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ABSTRACTS

NEW RESEARCH HORIZONS FOR PLANT PATHOLOGISTS IN BIOMASS PRODUCTION AND CONVERSION TO FUELS. Antonios A. Antonopoulos, Energy and Environmental Systems Division, Argonne National Laboratory, Argonne, IL 60439.

The traditional role of plant pathologists in providing abundant and healthy food for a better life is now extended to matters of fuel production, utilization, and conservation. New phytopathological problems resulting from the development of biofuel farms, the introduction and cultivation of new biofuel plants, and the use of microbes to degrade crop residues and industry wastes and to convert biomass to fuels will be encountered by plant pathologists. This paper discusses the results of three studies, namely: (a) the potential threat of plant pathogens to silvicultural yields of biomass-for-fuels; (b) lignin degradation, cellulose saccharification, and monosaccharide fermentation for fuel production; and (c) assessments of potential fuel savings in the application of plant disease control measures. Finally, contributions of plant pathologists to the national program of biomass-for-fuels are identified and evaluated.

PATHOGENICITY OF BOTRYODIPLODIA HYPODERMIA ON AMERICAN ELM. C. L. Ash and R.W. Stack, North Dakota State Univ, Fargo, ND 58105

Botryodiplodia hypodermia (Sacc.) Pet. causes a twig canker and dieback of American elm. The yellow foliar symptoms superficially resemble those of Dutch elm disease (DED). B. hypodermia has been isolated from about 20% of the samples sent in for DED diagnosis in North Dakota over a period of several years. B. hypodermia was isolated from 18% of branches with dieback and yellow foliar symptoms collected from mature city trees. It was not isolated from branches with yellow foliage but no dieback. B. hypodermia was isolated from 13% of young trees showing dieback symptoms. American elms were wound inoculated with spore suspension from April through September. Most infection occurred during April, May and June. B. hypodermia was reisolated from 56% of inoculated branches. Fruiting bodies developed in October on these inoculated branches. Pycnidia collected in March from naturally infected branches contained abundant spores. Infection is thought to occur through winter injuries in small twigs and branches.

FURTHER CHARACTERIZATION OF PANICUM MOSAIC VIRUS AND ITS SATELLITE VIRUS. F. G. Buzen and C. L. Niblett, Department of Plant Pathology, Kansas State University, Manhattan, KS 66506.*

Panicum mosaic virus (PMV) supports the replication of satellite panicum mosaic virus (SPMV). PMV replicates in the absence of SPMV, whereas SPMV requires PMV for its replication. PMV and SPMV are unrelated serologically and differ in their sedimentation coefficients and the sizes of their virions, RNAs and capsid proteins. At least six serotypes of PMV have been identified. They can be further separated into two groups based on their electrophoretic mobilities. Purified SPMV is activated in the presence of either PMV or Molinia streak virus (from Germany), which shares a distant serological relationship with PMV. Although biologically similar to tobacco necrosis virus and its satellite virus, PMV and SPMV share no serological relationship with either of these viruses.

*Presented in the Graduate Student Award Competition of the North Central Division of The American Phytopathological Society.

THE EFFECT OF NITROGEN ON PHYTOPHTHORA ROOT ROT OF SOYBEANS. C. H. Canaday and A. F. Schmitthenner, Dept. of Plant Pathology, and the Ohio Agric. Res. & Devel. Center, Wooster 44691.

The effect of nitrogen on Phytophthora root rot of soybeans was studied using field soil naturally infested with Phytophthora megasperma var. sojae (Pms). Soil collected from beneath diseased soybeans was mixed and packed into 1.9 liter cardboard cartons at a bulk density of 1.25 and soil matrix potential of -0.3 bar. After 1 mo at 5 C, the soil cartons were frozen and stored 1-5 mo at -8 C. Cartons were thawed and warmed over 3 wk to 18-24 C before planting with soybeans (cv. Amsoy). Urea and ammonium nitrate solutions were applied 10 days before planting at 4, 16, 40, and 100 ppm N. Soybeans were grown for 1 mo in growth chambers. Cartons were individually weighed and watered to control the average soil matrix potential. Both forms of nitrogen at 40 and 100 ppm significantly increased seedling damping-off and total plant kill due to Pms. Root rot and stunting were significantly increased by as little as 16 ppm N. Earlier application of ammonium nitrate (at the time of carton packing) did not increase disease.

EFFECT OF THREE DESSICANTS ON SOYBEAN STEM COLONIZATION BY PHOMOPSIS SOJAE AND COLLETOTRICHUM DEMATIUM VAR. TRUNCATA. R. F. Cerkauskas and J. B. Sinclair, Dept. of Plant Pathology, Univ. of Illinois, Urbana, IL 61801.*

Bonus and Wells soybeans at the R_7 stage (50% defoliation) were sprayed with Paraquat 29.1L (2.34 l/ha) and Bonus soybeans were sprayed with either $NaClO_3$ + $Na_2B_4O_7 \cdot H_2O$ (3.4 kg/ha) (50:50) or Roundup (9.35 l/ha). Ten stems from each of 3-5 sampling dates were cut from the mid-region of plants either sprayed or nonsprayed and rated (1 to 5) for presence of pycnidia (Pj) or acervuli (Cdt). Stems with 26% or more coverage with fruiting bodies were significantly ($p=.05\%$) greater on Paraquat sprayed than on nonsprayed stems for all sampling dates. No differences occurred in amount of fruiting bodies between stems from the $NaClO_3$ + $Na_2B_4O_7 \cdot H_2O$ and Roundup sprayed and nonsprayed plants, except at 19 days after spraying with Roundup. For the three dessicants there was no difference in the rate of the development of fruiting bodies on any cultivar between sprayed and nonsprayed plants.

GOLDEN STAIN OF LODGEPOLE PINE (PINUS CONTORTA DOUGL. ex LOUD.) HEARTWOOD. Wallace E. Eslyn, Forest Products Laboratory, U.S. Forest Service, P.O. Box 5130, Madison, WI 53705.

Utility poles of lodgepole pine were found to contain a golden orange stain in the vicinity of their heartwood-sapwood boundary. Questions subsequently arose as to the cause of the stain as well as to its possible effect upon wood strength. Sections of discolored wood observed microscopically contained yellowish, oily globules and hyaline, nodose-septate hyphae within cell lumina. Confertobasidium olivaceoalbum (Bourd. & Galz.) Jülich--formerly Corticium fuscostratum Burt--was isolated from the stained areas. Subsequent inoculation of lodgepole pine and southern yellow pine heartwood and sapwood with

the isolate resulted in staining of heartwood only in both species. Use of this fungus in differentiating between heartwood and sapwood in Pinus spp. may be indicated. C. olivaceo-album caused only minor weight losses in both pine heartwood and sapwood in standard (ASTM) soil block tests and probably is not capable of physically deteriorating wood in use.

IMMUNOFLUORESCENCE: A METHOD FOR IDENTIFYING ERWINIA TRACHEIPHILA. G.E. Evans and W.R. Stevenson. Dept. of Botany and Plant Pathology, Purdue Univ., West Lafayette, IN 47907.*

Immunofluorescent microscopy was used to detect Erwinia tracheiphila in culture and in infected melon stem sections and macerates. Antiserum to E. tracheiphila was produced in rabbits by weekly intramuscular injections of 1 ml of glutaraldehyde fixed bacterial cells ($3.5x10^9$ cells/ml) mixed with 1 ml of Freunds incomplete adjuvant. The resultant antiserum reacted with E. tracheiphila to a titer of 1:32,000 in micro-agglutination tests, but titers failed to exceed 1:64 with 30 other species belonging to the genera Erwinia, Xanthomonas, Pseudomonas, and Agrobacterium. Gamma globulins prepared by ammonium sulfate precipitation were conjugated with fluorescein isothiocyanate (FITC) for direct staining of E. tracheiphila. Unconjugated gamma globulins and FITC conjugated goat anti-rabbit serum were used for indirect staining, a superior method for detecting bright fluorescent masses of bacteria in infected xylem elements. Hence, immunofluorescence appears to be useful for rapid clinical diagnosis of infected specimens.

IMPROVED PURIFICATION OF WHEAT SOIL-BORNE MOSAIC VIRUS. Ferguson, M.W. and Uyemoto, J.K., Department of Plant Pathology, Kansas State University, Manhattan, Kansas 66506.*

Wheat soil-borne mosaic virus (WSBMV) was purified with sodium acetate buffer, pH 5.0, containing 1% sodium metaphosphate $(NaPO_3)_6$. Frozen infected wheat (Triticum aestivum L. cv. Eagle), was triturated in buffer (1:3, w/v) and filtered through cheesecloth. After differential centrifugation, high-speed pellets were resuspended in 0.05 M sodium borate pH 7.5 and 0.001 M EDTA, layered on a 10 ml pad of 20% sucrose in borate buffer, and repelleted. These pellets were resuspended in borate buffer and further purified by density gradient centrifugation and/or zone electrophoresis. Sodium metaphosphate increased virus yields 25-fold over that of sodium acetate alone. Grinding increased amounts of plant tissue (50 g-200 g) resulted in a near linear increase in virus yield; however, the requirement for $(NaPO_3)_6$ was non-linear (1%/50 g tissue vs. 2.5%/200 g tissue). Antiserum was prepared and tested in enzyme-linked immunosorbant assay (ELISA).

EFFECT OF SOIL FUMIGATION ON SURVIVAL OF MACROPHOMINA PHASEOLINA IN SOYBEAN STEM RESIDUE. L. E. Gray, USDA, SEA/AR, Department of Plant Pathology, University of Illinois, Urbana, Illinois 61801.

In 1977 the soil fumigant Sodium N-methyl dithiocarbamate (Metham) was applied to a Cisne silt loam soil and evaluated for the control of Macrophomina phaseolina in soybean stem residue. The fumigant was applied at the rate of 474 ml in 3.8 liters of water to each 1.8m x 2.4m plot and incorporated into the top 15 cm of soil. Total fungal population counts and total population counts of Macrophomina in soybean stem residue from fumigated plots were significantly lower than that in stem residue samples from control plots. Percent plant infection and percent root colonization of Wells soybean by Macrophomina was reduced by soil fumigation. Twenty-five percent of the tap roots of Wells soybeans in fumigated plots were infected compared to 97 percent in control plots. Soybean yields were increased 16 percent by fumigation.

MICROFLORA FROM BRANCH WOUNDS OF QUERCUS RUBRA. T. J. Hall and Curt Leben. Ohio Agric. Res. and Devel. Center, and The Ohio State Univ., Wooster 44691.

Branches of red oak trees 4-8 cm diam were removed at forks in October 1978, leaving 15-20 cm stubs. In December, stubs were removed, placed in plastic bags, and frozen until assayed. Ten disks, 6-8 mm thick, were cut serially from the exposed end of each frozen stub and then debarked and quartered into wedges. Frozen wedges were surface-sterilized by immersing 6 sec in boiling water. Wedges were incubated 40 hr at 24 C in a sterile dish containing water-saturated air and then each surface was printed for 2 min on an oak wood diffusate agar. A plug of a decay fungus (DF) was placed on the agar 2 cm from the edge of the print. After 6 days, bacteria, yeasts, and fungi inhibitory to DF were observed. Some isolates also prevented growth of Polyporus glomeratus and Stereum frustulatum through red oak disks when isolates were applied to surface-sterilized disks 3 days prior to adding DF. Bacteria were found in sapwood and heartwood of all wedges, whereas yeasts and fungi in sapwood but only occasionally in heartwood.

TRANSMISSION OF BARLEY YELLOW DWARF VIRUS (BYDV) FROM TOLERANT AND INTOLERANT SISTER OAT LINES BY RHOPALOSIPHUM PADI L. AND MACROSIPHUM AVENAE FAB. IN RELATION TO THE LENGTH OF ACQUISITION FEEDING. H. Jedlinski, USDA, SEA, AR, Department of Plant Pathology, University of Illinois, Urbana, IL 61801.

In parallel tests no apparent differences in transmissibility of BYDV by either M. avenae or R. padi to Coast Black oats from three pairs of infected sister oat lines, each tolerant and intolerant to the virus, were observed with acquisition feedings of 12, 24 or 48 hr. R. padi had higher transmission frequency (80%) than M. avenae (32%). Although transmission frequencies increased with the length of acquisition feeding, particularly for M. avenae, the mean disease incubation period remained 11 days when the virus was transmitted by R. Padi, and 16 days when the virus was transmitted by M. avenae regardless of the oat line used as a source plant or of the length of the acquisition period.

LEAF EXPANSION OF SOYBEANS INFECTED BY PHYTOPHTHORA MEGASPERMA VAR. SOJAE. D. R. Kittle, D. B. Peters and L. E. Gray, USDA, SEA/AR Department of Plant Pathology, University of Illinois, Urbana, Illinois 61801.*

An inexpensive potentiometric transducer capable of monitoring leaf enlargement of soybean plants was constructed. The tips of leaves were attached to a thread, while the petiole was immobilized at the axil. The thread was connected to a 500 ohm 10-turn potentiometer. As the leaf expanded the shaft of the potentiometer rotated, changing its resistance. This unit can detect changes in leaf size as small as 100μ. Susceptable Amsoy soybeans were grown in soil infested with various levels of Phytophthora megasperma var. sojae (PMS). Leaf expansion was monitored for 2 to 5 day periods. Leaf expansion was limited to periods of darkness. Leaves of PMS infected plants expanded less, had significantly slower rates of expansion, and required more time for expansion to begin after the onset of darkness, compared to healthy plants.

PSEUDOMONAS LACHRYMANS: MIGRATION FROM SEED TO ROOTS. Curt Leben. Ohio Agric. Res. and Devel. Center, and The Ohio State Univ., Wooster 44691.

Cucumber (Cucumis sativus) seeds inoculated with P. lachrymans were anchored with drops of melted 1.5% water agar on 2.4% water agar in petri or larger plates. Plates were sealed and incubated vertically 4-6 days in light. P. lachrymans was found on all parts of the symptomless seedling root system, which was on the agar surface. The bacterium was detected with selective agar M71 (Phytopathology 62:674) by plating the entire root system or root sections. It also was detected by velvet replica prints of roots on agar or of agar after root removal. When seeds were anchored on dialysis film placed on water agar, migration also took place. Removing roots and staining the agar or film surface revealed many bacterial cells. Most were in lightly stained material next to roots. Some cells were dividing. Thus, P. lachrymans may be an active member of the cucumber rhizosphere microflora.

RELATIONSHIP BETWEEN BROWN SPOT SEVERITIES AND YIELD LOSSES IN SOYBEANS. S. M. Lim, USDA-SEA-AR, Department of Plant Pathology, University of Illinois, Urbana, IL 61801.

The potential effect of Septoria glycines on yield, 300-seed weight of 'Wells' and 'Williams' soybeans, and the relationship between disease severity and yield loss were studied in

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1977 and 1978. Yield reductions in 'Wells' which were artificially inoculated at different growth stages ranged from 12.0 to 33.7% while yield reductions ranged from 8.7 to 12.0% in naturally infected 'Wells' when compared to yield from the fungicide-protected plots. Yield reductions in artificially inoculated 'Williams' ranged from 13.3 to 31.7% while yield reductions in naturally infected 'Williams' were from 8.0 to 13.0%. S. glycines caused reduction in 300-seed weight from 0 to 19% in 'Wells' and 5.7 to 13.0% in 'Williams'. Best estimates of reduction in yield were found with the linear expression of area-values under brown spot progress curves.

WHEAT STREAK MOSAIC VIRUS RESISTANCE IN HEXAPLOID WHEAT. T. Joe Martin, Fort Hays Branch Experiment Station, Hays, Kansas 67601.

Resistance to wheat streak mosaic virus (WSMV) was found in hexaploid wheats. In seedlings tested at 22 C, Eagle (CI 15068), PI 225237, PI 194358, and PI 195713 were less receptive to mechanical inoculation and developed systemic symptoms more slowly than Parker, the susceptible check. Infectivity assays of systemically infected plants of the four resistant cultivars showed they contained lower virus concentrations than did Parker. The resistance of Eagle was not detected at 27 C. PI 225237 was less resistant at 27 C than at 22 C. The resistance of PI 194358 and PI 195713 was unchanged at 27 C. Field studies and seedling tests on F_3 lines derived from Eagle x PI 194358 and Eagle x PI 195713 indicate the sources of resistance in these lines are additive. These results improve the prospects of developing an effective level of WSMV resistance in hexaploid wheats.

CONTROL OF ROOT KNOT NEMATODE WITH AN EXPERIMENTAL NEMATICIDE, DS-16813. Douglas W. McWhorter and Richard K. Lankow, Diamond Shamrock Corp. T. R. Evans Research Center, P.O. Box 348, Painesville, Ohio 44077.

DS-16813 (4-methyl-3-methylcarbamyloximinotetrahydrothiapyran) was evaluated for root knot nematode control by several application methods. Greenhouse tests indicated that DS-16813 controlled root knot in cucumbers and tomatoes at rates equivalent to 1.1 kg/ha. Effective control was noted with in-furrow application equivalent to 9-18 g a.i. 100m of row applied in a band 5 cm wide. Residual activity of DS-16813 was maintained for 3 weeks after treatment. Field tests were established in galvanized steel cylinders 75 cm in diameter and 90 cm deep. The cylinders were filled with sandy soil and infested with root knot inoculum. Six susceptible tomato plants were planted in each plot. DS-16813 reduced root knot an average of 87% and increased fruit yield by 79%. Aldicarb averaged 92% control of root knot and increased fruit yield 121%.

SEPTORIA BROWN SPOT OF SOYBEANS: EFFECT OF ROW WIDTH AND TILLAGE PRACTICE ON DISEASE DEVELOPMENT. M. T. Mmbaga, C. R. Grau and D. C. Arny, Dept. of Plant Pathology, Univ. of Wisconsin, Madison, WI 53706. *

Brown spot (caused by Septoria glycines Hemmi) development in the field was studied during the growing seasons of 1977 and 1978 to test the effect of row width on disease severity and on grain yield; 18, 38, and 76 cm rows were used in 1977 and 38 and 76 cm rows in 1978. The effect of shallow and deep tillage was studied. In 1977 naturally infected plots showed disease indices of 1.5, 2 and 4.5 for 76, 38 and 18 cm row widths, respectively, in early August, but by end of the season readings of 9.8 and 10 were obtained (scale 0-10). Eighteen cm rows produced about 7% more yield than 76 cm rows. In 1976, grain yield was 19% higher in 38 cm rows compared to 76 cm rows in deep plowed plots, while in disked plots 76 cm rows produced 11% more yield. Shallow tillage supported signficantly more disease than deep tillage (disease index 2 for row widths deep plowed vs 3 and 4 for 76 and 38 cm row widths disked).

THE EFFECT OF THE TIMING OF CHLOROTHALONIL APPLICATIONS ON APPLE FRUIT RUSSETTING

Robert Neundorfer, Richard K. Lankow, Diamond Shamrock, T. R. Evans Research Center, Box 348, Painesville, Ohio 44077

Chlorothalonil is an effective fungicide for the control of apple scab but has not been registered for this use, however, since it was found to cause russetting of apple fruit. The present study was conducted to determine which stages of development the apple fruit are most sensitive to injury from chlorothalonil. Single sprays were applied to individual blocks of 4 apple varieties at different times throughout the season. It was found that sprays applied prior to the pink bud stage did not cause fruit russetting. Sprays applied at pink bud onward resulted in severe apple fruit russetting, whereas sprays applied to fruit more than one-half inch in diameter did not. Thus, it would appear that carefully timed sprays of chlorothalonil may possibly have use in a multifungicide or SAT spray programs designed to prevent the formation of fungicide resistance to other materials.

SEEDLING BLIGHT AND STALK ROT OF MAIZE CAUSED BY GIBBERELLA ZEAE. S.K. Onken and H.L. Warren, Dept. Botany and Plant Pathology, USDA, Purdue University, W. Lafayette, IN 47907.*

Gibberella zeae (Schw.) Petch causes seedling blight, stalk, and ear rots of dent corn. Studies were conducted to determine a) the resistance of 50 corn inbreds to seedling blight and the role of nitrogen in disease expression; b) the effect of captan-seed-treatment on emergence in the field; and c) the resistance of 50 inbreds to stalk rot. Of the 50 inbreds screened for resistance to seedling blight, 24 were susceptible, 22 moderately susceptible, and 4 were resistant (187-2, A632, W37A, and W182B). The addition of nitrate-or ammonium-form of nitrogen caused an increase in disease severity in comparison to a no-nutrient treatment. Of the two nitrogen treatments, the nitrate treatment tended to have lower disease severity. Captan-seed-treatment resulted in an 8.7% increase in germination, from 59.2% to 67.9%. Of the 50 inbreds screened for stalk rot, 27 were resistant, 21 moderately susceptible, and 2 were susceptible to the pathogen. The correlation coefficient value for seedling blight severity to stalk rot severity was 0.0458.

MONITORING SOYBEANS IN ILLINOIS FOR FOLIAR DISEASES. J. K. Pataky, S. M. Lim, E. G. Jordan and R. L. Warsaw, Dept. of Plant Pathology, Univ. of Illinois, USDA-SEA, and USDA-APHIS, Urbana, IL 61801.

A soybean monitoring program was established in 1977 and 1978 to determine the incidence and intensity of foliar diseases in regions of Illinois, to identify disease risk situations, and to detect shifts in pathogen populations. For the 2 years, a total of 17 cultivars from 5 maturity groups were planted at 10 locations. Cultivars were evaluated every 2 to 3 weeks. In both years, severities of brown spot (Septoria glycines) were high at all locations and downy mildew (Peronospora manshurica) was prevalent in central and southern Illinois. Bacterial blight (Pseudomonas glycinea) was intense in northern Illinois in 1977. Late-maturing cultivars were more intensely infected than early-maturing cultivars when conditions were favorable for disease development.

ESTIMATING APHANOMYCES EUTEICHES POPULATION IN SOIL BY A MOST PROBABLE NUMBER TECHNIQUE. W. F. Pfender and D. J. Hagedorn, Dept. Plant Pathology, Univ. of Wisconsin, Madison, WI 53706.*

A procedure based on the "most probable number" technique was developed to estimate the density of infective propagules of Aphanomyces euteiches in soil. Infested field soil is mixed with sand or pasteurized field soil to produce several dilution levels. Each dilution level is divided into aliquots and placed as a 1-cm layer, sandwiched between layers of vermiculite, in compartments (2x2x8 cm) of a transplant tray. Peas are planted in the compartments. The tray is placed in a pan of water, with the water level 1 cm below the soil layer, at 24°C. At 2-3 wks after planting, each plant is removed and scored, by symptoms and/or plating, as positive or negative with respect to infection by Aphanomyces. These data can then be analyzed to estimate the number of infective propagules of this pathogen present in a unit volume of the undiluted field soil. Preliminary results indicate that this method may be helpful in understanding the behavior of this fungus in soil.

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DOUBLE-STRANDED RNA IN CERATOCYSTIS ULMI. Paul L. Pusey and Charles L. Wilson, Department of Plant Pathology, Ohio Agricultural Research and Development Center, Wooster 44691.*

American isolates of Ceratocystis ulmi were examined for the presence of double-stranded RNA (dsRNA) by electrophoresis on 2.4% polyacrylamide gels. DsRNA was detected in 5 of 10 "more aggressive" (MA) isolates and 4 of 5 "less aggressive" (LA) isolates. From MA isolates, electrophoresis revealed 1-2 dsRNA bands with approx. molecular weights (MW) of 1.5 X 10^6 and 1.6 X 10^6 daltons. DsRNA from 3 LA isolates separated into 5-7 bands with MW's ranging from 0.14 to 1.5 X 10^6 daltons. A fourth LA isolate possessed only 2 dsRNAs with MW's of 1.6 X 10^6 and 2.0 X 10^6 daltons. Overall, LA isolates had more dsRNA species than MA isolates. Although the presence of dsRNA may be related to aggressiveness, it is thought that other factors must also be involved. Other characters were studied in relation to aggressiveness. The most consistent differential character in culture has been the more rapid growth of LA isolates at the supraoptimal temperature of 33 C.

CULTURAL AND MORPHOLOGICAL VARIABILITY IN KABATIELLA ZEAE NARITA & Y. HIRATSUKA, THE CAUSAL AGENT OF EYESPOT OF MAIZE (ZEA MAYS L.). Francisco J. B. Reifschneider and Deane C. Arny. Department of Plant Pathology, University of Wisconsin, Madison, WI 53706.

A total of 28 monoconidial isolates from different regions (Canada-3; France-4; New Zealand-3; Yugoslavia-1; U.S.A.-17) were compared. Two basic colony types were identified on malt agar (MA): light (5 isolates) and dark (23 isolates) colored. Radial growth on MA at 24 C varied from 1.1 to 4.4 mm/day, the largest growth rates being characteristic of the light-colored isolates. Two isolates showed a distinct grey color and aerial mycelium, and they were found to have lost their sporulating ability in vitro and in vivo. The optimum temperature for radial growth was 24 C for 17/28 % of the isolates. Conidia in vivo (150 conidia measured/isolate) varied from 12.5-35.0 um x 2.0-3.0 um, with l/b ratios from 7.15-10.04 ($\bar{x}$ = 8.94). There were significant differences in conidial length among the isolates.

HOST RANGE OF KABATIELLA ZEAE, THE CAUSAL AGENT OF EYESPOT OF MAIZE. Francisco J. B. Reifschneider and Deane C. Arny. Dept. Plant Pathology, University of Wisconsin, Madison, WI 53706.*

The study was carried out by inoculating 63 grasses (37spp) in a greenhouse (GH), growth chamber (GC), and/or in the field. For GH and GC inoculations, a spore suspension was sprayed on the plants, which were placed in a mist chamber. In the field, grasses were planted alternately with maize line W64A, which was sprayed with a spore suspension and dusted with infected debris. In GH, Sorghum bicolor (3cvs) developed atypical symptoms: punctiform, purplish spots. In GC, Echinochloa crusgalli var. frumentacea, Setaria viridis, S. bicolor (4cvs) and S. sudanense (2cvs) showed similar atypical symptoms as well as larger (+ 7mm) necrotic spots. In GC, Zea diploperennis, Z. mays ssp. luxurians, Z. mays ssp. mexicana, and Z. perennis showed typical lesions. In the field, S. viridis and S. bicolor (1cv) showed atypical lesions on senescing tissue. Reisolation was possible, and sporulation observed in lesions from GC and field. Symptoms, sporulation in vivo, and reisolation were the criteria for considering the Zea spp. as hosts.

INHERITANCE OF RESISTANCE TO KABATIELLA ZEAE NARITA & Y. HIRATSUKA, THE CAUSAL AGENT OF EYESPOT OF MAIZE (ZEA MAYS L.). Francisco J.B.Reifschneider and Deane C. Arny. Department of Plant Pathology, University of Wisconsin, Madison, WI 53706.*

Inheritance of resistance to eyespot was studied in four crosses involving two resistant (R) and three susceptible (S) inbred lines, as follows: W64A (S) x Oh43 (R), WF9 (S) x C123 (R), Oh43 (R) x C123 (R), and W64A (S) x W117 (S). The inbreds, F 1's, F 2's, and backcrosses of F 1's with both inbred parents of each cross were evaluated by artificial inoculation in the field. The segregation observed suggested that resistance was quantitative in expression, and partially dominant. Estimates of minimum number of genes involved in the R x S crosses gave values close to two. Broad sense heritability estimates varied from 56 to 100 %, the lowest value obtained in the S x S cross. The F 1 of the S x S cross was more resistant than either parent, suggesting heterosis. The R x R cross suggested the presence of modifiers in inbred line C123.

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ONION TISSUE RESPONSE TO WOUNDING OR INOCULATION OF INTACT BULBS WITH COLLETOTRICHUM DEMATIUM var CIRCINANS AND BOTRYTIS ALLII INCUBATED IN LIGHT OR DARK. V. RUSSO, D. HARMAN, K. HAYDEN, A. IWEN, T. PORTLE, J. SPREENBERG, J. STONE AND A. PAPPELIS, DEPT. OF BOTANY, SOUTHERN ILLINOIS UNIVERSITY/CARBONDALE, CARBONDALE, ILLINOIS 62901 *

White, yellow, and red onions were exposed to air and inoculated with Colletotrichum dematium var circinans (CDC) and Botrytis allii (BA). Wounded and untreated tissue, on the same bulbs, served as controls. Bulbs were incubated in light or dark for upto 7 days. Lesion area, pH of control, lesion, and adjacent tissues were measured. Movement of nuclei, in 2 vertical rows, 20 cells/row, in tissue adjacent to wounds and lesions was recorded. Largest lesions were produced by BA. Dark incubated bulbs had smaller lesions than those incubated in light. The converse was true for CDC. Basal areas of bulbs exhibited smallest lesions. Lesion pH was shifted below that of controls. Nuclei moved to sides of cells toward lesions. Movement was not related to lesion size, lesion pH, pathogen tested, or section of onion inoculated.

PROTECTION AGAINST STRESS PREDISPOSITION TO BOTRYOSPHAERIA CANKER IN CORNUS STOLONIFERA SOIL-INJECTED WITH BENOMYL. D. F. Schoeneweiss, State Natural History Survey, Univ. of Ill. Urbana, Ill. 61801.

Containerized plants soil-injected with 36 or 72 g/m^2 benomyl in spring were inoculated and wilted to below -12 bars plant ψ, then incubated for 1 week. Benomyl levels in stems, determined by a chloroform extract bioassay, averaged 11.3 to 18.6 ug/g over the 32 day test period. Stems of treated plants and non-stressed controls were not colonized compared to stressed controls. Plants injected in fall with 36g/m^2 benomyl were frozen to -30°C. Benomyl levels averaged 8.3 ug/g in 1-year-old and 3.4 ug/g in 3-year-old stems. Stems of treated 1-year-old plants were not colonized but treated 3-year-old stems were colonized over half as much as frozen control. Apparently a single soil injection of benomyl provides long term protection against water stress predisposition, and against freezing predisposition in young but not older woody stems, possibly due either to greater benomyl accumulation in younger xylem or to greater susceptibility of older xylem to freezing stress.

ANTHOCYANIN ACCUMULATION IN STEMS OF CORNUS STOLONIFERA IN RESPONSE TO INFECTION BY BOTRYOSPHAERIA DOTHIDEA. Schoeneweiss, D. F. and C. Grunwald, State Natural History Survey, Univ. of Ill., Urbana, Ill. 61801.

A pronounced reddening surrounding inoculation sites appeared on young green stems of C. stolonifera following inoculation with B. dothidea. Spectrophotometric analysis of HCL-methanol stem extracts indicated accumulation of anthocyanins. Subsequent tests revealed that anthocyanin accumulation was a light-mediated response to the presence of the fungus and not a wound response. In stems of plants predisposed by water stress to attack by B. dothidea, anthocyanin accumulation was greater and more rapid than in turgid, resistant stems. The pathway of anthocyanin synthesis is similar to that of certain fungitoxic flavanoids and phytoalexins associated with host defense responses to infection.

COLLETOTRICHUM GRAMINICOLA: HOST SPECIFICITY AND PLANT AGE. Farhat F. Shahnaz and R.L. Nicholson. Department of Botany and Plant Pathology, Purdue University, W. Lafayette, IN 47907.

Colletotrichum graminicola isolates from infected corn, sorghum, & shattercane leaves were tested for host range & pathogenicity. Plants (15 days old) of corn (Mo940, 33-16, & $Mo17_{Ht}xB73_{Ht}$), sorghum (P72IN & Br-54) & a field selection of shattercane were inoculated with each isolate (10^6 sp/ml). Mo940 & $Mo17_{Ht}xB73_{Ht}$ were susceptible to the corn isolate and 33-16 was hypersensitively resistant. Corn only showed chlorotic flecks in response to sorghum (SO) & shattercane (SH) isolates; but, senescing leaves of Mo940 & $Mo17_{Ht}xB73_{Ht}$ showed lesion develop-

ment of the susceptible reaction type. No symptoms developed on sorghum in response to the 3 isolates unless plants were at least 5 weeks old at the time of inoculation. Br-54 was resistant to the SO & SH isolates & P72IN was susceptible to the SO isolate but resistant to the SH isolate. No symptoms developed on sorghum in response to the corn isolate. Thus, isolates were host-specific on vigorous tissue but senescing corn may also be susceptible to SO & SH isolates.

FUNGICIDE INFUSION OF SOYBEAN SEEDS USING AQUEOUS AND NONAQUEOUS CARRIER-SOLVENTS. B. J. Shortt and J. B. Sinclair, Dept. of Plant Pathology, Univ. of Illinois, Urbana 61801.*

Soybean (Glycine max cv. Bonus) seeds soaked in acetone, dichloromethane (DCM) or aqueous polyethyleneglycol 6000 (PEG) containing one of 14 contact or systemic fungicides were assayed for the presence of the incorporated fungicide. Only the systemic fungicides benomyl, carboxin, sisthane and thiabendazole could be detected in washed seeds. Thiram was inconsistently detected in seeds treated using DCM or PEG and apparently diffuses into the seedcoat in small quantities. Aqueous PEG was the most effective carrier-solvent, incorporating the most fungicide with none of the damage associated with treatment in acetone or DCM. Treating Wells soybean seeds with benomyl or sisthane in PEG greatly reduced the occurrence of seedborne fungi, although no treatment was 100% effective. Thiram in DCM or PEG slightly reduced the occurrence of seedborne fungi. In a 1978 field trial of several surface applied and incorporated fungicides, seeds treated with benomyl in PEG had the highest emergence.

SORGHUM DOWNY MILDEW IN KANSAS. Thomas Sim IV, Kansas State Board of Agriculture, Topeka 66612 and Venance H. Lengkeek, Kansas State University Southwest Area Extension Office, Garden City 67846.

Sorghum downy mildew, caused by *Sclerospora sorghi*, was first reported from Kansas in 1967, and has caused little economic loss. However, in 1978, disease incidence reached significant levels in several localized areas in Kansas. One such area was found in southwest Kansas in which approximately 1,000 to 1,500 acres in a 10 square mile area exhibited signs and symptoms of the disease. Fields in parts of northeast and north central Kansas were also found to be infected with downy mildew. Both shattercane *(Sorghum bicolor)* and johnsongrass *(Sorghum halapense)* were found to be infected. Many of the grain sorghum hybrids planted in Kansas are susceptible to downy mildew. Present research includes testing hybrids for resistance or susceptibility, existence of overwintering oospores and epidemiology of the disease.

THE EFFECT OF PLANTING DATE ON RUSTING CHARACTER OF SEVEN SPRING WHEAT CULTIVARS. J. W. Southern and R. D. Wilcoxson, Dept. of Plant Pathology, Univ. of Minnesota, St. Paul 55108.

Spring wheat cultivars previously reported to rust slowly were planted in hills at Rosemount, MN, on 10 May, 27 May, and 3 June, 1975, and on 15 April, 21 May, and 22 June, 1976. They were inoculated with Puccinia graminis tritici race TLM, generally at growth stages 5 to 12 (Romig's scale), and rust severity was judged weekly for 4 weeks. Area under the disease progress curve (AUDPC) was used to indicate the slow rusting characteristic of the cultivars. In 1975 the mean AUDPC of cultivars Lee, Redman, McMurachy, Exchange, Thatcher, Kenya 58, and Idaed 59 of the first planting ranged 532-3, the second planting 967-344, and the third planting 1441-240. In 1976 the mean AUDPC of these cultivars in the first planting ranged from 406-70, the second planting 1588-622, and the third planting 1996-343. Thus, late planting caused an increase in the mean AUDPC of these cultivars, suggesting that their slow rusting character becomes less effective with late planting.

SNOW ROT OF WINTER WHEAT IN NORTH DAKOTA. R.W. Stack, V.L. Jons and H.A. Lamey, North Dakota State University, Fargo, ND 58105

The winter of 1977-78 was unusual in western North Dakota because snow came early and remained until spring. Because of the continual snow cover throughout much of western N.D., there was no ground frost all winter. As snow melted in the spring, winter wheat plants appeared fresh and green, and farmers anticipated an excellent crop. However, during the next several weeks plants gradually withered and died. The aboveground symptom was severe dessication and this occurred in large spots or areas of fields. Dying plants had totally decayed roots and crowns and little evidence of new root development. Pythium was isolated from 274 out of 316 plants when crowns and roots were planted on agar incubated at 5°C. From successful isolations, 72% of 25 randomly selected isolates grew at 0.5°C. These Pythium isolates appear similar to the low temperature isolates reported by Lipps and Bruehl (Phytopathology 68:1120). Although not previously reported from N.D., statements from farmers and county agents suggests this disease has occurred sporadically for many years, but was called winter damage.

A PREDICTOR FOR MUSKMELON DOWNY MILDEW. W.R. Stevenson, G.L. Reed, and J.R. Mitchell. First and third authors, Associate Professor and Research Assistant, Dept. of Botany and Plant Pathology, Purdue Univ., W. Lafayette, IN 47904, respectively; second author, Research Entomologist, Fruit & Vegetable Insect Research Lab, AR, SEA, USDA, Vincennes, IN 47591.

Downy mildew caused by Pseudoperonospora cubensis is a serious problem on muskmelons in Indiana. First appearance of disease was related to the number and duration of periods of relative humidity (RH) $\geq$ 90% during the 1975-77 growing seasons. Temperatures and RH values used to compute severity values in Wallin's late blight forecasting method were adjusted for sporulation and disease progression optima for the downy mildew fungus. During 1978 weather data in 6 fields were recorded continuously from 14 days after planting and disease incidence data were collected weekly in 25 fields. First mildew symptoms appeared in fields with weather stations 7 days after a mean accumulation of 18.2 severity values. Increases in downy mildew incidence were correlated with increases in total severity values.

A METHOD FOR DEPLOYMENT AND MAXIMUM DIVERSIFICATION IN THE USE OF BROWN STEM ROT RESISTANT SOYBEANS. H. Tachibana, USDA, SEA-AR, Dept. of Botany & Plant Pathology, Iowa State University, Ames, Iowa 50011.

A brown stem rot (BSR) resistant soybean cultivar 'BSR 301' will be available for commercial production for the first time in Iowa and in other states participating in the release in 1981. Because BSR 301 is being released specifically for use in fields that had 75% or more BSR diseased plants in any recent year, it is suggested that BSR 301 and similar disease resistant varieties be designated as prescribed resistant varities (PRV). BSR 301 has yielded 30% more than comparable maturity BSR susceptible soybeans in BSR problem fields under optimum disease conditions in southern Iowa; the yields were a few bushels below but not significantly different than current or future higher yielding cultivars on the average in regional uniform test fields where BSR was not a problem. The release and utilization of BSR resistant soybeans by the PRV method will deploy the BSR resistant germplasm of PI 84,946-2 by an additional epidemiologically significant degree of diversity.

CORN LETHAL NECROSIS: A SEVERE DISEASE OUTBREAK IN 1978. J. K. Uyemoto, D. L. Bockelman, and L. E. Claflin, Dept. of Plant Pathology, Kansas State University, Manhattan, KS 66506.

Corn lethal necrosis disease (CLND) was epiphytotic in four irrigated districts in northwest and north central Kansas. Many corn fields were severely affected and some were harvested for silage. Symptoms of CLND include bright chlorosis and necrosis of leaves, small deformed ears, and plant death. The disease is caused by a synergistic interaction between maize chlorotic mottle virus (MCMV) and either maize dwarf mosaic virus (MDMV) or wheat streak mosaic virus (WSMV) (Niblett and Claflin, Plant Dis. Reptr. 62:15-19, 1978). Assays of mild mosaic and CLND diseased tissues showed that MCMV (two serotypes), MDMV strains A and B, and WSMV occurred alone or in combination. In several corn fields, a dry-ear condition was found on otherwise healthy plants. Extracts of various ear tissues contained both MCMV and MDMV-B, suggesting a causal relationship.

WESTERN GALL RUST IN SHELTERBELTS ON THE NORTHERN PLAINS. J. A. Walla and R. W. Stack, North Dakota State Univ, Fargo, ND 58105

*Presented in the Graduate Student Award Competition of the North Central Division of The American Phytopathological Society.

Western gall rust [Endocronartium harknessii (J. P. Moore) Y. Hiratsuka] has recently been found in shelterbelts in North Dakota, the first report of this rust in shelterbelts on the Great Plains. Galls were found on ponderosa pine in ten shelterbelts; incidence varied from 1% to 75%. Both main stem galls and multiple branch galls were found. A potential for damage in this region does exist since in Scots pine Christmas tree plantations 3% of the trees were unsalable and an additional 6% were reduced in value by the rust. Over 8,500 miles of pine shelterbelt rows have been planted in North Dakota since 1935. Currently, planting of single-row pine shelterbelts is being encouraged; about 250,000 pines are being planted per year in North Dakota in field shelterbelts and farmstead windbreaks. Other Great Plains states have used nursery stock infected with western gall rust, yet occurrence or damage in shelterbelts has never been reported. Conditions required for significant spread within and between shelterbelts need investigation.

NEW FUNGICIDES FOR CONTROL OF WHEAT LEAF RUST. Watkins, J.E., and B.L. Doupnik, Jr., Department of Plant Pathology, 448 Plant Sciences Bldg., University of Nebraska, Lincoln 68583, and South Central Station, P.O. Box 66, Clay Center, NE 68933.

Efficacy of Indar for the control of wheat leaf rust and its effect on grain yield was studied in five hard red winter wheat cultivars. When applied during the joint stage of plant growth, Indar significantly inhibited development of Puccinia recondita f. sp. tritici, on the cultivars Homestead, Scout 66, Buckskin, and Centurk. Increases in grain yield were from 34 kg/ha in Scout 66 to 282 kg/ha in Homestead. In a separate experiment, several fungicide treatments were evaluated for control of wheat leaf rust on the cultivar Centurk. Rust severity was significantly less in 24 of the 29 treatments. Bayleton, Baycor, and CGA-64251 were the most effective. Of the treatments, 12 performed better than mancozeb and 19 were better than zineb. Grain yield in 21 of the treatments was significantly higher than that of the nontreated check.

FUNGICIDE SUPPRESSION OF FUSARIUM BLIGHT ON BLUEGRASS TURF. Watkins, J. E. and R. C. Shearman, Department of Plant Pathology, 448 Plant Sciences and Department of Horticulture, 377 Plant Sciences, University of Nebraska, Lincoln, NE 68583.

Fungicide trials for the control of Fusarium blight were conducted in 1977 and 1978 on a Kentucky bluegrass fairway. In both years, Fusarium blight severity was moderate and incidence was uniform over the fairway. In 1977, all treatments except Fore controlled Fusarium blight. Turfgrass treated with Tersan 1991 alone or in combination with Fore, Daconil 2787, or Tersan 75 showed recovery one month after treatment. In 1978, Tersan 1991 in combination with Daconil 2787, Bayleton, or DPX 4424 significantly suppressed Fusarium blight and resulted in up to 78% turfgrass recovery 6 weeks after treatment. Tersan 1991 or RP 26019 gave better control when applied as a soil drench treatment than when applied with the Greensaire II with Ryan injector attachment (Outboard Marine Corp., Lincoln, NE 68501).

SPATIAL DISTRIBUTION OF PLANT-PARASITIC NEMATODES ASSOCIATED WITH CORN. J. M. Willut and R. B. Malek, Department of Plant Pathology, University of Illinois, Urbana, Illinois 61801*

Spatial distribution of Longidorus breviannulatus, Xiphinema americanum, Hoplolaimus galeatus and Pratylenchus scribneri on 4th-year corn in irrigated Plainfield sand was monitored from May 24 to September 23, 1978. Populations were sampled at monthly intervals between 76-cm rows at depths of 0-15 cm and 16-30 cm at 5, 20, and 36 cm from the base of the plant. Population peaks for each species generally occurred at the same time at all distances. Populations of L. breviannulatus peaked in July. Numbers of X. americanum and P. scribneri in soil reached a maximum in either August or September, depending on distance from the plant. Highest numbers of H. galeatus in soil occurred in September. Densities of P. scribneri and H. galeatus in roots were greatest in August. At the end of the season, L. breviannulatus was concentrated in the 16-30 cm depth, H. galeatus and P. scribneri in soil were most abundant in the 0-15 cm depth, and X. americanum was evenly distributed between the two horizons.

PROPERTIES OF THE SELECTIVE PATHOTOXIN PRODUCED BY PERICONIA CIRCINATA. T.J. Wolpert and L.D. Dunkle. Dept. of Botany and Plant Pathology, Purdue University, W. Lafayette, IN 47907.*

The selective pathotoxin produced by P. circinata was partially characterized. Criteria of purity included coincidence of toxicity with homogeneous ninhydrin reactivity following two-dimensional thin layer electrophoresis (TLE) -- chromatography (TLC). The purified product was a low MW (<1800) peptide having a pI of ca. 2.75 and containing aspartic acid, which accounted for 80 to 90% of the weight. Derivatization with dansyl Cl and analysis by TLC and TLE revealed a single fluorescent compound (dns-toxin). Acid hydrolysis of dns-toxin yielded two unidentified dns-compounds, which reacted with ninhydrin and were assumed to be diamines. Absence of α-dns-aspartate in dansylation analysis and resistance of toxic activity to treatment with proteases suggested that the toxin is cyclic. Incubation at pH 12 at room temp abolished toxic activity and altered chromatographic and electrophoretic characteristics. Purified toxin inhibited root growth of susceptible sorghum genotypes by 50% at 1 to 3 ng/ml.

CONIDIUM ONTOGENY AND MORPHOLOGY OF A SOYBEAN SEED ISOLATE OF CERCOSPORA KIKUCHII. C.-C. Yeh and J. B. Sinclair, Dept. of Plant Pathology, Univ. of Illinois, Urbana, IL 61801.*

Previous descriptions of Cercospora kikuchii made from infected soybean tissues did not illustrate conidium ontogeny. Conidium development and morphology of an isolate of C. kikuchii (ATCC-36864), recovered from soybean (cv. Amsoy) seeds with symptoms of purple seed stain, cultured on carrot leaf-decoction agar (CLDA), and was artificially inoculated onto soybean (cv. Amsoy) leaves, stems and seeds is reported. Holoblastic conidium development was observed from integrated, sympodial conidiogenous cells at the apex of conidiophores within 36 hours (optimum 4 to 5 days) on CLDA under 12 hours of artificial light at room temperature (23 to 27C). Five or six conidia may develop sympodially from one conidiophore in 7 days and conidiophores may reach the length of more than 2 mm. The distance between conidial scars varied from 10 to 150 µm. No scars were observed on newly formed conidiophores. The morphological characteristics of the isolate did not vary between the two substrates.

*Presented in the Graduate Student Award Competition of the North Central Division of The American Phytopathological Society.