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ABSTRACTS

INFECTION AND COLONIZATION OF GRAPE BY GANODERMA LUCIDUM. J.E. Adaskaveg and R.L. Gilbertson, Department of Plant Pathology, University of Arizona, Tucson, AZ 85721. \*

Twenty-four, one year old grape plants (variety Dogridge) growing in the greenhouse were inoculated with isolates of Ganoderma lucidum by placing infested wood blocks adjacent to wounded and non-wounded roots. In the wounded treatment, one plant died and three other plants declined while in the non-wounded treatment only one plant developed symptoms. Reisolations after 24 mo from inoculated plants yielded only G. lucidum from the dead and declining plants demonstrating pathogenicity. The fungus initially invaded the heartwood tissue and in latter stages infected the sapwood. Infected plants developed water stress symptoms with leaves wilting, yellowing, and dying. Trunk inoculations of field-grown grapevines developed decay columns up to 42 cm in 17 months. Decay was limited to the heartwood; no symptoms were observed on the field plants at the end of the study.

COMPARISON OF PROTEINS FROM PYTHIUM SPECIES BY ISOELECTRIC FOCUSING. J.E. Adaskaveg, M.E. Stanghellini, and R.L. Gilbertson, Department of Plant Pathology, University of Arizona, Tucson, AZ 85721. \*

Water soluble mycelial proteins of several Pythium species were compared by isoelectric focusing. The species studied were: P. aphanidermatum (P.a.), P. ultimum var. ultimum (P.u.u.), P. u. var. sporangiiferum (P.u.s.), P. deliense (P.de.), P. violae (P.v.), P. myriophyllum (P.m.), and P. dissotocum (P.di.). Isolates of P.a., P.u., and P.de. were collected from various regions of North America. Each species studied produced a readily identifiable protein pattern with minor variations between isolates when focused between a range of pH 4-8. However, no differences were observed between P.u.u. and P.u.s. Previous studies by other researchers indicated that several Pythium species could be distinguished by zone electrophoresis of extracted proteins. However, isoelectric focusing provided greater resolution than other electrophoretic methods.

EFFECT OF LEAF AGE AND FUNGICIDE APPLICATION TIMING ON THE CONTROL OF CUCUMBER POWDERY MILDEW. Marianne E. Ames, Ted R. Knous, and W.S. Johnson. University of Nevada, Department of Plant Science, Reno, NV 89557.

Triforine was sprayed to drip at .02 oz a.i./gal to cucumber cv. 'Marketer' to control powdery mildew caused by Sphaerotheca fuliginea. Nine groups of plants, each differing in age by 4 days, received foliar triforine sprays at different application times including: 1) a post-inoculation spray after visual infection, 2) a pre-inoculation spray and 1 post-inoculation spray 2 weeks later, and 3) a pre-inoculation spray followed by 3 post-inoculation sprays each 2 weeks apart. The percentage of germinative conidia and a disease severity rating were recorded for 8 weeks. The disease severity rating based on a scale from one-to-five was determined by the amount of leaf area infected with powdery mildew. The percent germination was not significantly different between the treated and non-treated plants within all age groups even though there was an overall decrease in germination with time. Severity ratings, increased with time and differed significantly with age of the plant. Older plants exhibited a more severe initial incidence and greater disease progression regardless of treatment.

\* = Student Paper Competition

Camera-ready abstracts are published as they were submitted by the Division. The abstracts are not edited or typed in the APS headquarters offices.

CONTROL OF MAJOR WINTER WHEAT DISEASES WITH FOLIAR FUNGICIDES. Louis Anzalone, Jr., Dept. Plant Path. and Crop Physiol., La. Agric. Exp. Stat., La. State Univ. Agric. Ctr., Baton Rouge, LA 70803.

Foliar fungicides were screened for effectiveness in controlling leaf rust caused by Puccinia recondita f. sp. tritici, Septoria caused by Septoria spp., and powdery mildew caused by Erysiphe graminis on soft red winter wheat Triticum aestivum (Coker 68-15) in a field test at Baton Rouge, LA. Single fungicide applications were made at the flag leaf stage of plant growth and double applications were made at flag and 14 days later. Fourteen of the 25 treatments significantly (P = 0.05) increased grain yields above the unsprayed control plots. All three diseases were controlled with two applications of DPX H6573, XE 779, HWG 1608, and A 1055 used alone and combinations of Bayleton plus Manzate, HWG 1608 plus KWG 0519, and Tilt plus Bravo resulting in yield increases of 79, 60, 49, 44, 74, 63, and 54%, respectively.

SEROLOGICAL RELATIONSHIPS AMONG STRAINS OF XANTHOMONAS CAMPESTRIS PV. TRANSLUCENS. H. Azad and N. W. Schaad, Dept. of Plant, Soil and Entomol. Sci., University of Idaho, Moscow, Idaho 83843

Antisera to membrane protein of four strains of Xanthomonas campestris pv. translucens (X. translucens) were used to determine serological relationships among 26 strains of X. translucens, 32 strains of other xanthomonads, and 12 strains of other bacteria. Two lines of precipitin were observed in Ouchterlony agar double diffusion tests. The line nearest the antigen well was specific at the pathovar level whereas the other line was specific at the genus level. Based upon the pathovar specific line, 24 of the X. translucens strains grouped into two serovars. Two strains were untypable. No other bacteria tested contained the pathovar specific immunogen. The genus specific immunogen cross-reacted only with other xanthomonads and P. solanacearum. Membrane proteins of X. translucens apparently contain both pathovar and genus specific antigenic determinants.

INFLUENCE OF FURROW IRRIGATION ON DEVELOPMENT OF PHYTOPHTHORA ROOT ROT IN PROCESSING TOMATO. Jean Beagle-Ristaino, J. M. Duniway, and J. J. Marois. Department of Plant Pathology, Univ. of California, Davis, California 95616. \*

Plots infested or not infested with Phytophthora parasitica were either irrigated normally for 4-8 hr once every 14 days, irrigated for 24 hr every 14 days on alternate irrigations, or irrigated for 4-8 hr every 28 days. Disease developed more rapidly and symptom severity was greater on shoots and roots in treatments that received prolonged irrigations for 24 hr rather than 4-8 hr. Less frequent irrigation delayed the onset of disease but high levels developed late in the season. Yield reductions of 72, 35, and 20 percent were found in the prolonged, normal and less frequently irrigated treatments, respectively. There was a significant and negative correlation (r=-.86) between root rot severity and final yield. Noninfested plots had few plants with symptoms and high yields in all treatments. The results indicate that variation in the duration and frequency of irrigation can have large effects on the development of Phytophthora root rot on tomato.

INHERITANCE OF LATENT PERIOD, INFECTION TYPE AND AREA UNDER THE DISEASE PROGRESS CURVE IN TWO SLOW LEAF RUSTING SPRING

WHEAT CULTIVARS. M. E. Bjarko and R. F. Line, Dept. of Plant Path., Wash. State Univ., and ARS, USDA, Pullman, WA 99164.\*

Crosses of the resistant cultivars Borah and Wampum by the susceptible cultivars Twin and Lemhi were used to determine the inheritance of slow rusting resistance. Rust intensity, converted to area under the disease progress curve (AUDPC) and infection type (IT) were measured in the field, and latent period (LP) and IT in adult plants were measured in the greenhouse. Inheritance of IT, LP and AUDPC was recessive in the Borah crosses. Segregation for AUDPC and LP followed nearly identical patterns, indicating that LP and AUDPC in Borah are under the same genetic control. In the Wampum crosses, inheritance of LP was recessive, inheritance of IT was recessive or partially recessive and inheritance of AUDPC was partially recessive. The segregation patterns for LP and AUDPC were distinctly different for Wampum, indicating that although LP probably contributes to the resistance expressed as AUDPC, other components of resistance are involved.

COMPARISON OF QUANTITATIVE FORMULAS AND MENDELIAN RATIOS IN DETERMINING THE NUMBER OF LEAF RUST RESISTANCE GENES IN BORAH WHEAT. M. E. Bjarko and R. F. Line, Dept. of Plant Path., Wash. State Univ., and ARS, USDA, Pullman, WA 99164. \*

Formulas used to determine the number of segregating loci from quantitative data are commonly based on assumptions that there is no linkage, epistasis, or dominance. This is not always true and interpretations can be misleading. Inheritance of latent period (LP) and area under the disease progress curve (AUDPC) in crosses of Borah by the susceptible cultivars Twin and Lemhi show continuous variation in  $F_2$  and backcross (BC) generations. Quantitative formulas estimated 1-2 segregating loci for AUDPC and LP in the  $F_2$  and one locus in the BC to Borah. Based on the resistant parent, Mendelian ratios for the  $F_2$  and BC to Borah fit a model for two complementary genes, with the  $F_2$  exhibiting a 3:13 ratio of resistant to susceptible plants. Tests of quantitative formulas to a theoretical 3:13 gene model produced estimates of segregating loci that correspond to those obtained using actual data and support conclusions obtained using Mendelian ratios.

INTERACTION OF SOLARIZATION AND METHAM-SODIUM IN CONTROLLING SOILBORNE PATHOGENS AND WEEDS AND ON YIELD OF RADISH. Y. Ben-Yephet<sup>1</sup>, J.M. Melero<sup>1</sup>, J.E. DeVay<sup>1</sup>, and C. L. Elmore<sup>2</sup>  
<sup>1</sup>Department of Plant Pathology and <sup>2</sup>Department of Botany, University of California, Davis, California, U.S.A.

The effects of soil solarization (S-S), metham-sodium (MES) at 12.5 or 25 ml/square meter, and combined treatments (S-S plus MES) were determined on the viability of microsclerotia of *Verticillium dahliae* (VD) and chlamydozoospores of *Fusarium oxysporum* f. sp. *vasinfectum* (FOV). Effects on weed control and growth response of radish (*Raphanus sativus* cv. Mayashige Long White Neck) also were studied. In field experiments at Davis, CA, begun July 24 and August 8, combined treatments (S-S plus MES) were synergistic in controlling VD and FOV, compared with either treatment alone. In the August experiment, all treatments were less effective in controlling VD and FOV than in the July experiment. In each experiment, radish yield was higher and weed control was more effective with the combined treatments compared with either treatment alone.

FUNGICIDAL CONTROL OF POST-HARVEST FRUIT ROTS OF RED RASPBERRY WITH PRE-HARVEST APPLICATIONS. P. R. Bristow and G. E. Windom, Wash. State University (WVREC), Puyallup, 98371.

Controlling post-harvest rot is one component in extending the shelf-life of fresh red raspberries shipped by air. Captan (2.24 kg/ha), iprodione (1.12 and 2.24 kg/ha) and vinclozolin (0.84 and 1.12 kg/ha) were applied 4 or 5 times between first bloom and harvest. Berries at the fully ripe and red ripe stages of maturity were hand picked on each of 3 harvest dates. Fully ripe berries were incubated individually at 20C in a moist chamber for 3 days. All three chemicals reduced rot caused by *Botrytis cinerea*, while only captan and iprodione were effective against *Cladosporium* sp. Only *Botrytis* fruit rot developed when red ripe fruit was stored for 6 days under air shipment conditions (day 1 at 0C, day 2 at 3C, days 4-6 at 20C). All fungicides reduced this rot and delayed its appearance. When the interval between the last application and harvest was lengthened, efficacy decreased.

Partial Characterization of a Geminivirus Isolated from Tomato with Yellow Leaf Curl Symptoms. J. K. Brown, D. E. Goldstein, and M. R.

Nelson. Department of Plant Pathology, University of Arizona, Tucson, AZ 85721

A whitefly-transmitted virus with geminate particles was isolated from tomato plants with yellow leaf curl symptoms from Sonora, MX. Preliminary results of a host range study indicate the virus infects primarily species within the Leguminosae and Solanaceae. The virus was purified by homogenization in glycine extraction buffer (pH 8.2), ultracentrifugation through sucrose cushions and density gradient centrifugation. Single (~18-20nm) and paired (18x30nm) particles were observed by electron microscopy. Viral nucleic acids were isolated and fractionated by agarose gel electrophoresis. Two bands were visualized following staining with ethidium bromide and are tentatively interpreted as linear and circular forms of genomic single-stranded DNA. The Sonoran virus isolate resembles both biologically and morphologically the causal agent of tomato yellow leaf curl disease, which to date has been neither purified nor reported from North America.

ASSOCIATION OF SOIL BORNE FUNGI WITH STEM NEMATODES ATTACKING ALFALFA IN COLORADO. W. M. Brown, Jr., C. Rasmussen-Dykes, L. G. Skoglund and L. S. Pickett. Dept. of Plant Pathology and Weed Sci., Colo. State Univ., Fort Collins, CO 80523 and E. A. Nigh, Arizona Ag-Con, Inc., 1365 W. 17th Place, Yuma, AZ 85364. \*

Stem Nematode (*Ditylenchus dipsaci*) was reported on alfalfa in Colorado in 1983. Alfalfa in areas initially surveyed on the Western Slope of the Rocky Mountains was also infected with soil borne plant pathogenic fungi. Isolations showed the fungi most frequently associated with stem nematode infested alfalfa were *Fusarium*, *Rhizoctonia*, and *Colletotrichum* spp. Subsequent surveys in 1984 and 1985 found that *F. equiseti*, *F. oxysporum*, and *F. solani* were the principal *Fusarium* spp. associated with stem nematode infested alfalfa. The nature of this association and its role in accelerated alfalfa stand decline is presently under study.

SEROLOGICAL RELATIONSHIPS AMONG FOUR TOBACCO STREAK VIRUS ISOLATES. D. L. Clement and R. H. Converse, Dept. of Botany & Plant Pathology, Oregon State University, and USDA-Agricultural Research Service, Corvallis, OR 97331.

Polyclonal rabbit antisera were used to compare serological differentiation indices (SDIs) between two roseaceous isolates of tobacco streak virus from black raspberry (R), and strawberry (NC), in relation to the co-type isolate from white clover (WC), and an isolate from bean (RN). SDIs were determined by agar gel double diffusion endpoint, enzyme-linked immunosorbent assay (ELISA) endpoint, and the ELISA regression line comparison (ELISA-RLC) of Clark and Barbara. The 3 SDI methods placed R and NS in one group (SDIs predominantly < 1), and separated them (SDIs predominantly > 1) from WC and RN in a second group (SDIs predominantly < 1). ELISA-RLC was highly sensitive and gave the most reliable data of the 3 methods tested since antibody titers were estimated from midpoint values and slopes were equalized.

THE BUTTE POTATO CULTIVAR: A TOOL FOR INTERPRETING FIELD INTERACTIONS BETWEEN *VERTICILLIUM DAHLIAE* AND *PRATYLENCHUS* SPP. Davis, J.R., S.L. Hafez\*, and L.H. Sorensen, University of Idaho Res. & Ext. Center, Aberdeen, ID 83210, and Parma\*, ID 83660.

Greenhouse and field studies involving comparisons of Russet Burbank and Butte potato cultivars showed Butte to be highly resistant to both *Pratylenchus neglectus* and *P. penetrans*. In contrast, Butte was more susceptible to *Verticillium dahliae*. Field studies showed that Butte reduced populations of *P. neglectus* in both soil and roots within a 2-month period. This degree of reduction was equivalent to the effects of either of two nematicides (aldicarb and isofenphos) at 3.4 to 4.0 kg a.i./ha. Although populations of *P. neglectus* were reduced by both nematicides and Butte, wilt severity was higher with Butte than Russet Burbank. Results suggested wilt reduction and yield increases to be unrelated to nematode control. Butte may provide a useful tool for studying *V. dahliae* x *Pratylenchus* sp. interactions.

EVALUATION OF SEED TREATMENTS FOR ERADICATION OF *CLAVIBACTER MICHIGANENSE* SUBSP. *MICHIGANENSE* FROM TOMATO SEEDS. M. Fatmi, N. W. Schaad and H. A. Bolkan. Dept. Plant, Soil and Entomol. Sci., Univ. of Idaho, Moscow, ID 83843, and Campbell Inst. for Research and Technology, Davis, CA 95616\*

\* = Student Paper Competition

Several seed treatments were evaluated for eradicating *Clavibacter michiganense* subsp. *michiganense* (Cm) from tomato seeds. Naturally contaminated seeds were treated with hydrochloric acid (HCl), sodium hypochlorite (NaClO), calcium hypochlorite (CaClO), formalin, acidified cupric acetate (ACA), hot water, and a combination of each treatment with hot water. Treatments were evaluated by 1) assaying washings of triplicate samples of 10,000 seeds on SCM agar and 2) testing seed germination. Hot water (52C for 20 min.) alone and hot water combined with HCl (0.29%), NaClO (1.05%), formalin (0.1%) and ACA (0.25%) were all effective in eradicating Cm without hurting germination. Addition of these chemicals resulted in a further reduction in saprophytes over hot water alone. Additional tomato cultivars are being tested.

EFFECTS OF INFECTION OF WINTER WHEAT BY *TILLETIA CONTROVERSA* ON THE NUMBERS OF SPIKES PER PLANT. H. S. Fenwick, D. J. Eschen, and S. V. Jones. Dept. of Pl., Soil, & Ent. Sci., Univ. of Idaho, Moscow, ID 83843

A total of 30020 winter wheat plants (cv Stephens or Hill-81) were removed from 217 1-m<sup>2</sup> reps of inoculated or non-inoculated plots over four years (1982-1985) and separated into categories of non-smutted (NS), partially smutted (PS), and totally smutted (TS). The means of spikes per plant (S/P) in each category were tabulated. PS plants consistently produced more S/P than NS or TS plants and TS plants consistently produced fewer S/P than NS plants. The yearly and four year means of S/P were: 1982 - PS 4.5, NS 3.3, TS 2.6; 1983 - PS 4.2, NS 3.4, TS 2.0.; 1984 - PS 3.9, NS 2.9, TS 2.4; 1985 - PS 3.8, NS 2.7, TS 1.9; four year means - PS 4.0, NS 3.1, TS 2.1.

EFFICACY OF BAY HWG 1608, BAY KWG 0519, AND BAY NTN 19701 FOR CONTROL OF RHIZOCTONIA ROOT AND CROWN ROT OF SUGARBEET. John A. Fernandez, Plant Science Department, University of Wyoming, Laramie, WY 82071.

Three experimental fungicides (Mobay Chemical Corp.) were tested for efficacy in controlling root and crown rot of sugarbeet, caused by *Rhizoctonia solani* Kuhn. Field plots were artificially infested with inoculum prior to planting, fungicides were applied as foliar sprays in mid-June, and disease severity was rated at harvest on a scale from 0 to 7. The fungicides studied and the rates at which they were applied (g a.i./100 m of row in 94 l/ha water) were BAY HWG 1608 1.2 EC (2.3, 4.7, and 9.3); BAY KWG 0519 25% DF (3.2 and 4.7); and BAY NTN 19701 75% WP (4.7 and 9.3). Mean disease ratings for the above treatments were, respectively, 0.5, 0.2, 0.1, 1.3, 0.5, 0.6 and 0.5; all of which were significantly (p=0.05) less than the untreated control, which was 3.6.

THE ULTRASTRUCTURE OF STRAWBERRY MILD YELLOW-EDGE VIRUS, A LUTEOVIRUS, IN CELLS OF *FRAGARIA VESCA*, CULTIVAR UC-4. E. R. Florance, T. C. Allen and R.H. Converse, Dept. of Biology Lewis and Clark College, Portland, Oregon 97219. Dept. of Botany and USDA-ARS, Oregon State University, Corvallis, Oregon 97331.

Techniques of transmission electron microscopy (TEM) revealed Strawberry Mild Yellow-Edge Virus (SMYEV) particles in cells of *Fragaria vesca*, cultivar UC-4. Diseased tissue was produced by infecting *Fragaria* plants at weekly intervals for six weeks using the aphid *Chaetosiphon fragaefolii* carrying Oregon isolate MY-18. This infection regime produced diseased tissue in different developmental stages, i.e. 1-6 weeks, for fixation. Comparable healthy tissue was also prepared. Virus particles were first located in phloem parenchyma cells of the youngest leaf from plants infested for four weeks. In some cells the particles occurred in aggregates, which is unusual for members of the Luteovirus group. In cross section the particles appeared spherical to hexagonal, contained a small densely stained core, and ranged in diameter from 25nm to 34nm with a mean of 30nm (N=27 @ 6 different magnifications). These particles appear quite different from the 22-25nm SMYEV particles reported in situ by researchers in an earlier publication, and are larger than the 23nm diameter published for purified particles. Virus-like particles were not present in healthy controls.

SYMPTOMATOLOGY OF SOME NEW DISEASES OF NATIVE HAWAIIAN FOREST SHRUBS. D. E. Gardner, NPS, CPSU/UH, Department of Botany, University of Hawaii, Honolulu 96822.

Certain diseases of important native Hawaiian forest shrubs have been recognized only recently in spite of their prominent symptoms. Hosts and tentative disease designations include: red leaf disease of *Vaccinium* spp. ('ohelo), decline of *Styphelia tameiameia* (pukiawe), spiral necrotic leaf spot of *Rubus hawaiiensis* ('akala), and yellow witches'-broom of

*Dodonaea* spp. (a'ali'i). One, and possibly two *Exobasidium* spp. are associated with the *Vaccinium* disease, but the origin of the pathogen(s), whether endemic or introduced, is undetermined. The etiologies of the remaining diseases are unknown; however, distinctive symptoms suggest a viral pathogen for the *Rubus* disease and a submicroscopic yellows agent for the *Dodonaea* disease. The *Vaccinium*, *Styphelia*, and *Dodonaea* diseases are severe and potentially destructive.

WATER STATUS OF VINEYARD-GROWN VITIS VINIFERA CV. 'CHARDONNAY' WITH PIERCE'S DISEASE. Paul Goodwin, J. E. DeVay, Department of Plant Pathology, C. P. Meredith, Department of Viticulture and Enology, University of California, Davis, CA 95616.\*

Water potential ( $\psi_w$ ), solute potential ( $\psi_s$ ) and turgor ( $\psi_p$ ) was measured for healthy and Pierce's diseased leaves of *V. vinifera* cv. 'Chardonnay'. The average values for diseased leaves were  $\psi_w$ =-18.45 bars,  $\psi_s$ =-22.96 bars and  $\psi_p$ =4.51 bars for green leaf tissue adjacent to the petiole attachment; whereas the ave. values were  $\psi_w$ =-18.57,  $\psi_s$ =-17.96 and  $\psi_p$ =-0.60 bars for chlorotic diseased leaf tissue adjacent to necrotic margins. The ave. values for healthy leaves were  $\psi_w$ =-13.93,  $\psi_s$ =-20.28 and  $\psi_p$ =6.38 bars for leaf tissue adjacent to the petiole attachment, and were  $\psi_w$ =-15.16,  $\psi_s$ =-25.04 and  $\psi_p$ =9.88 bars for healthy leaf tissue adjacent to leaf margin. The drop in turgor to near zero for the chlorotic tissue is consistent with pathogen-induced water stress and is related to a significant increase in  $\psi_s$  indicating less cellular solutes.  $\psi_w$  within a diseased leaf did not differ significantly, but  $\psi_w$  of diseased leaves was significantly lower than that of healthy leaves.

Isozymes in *Rhynchosporium secalis*. S.B. Goodwin, M.A. Saghai-Marouf, R.W. Allard, and R.K. Webster\*. Dept. of Genetics and Dept. of Plant Pathology\*, University of California, Davis, CA 95616 \*

Four isolates of *Rhynchosporium secalis* with widely different pathogenicities were used to assay for activity of 54 isozymes. Gels were run on six different buffer systems with a range in pH from 5.7 to 8.6. Activity was detected for 27 of the 54 enzyme systems tested. Among these 27, 10 allow sufficient resolution to warrant further study. Polymorphisms have been found for four of the 10 enzymes. Races 40, 61, 72, and 74 can be easily distinguished solely on the basis of isozyme differences. Ten single spore isolates of race 40 had identical isozyme phenotypes, even after a number of subculturings. Because these markers differentiate isolates of this fungus and are stable in culture they may prove useful in future studies of the population genetics of this organism.

OCCURRENCE AND CONTROL OF PHYTOPHTHORA SEED ROT AND SEEDLING BLIGHT OF SAINFOIN. F.A. Gray and D.S. Wofford, University of Wyoming, Box 3354, Laramie, WY 82071.

*Phytophthora megasperma* was recovered from damped-off seedlings of sainfoin (*Onobrychis viciifolia*) grown in nonsterile field soil naturally infested with *P. megasperma*. In tests conducted in the greenhouse using autoclaved soil, seeds and young seedlings were attacked and killed by an alfalfa isolate of *P. megasperma*. Older plants were resistant to attack both in the field and greenhouse. Seedling resistance was expressed in the Canadian cultivar Nova, in the Montana experimental line Bozeman and in several plant introductions of *O. viciifolia*. The highest level of resistance was shown in P.I. 229613 from Iran. Treating seed with the fungicide metalaxyl increased seedling survival in autoclaved soil artificially infested with *P. megasperma* by 68% and in naturally infested field soil by 47%.

THE IMPORTANCE OF NEMATODE RESISTANCE ON THE INTERACTION OF MELOIDOGYNE HAPLA AND FUSARIUM OXYSPORUM ON ALFALFA. G. D. GRIFFIN, USDA-ARS, Forage and Range Research, Utah State Univ., Logan, UT 84322-6300; and B. D. Thyr, USDA-ARS, Univ. of Nevada, Reno, NV 89557.

Fusarium wilt of alfalfa was synergistically increased from combined inoculations of *M. hapla* and *F. oxysporum* on root-knot susceptible Ranger, but not on root-knot resistant Nev Syn XX alfalfa. There was a positive relationship between plant growth suppression and the incidence of vascular bundle infection and discoloration. Disease severity was increased when inoculations of *M. hapla* preceded that of *F. oxysporum*. *F. oxysporum* did not affect the resistance of Nev Syn XX to *M. hapla*. Combined inoculations suppressed the incidence of

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root galling and nematode reproduction; the greatest reductions coming from sequential inoculations of the two pathogens.

HOST RANGE OF *PYRENOCHAETA LYCOPERSICI*. G.G. Grove and R.N. Campbell. Department of Plant Pathology, University of California, Davis, CA 95616.

Fifty-eight California crop and weed species were evaluated for susceptibility to *Pyrenochaeta lycopersici*, causal agent of tomato corky root. Seeds of potential hosts were sown in 250 ml plastic pots containing vermiculite infested with  $10^5$  conidia/ml and incubated in a controlled-environment chamber at 20 C for 30 d. To isolate the pathogen from symptomatic roots, the seedling roots were washed, sectioned, surface sterilized in 0.525% NaOCl, and incubated on semi-selective medium at 22 C for 15 d. Transfers were made to 2xV8 agar to induce sporulation. Hosts of *P. lycopersici* included spinach (*Spinacia oleracea* L.), honeydew melon (*Cucumis melo* L.), squash (*Cucurbita pepo* L.), and pepper (*Capsicum annuum* L.). Species of the Cruciferae, Gramineae, and Leguminosae tested negative as hosts for the fungus.

DEVELOPMENT OF ALTERED HOST RANGE MUTANTS OF *XANTHOMONAS CAMPESTRIS* PV. *TRANSLUCENS*. Valerie N. Hall and D. A. Cooksey, Dept. of Plant Pathology, University of California, Riverside, CA 92521 \*

The cereal grain pathogen *Xanthomonas campestris* pv. *translucens* (Xct), is the causal agent of bacterial leaf streak of five major cereals: barley, wheat, oats, rye and triticale. Individual wild type strains of Xct vary in host range among these five hosts. Strain Xct4, originally isolated from wheat, was found to be highly virulent on all five hosts, producing water-soaked lesions on leaves four days after inoculation. Chemical and transposon mutagenesis were conducted to alter the host range of strain Xct4. The resulting mutant colonies were inoculated individually into two-week-old cereal seedlings by hypodermic injection. Several mutants were obtained that no longer caused water-soaking on one or more members of the host range. Included are those negative on barley, wheat, rye and triticale, and barley and wheat, and triticale and rye. No totally avirulent mutants were found, and no hypersensitive reaction was noted in association with reduction in host range.

BLUEBERRY RED RINGSPOT VIRUS DETECTION IN CRUDE SAP OF INFECTED Highbush BLUEBERRY PLANTS. R. F. Hepp and R. H. Converse, Fac. Cs. Agropec. y Forestales, Univ. de Concepcion, Chile, and USDA, ARS, Dept. of Botany & Plant Path., Oregon State University, Corvallis, OR 97331

A 2-animal ELISA (enzyme-linked immunosorbent assay) was developed to detect blueberry red ringspot virus (BBRRSV) in crude blueberry sap after ELISA tests using antisera from one species failed. Polyclonal antisera were prepared in rabbit (courtesy, D. C. Ramsdell, Michigan St. Univ.) and in mouse in our laboratory. Crude leaf sap homogenates from frozen BBRRSV-infected *Bluehita* field plants gave positive ELISA absorbances (A405 nm) when harvested in April, September and October but not in May-August. During plant dormancy, BBRRSV was detected in homogenized bark sampled from 10/11 (91%) of *Bluehita* plants in January from a known BBRRSV-infected field, and 7/11 (64%) in February. Cross-absorbing mouse (detecting) globulin with crude healthy blueberry sap halved healthy background. All known-healthy blueberry plants tested were negative. This 2-animal ELISA system appears to be reliable, sensitive, and suitable most of the year for routine BBRRSV detection in crude homogenates of highbush blueberry leaves or bark.

EFFECT OF PLANTING DATE ON THE SEVERITY OF FUSARIUM WILT IN FOUR COTTON SELECTIONS. D. P. Jeffers<sup>1</sup>, A. H. Hyer<sup>2</sup>, and P. A. Roberts<sup>3</sup>; <sup>1</sup>Dept. of Plant Pathology, University of California, Davis, CA 95616; <sup>2</sup>U.S. Cotton Research Station, Shafter, CA 93263 (deceased); <sup>3</sup>Dept. of Nematology, Univ. of California, Riverside, CA 92521.\*

The influence of three planting dates (3/29, 4/12, and 4/29) on the development of Fusarium wilt in cotton cultivars Acala SJ-2 and Acala SJ-1, and cotton breeding lines N6072 and N8577 was determined in a replicated split-plot experiment. These cotton selections differ in their reaction to *Fusarium oxysporum* f. sp. *vasinfectum* (Fov) and *Meloidogyne incognita* (Mi). Wilt susceptibility was evaluated by measuring root galling, root and vascular discoloration, and foliar symptoms. Isolation of Fov from serial sections of stem and leaf tissue also were made. Percent of plant height colonized during times of boll stress, foliar symptoms, extent of plant death, and yield loss were

greatest for the 3/29 planting date. A significant negative correlation was found between resistance (to Fov and Mi) and percent of plant height colonized by Fov.

TWO-STEP ELISA METHODS FOR QUICK AND RELIABLE DETECTION OF POTATO VIRUSES. W. K. Kaniewski and P. E. Thomas. Institute of Plant Protection, Mieczurina 20, 60-318 Poznan, POLAND, and USDA-ARS, Irrig. Agric. Res. & Ext. Center, P.O. Box 30, Prosser, WA 99350

The sensitivity and reliability of ELISA results were compared between the standard double antibody sandwich (DAS) procedure and shorter DAS procedures in which sample and conjugate were mixed and incubated together in one step. All experiments were performed with potato leafroll, M, S, X, and Y viruses and beet western yellows virus. Sensitivity and reliability of the two-step procedures were equal to or better than the standard DAS method. All of the viruses tested reacted properly at high incubation temperatures (30 and 37 C). Therefore, assays could be completed within 2-hrs with the two-step procedure using precoated plates as compared to 2-days for the standard procedure. Reliable results were achieved with samples prepared by grinding tissue in buffer or, more simply, by adding pure, pressure-extracted juice directly to conjugate in plate wells. In some cases, coating plates with F(ab')<sub>2</sub> fragments in place of whole gamma-globulin increased the sensitivity of both the standard DAS and the two-step procedures.

IDENTIFICATION OF A HOST-SPECIFIC TOXIN PRODUCED BY THE CORKY ROOT ROT BACTERIAL PATHOGEN OF LETTUCE. John Kao, Donna H. Mitten, Cyndi A. Milich, PLANT GENETICS, INC., 1930 Fifth Street, Davis, CA 95616

The pathogenic bacterium of lettuce corky root rot produced a toxin in culture that elicited symptoms including chlorosis, root discoloration, and growth inhibition on lettuce. The toxin has been partially purified by charcoal absorption, gel filtration, thin-layer chromatography, and HPLC. It is heat stable, has a molecular weight less than 340 and is soluble in polar solvents. In a long-term assay (5 weeks), the toxin stimulated the growth of resistant cultivars at higher concentrations; whereas it inhibited the susceptible cultivars. At low concentrations, the toxin stimulated both resistant and susceptible plants. In a short-term assay (10 days), however, only inhibitory effects of the toxin were observed. Correlation between the segregation pattern of disease reaction and that of toxin reaction in lettuce F<sub>2</sub> hybrids indicates that resistance to the bacterium and to the toxin are related and both are controlled by more than one gene.

SPRING BLACK STEM EVALUATION IN SPRINKLER IRRIGATED ALFALFA WITH FOUR LEVELS OF APPLIED WATER. Ted R. Knous, Bill D. Thyr, W.W. Miller, C.N. Mahannah, and K. Kimbell. Department of Plant Science, University of Nevada, Reno, Nevada 89557.

Spring black stem (*Phoma medicaginis* Malbr. & Roum.) is a serious disease of alfalfa, affecting principally the first crop in most alfalfa growing regions. An evaluation scheme was devised based on a 0 to 6 scale, with 0 = no spring black stem lesions and 6 = with complete collapse of stems as a result of stems being girdled by lesions. Alfalfa was evaluated from four sprinkler irrigation regimes: 50, 75, 100, and 125% of FAO modified pan evaporation. Average severity index (ASI) for each of the four treatments was strongly correlated with forage yield ( $r = .82$ ), and with applied water ( $r = .91$ ) for the first 1985 harvest. The ASI was slightly lower for the 125% than for the 100% treatment. This may be at least partially explained by fewer stems (6%) in the 125 vs the 100% treatment. We speculate that the lower stem count resulted from early class 6 spring black stem infections wherein the stems died and fell to the ground before our evaluation was conducted.

CURD SMUDGE - A NEW DISEASE OF CAULIFLOWER IN IMPERIAL VALLEY, Franklin F. Laemmlen, Court House, 939 W. Main St., El Centro, CA 92243-2870.

Since the winter of 1983-84 cauliflower growers in Imperial County, CA, have sustained crop losses due to curd smudge. The disease, caused by *Cladosporium* sp., results in small, circular black mycelial aggregations growing over the curd surface. The fungus apparently feeds on floral exudates. There is no evidence of injury to the floral tissues from *Cladosporium* activity. Inoculum sources are hay stacks and the dead vegetation which lines most valley drainage ditches. Fungus growth occurs in cool weather when a light rain is followed by several days of heavy dew. Control is by jet sprays of chlorine water to dislodge the black mycelial mats followed by a chlorine dip (100-400 ppm) to prevent further fungal activity in storage and transit. The name "curd smudge" is suggested to separate this condition from black spot which is caused by *Alternaria brassicae*.

\* = Student Paper Competition

PHYTOPHTHORA SPECIES CAUSING ROOT AND CROWN ROT OF APPLE TREES IN ARIZONA. M.E. Matheron, Department of Plant Pathology, University of Arizona, Yuma Mesa Agricultural Center, Yuma, AZ. 85364; and D.J. Young, University of Arizona Cooperative Extension, Willcox, AZ., 85643.

Four different *Phytophthora* spp. were isolated from dead and declining apple trees in commercial orchards in Arizona during 1984 and 1985. *Phytophthora cactorum*, *P. cambivora*, *P. drechsleri* and *P. parasitica* were recovered from 8, 2, 1 and 1 of 9 orchards, respectively. Additionally, *P. cactorum* and *P. cambivora* were recovered from nursery-grown apple rootstocks and trees. In initial pathogenicity tests using apple seedlings grown in artificially infested potting soil, *P. cactorum* and *P. cambivora* caused plant death, while *P. drechsleri* and *P. parasitica* caused stunting of plants. These results implicate *Phytophthora* species in the decline and death of apple trees in Arizona. The association of *P. cactorum* and *P. cambivora* with roots of nursery-grown apple plants may partially explain the occurrence and spread of *Phytophthora* root and crown rot in Arizona.

DEVELOPMENT OF HYPOVIRULENCE FOR THE CONTROL OF A GRAPE DISEASE CAUSED BY BOTRYODIPLODIA THEOBROMAE. D. M. Mathews and J. A. Dodds, Dept. of Plant Pathology, University of California, Riverside, CA 92521 \*

The ascomycete fungus *Botryodiplodia theobromae* causes a canker disease of grapevines in California and losses up to 15% of yearly yield have been attributed to the disease. Our objective is to find or create a hypovirulent isolate(s) of the fungus to be used as a disease management agent when applied at the pruning site, the normal center of infection. Fifty-seven percent of 68 isolates of *B. theobromae* tested positive for the presence of double-stranded (ds) RNA. The electrophoretic mobility patterns of the dsRNAs on polyacrylamide gels were of varying complexity, consisting of from 1 to 14 separate bands. Several patterns of dsRNA bands have been observed. Inoculation assays on yam slices indicate that the presence of dsRNA may be correlated with virulence for some isolates. Research is now in progress to determine the relatedness and origin of the dsRNA types detected to date, and to test the transmissibility of dsRNA between isolates, and through spores.

DISTRIBUTION OF MONILINIA SPECIES AND DETECTION OF BENOMYL-RESISTANT ISOLATES IN PRUNE AND APRICOT ORCHARDS IN CALIFORNIA. T. J. Michailides<sup>1</sup>, J. M. Ogawa<sup>1</sup>, and D. C. Opgenorth<sup>2</sup>, <sup>1</sup>Dept. of Plant Pathology, Univ. of Calif., Davis, CA 95616, and <sup>2</sup>California Dept. of Food and Agriculture, Sacramento, CA 95814.

Brown rot blossom and twig blight and fruit rot of 'French' prunes (*Prunus domestica*) and apricots (*Prunus armeniaca*) in California are caused by *Monilinia fructicola* and *M. laxa*. *M. fructicola* was more frequently isolated than *M. laxa* from prune and apricot samples. Although all *M. laxa* isolates were sensitive to benomyl, *M. fructicola* isolates resistant to benomyl at a level of 1 µg a.i./ml were detected in prune orchards in Butte, Sutter, Colusa, Tehama, Yuba, Sonoma, Solano, Merced, Madera, and Tulare counties, and in apricot orchards in Contra Costa, Merced, San Joaquin, Santa Clara, Stanislaus, and Yolo counties. In addition, *M. fructicola* isolates resistant to benomyl at levels ≥ 4 µg a.i./ml were detected in a total of 13 prune and 9 apricot orchards in 1982 and 1983. Reasons for the shift of populations of *Monilinia* species in prune and apricot orchards are discussed.

PATHOGENICITY OF COLLETOTRICHUM COCCODES TO AERIAL PARTS OF POTATO PLANT. S. K. Mohan and J. R. Davis, University of Idaho, Aberdeen ID 83210.

Artificial inoculations under growth chamber conditions demonstrated that *Colletotrichum coccodes* is pathogenic to aerial parts of potato plants. Spray inoculations with conidial suspensions of isolate C-4 (10<sup>6</sup> cfu/ml) on 50-day old plants of 14 cultivars/clones induced dark, sunken, elongated lesions on stems, petioles and inflorescences 72 h after incubation at high relative humidity and 24°C day and 18.5°C night temperatures. Symptoms included chlorosis and necrosis of leaves, defoliation or wilting and drying of leaves, followed by premature death of the plant. These were more severe in plants that were injured before inoculation. There was variation in virulence among strains of the fungus and differences in susceptibility of potato genotypes. These observations on the hitherto unknown pathogenic potential of *C. coccodes* to aerial parts of potato plant suggest that it may be an important component in premature death of potato under certain conditions.

Effect of pH on growth of *Cephalosporium gramineum* in vitro. T. D. Murray, Department of Plant Pathology, Washington State University, Pullman, WA 99164-6430.

Growth of *C. gramineum* was measured on corn meal agar (CMA) and mineral salts agar (MSA) that were adjusted to pH 4.5 to 7.5 at 0.5 pH unit intervals with potassium phosphate buffer. Radial growth at 20°C was linear with time and overall growth rate was slower on MSA than on CMA. On CMA, growth rate was greatest in the range of pH 5.5-6.0 averaging 2.8 mm/day, and was faster at pH 4.5 than pH 7.5 (2.4 vs. 1.6 mm/day, respectively). Likewise, on MSA maximum growth rate occurred between pH 5.5 and 6.0, however, the growth rate slowed more abruptly above pH 6.0 than on CMA. Differences in growth rate occurred among isolates and interactions between isolates and pH occurred; some isolates exhibited near-maximal growth at pH 4.5 while other isolates displayed growth rates well-below the maximum. *Cephalosporium gramineum* grows over a wide range of pH values but appears to be favored below pH 6.0. These data may partially explain the increased prevalence of cephalosporium stripe of winter wheat in soils with low pH.

O<sub>2</sub> EFFECTS ON PHOTOSYNTHESIS AND VIABILITY OF ISOLATED SOYBEAN MESOPHYLL CELLS. J.A. Omiclan and E.J. Pell, The Pennsylvania State University, University Park, PA 16802. \*

We tested the hypothesis that active photosynthesis resulted in a greater cellular response to O<sub>2</sub>. Two experiments were conducted with suspensions of isolated soybean mesophyll cells: I-cells were exposed to air or O<sub>2</sub> in the light, either with or without NaHCO<sub>3</sub>; II-cells were exposed to air or O<sub>2</sub> either in light or in darkness. Carbon fixation rates and cell viability were measured before and after treatment. Treatments were arranged and data analyzed as 2 X 2 factorials. Photosynthetic rates were reduced to a greater degree than cell viability by O<sub>2</sub>. Post-treatment photosynthetic rates were higher in cells exposed with NaHCO<sub>3</sub> than those without. The only interaction detected was gas X light with relative viability in experiment II. Although this interaction supported the hypothesis we could not discount the role of experimental error. Further experimentation was necessary to clarify the importance of active photosynthesis to the O<sub>2</sub> response.

A new *Phytophthora* corm rot of taro in Hawaii. J. J. Ooka, and J. Y. Uchida. Department of Plant Pathology, University of Hawaii, Honolulu, HI 96822.

Root and corm rots of taro (*Colocasia esculenta* L.) in paddy culture are generally associated with *Pythium* spp. in Hawaii. In 1984, a *Phytophthora* sp. with papillate sporangia distinct from *P. colocasiae* was isolated from a shallow subepidermal corm rot specimen collected in Hanalei, Kauai, Hawaii. The fungus grew on corn meal agar or 10% V8 Juice agar from 20 to 31°C with an optimum at 28°C. Pathogenicity of the *Phytophthora* sp. to taro was established on pathogen-free test plants of cultivar Lehua Maoli in 100-cm<sup>2</sup> pots which were inoculated by drenching with 25 ml of a 1x10<sup>4</sup> zoospore/ml suspension. After 4 weeks of incubation in the greenhouse, roots of inoculated plants were determined to be necrotic. The fungus was reisolated from both root rots and adjacent necrotic corm tissue. At this time, corms were essentially unaffected. *In vitro* fungicide tests demonstrated that the *Phytophthora* sp. was inhibited by metalaxyl and ethazol, but only slightly sensitive to fosetyl-Al, and propamocarb.

ELECTROPHORETIC CHARACTERISTICS OF THREE VERTICILLADIELLA WAGENERI VARIANTS. William J. Orosina, USDA Forest Service, P.O. Box 245, Berkeley, CA 94701, and Fields W. Cobb, University of California, Department of Plant Pathology, Berkeley, CA 94720.

Several isolates of 3 *Verticilladiella wagneri* variants from hard pines (*ponderosa*, Jeffrey, and lodgepole), Douglas-fir, and pinyons were subjected to isozyme analysis by starch gel electrophoresis of mycelial extracts. Ten loci produced scoreable banding patterns. From the resultant genotypic information, allele frequencies and genetic distances among the variants were calculated. Seven of the 10 loci were monomorphic in all 3 variants, indicating a high degree of genetic uniformity in the fungus. The Douglas-fir and the hard pine variants shared a common allele in the isocitrate dehydrogenase locus while the pinyon variant was fixed for an alternative allele for this locus. The genetic divergence of the pinyon variants from the hard pine and Douglas-fir variants is indicated by fixation and large genetic distance values between these groups.

\* = Student Paper Competition

A VIRUS-LIKE DISEASE OF ROMAINE LETTUCE VECTORED BY *OLPIDIUM BRASSICAE*. C. L. Patterson and R. G. Grogan. Dept. of Plant Pathology, University of California, Davis, CA 95616.

A previously undescribed virus-like disease of romaine lettuce is increasing in incidence in the Salinas and Arroyo Grande valleys of California. The disease symptoms include chlorosis and necrosis of older leaves, followed by death of the plant. Virus particles were not detected by leaf dip techniques. The causal agent was not transmitted by sap, *Myzus persicae*, or *Bemisia tabaci*, but was soil and graft transmitted. Foliar symptoms were evident about 6 wk after inoculating romaine roots with zoospores of *Olpidium brassicae* (OB) obtained from the roots of diseased plants. Zoospores of OB lost the ability to transmit the agent after several generations on sugar beet, a nonsusceptible host of the romaine disease agent. Non-infective OB acquired disease transmissibility, however, from the roots of romaine plants infected by graft transmission. These results indicate that the causal agent of the romaine disease is vectored by OB and may be etiologically similar to the lettuce big-vein agent.

ALTERNARIA LEAF SPOT OF CALENDULA. Robert D. Raabe, Department of Plant Pathology, University of California, Berkeley, CA 94720

In a large bedding plant nursery in northern California, a serious leaf spot of *Calendula officinalis* was determined to result from infection by an *Alternaria* with large, long beaked spores. *A. porri* "Calendula" has been reported from Europe but this is believed to be the first report of the fungus on this plant in North America. The conidia of the fungus vary from 20 to 36  $\mu$  wide (ave. approximately 26  $\mu$ ) by 124-128  $\mu$  long (ave. approx. 188  $\mu$ ). Lesions produced by the fungus are small and range from 1 mm to 5 mm in diameter, and frequently coalesce to kill large leaf areas. Although the fungus occurs naturally through the winter, inoculations were successful at 60, 70, 80, 90 F and at fluctuating temperatures. Plants inoculated at 90 F were more severely damaged than those inoculated at other temperatures. Biweekly sprays of akutel, mancozeb, propiconazole, iprodione, triadimephon, chlorothalonil and a mixture of mancozeb and thiophanate methyl gave good control.

OCCURRENCE OF HOLLOW HEART OF PEAS IN THE PACIFIC NORTHWEST. Charles M. Rush, USDA-ARS, Irrig. Agric. Res. & Ext. Center, P.O. Box 30, Prosser, WA 99350

An unusual number of stunted, nonvigorous pea seedlings were observed in research plots in 1985. Further investigation revealed that over 50% of the seed were affected by the physiological disorder known as hollow heart or cavitation. During germination, seed predisposed to hollow heart may develop bleached sunken cavities on the adaxial surface of the cotyledons. Often a deep crack will traverse the depressed area. Development of the disorder is dependent on plant stress during seed set and subsequent environmental conditions during germination. When germinated in nonsterile soil, seed with hollow heart are susceptible to colonization by saprophytic fungi and bacteria which may cause rot of the affected area only or the entire seed. With field grown peas, hollow heart may easily be confused with marsh spot or Pythium seed rot.

CLONED PHASELOTOXIN GENE AS A HYBRIDIZATION PROBE FOR IDENTIFICATION OF *PSEUDOMONAS SYRINGAE* PV. *PHASEOLICOLA*. N. W. Schaad, H. Azad, R. C. Peet and N. J. Panopoulos. Dept. Pl., Soil, & Ent. Sci., Univ. Idaho, Moscow, ID 83843 and Dept. Plant Pathology, Univ. Calif., Berkeley, CA 94720.

A 2.6 Kb EcoRI fragment containing Tn5 cloned from TOX<sup>-</sup> mutant *Pseudomonas syringae* pv. *phaseolicola* (PSP) NPS 4336 and sub-cloned into pBR-325 to produce plasmid pRCP2 (Peet, et al. J. Bacteriol. In Press) was tested for identification of PSP. This plasmid was extracted, nick translated with <sup>35</sup>S-dCTP, and used for colony hybridization. The following number of pseudomonad strains were tested to determine specificity: 30 PSP, 68 *P. s. syringae* from beans, 5 *P. s. viridiflava*, 5 *P. s. tomato*, 3 *P. s. tabaci*, 2 *P. s. coronafaciens*, 9 *P. s. pisi*, 2 *P. s. glycinea*, and 28 unknown fluorescent oxidase positive strains from bean seeds. All strains of PSP were positive. All other bacteria were negative except one strain of *P. s. glycinea*. This toxin gene probe should prove useful for the rapid identification of PSP isolated from bean plants and/or seeds.

THE FIRST REPORT OF CANKERING OF TRUE FIR IN CALIFORNIA BY *NECTRIA FUCKELIANA*. M. E. Schultz and J. R. Parmeter, Dept. of Plant Pathology, Univ. of California, Berkeley, CA 94720. \*

A canker of true firs (*Abies concolor* and *A. magnifica*) caused by *Nectria fuckeliana* has been found in southern OR and northern CA, most commonly in overstocked fir stands. Isolates from cankers produced only the microconidial state in culture, but the *Nectria* state usually appeared after 2 years on cankers resulting from inoculation. Cankers rarely girdle trees but do form weak points where trees break during winter storms. It was isolated from 23% of necrotic areas on live branches of stem cankered trees, and from 19% of the dead branch tips of trees without cankers. It was isolated from all stem cankers with fruiting *Nectria*; 30% of cankers without fruiting yielded the pathogen. Nonsporulating fungi of various colony morphologies were also isolated, but inoculations with these fungi never resulted in cankers. Inoculation of stressed trees resulted in larger stem cankers than unstressed controls. A clearwing moth (Noctuidae) was observed feeding on the callus tissue of healing cankers.

Genetic Analysis of *Xanthomonas* Using Bioluminescence. J.J. Shaw and C.I. Kado, Department of Plant Pathology, UC Davis, Davis CA 95616 \*

*Xanthomonas campestris* pv. *campestris* (XCC) affects plants in the Brassicaceae causing the disease black rot. Several mechanisms of symptom induction have been proposed including the elaboration of extracellular enzymes and toxin production. The bioluminescence (*lux*) genes of *Vibrio fischeri* are expressed in XCC and, as a promoterless gene cassette, are amenable to transcriptional fusions. The promoterless *lux* cassette has been inserted into Tn1731 creating the new transposon Tn4431. Tn4431 is able to generate in vivo fusions of the bioluminescence genes and resident XCC promoters. A suicide vector is used to introduce Tn4431 into XCC generating a variety of mutants which are screened for pathogenicity and production of hypothesized pathogenicity related enzymes. The uses of bioluminescence to detect and quantify bacteria and to detect gene expression in planta are discussed.

DU PONT FUNGICIDE DPX-H6573 TEST RESULTS FROM BRAZIL. L. G. da Silva and L. T. Palmer, C. P. 9, 13140 Paulinia, S. P., Brazil and 13130 Road 19, Madera, CA. 93637.

DPX-H6573, 1-((4-(4-fluorophenyl)methylsilyl)methyl)-1H-1,2,4-triazole, Nustar<sup>®</sup>, is a new ergosterol biosynthesis inhibiting fungicide. It has shown activity on a number of diseases. Field tests in Brazil demonstrated control of *Venturia inaequalis* of apple; *Mycosphaerella fragariae* of strawberry; *Hemileia vastatrix* of coffee; *Ascochyta arachidis*, *Cercospora* spp., and *Sphaceloma arachidis* of peanut; *Puccinia recondita* f. sp. *tritici*, *Erysiphe graminis* f. sp. *tritici*, *Helminthosporium sativum* and *Pyrenophora trichostoma* of wheat; rose black spot, *Diplocarpon rosae*; *Sphaerotheca fuliginea* of okra and *Erysiphe cichoracearum* of cucumber. The number of sprays and rates varied with each crop. Performance of Nustar<sup>®</sup> was equal or superior to commercial standards or other sterol inhibitors tested in these trials. Phytotoxicity was not observed at rates tested on crops reported in this study.

EFFECTS OF COMBINED CHEMICAL AND SOLAR TREATMENT ON POPULATION DENSITIES OF *FUSARIUM* SPP. L. G. Skoglund, C. Rasmussen-Dykes and W. M. Brown, Jr. Dept. of Plant Path. and Weed Sci., Colo. State Univ., Fort Collins, CO 80523, and G. A. Weinstein Denver Botanic Gardens, 909 York St., Denver, CO 80206. \*

Trials to eliminate soil inhabiting *Fusarium* spp. were established in June 1985 at the Denver Botanic Gardens (alt 1589 m) in beds naturally infested with *F. oxysporum* and other *Fusarium* spp. Treatments were metam-sodium (plots sealed with water), solarization under clear plastic covers, and a combination of metam-sodium plus solarization. *Fusarium* population densities (PD) were determined on Komada's medium by soil dilution prior to treatment, at end of the treatment period (5 wks), and 14 weeks later. *Fusarium* spp. PD were significantly decreased by all treatments, with combined metam-sodium/solarization giving the greatest decrease, followed by solar, metam-sodium alone and an untreated check.

EVALUATION OF SEED- AND FOLIAR FUNGICIDES FOR CONTROL OF KARNAL BUNT OF WHEAT. J. L. Smilanick, N. L. Cashion, and

\* = Student Paper Competition

J. M. Prescott. USDA-ARS, Logan, UT, 84322-6300 and CIMMYT, Londres 40, 06600 Mexico, D.F.

Eight seed- and 16 foliar-applied fungicides were evaluated for control of Karnal bunt on spring wheat cv. Seri in Sonora, Mexico. Natural infection was reduced more than 80% with two applications of propiconazole or etaconazole (250 g a.i./h), or four applications of mancozeb or copper hydroxide (2.4 kg and 3.0 kg a.i./h, respectively) applied to wheat plants at the awns-emerging to anthesis growth stages (Feeke's 10.0-10.5). Infection induced by boot inoculation of secondary sporidia of *Tilletia indica* (10,000 sporidia/ml) was reduced 85% by propiconazole and etaconazole applied 72 h after inoculation. Applications of these fungicides 48 h or 24 h before, or 24 h after inoculation were less effective. None of the fungicides applied to seed reduced natural or artificially-induced Karnal bunt infection.

**INHIBITORY AND LYTIC EFFECTS OF AGRAL, A NON-IONIC SURFACTANT, ON VARIOUS ASEQUAL STAGES IN THE LIFE CYCLE OF *PHYTHIUM* AND *PHYTOPHTHORA* SPECIES.** M. E. Stanghellini, Dept. of Plant Pathology, Univ. of Arizona, Tucson, AZ 85721, and J. A. Tomlinson, National Vegetable Research Station, Wellesbourne, England CV35 9EF.

Zoospores of *Pythium aphanidermatum*, *P. tracheiphilum*, *P. intermedium*, *P. dissotocum*, and *Phytophthora nicotianae* ceased motility and lysed within 1 min after placement in a solution containing 20 ug Agral/ml. The concentration was also totally inhibitory to vesicle formation and zoospore production by the four species of *Pythium* and to zoospore production by *Ph. nicotianae*. The lysis of both zoospores and vesicles suggests that Agral disrupts the integrity and/or permeability of the plasma membrane of fungus structures lacking a cell wall. Agral had little or no effect on mycelial growth or direct germination of encysted zoospores and sporangia of the same fungi. Results indicate a potential use of Agral for the control of root diseases of hydroponic-grown crops caused by species of *Pythium* and *Phytophthora* which rely on zoospores for plant-to-plant spread.

**IMMUNOLOGIC AND ELECTROPHORETIC COMPARISON OF CITRUS CANKER AND A CITRUS LEAF SPOT DISEASE IN MEXICO.** J.J. Stapleton, Dept. of Plant Pathology, University of California, Davis, CA 95616.

A leaf spot disease (LSD) of unresolved etiology that primarily affects Mexican lime trees (ML) along the Pacific coast of Mexico is a suspected form of citrus canker (*Xanthomonas campestris* pv. *citri*=XCC) called "bacteriosis". Antiserum (AS) prepared against field-collected LSD leaf lesion tissue from ML was evaluated by several immunologic techniques. AS was reacted against heat-stable proteins from reference isolates of XCC strains, as well as from bacteria isolated from LSD lesions on ML and provisionally identified as XCC. Challenges also were made between AS and diseased and healthy tissue of ML and other citrus hosts. The same antigenic materials were analyzed by SDS-PAGE. Positive reactions occurred between AS and natural LSD extracts of ML and of other Citrus hosts. Reactions were occasionally observed to extracts from healthy tissue. SDS-PAGE analysis indicated protein differences among all the bacterial isolates.

**SELECTED HOST PLANTS INFECTED WITH BEET LEAFHOPPER TRANSMITTED VIRESCEENCE AGENT EXHIBIT GIBBERELIC ACID MEDIATED RESPONSES.** D. A. Sullivan, G. N. Oldfield, and D. J. Gumpf\*, USDA-ARS, Boyden Lab., University of California\*, Riverside, Ca. 92521\*

Infection by the beet leafhopper transmitted virescence agent (BLTVA), a mycoplasma-like organism (MLO), induces flowering in a radish and dill grown under short days, overcoming their requirement for long days to initiate blooming. Likewise, infected Chinese cabbage, carrot, celery, and parsley will flower without vernalization. Gibberellic acid (GA) is the only plant growth substance which will induce flowering in these groups of plants under non-inductive conditions. The GA biosynthesis inhibitor AMO-1618 reduced flowering of infected radish at five weeks from 92% to 48%. *Catharanthus roseus*, a host with a GA-insensitive flowering rate, does not bloom prematurely when infected. This evidence suggests that BLTVA either induces an increase in host GA levels or contributes directly to the synthesis of GA in infected plants.

**EVALUATION OF CERTAIN HYPHOMYCETES AS BIOCONTROL AGENTS FOR AZALEA ROOT ROT CAUSED BY *PHYTOPHTHORA CINNAMOMI*.** Abraham Szejnberg and Peter H. Tsao, Department of Plant Pathology, University of California, Riverside, CA 92521.

Twenty seven isolates (19 species) of hyphomycetes among 155 isolates (101 species) of soil fungi tested showed strong antagonism *in vitro* against *Phytophthora cinnamomi* (PC) and *P. parasitica*, and were evaluated in greenhouse pot tests as bio-control agents for azalea root rot caused by PC. Rooted cuttings of azalea, cv. Chimes, were inoculated simultaneously with PC (grown on millet seeds) and with each of the candidate antagonists [grown on bran/peat (1:1, v/v) medium] by mixing them into the planting mix [redwood bark/perlite/peat (2:2:1)]. Plants were heavily watered at weekly intervals and harvested at 5-6 weeks. *Aspergillus flavipes*, *A. flavus*, *A. ochraceus*, *Penicillium decumbens*, *P. janthinellum* and *P. ochro-chloron* suppressed PC infection of azalea roots to various degrees, as indicated by reduced root-rot ratings (from 4.7-6.6 to 2-3.3, on a scale of 7). Some isolates inhibitory *in vitro* did not reduce root infection.

**OVERWINTERING OF POTATO LEAFROLL AND BEET WESTERN YELLOWS VIRUSES IN WINTER ANNUAL WEEDS.** P. E. Thomas and W. K. Kaniewski, USDA-ARS, Irrig. Agric. Res. & Ext. Center, P.O. Box 30, Prosser, WA 99350, and Institute of Plant Protection, Miczurina 20, 60-318 Poznan, POLAND.

Many weed species in Washington state were analyzed in early spring for potato leafroll and beet western yellows viruses by serology and aphid transmission. Both viruses commonly infected major cruciferous species and a few other weeds. The viruses were found in the weeds, not only in the major potato growing region, but also in both cultivated and noncultivated regions remote from potatoes. The Cruciferae are the dominant spring weeds of the potato growing regions of the Pacific Northwest. Some Cruciferae are perennials. Most are winter annuals which germinate in the fall when leafroll virus infective aphids are abundant. They mature late the following spring at a time corresponding with a major late spring aphid flight, when most leafroll infection in potatoes is known to occur. As overwintering hosts of the virus, these weeds may play a major role in the epidemiology of potato leafroll disease in the region.

**EFFECT OF HUMIDITY AND HOST PLANT ON EPIPHYTIC GROWTH AND SURVIVAL OF XANTHOMONADS.** L.W. Timmer, Univ. Florida, CREC, Lake Alfred, FL and J.J. Marois, Univ. Calif., Davis, CA.

Detached leaves or entire plants were sprayed with bacterial suspensions ( $10^4$ - $10^5$  cells/leaf) and held under different relative humidities (RH). Population densities on leaf surfaces were determined daily by washing and dilution plating on a selective medium. *Xanthomonas campestris* pv. *vesicatoriae* (Xcv) populations increased 10-100 fold on tomato leaves at high RH (>90%), survived erratically at moderate RH (40-60%), and declined to low or non-detectable levels at low RH (<25%). At high RH, Xcv populations remained constant or increased on leaves of almond, plum, peach, walnut, and sweet orange. *X.c. alfalfae*, *X.c. campestris*, *X.c. translucens*, *X.c. vitians* and a saprophytic isolate of *X. campestris* multiplied as well on detached tomato leaves at high RH as did Xcv. In competition studies, Xcv and the saprophytic isolate of *X. campestris* multiplied independently of one another when applied simultaneously to detached tomato leaves at high RH.

**BIOLOGICAL CONTROL OF APPLE CROWN ROT.** R.S. Utkhede, Agriculture Canada Research Station, Summerland, B.C. V0H 1Z0

*Enterobacter aerogenes* isolated from local soil produced diffusible antibiotics antagonistic to *Phytophthora cactorum*, causal agent of apple crown rot. This substance was fungistatic and fungicidal. *E. aerogenes* significantly reduced the percent infection under greenhouse conditions. *E. aerogenes* applied alone has significantly reduced the percent infection under field conditions. However, when metalaxyl and *E. aerogenes* were applied alternately they controlled the disease comparable to metalaxyl alone. In another field test where all the trees in the test were naturally infected with *P. cactorum* the trees treated with *E. aerogenes* remained alive and produced normal fruit while the untreated trees were terminally diseased and produced only a few small fruits.

**DISEASE SURVEY OF CHERRY (*Prunus avium* L.) ORCHARDS.** J. K. Uyenoto, S. K. Lowe, W. R. Schraeder<sup>1</sup>, and W. D. Gubler, Department of Plant Pathology, University of California, Davis 95616, and <sup>1</sup>Cooperative Extension, Stockton, 95205.

\* = Student Paper Competition

Thirty sweet cherry orchards were randomly selected in San Joaquin County, California for disease survey. A minimum of 0.4 ha per orchard was examined and mapped on a tree by tree basis, i.e. ratio of surveyed parcel (also selected randomly) to orchard size was 0.4 ha/4-8 ha. Tree sites were examined for replanted, dead/missing, and diseased trees. Surveys in May 1985 of 5,642 tree sites showed 21% with replants (5 years or less) and 9% with dead/missing trees. Of diseased trees, 3% each had *Phytophthora* and buckskin, 1.7% had viruses, 23% had crinkle/deep suture, and 0.3% had gopher injury, bacterial canker or crown gall. Surveys of the same tree sites in July revealed that of 3,310 healthy trees in May, 52 had died. Likewise, of 164 *Phytophthora* and 162 buckskin diseased trees, 40 and 26, respectively, had died; of 98 virus infected trees, 4 died; of 1,326 crinkle/deep suture symptomatic trees, 35 died; and of 19 trees affected by other causes, 10 died.

OCCURRENCE AND CONTROL OF HELMINTHOSPORIUM LEAF SPOT IN TROPICAL BOLIVIAN SPRING WHEAT. Vidal Velasco and William Brown, Jr., Dept. of Plant Pathology and Weed Sci., Colorado State Univ., Fort Collins, CO 80523. \*

Spring wheat cultivars in tropical eastern Bolivia were affected with a leaf spot disease during 1978-1980. The pathogen was subsequently identified as *Cochliobolus sativus* (imperfect stage *Helminthosporium sativum*). This is the first report of this pathogen on spring wheat under tropical conditions in eastern Bolivia. Seed treatment trials during 1978 and 1979 showed carboxin provided better control than triadimenol and lesan, when used at labeled rates. Foliar application trials during the same period showed mancozeb controlled leaf spot more effectively than propineb or benomyl at labeled rates.

\* = Student Paper Competition