OF FIELD POPULATIONS. C. A. Clark and R. J. Thomas, Dept. Plant Path. & Crop Physiol., LSU Agric. Expt. Sta., Baton Rouge, LA 70803.

The methods of Hussey and Barker (Plant Dis. Repr. 57: 1025-1028) and Byrd et al. (J. Nematol. 4: 226-269) were adapted for extraction of eggs of Rotylenchulus reniformis. Eggs extracted from root of sweet potato hatched more rapidly in vitro than eggs of Meloidogyne incognita extracted similarly. Extraction for 4 min. with 0.53% NaOCl did not significantly reduce the hatching compared to a 2 min. extraction but resulted in increased numbers of eggs extracted for both nematode species. Extraction of reniform eggs from sweet potato cultivars each inoculated with 300, 1500, and 3000 eggs per 10-cm pot yielded 2665, 5808, and 11047 for Centennial; 1578, 5330, and 5675 for Jasper; and 1507, 2201, and 1969 for Goldrush, respectively. Egg production of R. reniformis in the greenhouse was greatest on Bonny Best tomato, Centennial sweet potato, and Black Beauty eggplant. August field populations from 9 sweet potato cultivars averaged 527 eggs and 2711 larvae per 500 cm³.

DAMPING OFF SYMPTOMS PRODUCED BY NON-VIABLE MYCELIUM OF PYTHIUM MYRIOTYLUM ON GERMINATING TOMATO SEED. A.S. Csinos, Plant Pathology Department, University of Georgia, Coastal Plain Experiment Station, Tifton, GA 31794.

Pythium myriotylum and other fungi were cultured on liquid medium, frozen and lyophilized. Mycelium was added to water agar at the rate of 250 mg/l, blended, pH adjusted to 4.5, autoclaved, poured in Petri plates (9 cm) and allowed to gel. Five surface sterilized 'Chico III' tomato seeds were placed

on each plate and incubated in a continuously lighted (500 lux) incubator at 27°C for five days. Tomato seeds plated on agar amended with mycelium of P. myriotylum germinated and grew slowly compared with non-amended controls and agar amended with non-toxic mycelium from other fungi. In severe cases roots and hypocotyls turned brown and the seedlings died. This indicates that non-viable mycelium of P. myriotylum contains a toxin which is heat stable and has the capacity to cause stunting, browning and death of germinating tomato seed similar to that caused by the living fungus.

SUPPRESSION OF RHIZOCTONIA SOLANI AND DAMPING-OFF IN COTTON BY MYCOPHAGOUS INSECTS OF THE ORDER COLLEMBOLA. E.A. Curl, Department of Botany and Microbiology, Auburn University, Auburn, AL 36830.

Mycophagous Collembola, Proisotoma minuta and Onychiurus encarpatus, are predominant in the rhizosphere of cotton seedlings in Alabama. Their feeding preference for Rhizoctonia solani in the presence of Trichoderma harzianum and species of Aspergillus was demonstrated in laboratory tests. In growth tubes with either sterilized or nonsterilized sandy loam, the Collembola destructively altered the inoculum density of R. solani and reduced disease severity in cotton seedlings. Results of repeated greenhouse experiments in nonsterilized field soil showed that the insects can act suppressively upon R. solani in the presence of other organic food sources. Populations of 1000 and 2000 Collembola/kg soil added to soil with pathogen inoculum on chopped oats (20 mg/kg soil) resulted in increased seedling emergence, decreased disease severity, and increased plant growth.

THE EFFECT OF FOLIAR APPLICATIONS OF FUNGICIDES ON THE INTERNAL MICROFLORA OF SOYBEAN SEED IN MISSISSIPPI. R.G. Davis and C. Hunter Andrews, Mississippi Agr. and For. Exp. Sta., Stoneville 38776 and Mississippi State 39762, respectively.

The internal microflora of soybean seed grown in 1975 was determined after harvest. Seed from a test of 37 foliar fungicide treatments at Stoneville were either sterile or the incidence of microorganisms was generally less than 1%. At Mississippi State, two rates of benomyl were used on three cultivars. Three harvests were made for each cultivar at 15-day intervals. Diaporthe phaseolorum occurred in 7% to 88% of the seed and was present in seed from all treatments. The level of D. phaseolorum was apparently related to the high incidence of stem and pod blight in the test plots at Mississippi State. Alternaria sp., Colletotrichum sp., Fusarium spp., Penicillium spp., and unidentified fungi and bacteria were isolated from less than 1% to 18% of the seed of some treatments. Field exposure due to harvest date appeared to affect the microflora more than the fungicide treatments.

INFLUENCES OF MELOIDOGYNE HAPLA AND MACROPOSTHONIA ORNATA ON THE EFFECTIVENESS OF MICROSCLEROTIAL INOCULA OF CYLINDROCLADIUM CROTALARIAE IN CAUSING BLACK ROT (CBR) ON PEANUTS. M. Diomande and M. K. Beute, Department of Plant Pathology, North Carolina State University, Raleigh, N. C. 27650.

Influences of Meloidogyne hapla and Macroposthonia ornata on the capacity of Cylindrocladium crotalariae to cause black rot (CBR) on peanut were investigated in greenhouse factorial experiments. Two peanut cultivars (CBR-resistant 'NC 3033' and CBR-susceptible 'Florigiant') were used. Four inoculum densities of C. crotalariae microsclerotia (0, 0.5, 5 and 50 ms/cm³ of soil for NC 3033 or 0, 0.025, 0.25 and 2.5 ms/cm³ for Florigiant) and three inoculum densities of M. hapla eggs or M. ornata larvae and adult mixtures (0, 1,000 and 10,000/15-cm-diam clay pot) were tested. CBR severity increased in the presence of 1,000 and 10,000 M. hapla eggs on both NC 3033 and Florigiant. M. ornata was found to increase disease severity at 10,000 nematodes/pot with 0.25 and 2.5 ms/cm³ on Florigiant but failed to affect the disease syndrome on NC 3033 at all density combinations tested.

COMPARISON OF PLANT RESISTANCE AND A NEMATICIDE FOR CONTROL OF SOUTHERN ROOT-KNOT NEMATODES IN SOUTHERN PEAS, VIGNA UNGUICULATA. P. D. Dukes, R. L. Fery and M. G. Hamilton, USDA, SEA, U. S. Vegetable Lab., Charleston, SC 29407

Field tests conducted in 1977 and 1978 indicate that plant resistance and the nematicide ethoprop are effective in

reducing yield-loss in southern peas caused by southern root-knot nematodes, *Meloidogyne incognita*. Ethoprop treatments (6.73 kg/ha) of heavily infested soil increased the seed yields of susceptible cultivars. The respective increases for the 1977 and 1978 tests were: 'Knuckle Purple Hull', 5 and 19%; 'Pinkeye Purple Hull', 12 and 20%; 'New Era', 69% (1978 only). Ethoprop did not affect the yields of resistant cultivars (Mississippi Silver and Colossus). Comparison of mean gall indices and number of eggs extracted from roots indicated that resistance is more effective in reducing nematode damage than ethoprop. Plant resistance, however, did not confer immunity. Roots of many resistant plants exhibited galling and supported egg production by the parasite.

SUSCEPTIBILITY OF HALF-SIB FAMILIES OF SLASH AND LOBLOLLY PINE TO THE PITCH CANKER FUNGUS, *FUSARIUM MONILIFORME* VAR. *SUBGLUTINANS*. L. D. Dwinell and Jane Barrows-Broadbent. USDA For. Ser. For. Sci. Lab, Carlton St., Athens, GA 30602

Half-sib families of slash and loblolly pine were screened for resistance to the pitch canker disease caused by *Fusarium moniliforme* var. *subglutinans* (FMS). Seven families of slash derived from parent tree selections made in natural stands in Florida were inoculated with two cultures of FMS isolated from pitch cankers on slash pine. Twelve loblolly families from clones in two Southern seed orchards were inoculated with two cultures of FMS isolated from pitch cankers on loblolly pine. One-yr-old, greenhouse-grown seedlings were inoculated by puncturing the shoot epidermis through a 5 μ l droplet of conidial suspension adjusted to 10^6 conidia per ml. After 2 months, shoot dieback for the slash families ranged from 46-96% with a mean of 80%. With loblolly, shoot dieback ranged from 25-78% with a mean of 52%. There were significant differences among families of both species in susceptibility to FMS. These results indicate genetic variation in resistance and suggest the possibility of breeding to control the disease.

HARDWOOD HOSTS FOR *PORIA LATEMARGINATA*. T. H. Filer, Jr., R. G. Davis and C. P. Hegwood. South. For. Exp. Stn. and Delta Branch Exp. Stn., Stoneville, MS 38776.

The pathogenicity of *Poria latemarginata* on six southern hardwoods was studied in a lath house. The fungus was isolated from diseased roots of peach (*Prunus persica* "Redglobe") at the Mississippi Delta Branch Experiment Station. The hardwood species used were cottonwood (*Populus deltoides*), green ash (*Fraxinus pennsylvanica*), yellow-poplar (*Liriodendron tulipifera*), cherrybark oak (*Quercus falcata* var. *pagodaefolia*), sycamore (*Platanus occidentalis*) and sweetgum (*Liquidambar styraciflua*). *Prunus persica* was also inoculated. Seventy percent mortality was observed in peach. Sixty-seven percent in cottonwood and yellow-poplar and 35% in sycamore after 9 months. Mortality in cherrybark oak (35%) occurred only in the root dip treatment. No mortality occurred in sweetgum or green ash.

ETIOLOGY OF SHORE JUNIPER DECLINE. Deborah R. Fravel and D. M. Benson, Dept. Plant Path., N. C. State Univ., Raleigh, 27650.

Typical decline symptoms of *Juniperus conferta* Parl. are chlorosis and necrosis of older needles beginning near the soil line and progressing up the plant. A binucleate-Rhizoctonia-like organism, frequently isolated from surface-sterilized needles, failed to reproduce symptoms under several relative humidity and wounding regimes. Root inoculations using oat grain cultures of *Phytophthora cinnamomi* Rands isolated from shore juniper resulted in chlorosis after 6 wk of the needles of the lower third of 1-yr-old plants and necrosis after 8 wk. Stunting and root necrosis were observed also. Similar symptoms also appeared after 10-14 wk when roots of 2-yr-old shore junipers were maintained under saturated soil moisture. Cycles of withholding water for 12 days followed by a thorough watering resulted in decline symptoms after 8 wk on 2-yr-old plants. Exposure of 1-yr-old plants to 4 hr of 15 pphm each NO_2 and SO_2 , combinations of these gases with 30 pphm O_3 , or 30 pphm O_3 alone resulted in tan to dark brown lesion on the needles of the lower third of the plants after 2-4 days.

POTATO LECTIN Lyses ZOOSPORES OF *PHYTOPHTHORA INFESTANS* AND PRECIPITATES ELICITORS OF TERPENOID ACCUMULATION PRODUCED BY

THE FUNGUS. Nabil A. Garas and Joseph Kuć, Department of Plant Pathology, University of Kentucky, Lexington, Ky. 40506.*

Potato lectin lyses zoospores of races 0, 1, 4, 1.4, and 1.2.3.4, of *Phytophthora infestans*. A solution of lectin (25 μ g glucose equiv./ml) caused 80-100% lysis of zoospores in one hr. Solutions of sucrose, dextran, soluble starch, inulin, bovine serum albumin, and collagen (300 μ g/ml) did not lyse zoospores. Citrus pectin (300 μ g/ml) killed or lysed zoospores, whereas, at 100 μ g/ml, pectin neither killed nor lysed zoospores. The lysis of zoospores by lectin does not appear to be an osmotic effect. Cystospores and zoosporangia were not lysed by potato lectin, and mycelial growth of the fungus appeared normal in solutions of lectin which lysed zoospores. Elicitors of terpenoid accumulation were precipitated from solutions containing lectin. Lectin may serve as a binding site for elicitors of terpenoid accumulation found in *P. infestans*, and it may regulate their solubility and activity.

STOMATAL INGRESS OF *PSEUDOMONAS ALBOPRECIPITANS* INTO CORN LEAVES. R. D. Gitaitis, D. A. Samuelson, and J. O. Strandberg. Plant Pathology Dept. and College of Veterinary Medicine, University of Florida, Gainesville, FL 32611, and AREC, Sanford, FL 32771.*

In a field study, application of phenylmercuric acetate (PMA) into the corn-plant whorl protected plants from infection by *Pseudomonas alboprecipitans*. The effects of a local application of PMA confirmed the importance of the whorl as a penetration court for the bacterium. The penetration court was studied further by applying a bacterial suspension of either 10^7 cells/ml or 10^9 cells/ml into the whorl of corn seedlings. Leaf tissues from inoculated areas were sampled and prepared for scanning electron microscopy. Small numbers of bacteria were observed in stomata and sub-stomatal chambers only in those samples exposed to 10^9 cells/ml. Infection also occurred when stomatal opening was inhibited with abscisic acid. Ingress, therefore, does not require that stomata be fully opened.

LEAF SURFACE INTERACTIONS BETWEEN *COCHLIOBOLUS MIYABEANUS* AND SUSCEPTIBLE AND RESISTANT RICE CULTIVARS. F. C. Hau and M. C. Rush, Dept. Plant Path. & Crop Physiol., Louisiana State Univ. Agric. Expt. Sta., Baton Rouge, LA 70803.

Comparisons were made of the surface activities of *Cochliobolus miyabeanus* (*Helminthosporium oryzae*) on susceptible and resistant rice cultivars with light and scanning electron microscopy. The percentage of conidia germinating on leaf surfaces was not significantly affected by cultivar susceptibility, but germ-tubes were much longer on resistant cultivars. On susceptible cultivars germ tubes were short, appressoria were produced rapidly, and the hyphal mass following germination was much greater. Significantly more appressoria were concentrated over bulliform cells and at junctures of epidermal cells. On polystyrene leaf replicas, appressoria formed equally well over all cell types, regardless of the resistance level of the template leaf. However, they were located mainly at cell junctures. Failure of appressoria to form mainly over bulliform cells on leaf replicas may be due to the absence of chemical stimulation

INHIBITION OF RIBULOSE 1,5-BISPHOSPHATE CARBOXYLASE BY VICTORIN AND RECOVERY OF VICTORIN AFTER BINDING TO FRACTION 1 PROTEIN. Martha C. Hawes, and S. J. Sheen, Department of Plant Pathology, University of Kentucky, Lexington, Kentucky 40506*

Partially purified victorin caused up to 60% inhibition of ribulose 1,5-bisphosphate (RUBP) carboxylase activity of Fraction 1 (F-1) protein of tobacco. The same toxin concentration inhibited growth of susceptible oat seedlings by 50%. Carboxylase activity was not affected by culture filtrates of a non-pathogenic strain of the fungus or by inactivated victorin. Victorin-treated F-1 protein was subjected to gel permeation chromatography. Carboxylase activity of protein so treated remained inhibited, suggesting that victorin is bound to F-1 protein. Bound victorin was dissociated from the protein by treatment with 2N NaCl and was found to be toxic to susceptible oats. These results suggest that inhibition of RUBP carboxylase may provide a means for bioassay of victorin, and the binding of victorin to F-1 protein may allow separation of victorin from other fungal metabolites.

THE ECOLOGY OF PENICILLIUM SPECIES ON BARLEY GRAIN. Robert Hill, Plant Pathology Dept., Coastal Plain Experiment Station, Tifton, GA 31794; John Lacey, Plant Pathology Dept., Rothamsted Experimental Station, Harpenden Herts., AL5 2JQ, England.

Inflorescences of barley (*Hordeum vulgare*) are colonized by bacteria, yeasts and filamentous fungi. Fungi characteristic of stored grain, including many *Penicillium* species, can be isolated before harvest. No sharp distinction exists between 'field fungi' and 'storage fungi'. Molding in storage is largely governed by grain water activity (a_w), temperature and aeration. Between 0.65 a_w and 0.87 a_w the *Aspergillus glaucus* group predominates. *Penicillium verrucosum* var. *cyclopium* is often dominant in grain with more than 0.87 a_w when heating does not occur. Above 0.9 a_w spontaneous heating, initiated by growth of species like *P. verrucosum* var. *cyclopium*, *P. funiculosum*, *P. variable* and *P. janthinellum*, usually occurs followed by thermotolerant fungi including *P. capsulatum* and *P. piceum*. Restricting oxygen reduces microbial activity and *P. roqueforti* and yeasts may become abundant.

MUTAGENIC ACTION OF NEMATODES ON PLANTS. J. P. Hollis, Dept. Plant Path. & Crop Physiol., La. State Univ. Agric. Expt. Sta., Baton Rouge, LA 70803.

Plant parasitic nematodes alter chromosome and plasmid complements in host cells. A survey (B. M. Duggar, ed. Biological Effects of Radiation, Vol 2, McGraw Hill, New York, 1936) revealed similarities between biological effects of radiation and nematodes on seedlings and supports the view that nematode feeding on growing point initials can cause mutations in plants by altering chromosomes on an analogy with mechanical effects of radiation on chromosomes. Thus, nematodes may cause changes in the host manifested as selection pressure (SP) for new nematode races; as occurs in *Ditylenchus* spp. More interesting is the probability of formation of localized root chimeras due to feeding of root nematodes on host plants. Physiological SP manifested as nutrient alteration in new root initials on nematode-infested root systems provides a model for the origin of countless new races of nematodes identifiable by host differentials.

NEMATODES: BIOLOGICAL TRANSFER AGENTS BETWEEN DIVERSE ORGANISMS. J. P. Hollis, Dept. Plant Pathology & Crop Physiology, Louisiana State Univ. Agric. Expt. Sta., Baton Rouge, LA 70803

Dorylaimus spp. feed on the roots of higher plants (G. Thorne and Helen Heinly Swanger, A Monograph of the Nematode Genera *Dorylaimus* Dujardin, *Aporcelaimus* N. G. *Dorylaimoides*, N. G. and *Pungentus* N. G., Martinus Nijhoff, The Hague, 1957). These authors reported from examination of intestinal contents of "hundreds of dorylaimus" (p. 10) that, "generally they have been filled with material from the higher plants, indicating that these are their preferred source of food." During the same year, the broad microbial host range of *Dorylaimus ettersbergensis* de Man 1885 was revealed in laboratory studies (Phytopath. 47: 468-473, 1957). Hosts included blue-green and green algae, protozoan cysts, fungus spores and hyphae, and saprozoic nematodes. The data suggest dorylaims can act as agents for the transfer of protoplasmic constituents, involving the alteration and transfer of chromosome and plasmid-linked life support systems between microorganisms and higher plants.

SEASONAL CONCENTRATIONS OF BACTERIAL PLUGS IN GRAPEVINES SEVERELY INFECTED WITH THE PIERCE'S DISEASE BACTERIUM. D. L. Hopkins, University of Florida, Agricultural Research Center, Leesburg, FL 32748

Seasonal concentrations of the Pierce's disease (PD) bacterium in infected vines were studied. Stem, petiole, and leaf vein tissues were collected five times during the season. Transverse sections of the tissues were stained and examined by light microscopy for bacterial plugs. The highest concentration of the bacterial plugs occurred in all three tissues at the June 7 sampling date, with high concentrations also present in the July 28 sample. On June 7, leaf veins had 57% of the vascular bundles infested, petioles had 37%, and stems 21%. Between April 21 and June 7 there was a 10-fold, or greater, increase in the number of infested vessels per cross section in all three tissues. PD bacterial concentrations in leaf

veins were highly correlated with leaf marginal necrosis. Seasonal concentrations of PD bacterial plugs correlated very well with symptom development and with seasonal transmission data.

DETECTION OF MAIZE DWARF MOSAIC VIRUS USING ELISA. A. Huebner & R.W. Toler, Texas A&M University, College Station, TX 77843.

Enzyme-linked immunosorbent assay (ELISA) was used to detect maize dwarf mosaic virus strain A (MDMV-A) in corn and sorghum. Two enzyme systems were used: horse-radish peroxidase (HRP) in conjunction with the substrate 2,2'-azino-di-(3-ethyl-benzthiazoline-5-sulfonate) (ABTS), and alkaline phosphatase with the substrate p-nitrophenyl phosphate. The enzyme conjugates have remained stable at least 6 months at 4 C. Using ELISA with purified preparations of MDMV-A we detected virus concentrations as low as 50 and 10 $\mu\text{g/ml}$ for the peroxidase and phosphatase systems, respectively. The sensitivity of these systems may be greater, since lower virus concentrations were not tested. Sap from infected plants diluted 1:5000 gave positive results with the HRP conjugate. The alkaline phosphatase system gave positive results at a dilution of 1:2500. We can accomplish the test routinely within 8 hr, however, slight but readable results can be obtained after 4 hr. The HRP system consistently gave a more visible reaction than the phosphatase system, but also showed some non-specific reactions.

THE INFLUENCE OF FUNGICIDE AND INSECTICIDE APPLICATIONS ON PERSISTENCE OF LADINO CLOVER. J. R. James, L. T. Lucas, D. S. Chamblee, and W. V. Campbell. Department of Plant Pathology, North Carolina State University, Raleigh 27650.*

Applications of benomyl, carbofuran, and benomyl plus carbofuran to plots of Ladino clover (*Trifolium repens*) indicate that a pathological-entomological complex is a major factor involved with lack of persistence of Ladino clover. The area covered with Ladino clover in control, benomyl, carbofuran, and carbofuran plus benomyl treated plots after 3 1/2 years was 12, 24, 75 and 88%, respectively. In the third year, yields of clover in control, benomyl, carbofuran, and carbofuran plus benomyl plots were 617, 1683, 3625, and 3825 kg/ha, respectively. In September of the third year, percent stolon rot in control, benomyl, carbofuran, and carbofuran plus benomyl treated plots was 30.6, 20.2, 7.6, and 8.4%, respectively. Less root injury from the clover root curculio (*Sitona hispidula*) was observed in plots treated with carbofuran. Insect damage and rot of roots and stolons were highly correlated in plant samples collected throughout the experiment.

AIRBORNE POPULATIONS OF ASPERGILLUS FLAVUS IN IRRIGATED AND NON-IRRIGATED FIELD CORN. Roger K. Jones and H. E. Duncan, Department of Plant Pathology, North Carolina State University, Raleigh 27650.*

Andersen air samplers were used to monitor airborne spores of *Aspergillus flavus* Link ex Fries in non-irrigated and irrigated corn plots. Spores were monitored for 166 days (May 13-Oct 27) during 1978. The samplers were adjusted to operate for 30 sec. each hour at a volume of 1 cubic foot/minute. One sampler was placed in each plot at a height of 3 feet. Spores were trapped on Petri dishes of Czapek Dox Agar (Difco) + 6% NaCl and plates were changed daily at 0800. Colonies of *A. flavus* were identified following incubation for 6 days at 25°C. Spore concentrations remained low during May, June and July in both treatments. Thereafter, spore concentrations increased in both treatments but remained lower in the irrigated treatment. Late in the season spore counts rose sharply in both plots during and after harvests. Unidentified species of *Cladosporium* and *Penicillium* were the predominant fungi trapped during the growing season.

CONTROL OF FUSIFORM RUST ON LOBLOLLY PINE SEEDLINGS WITH THE FUNGICIDE, BAYLETON. W. D. Kelley, Botany and Microbiology Dept., Auburn Univ. Agric. Exp. Sta., Auburn, Alabama 36830.

Efficacy of Bayleton [1-(4-chlorophenoxy)-2,3-dimethyl-1-(1H-1,2,4-triazol-1-yl)-2-butanone] to control fusiform rust on loblolly pine was determined in a greenhouse test. Treatments were 1) control; 2) Bayleton soil treatments (2 and 5 kg a.i./ha, preplant incorporated [PPI]); 3) Bayleton foliar spray (FS)

(0.56 kg a.i./ha one application either 21, 14, or 7 days before inoculation or 2 or 7 days after inoculation). Seedlings were inoculated with *C. fusiforme* at the USDA Forest Service Rust Testing Center (Asheville, N.C.) 40 days after being transplanted. Thirty-six weeks later seedlings were free of galls in all treatments except the controls (32% galled) and the Bayleton FS applied 21 days before inoculation (1%). Results indicate that: 1) Bayleton PPI at a rate of 2 kg a.i./ha provided complete protection for at least 40 days; and 2) a single foliar spray with Bayleton at 0.56 kg a.i./ha gave acceptable control for 21 days after application and eradicated all infections that occurred 7 days prior to application.

PREVIOUSLY UNREPORTED APHID VECTORS OF TOBACCO VEIN MOTTLING VIRUS. G. G. Kennedy, Donna Wade, and G. V. Gooding, Jr., Departments of Entomology and Plant Pathology, N. C. State University, Raleigh 27650.

Nicotiana tabacum cv. Burley 21 was used both as candidate virus donor and recipient. Aphids were starved for 30 to 60 min, given a 5 min acquisition period on a TVMV infected leaf and then transferred in lots of 10 to each of 10 Burley 21 tobacco seedlings for a 1 hr inoculation period. Transmission results (no. infected/total no. plants tested) were as follows: *Aphis craccivora* (5/20), *A. gossypii* (18/20), *Myzus persicae* (13/20), *Rhopalosiphum maidis* (4/20), *R. padi* (1/20), *Lipaphis erysimi* (0/20), or *Aulacorthum circumflexus* (0/20). In a second study with the latter two species, 100 prestarved aphids of each species were observed to probe on a TVMV infected leaf and transferred in lots of 10 to each of 10 indicator plants. No transmission occurred whereas *M. persicae*, treated similarly, transmitted to 5 of 5 plants.

INCUBATION TEMPERATURE AS A METHOD OF SELECTIVE ISOLATION OF *ASPERGILLUS FLAVUS* FROM SOIL AND ORGANIC SUBSTRATES. Graydon Kingsland, Dept. of Plant Pathology and Physiology, Clemson University, Clemson, SC 29631.

Thermotolerant characteristics of *A. flavus* are of value in isolating it from mycofloristically complex substrates. Approximately 235 propagules of *A. flavus* per g (p/g) of corn-field soil were identified on dilution plates of malt-salt agar (MSA) incubated at 40 C. It was identified on 89% of corn roots from the field when plates were incubated at 40 C. Comparable figures were 0 p/g and 33%, respectively, when plates were incubated at 25 C. Approximately 600 p/g of *Fusarium roseum* were identified from these soil samples when incubated at 25 C. *F. roseum* developed on all root pieces at 25 C. At 40 C *F. roseum* did not develop on dilution plates or from root pieces. *A. flavus* grew from 30% of corn kernels on plates incubated at 25 C, compared with 68% when incubated at 40 C. Incubation temperature did not affect quantitative differences in the p/g of *A. flavus* recovered from corn grain. The dilution plates, however, can be counted after a shorter incubation period with fewer competing fungi when incubated at 40 C, than at 25 C.

A LEAF SPOT DISEASE OF WHEAT CAUSED BY *HELMINTHOSPORIUM SOROKINIANUM* IN SOUTH CAROLINA. Graydon Kingsland, Dept. of Plant Pathology and Physiology, Clemson University, Clemson, SC 29631.

H. sorokinianum was the only pathogen isolated from lesions of a leaf spot disease of Holley wheat collected during a small grains disease survey. Significantly larger numbers of lesions developed on Blueboy and Coker 68-15 wheat than on Arthur or Holley wheat or on barley or rye when inoculated with conidia of a pure culture of *H. sorokinianum* originally isolated from the wheat. No lesions developed on controls. *H. sorokinianum* was recovered from all leaf lesions of rye and Holley wheat examined after incubation in moist chambers. Seventy percent of the barley lesions revealed the presence of the pathogen. The wheat and rye leaf lesions were rated between 4 and 5 for sporulation on a 0 to 5 scale (0 = no sporulation; 5 = prolific sporulation on all of the lesions observed). Barley lesions were rated 2. This isolate of *H. sorokinianum* appears to be more virulent on wheat and rye than on barley.

NUMBERS OF COVER SPRAYS AS RELATED TO CONTROL OF SCAB IN PEACH. Ernest G. Lawrence and Eldon I. Zehr, Dept of Plant Pathology and Physiology, Clemson University, Clemson, SC 29631.

A long period of latent infection (42-77 days) is characteristic of the peach scab disease caused by *Cladosporium carpophilum*. Effects of mid- and late-season cover sprays for scab and brown rot control were studied on Redskin and Redhaven peach trees. The number of sprays required for adequate control depended upon time of maturity of peach fruit, fungicide used, and weather conditions. During dry weather, which prevailed in 1977 and 1978, scab control was satisfactory when one late-season spray of sulfur or two sprays of captan or chlorothalonil were omitted. In 1976 when rainfall was frequent and plentiful, one spray of captan or two of benomyl were omitted without adversely affecting disease control. Eradicant properties of chlorothalonil, captan and sulfur were not sufficient to permit omitting the first two or three cover sprays. Control of brown rot was not adversely affected by omitting late-season sprays.

COMPARISON OF TWO FORMULATIONS OF TRIPHENYLTIN HYDROXIDE FOR CONTROL OF *CERCOSPORA* AND *CERCOSPORIDIUM* ON PEANUTS. R. H. Littrell and June B. Lindsey, University of Georgia, Coastal Plain Station, Tifton, Georgia 31794.

Du-ter 47.5% WP and an experimental flowable formulation (FF) of triphenyltin hydroxide were compared on Florunner peanut (*Arachis hypogaea*) for control of *Cercospora arachidicola* and *Cercosporidium personatum* and as antisporulants for *C. arachidicola*. The FF was a product of a wet-mill grind that produced a particle size of 4 μ and contained 1.8 kg a.i. per 3.78 l. Formulations were tested at 2,135 ppm as a foliar spray (15.3 l/ha) and as a leaflet dip. Percent infection in the field was determined just prior to harvest and percent sporulation of lesions on dipped leaflets was determined after incubating 5 days in a moist chamber at 28 C. Plants treated with FF or Du-ter had 71 and 83% infection, respectively, and non-sprayed plants had 89%. All three differences were significantly different at the .05 level of probability. Sporulation of *C. arachidicola* was observed on 13.3% and 73.3% of lesions treated with FF and Du-ter, respectively.

CONTROL OF *BELONOLAIMUS LONGICAUDATUS* ON BERMUDAGRASS GOLF GREENS. L. T. Lucas, Department of Plant Pathology, N.C. State University, Raleigh, N.C. 27607.

Poor growth of 'Tifton 328' bermudagrass (*Cynodon dactylon*) on golf greens with sandy soil along the coast of North Carolina was associated with *Belonolaimus longicaudatus*. An average of 400 *B. longicaudatus* and 966 *Macroposthonia ornata* per 500 cm³ of soil were found in soil samples before treatment with nematicides. Phenamiphos, fensulfothion and 1, 2-dibromo-3-chloropropane (DBCP) were applied as granules at 0.2, 0.2 and 0.64 kg (a.i.)/93 m², respectively, on August 8, 1977. Turf quality ratings (9 being the best quality) were 6.2, 6.2, 4.7, and 2.7 4 weeks after treatment, and 8.7, 4.0, 4.0 and 4.0 40 weeks after treatment in phenamiphos, fensulfothion, DBCP and nontreated plots, respectively. Densities of *B. longicaudatus* were 160, 100, 315 and 1390 4 weeks after treatment, and 106, 823, 406 and 752 40 weeks after treatment in phenamiphos, fensulfothion, DBCP and nontreated plots, respectively. Densities of *M. oranta* were reduced in DBCP treated plots only.

ACROCONIDIPELLINA AND EPIPOLAEUM LEAF MOLDS OF BERMUDAGRASS. E. S. Littrell and C. W. Bacon. Dept. of Plant Pathology, Univ. of Georgia, Athens, GA 30602, and Field Crops Lab., R. B. Russell Agric. Res. Center, Athens, GA 30604.

Two superficial fungi produce conspicuous growths on living leaves of *Cynodon dactylon* in Georgia. *Epipolaeum erysipheoides* (Dimeriaceae) forms crusts of small, black ascocarps and sclerotia on green and discolored tissues of mature leaves. On V-8 juice agar ascospore cultures develop colonies of sparse, brown mycelium and sclerotia in 4 wk. *Acroconidiellina chloridis* (Hyphomycetes) covers young green tissue with a white mycelium supporting a turf of conidiophores and conidia. Black, disk-shaped sclerotia develop on exposed surfaces and between leaf sheaths. Germination of sclerotia is by eruption of a column of conidiophores through the rind. Cultures from conidia and sclerotia produce conidia abundantly on several media. Inoculations on grasses other than Bermudagrass, including *Chloris* spp., failed.

LIGHT-TEMPERATURE INTERACTIONS IN GROWTH AND SPORULATION OF CERCOSPORA KIKUCHII. S.D. Lyda, M.D. Chen and R.S. Halliwell. Department of Plant Sciences, Texas A&M University, College Station, TX 77843.

Cercospora kikuchii (Matsumoto & Tomoyasu) Chupp was grown on ten media at temperatures ranging from 5 to 40 C. Maximum growth on solid media occurred at 28 C on malt extract agar (MEA) and potato dextrose agar (PDA) with the least growth on water agar (WA). In liquid media best growth was obtained in V-8 juice broth and the fungus sporulated best on V-8 juice agar (5.7×10^4 conidia/cm²) (C/SC) and carrot-leaf-decoction agar (5.6×10^4 C/SC). No sporulation occurred on corn meal agar, MEA, PDA, or WA. Cultures were grown on V-8 juice agar and subjected to three temperature and light regimens: 13, 22 and 28 C under continuous light (CL) (0.48m W/cm²), continuous darkness (CD) or alternate light (12 hrs) and dark periods (12 hrs) (ALD). At 13 C sporulation was best under CL or ALD periods (3.3 and 3.0×10^4 C/SC) compared to CD (2.0×10^4 C/SC). At 28 C there was no significant difference in sporulation between CL and CD periods (5.7 and 6.4×10^4 C/SC).

POTENTIAL IMPACT OF SHEATH BLIGHT ON YIELD AND MILLING OF SHORT-STATURED RICE LINES. M. A. Marchetti, USDA-SEA/AR-SR, Rt. 7, Box 999, Beaumont, TX 77706.

Major objectives of U.S. rice breeding programs include lodging resistance and improved plant type through shorter stature. Yield and whole-kernel milling yield reductions caused by sheath blight (*Rhizoctonia solani* Kuhn) were compared in field plots of several susceptible standard (110-120 cm) and short-statured (s-s, 85-90 cm) lines. S-s lines showed maximal symptoms a week before standard lines. In 1977, 'Labelle' sustained yield and milling reductions of 16% and 2%, respectively, compared to 40% and 48%, for s-s line CI9881/PI331581. In 1978, 'Lebonnet' and 'Bluebelle' yields were reduced 11%, while closely related CI9881/PI331581 and PI331581 ("dwarf Bluebelle") yields dropped 25%. Milling reductions of 2% to 17% were not associated with stature. Greater vulnerability to sheath blight probably will not determine the release of s-s rice lines, but growers should plan appropriate control measures.

OCCURRENCE OF MICROORGANISMS IN CHINESE CHESTNUTS AT HARVEST AND DURING STORAGE. S. M. McCarter, S. J. Kays, J. A. Payne, and F. M. Shokes. Departments of Plant Pathology and Horticulture, University of Georgia, Athens, GA 30602, SE Fruit and Nut Tree Laboratory, Byron, GA 31008 and University of Florida, Quincy, FL 32351, respectively.

Deterioration of the nuts of Chinese chestnut (*Castanea mollissima* Bl.) is a serious problem in the southeastern United States. Laboratory isolations made from the pericarps and kernels of chestnuts from closed and open burs at harvest and from nuts in storage yielded mainly members of the fungal genera *Fusarium*, *Phoma*, *Paecilomyces*, *Phomopsis*, *Gloeoporum*, *Diplodia*, *Candida*, *Pestalotia*, *Alternaria*, *Rhizopus*, *Aspergillus*, *Penicillium*, and *Trichoderma* and the bacterial genus *Bacillus*. *Aspergillus flavus* and *A. parasitica* occurred infrequently among the *Aspergillus* isolates, but some isolates yielded B₁, G₁, and G₂ aflatoxins in laboratory tests. The incidence of the various fungi was highest in nuts stored under improper conditions, but many were present in apparently healthy nuts at harvest.

MAILING ELISA PLATES EXTENDS VIRUS INDEXING POTENTIAL. M. R. McLaughlin, O. W. Barnett, and P. B. Gibson, Dept. of Plant Pathology and Physiology, Dept. of Agronomy and USDA-SEA, Clemson University, Clemson, SC 29631.

An ELISA procedure was used in regional project S-127, Forage Legume Viruses, in indexing forage legumes for alfalfa mosaic, bean yellow mosaic, clover yellow mosaic, clover yellow vein, peanut stunt, red clover vein mosaic, and white clover mosaic viruses. Polystyrene plates were sensitized with antibodies to these viruses, rinsed but not dried; covered with spent plates as lids, sealed inside ziplock plastic bags containing wet paper towels, boxed with healthy and virus-infected plant tissue for controls and buffer concentrate for sample preparation and mailed to S-127 cooperators. Cooperators prepared samples by grinding leaf tissue to obtain 0.2 ml sap for each virus test. Plates containing samples were covered and sealed in plastic bags as before and held overnight at 5C. Samples were rinsed from plates with cold tap water. Plates were packed as before and mailed to

Clemson for completion of tests. From June-Sept 1978 we indexed 1,034 samples from cooperators in AL, KY, LA, MD, MS, NC, and VA and noted no adverse effects due to mailing.

AN ULTRASTRUCTURAL COMPARISON OF CRONARTIUM COMANDRAE IN PINUS ECHINATA AND COMANDRA UMBELLATA. Margaret A. Mead and F. H. Tainter, Dept. of Plant Pathology, University of Arkansas, Fayetteville, AR 72701.

The ultrastructure of comandra blister rust, *Cronartium comandrae*, was compared in a primary host, *Pinus echinata*, and in an alternate host, *Comandra umbellata*. A matrix similar to the host cell walls entirely surrounded the intercellular hyphae in pine. In comandra, the homologous matrix was heterogeneous and was restricted to areas between the host cell wall and the wall of an intercellular hypha. In pine, intercellular hyphae often deeply penetrated the host cell walls. These hyphae resembled haustoria in transverse section although they lacked an haustorial matrix and were surrounded by a layer of host cell wall material. A comparable phenomenon was not apparent in comandra. Unusual globular structures containing tubular material were seen in the cytoplasm of all collections of infected and control comandra. Both the matrix and tubules of these globules stained black in OsO₄ indicating an unsaturated lipid composition.

EFFECTS OF ARTIFICIAL DRYING AND CONTROLLED ATMOSPHERE STORAGE ON CONTROL OF BLACK MOLD (*ASPERGILLUS NIGER*) OF ONIONS. Marvin E. Miller and R. C. Dillon, Jr., Texas Agricultural Experiment Station, Weslaco, Texas 78596.

Aspergillus niger, black mold, was the major cause of bulb losses of yellow onion varieties 'Texas Grano 502', 'Yellow Granex', 'New Mexico Yellow Grano' and 'Ben Shamen' during a 4 yr. survey. Bacterial soft rots and *Fusarium* basal rot were of minor importance, while *Botrytis* neck rot was not evident. Control of black mold was attempted by drying onions for 8-31 hrs. with dehumidified-heated air and by storage in controlled atmosphere holding chambers. Although differences between drying treatments and nondried controls were not significant, onions dried with air at or below 36% relative humidity (RH) at 37.8C usually had less black mold than untreated controls. In storage tests following drying treatments, RH and air temperature in the holding chambers significantly affected black mold losses after 1-2 wks. independently of artificial drying effects.

RESPONSE OF SELECTED PEANUT CULTIVARS TO CYLINDROCLADIUM BLACK ROT IN SOUTH CAROLINA. C. S. Morton and L. W. Baxter, Jr., Department of Plant Pathology and Physiology, Clemson University, Clemson, SC 29631.

Selected peanut cultivars were evaluated for 3 years on land infested with *Cylindrocladium crotalariae* to determine yield response. Two peanut cultivars, GK-3 and Tifrun, yielded higher than Florunner and Florigiant (the two common peanut cultivars grown in SC) in 2 of 3 and 1 of 2 years respectively. NC-6 and Early Bunch were found to yield as well as Florunner and Florigiant. Microplot evaluations of field tolerance to root necrosis were made using the previously mentioned cultivars and NC-3033, a CBR-resistant breeding line. Soil was infested with 25 microsclerotia of *C. crotalariae*/g of soil to a depth of 7.2 cm. Peanuts were in four replicates, harvested, and evaluated for root necrosis. NC-3033 had less root necrosis than any other peanut cultivar. GK-3 and Tifrun had less root necrosis than Florunner, Florigiant or NC-6. Early Bunch had the most root necrosis. All cultivars increased microsclerotial levels with the exception of NC-3033 which essentially maintained them.

A STORAGE ROOT ROT OF SWEET POTATO CAUSED BY *FUSARIUM SOLANI*. J. W. Moyer and L. W. Nielsen, Department of Plant Pathology, North Carolina State University, Raleigh 27650.

Storage rot of sweet potato caused by *Fusarium solani* is characterized by circular surface lesions with tan to brown concentric rings radiating from the infection site and resembles the surface rot caused by *F. oxysporum*. However, the necrosis caused by *F. solani* extends internally beyond the vascular ring frequently with lens-shaped cavities containing white mycelium. Roots of Jewel cv. were more suscept-

ble than were roots of Jersey Orange, Georgia Red, Centennial, Nugget or Porto Rico. Infection of vine cuttings was limited to tissue below the first node and had no effect on plant vigor. *F. solani* isolates from sweet potato were also capable of infecting fruits of apple, cucumber, eggplant, pepper, squash and tomato and potato tubers. Curing provided effective control for the disease on roots of the susceptible cv. Jewel.

EFFECTS OF FIVE FUNGICIDES ON ENDOMYCORRHIZAL DEVELOPMENT IN SOUR ORANGE. S. Nemeč, USDA, SEA, Orlando, FL 32803.

Copper (Cu) up to 224 kg/ha, CGA 48988 [N-(2, 6 dimethylphenyl)-N-methoxyacetyl] alanine methyl ester] up to 9 kg/ha, and thiabendazole (TBZ) up to 18 kg/ha, were tested against *Glomus etunicatus* (GE). Chlorothalonil up to 22.4 kg/ha, and sodium azide (NaN₃) up to 31.4 kg/ha were tested against *G. mosseae* (GM). Sour orange seed were planted in 15-cm pots containing low-phosphorus soil mixed with these fungicides and chlamydo-spores. After 8 mos., the middle and high rates of Cu depressed plant growth (P = ≤0.01) but not infection and sporulation, compared to the GE control. Vesicle number and plant growth were not adversely affected by CGA 48988, but mycelial colonization and chlamydo-spore numbers were higher than the GE control. All rates of TBZ reduced plant growth (P = ≤0.01) and infection and sporulation decreased as rates increased. Plant growth and sporulation in the middle and high rates of chlorothalonil were significantly less than the control. Plant growth was better (P = ≤0.05), and fungus sporulation higher than the GM control in all NaN₃ treatments.

LIPID ANALYSIS OF *GLOMUS MOSSEAE*-INFECTED AND NONINFECTED CITRUS ROOTS. S. Nemeč, USDA, SEA, Orlando, FL 32803; S. Nagy and H. Nordby, USDA, SEA, Winter Haven, FL 33880.

Six citrus rootstock cultivars were inoculated with *Glomus mosseae* in a low-phosphorus sand in the greenhouse and fertilized monthly with a liquid 12-0-6. Noninoculated cultivars served as controls. After 140 days, roots were washed, weighed and extracted in chloroform/methanol, 2:1. Lipids were purified by Sephadex G-25 and separated by silica gel chromatography. Neutral lipids (NL) and coumarins comprised about 75-86%, glycolipids (GL) about 8-22%, and phospholipids (PL) 2-7% of the total fat soluble extracts. In general, GL were higher in controls; PL were higher in all inoculated cultivars; and no differences were present in the NL and coumarin fraction. However, among the NL, triglycerides were significantly higher in all inoculated cultivars. PL as mg/g root ranged from 1.62-3.95 in inoculated cultivars and from 0.79 to 1.56 in controls, and were significantly higher in all inoculated cultivars. In general, cholesterol, stigmasterol, and β-sitosterol as percentages of total sterols were higher in the controls.

EFFECT OF TEMPERATURE ON INCIDENCE AND GROWTH OF BITTER ROT LESIONS ON APPLES. J. P. Noe and T. E. Starkey, Department of Plant Pathology, University of Georgia, Athens, 30602*

Bitter rot of apples, caused by *Glomerella cingulata*, is a serious disease in southern apple orchards. Development of this disease is linked to periods of high temperature and rainfall. Mature apples harvested during 1978 were washed, rinsed, and allowed to air-dry. Inoculum was prepared from 11-day-old cultures grown on PDA. Each apple was inoculated by atomizing it with 10 million conidia in an aqueous suspension and placed in moist chambers. Thirty apples were placed in incubators at 22, 26, 28, 30, and 34 C. Total lesion area (>1 mm) per infected apple was determined for each temperature at 12, 15, and 18 days following inoculation. No infection occurred at 34 C or in controls. The highest percentage of apples were infected at 26 C, and the lowest at 30 C. The greatest number of lesions per apple occurred at 26 C. Average lesion size increased with temperature from 4.8 mm² at 22 C to 8.8, 24.1 and 88.0 mm² at 26, 28, and 30 C, respectively.

CHARACTERISTICS OF THE INSUSCEPTIBILITY OF CULTURED TOBACCO CELLS TO MICROINJECTED MAIZE DWARF MOSAIC VIRUS. Jacqueline F. Perryman and Robert S. Halliwell. Department of Plant Sciences Texas A&M University, College Station, Texas 77843*

Plants having subliminal or latent virus infections are often considered immune, but microscopic study might reveal cytopa-

thic effects if resistance mechanisms are operating. Cultured single cells and cell chains of *Nicotiana tabacum* 'Samsun NN' were microinjected with maize dwarf mosaic virus, to which they are reportedly immune. The purity of the virus preparations was analyzed by polyacrylamide gel electrophoresis, and all samples tested contained a single protein band of MW 36,560. Tobacco cells were injected with infectious virus, heat-inactivated virus, or "purified sap" from healthy plants. After injection, all cells showed a typical wound response. No effect on cytoplasmic activity, organelle appearance, or longevity was noted. One cell divided three times within 48 hrs, a phenomenon typical of normal, healthy cells. Thus, if viral replication was occurring, it was not at the expense of the normal replicative function of the host genome.

COMPARATIVE APHID TRANSMISSION PROPERTIES OF ISOLATES OF TOBACCO ETCH VIRUS. T. P. Pirone, Department of Plant Pathology, University of Kentucky, Lexington, Kentucky 40546

The aphid transmissibility of an isolate of tobacco etch virus (TEV) maintained for several years by mechanical transfer (TEV-M) was compared with that of a recent field isolate maintained by aphid transfer (TEV-A). The frequency of transmission of TEV-A was 10X that of TEV-M when aphids acquired virus from infected plants. Transmission from plants doubly infected with either TEV isolate and an isolate of potato virus Y (PVY) which is readily aphid-transmissible did not change the transmission frequency of either TEV isolate. When purified, neither TEV isolate could be transmitted unless helper component, prepared from PVY-infected plants, was added to the virus preparations. Purified TEV-A was then transmitted with at least twice the frequency (up to 10 times the frequency, in some experiments) at which TEV-M was transmitted. The results suggest that the aphid transmissibility of potyvirus isolates may not be solely dependent upon the ability of poorly transmitted isolates to induce the production of helper component.

THE DISTRIBUTION OF THE SOYBEAN CYST NEMATODE, *HETERODERA GLYCINES* IN LOUISIANA. Mazo Price, Choi-Pheng Yik, and *Henry C. Hill Jr., USDA-SEA-CR, Department of Plant & Soil Sciences, Southern Univ., Baton Rouge, LA 70813 and *Department of Plant Pathology, Louisiana State Univ., Baton Rouge, LA 70803.

Soybean, *Glycine max* (L.) Merr., is the major crop grown in Louisiana, comprising 2.95 million acres in 1978. The soybean cyst nematode (SCN) was first discovered in Richland parish, Louisiana, in 1967. A survey was made from 1967 - 1977 and showed the distribution of SCN in 15 parishes. Soybean fields sampled for soil and plants in 1978 showed the presence of SCN in four additional parishes - Washington, Franklin, East Baton Rouge, and East Carroll. Distribution in 1978 encompassed 19 of 64 parishes (30%) and the survey showed that the area of infestation by SCN is enlarging rapidly. SCN infestations are concentrated mostly in the parishes bordering the Mississippi River, its abandoned channels, and ox-bows. To date, only race 3 is known to occur in Louisiana.

INTERACTION OF PRECIPITATION, TEMPERATURE, AND ANNUAL RADIAL GROWTH OF WHITE OAK IN NORTHWEST ARKANSAS. D. Rhodes and F. Tainter, Dept. of Plant Pathology, University of Arkansas, Fayetteville, AR 72701.*

A decline of oak trees has occurred in northwest Arkansas during the past decade. To determine the effect of climate in initiating this decline, base-line climatic and growth data were analyzed. Ring-width indices were determined for the period 1900-1976. A below average radial growth was evident from 1963-1973. Correlation coefficients were calculated for April-May and July-September average temperature, total precipitation (1962-1972) and ring-width indices for concurrent and following years (1963-1973). A significant correlation (negative) was found only between average temperature of July-September and ring-width indices of the subsequent year. High temperature, and stress due to low soil moisture during July-September, apparently caused cellular injury which resulted in depressed growth the following year.

INDUCED RESISTANCE TO TOBACCO MOSAIC VIRUS IN HYPERSENSITIVE PLANTS UNAFFECTED BY SYMPTOMLESS INFECTION BY POTATO VIRUS X. D. A. Roberts, University of Florida, Gainesville, FL 32611.

Systemic symptomless infection of Nicotiana tabacum L. ('Samsun' NN) by potato virus X (PVX) almost doubled the diameters of lesions that formed after inoculation by tobacco mosaic virus (TMV). But PVX, provided it had been established in test plants at least 2 weeks before the first inoculation with TMV, did not interfere with the detection of systemic induced resistance to TMV. For example, the diameters of localized lesions in TMV-induced-resistant leaves of 8 PVX-infected plants in each of 3 experiments were, on the average, 48% of the diameters of those in non-resistant control plants; in plants not infected by PVX, the diameters of lesions in resistant leaves were 36% of those in the controls. The expression of induced resistance to TMV in hypersensitive tobacco plants thus seems unaffected by systemic infection of test plants by the lesion-enlarging virus, PVX.

EFFECTS OF SALTS OF LOWER FATTY ACIDS ON SCLEROTIUM ROLFSSII AND SPECIES OF TRICHODERMA IN SOIL. R. Rodriguez-Kabana. Botany and Microbiology Dept., Auburn University, Auburn, Ala. 36830.

Cupric salts of straight chained C-1 to C-8 saturated monocarboxylic fatty acids were examined for activity against Sclerotium rolfsii (SR) and selectivity for Trichoderma spp (T). When soil plates infested with SR received 20 kg/ha of the salts, growth, and production of sclerotia were reduced only in plates with formate, acetate, propionate, or butyrate. Growth of SR was eliminated only in plates with propionate which showed a 4- to 9-fold increase in colonization of SR by T compared with plates that received the other salts. Changing the cation to Na⁺, NH₄⁺, Zn⁺⁺, or Fe⁺⁺, did not alter the selective properties of propionate for T or its fungitoxicity to SR. Application of Cu propionate (CuP) to soil plates at rates of 0-30 kg/ha revealed that maximal selectivity for T occurred between 15 and 20 kg/ha. Pentachloronitrobenzene or CuP applied at 25 kg/ha stopped growth of SR but only plates with CuP had T. In greenhouse tests with Florunner peanuts in soil with SR, application of CuP at 23 kg/ha reduced mortality to 9%.

THE RELATIONSHIP OF SOIL PH TO NEMATOCIDAL EFFICACY IN SOY-BEANS. D. P. Schmitt, Department of Plant Pathology, North Carolina State University, Raleigh, NC 27650.

Each of four 9.2 X 19.5-m areas in a Lakeland sand infested with Belonolaimus longicaudatus was adjusted to pH 5.5 and 6.7 with sulfur and calcium hydroxide, respectively, or left untreated (ck) (pH 6.0). Each main plot was subdivided into five 97-cm X 9.2-m subplots which were treated with either 10-kg (a.i.)/ha of 1,2-dibromo-3-chloropropane (D), 4.5-kg (a.i.)/ha of ethoprop (E), fensulfothion (F) and phenamiphos (P). D was injected to a depth of 20-cm and bedded. E, F, and P were applied in a 30-cm band and incorporated to a depth of 15-cm. All plots were planted to Glycine max 'Essex'. The yields (g/18.4 m of row) for each pH were: pH 5.5--ck-1075, D-998, E-1718, F-1695, and P-2603; pH 6.0--ck-460, D-1827, E-1539, F-1839, and P-2086; and pH 6.7--ck-1381, D-1545, E-1945, F-2674, and P-2890. Soil pH affected nematocidal efficacy and the resulting nematode numbers at 35 and 74 days after planting which were negatively correlated (r=-0.50*) with yield.

A COMPARISON OF BAITS FOR ISOLATING PHYTOPHTHORA CINNAMOMI FROM SOIL. H. D. Shew, D. M. Benson, and L. F. Grand. Dept. Plant Pathology, N. C. State University, Raleigh 27650.

Leaf disks (9 mm diam) of 'Hershey Red' azalea (Rhododendron obtusum) and Rhododendron catawbiense, 4 to 8-wk-old seedlings of Fraser fir (Abies fraseri), 3-day-old radicles of blue lupine (Lupinus angustifolius) and needles of cedar (Cedrus deodora) were used as baits for recovery of P. cinnamomi from naturally infested soil from azalea and fir. Soil sample size varied between 5 and 150 g. Samples >50 g were washed through nested 125µm and 38µm sieves to reduce volume. Samples <50 g or 38µm sieve residue were combined with 100 ml of distilled water and 1 drop of Tween 20 in a 150 ml beaker. Baits (3-5) were floated on the water surface for 1 or 2 days at 20 C, then removed and placed on a Phytophthora selective medium and incubated at 20 C for 48 hr. Leaf disks, fir seedlings, cedar needles, and lupine radicles yielded colonies of P. cinnamomi from 100, 83, 50, and 38% of the baits cultured, respectively. Leaf disks also yielded fewer contaminants than other baits. A known inoculum density of 10 p/kg of soil could be detected.

INFLUENCE OF MELOIDOGYNE INCOGNITA AND VERTICILLIUM DAHLIAE ON TOMATO AT DIFFERENT INOCULUM DENSITIES. P. B. Shoemaker and K. R. Barker, Dept. of Plant Pathology, N.C. State Univ., Raleigh, NC 27650, respectively.

The effects of Meloidogyne incognita and Verticillium dahliae on 'Walter' tomato were studied in 4x4 factorial experiments in outdoor 16x16-cm tile microplots. Initial densities for M. incognita were: 0, 0.32, 2.54 and 20.3 eggs per cm³ of soil in 1977 and 0, 0.1, 1.0 and 10.0 in 1978. Densities for V. dahliae in both years were 0, 0.1, 1.0 and 10.0 microsclerotia (ms) per cm³. Analyses indicated that main effects for both nematode and fungus were significant, but interaction was not significant. For example, mean yields (1977) for inoculum densities of V. dahliae alone were: 0 ms (control) - 2.8 kg, 0.1 ms - 2.1 kg, 1.0 ms - 2.0 kg, and 10 ms - 1.5 kg; where the fungus was combined with the high nematode density (20.3 eggs/cm³), yields were 0 ms - 1.3 kg, 0.1 ms - 1.4 kg, 1.0 ms - 1.5 kg, and 10 ms - 0.8 kg. Thus, results of experiments over 2 years showed that M. incognita had no synergistic effect on Verticillium wilt of tomato under these semi-controlled conditions.

TABASCO PEPPER REACTION TO CUCUMBER MOSAIC VIRUS.

L. B. Simmons and L. L. Black, Dept. Plant Path. & Crop Physiol. La. State Univ. Agric. Expt. Sta., Baton Rouge, LA 70803.

Tabasco pepper plants rarely are found to be infected with Cucumber Mosaic Virus (CMV), although CMV often occurs in other pepper cultivars. Tabasco seedlings used as indicator plants are known to be susceptible to CMV. The age of plants when mechanically inoculated was found to affect symptom expression. Plants less than 8 wk old exhibited shock symptoms including veinal necrosis, ringspots, necrotic stem streaks, and leaf abscission. Growth resulting from development of lateral buds on necrotic stems was stunted, chlorotic, and distorted. Individual lateral stems of well branched 11-wk-old plants showed shock symptoms only in inoculated branches, while uninoculated branches exhibited no symptoms. Inoculated leaves of 17-wk-old plants usually developed a few necrotic ringspots but did not result in systemic symptoms. Thus, after lateral branch development CMV symptoms are restricted to inoculated branches rendering the Tabasco plant effectively resistant to field infection by CMV.

PROTEASE ACTIVITY IN RED CLOVER CLONES RESISTANT AND SUSCEPTIBLE TO BEAN YELLOW MOSAIC VIRUS. L. C. Su, Pear Ueng and S. J. Sheen, Department of Plant Pathology, University of Kentucky, Lexington, Kentucky 40506

Proteases (papain, chymotrypsin and carboxypeptidase) were detected in leaf homogenates of red clover clones KyC13, KyC71-8 and KyC36 (representing hypersensitive, systemic necrosis and chlorosis genotypes, respectively) when infected with bean yellow mosaic virus. KyC13 had the highest activity of all proteases, whereas KyC36 had the lowest. Papain activity was predominant among the proteases. At 22°C, the systemic hosts had about two-thirds the papain activity of KyC13 48 hours after inoculation. When inoculated plants were kept at 32°C, the papain activity of KyC71-8 increased to a level comparable to that of KyC13. This coincided with the localization of virus which occurs at 32°C. Protease activity in KyC36 did not increase at 32°C. Partial purification of the papain from KyC36 and KyC71-8 markedly increased its activity. It is proposed that the regulation of protease activity by endogenous and exogenous factors may be involved in the virus localization.

SURVIVAL AND INOCULUM POTENTIAL OF RHIZOCTONIA SOLANI IN DOTHAN LOAMY SAND SOIL. Donald R. Sumner, Coastal Plain Station, Tifton, GA 31794

Pasteurized soil was infested separately with 3 isolates of Rhizoctonia solani (AG 4) and 3 soil dilutions were made to produce <0.1 to >3.2 propagules/g (PG) of soil. Cucumber, polebean, and cowpea were planted in infested soils in a greenhouse. Populations were determined by placing soil on tannic acid-benomyl agar (TAB). Approximately 0.2 PG caused 50% damping-off in all crops. In March those soils and soils infested separately with 6 other isolates of R. solani were placed in clay pots and buried 5 cm below the rim in a field, where they remained fallow and exposed to weather for 25 wk.

Soil temperatures 10 cm deep in the pots were 22 to 40°C from June through August. Soils were then re-assayed and planted to Eagle snapbean for 2 wk. Six of 9 isolates survived and caused root disease. Damping-off was correlated ($r=0.67$) with numbers of colonies >2 cm diam, but root disease index ratings were correlated with the total number of colonies on TAB.

THE EFFECTS OF FOUR VIRUSES ON BELLS, JALAPEÑOS, CHILES AND OTHER PEPPER TYPES. Ben Villalon, Texas Agricultural Experiment Station, Weslaco, Texas 78596.

Viruses are the major disease factor in the decline of profitable pepper production in Texas. A virology-breeding program has yielded breeding lines resistant to tobacco etch, pepper mottle, potato y, and tobacco mosaic virus. Resistant lines include bells, jalapeños, chiles, pimientos, anchos, cherries, cayennes, serranos, yellow pickling and pepperoncini. Tests indicated a significant difference in yields and overall performance between resistant and susceptible germplasm. Significantly higher yields were found between healthy and virus inoculated peppers. Six bell cultivars inoculated with 4 viruses ranked line 7506 the highest yielding followed by K.R.G. no. 3, Delray Bell, Lucky Green Giant, VR-2 and Pip. In noninoculated trials, there were no significant differences in 24 highest yielding bells, 10 of which were resistant, 6 chile lines yielded higher than 3 commercial varieties. The 10 highest yielding jalapeños were virus resistant lines.

ENERGY COMPARISONS OF ALTERNATE PEST MANAGEMENT SYSTEMS. G. Vredeveld, R. Bullard, M. Sells, S. Sims, and J. West, University of Tennessee, Chattanooga, TN 37401.

Deleterious effects of chemical pesticides on many plant and animal populations have been described. Rapidly increasing costs of convenient energy sources have increased cost-benefit ratios of chemical pesticides used. We compared biological control techniques versus chemical pesticides for inputs of human labor, machinery, and fuel per hectare at each pertinent step of the production procedure. We selected three pest-crop systems and converted all applicable factors into Kcal. of energy required. The three are (1) citrus-red scale Aonidiella aurantii using oil as a chemical and the predator wasp, Aphytis melins as a biological control, (2) tomato-hornworm using Sevin or the bacterium, Bacillus thuringiensis, and (3) pea-damping off treating the seed with Captan or

spores of the fungus Penicillium oxalicum. In system (1) the pesticide required 14,864,000 Kcal., the wasp 119,000 Kcal.; (2) Sevin 97,903, B. thuringiensis 39,824; (3) Captan 73,000, P. oxalicum 24,000 Kcal.

MYCOFLORA AND MARKET QUALITY OF CHESTNUTS TREATED WITH HOT WATER FOR CONTROL OF THE CHESTNUT WEEVIL. John M. Wells and Jerry A. Payne. United States Dept. of Agriculture, Science & Education Administration, Agricultural Research, Southeastern Fruit and Tree Nut Laboratory, P. O. Box 87, Byron, GA 31008.

Post-harvest treatments of Chinese chestnuts in 52 C water for 5 or 15 minutes reduced the percentage of infection of weevil-damaged or discolored kernels and the number of fungal colonies isolated by about 50% compared to nontreated checks. Thirty minute treatments were significantly more effective but also resulted in a decrease of soluble sugars, thereby slightly affecting market quality. The addition of the fungicide 2,6-dichloro-4-nitroaniline (Botran) to the hot water reduced total number of colonies isolated compared to hot water alone but did not reduce percentage of kernels infected. Species of Alternaria, Penicillium, and Aspergillus were the major genera of fungi most commonly isolated from discolored or damaged chestnuts.

ROOT TISSUE REACTIONS OF SWEET POTATO TO THE RENIFORM NEMATODE. Choi-Pheng Yik and W. Birchfield, Dept. Plant & Soil Science, Southern Univ., Baton Rouge, LA 70813 and USDA-SEA, Dept. Plant Path. & Crop Physiol., La. State Univ., Baton Rouge, LA 70803.

The reniform nematode, Rotylenchulus reniformis Linford and Oliveira 1940, severely reduces tuber size and grade quality of sweet potatoes in Louisiana. Feeder roots of Centennial sweet potato had abundant females and egg-masses 3 wk after inoculation. The female nematodes were present in the root cortex. The juveniles penetrated intercellularly and fed in the single-layered endodermis. A single endodermal cell at the nematode head hypertrophied into a giant cell. The uniseriate pericycle adjacent to the giant cell reacted to the infection and hypertrophied into a curved sheet of syncytia encompassing 7-10 cells on either side of the infection site. These infected pericycle cells stained darkly with methylene blue and showed dense cytoplasmic contents. Phloem cells at the infection point enlarged crushing the cambium layer and compressing the xylem vessels.

*Presented in the Graduate Student Award Competition of the Southern Division of the American Phytopathological Society.