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Abstracts

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Alphabetized by first author's last name

CHANGE IN PATHOGENICITY OF POTATO VIRUS Y THROUGH ONE HOST PASSAGE. R. Acosta-Leal, and Z. Xiong. Department of Plant Pathology, University of Arizona, Tucson, AZ 85721.

Virgin A Mutant (VAM) is a tobacco line with monogenic resistance to potato virus Y (PVY) NN strain. Tobacco line NC 745 resistant to PVY-NN is a descendant of anther-doubled haploid progenies of tobacco Coker 86 x VAM cross. The resistance genes in both lines are theoretically the same, but massive inoculation of a single lesion isolate PVY-NN produced 0/697 and 17/548 infected plants on VAM and NC 745 tobacco, respectively. When the infected NC 745 plants are used as inoculum, almost 100% of VAM and NC 745 plants were infected. Two new strains have been isolated from PVY-NN passage through NC 745 tobacco: a severe vein necrosis (SVN) strain and a mild vein necrosis (MVN) strain. The symptoms induced by PVY-SVN is very similar to those of PVY-VAM previously reported. The susceptibility of VAM and NC 745 tobacco plants to infections by PVY-VAM and PVY-SVN strains depends on virus concentration. The dilution end point of the two strains is 10 to 100 times lower in VAM than in NC 745, indicating a subtle difference in the resistance of the tobacco lines.

LABORATORY AND FIELD EVALUATIONS OF PROPICONAZOLE FOR CONTROL OF ARMILLARIA ROOT ROT. J. E. Adaskaveg, J. M. Ogawa, and M. L. Wade. Department of Plant Pathology, University of California, Davis, CA 95616.

In the central valleys of California, Armillaria root rot caused by the putative species *Armillaria mellea* (Vahl.: Fr.) Kummer is a lethal disease of *Prunus* and other tree species. The disease has been controlled with some success with soil fumigants (e.g. CS₂, MeBr) and resistant rootstocks, but not with other fungicides. In laboratory studies, potato-dextrose agar (PDA) was amended with the fungicide Alamo 1.IEC to give a final concentration of 0.01, 0.1, 1.0, or 10.0 µg/ml propiconazole (a.i.). For each of 3 isolates, a 4-mm diam. agar plug was placed on PDA or fungicide amended PDA. Colony diameter was measured weekly for 4 wk. The log₁₀ of fungicide concentration was regressed on the percent reduction of growth. The model was significant ($P < 0.05$) and linear ($R^2 = 0.88$). The equation was $Y = -0.82 + 0.5X$ and the EC₅₀ was calculated as 0.15 µg/ml. Propiconazole was completely inhibitory at concentrations of 10 µg/ml. In June 1992, therapeutic passive injections of Alamo (400 µg a.i./ml) were made in five, 7-yr old almond trees (Lovell peach rootstock) infected with the fungus. On a rating of 0 to 4 (4=death), initial mean disease severity (DS) ratings were 1.8 for treated and 2.0 for nontreated trees. After 5 months, all treated trees were alive (DS=1.8), whereas 4 of 5 nontreated trees were dead (DS=3.6). Soil drenches of Alamo are currently being evaluated as a noninjurious application method for preventative control and as a possible replacement for fumigants for control of this disease.

DETECTION OF MYCOPLASMALIKE ORGANISMS IN *FRAXINUS* VARIED WITHIN ARIZONA. Jerald S. Bricker and Jean C. Stutz. Department of Botany, Arizona State University, Tempe, AZ 85287-1601

Ash decline (AD) is a disease of *Fraxinus velutina* in the Phoenix, AZ metropolitan area. Mycoplasma-like organisms (MLOs) have been detected in ash stem and root tissue using the DAPI staining technique, but because of low titer detection is difficult. Infection of

ash tissues with MLOs has now been confirmed by DNA amplification using the polymerase chain reaction (PCR) with MLO-specific primers. Tissue from *Fraxinus* sp. trees was collected from different locations in Arizona, during a survey for symptoms of AD, and analyzed using the DAPI test and the PCR technique. Based on data gathered from the DAPI and PCR tests, a higher percentage of the *F. velutina* 'Modesto' trees sampled are infected with MLOs than are *F. velutina* 'Rio Grande', native *F. velutina*, or *F. uhdei* trees.

BRANCH DIEBACK IN THE SOUTHERN CALIFORNIA CHAPARRAL CAUSED BY *BOTRYOSPHAERIA* *DOTHIDEA*. Fred E. Brooks and Donald M. Ferrin. University of California, Riverside 92521.

Botryosphaeria dothidea, a known pathogen of agricultural and horticultural crops, was determined to be the cause of severe branch dieback on a variety of plants in the southern California chaparral from 1985 to 1990. *B. dothidea* has been isolated from more than 50 species of California native plants since mid-1989. The non-host specific pathogenicity of this fungus was demonstrated by field inoculations of *Arctostaphylos glauca* with isolates of *B. dothidea* from four different hosts. Rapid disease development followed inoculation in September 1990 with 6- to 10-cm-long lesions at 1 wk and branch death by 6 wk. Results of a 2-yr study on three chaparral species inoculated in January, May, and September of 1991 and 1992 showed an increase in disease severity as the season progressed. Decreasing xylem pressure potentials coincided with an increase in lesion length.

A NEW VIRUS DISEASE OF PASSIONVINE (*PASSIFLORA EDULIS* VAR. *FLAVICARPA*) CAUSED BY A WHITEFLY-TRANSMITTED GEMINIVIRUS. J. K. Brown^{1,2}, J. Bird², D. Fletcher¹, A. Monllor² and J. Escudero². ¹Plant Sci. Dept., U. of AZ, Tucson, AZ 85721, ²Crop Protect. Dept., U. of Puerto Rico, Rio Piedras, PR 00929.

A new disease of passionvine, *Passiflora edulis* was observed in passionfruit plantations in Puerto Rico during 1991. Plants affected by *Passiflora* virus (PV) exhibited curling, distortion, and irregular mottling of leaves. Attempts to experimentally transmit the virus to and from passionvine by sap inoculation were unsuccessful. Biolistic inoculation with total nucleic acid preparations from infected *Passiflora* resulted in symptom development in bean, but not in *Passiflora*. Total DNA isolated from symptomatic bean was transmissible by biolistic inoculation and by *B. tabaci* "B" biotype from bean to bean, but not from bean to *Passiflora*. Typical symptoms were also observed following inoculation of *Passiflora* by *B. tabaci* "Jatropha" biotype allowed acquisition-access on *Jatropha gossypifolia* infected with the uncharacterized whitefly-transmitted (WFT) *Jatropha* mosaic virus (JMV). DNA preparations isolated from PV or JMV-inoculated bean were positive for geminivirus by dot-blot hybridization using a cocktail of DNA probes for whitefly-transmitted geminiviruses. Agarose gel electrophoresis and Southern hybridization of DNA isolated from symptomatic bean, *J. gossypifolia* and *P. edulis* revealed the presence of geminivirus DNA. The *Passiflora* disease appears to be caused by a WFT geminivirus.

BARLEY STRIPE RUST, PUCCINIA STRIIFORMIS, FOUND IN COLORADO. W.M. Brown, Jr., V. Velasco, J.P. Hill¹ and M.A. Dillon². ¹Dept. of Plant Pathology & Weed Science, Colorado State University, Fort Collins, CO 80523 and ²San Luis Valley Research Center, 0249 E. Road 9N, Center, CO 81125.

Barley stripe rust (*Puccinia striiformis*) race 24 was identified in Ulvalde, Texas in 1990. In September of 1992 a

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stripe rust attacking irrigated barley was observed in the San Luis Valley of Colorado. The stripe rust was observed on Moravian III and Morex barley and not on adjacent wheat. Foxtail barley (*Hordeum jubatum*) was also found infected with stripe rust. Urediospores from the foxtail barley were used to successfully inoculate barley in the greenhouse. This is the first confirmed report of barley stripe rust outside of Texas.

EFFECT OF INOCULUM DENSITY AND CONSECUTIVE YEARS OF PROPANE FLAMING OR TILLAGE ON VERTICILLIUM WILT AND YIELD AND OIL COMPOSITION OF PEPPERMINT. F.J. Crowe, Central Oregon Agricultural Research Center, Oregon State University, 850 N.W. Dogwood Ln. Madras OR 97741

A uniformly infested field trial was used to evaluate the effects of *Verticillium dahliae* on wilt incidence and peppermint performance, together either with propane flaming of mint stems after harvest or with spring tillage. Split plots were 5x-replicated with inoculum density (ID) as the main plot and cultural practices as the subplots. Wilt symptoms increased in tilled plots from 1990 through 1992, but remained similar in flamed plots. Winter damage (1991-92) was severe only in the flamed plots with the highest rate of initial infestation. Stands were weedier in the flamed plots at all ID in 1991 and 1992. Cultural practices had no direct effect on hay or oil yield in 1991 or 1992, but there were significant effects ($P < 0.05$) of ID and there was a significant cultural practice x ID interaction. ($P < 0.05$). In 1992, for example, for initial ID of 0, 0.01, 0.1, 1.0 and 5.0 microsclerotia/gm soil, tilled plots yielded 74.5, 67.9, 67.3, and 58.7 lb/ac of peppermint oil, whereas flamed plots yielded 71.7, 65.7, 68.0, 70.1, and 59.9 lb/ac of peppermint oil, respectively. Thus, in the second and third year of mint production mint performed better with tillage for initial ID's lower than 0.1 microsclerotia/gm soil, but above this initial ID peppermint performed better with flaming. Of 23 oil components analyzed in 1992, two decreased and three increased significantly ($P < 0.05$) with increasing ID. Similarly, two were reduced and two were increased in tilled Vs flamed plots. Changes in ID are being monitored within the trial area, and evaluations of ID in non uniformly infested commercial fields are in progress.

CORRELATIONS AND TREATMENT EFFECTS OF VERTICILLIUM TRICORPUS WITH VERTICILLIUM WILT OF POTATO

J.R. Davis, L.H. Sorensen, and Ann T. Schneider, PSES Dept., University of Idaho, Aberdeen, ID 83210.

Several field studies compared the relationships between soilborne populations of *Verticillium tricorpus* (Vt) and Verticillium wilt of potato. The correlations between Vt and wilt were shown to be consistently negative. These observations were corroborated with greenhouse studies involving the addition of Vt to field soil at 2x10⁵ Vt/18x15 cm dia pot. In the presence of Vt, both wilt incidence and *V. dahliae* colonization were suppressed. With disease suppression, yields were significantly increased by 15 percent. In 1989, three isolates of Vt were applied to field plots as alginate pellets at 63 Kg/ha. Potatoes were then grown in these plots during 1989 through 1991. During 1989 and 1990, soil assays showed 8-22 fold increases of soilborne Vt populations following treatment with Vt isolate V-31 when compared with control plots. Yield data during 1989 showed all three Vt isolates to be mildly pathogenic on Russet Burbank as evidenced by significant increases of the percent of malformed potatoes when compared with uninoculated controls. 1990 data showed a significant reduction of U.S. #1 tubers with two isolates of Vt (V-17 and V-31) and wilt suppression with all isolates. By 1991, neither soil populations of Vt nor incidences of wilt were shown to differ between treatments.

CHLOROTHALONIL (CTH) AND FENTIN HYDROXIDE (FH) ON SCLEROTINIA SCLEROTIORUM (Ss) AND VERTICILLIUM DAHLIAE (Vd) ON POTATO.
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Ss and Vd are considered "nontarget" pathogens when CTH or FH are applied according to the label for control of *Alternaria solani* and *Phytophthora infestans*. Six to eight applications of each were applied each season to potato foliage in a dry bean-potato rotation from 1987-91. Percent of Ss infected plants, on examining stems in 3-10 or 3-20 ft plot rows of six replicates of each treatment, did not exceed 2% in unsprayed plots but was as high as 17% in sprayed plots. Sclerotinia stem rot in sprayed plots declined naturally from a high of 16% in 1987 to 2% in 1990, and in 1991 Ss was too low to score. Infections of Vd, on examining stems/plot row of six replicates for each treatment, did not exceed 8% in unsprayed plots but was as high as 72% in sprayed plots. Potato plants wilted due to Vd, tuber yields, and percent U. S. No. 1 tubers were not affected by fungicide sprays. The reason for increases in incidence of nontargeted diseases by CTH and FH sprays has not been determined.

BIOLISTIC INOCULATION TO EVALUATE COTTON BREEDING LINES FOR RESISTANCE TO COTTON LEAF CRUMPLE VIRUS AND A WHITEFLY-TRANSMITTED GEMINIVIRUS AFFECTING COTTON IN GUATEMALA. D.C. Fletcher¹, J.K. Brown¹ and D. Wilson². ¹Plant Science Dept., University of Arizona, Tucson, AZ 85721 and ²Western Cotton Research Laboratory, USDA/ARS, Phoenix, AZ 85040.

Eleven cotton breeding lines were tested for tolerance/resistance to cotton leaf crumple virus (CLCV), a virus indigenous to Arizona cotton and to an uncharacterized whitefly-transmitted geminivirus from cotton in Guatemala, Guatemala Virus (GV). Cotton seedlings were inoculated at the cotyledon stage by biolistic means with total nucleic acid preparations isolated from CLCV or GV infected cotton. Symptom development was first observed approximately 20 days post-inoculation. Both viruses caused stunting, leaf crumpling and distortion in most cotton lines tested. In general, cotton lines inoculated

with GV exhibited more severe symptoms and developed a yellow mosaic that was not present in plants inoculated with CLCV. One breeding line, Cedix 523-11 appeared to be tolerant to both viruses. Previous experiments indicated that Cedix 523-11 has high tolerance to CLCV when plants are inoculated with viruliferous whiteflies. Our data indicate that none of the lines tested were entirely resistant to both GV and CLCV, but high level tolerance was corroborated in the breeding line Cedix 523-11.

LOSS OF PATHOGENICITY GENES ASSOCIATED WITH LOSS OF CHROMOSOMAL ELEMENTS IN *NECTRIA HAEMATOCOCCA*. D. L. Funnell-Baerg, P. S. Matthews and H. D. VanEtten, Department of Plant Pathology, University of Arizona, Tucson, Arizona 85721.

Strains of the fungus *N. haematococca* pathogenic on pea are able to detoxify the pea phytoalexin pisatin, a trait designated Pda⁺. Crosses involving a highly virulent, Pda⁺ isolate (34-18) with Pda⁻ isolates, resulted in unusual segregation ratios for Pda, and most of the progeny, regardless of Pda phenotype, had relatively low virulence on pea. Subsequent analysis has shown that there are two active *PDA* genes (*PDA1* and *PDA5*) and one non-functional gene (*PHD*) in 34-18. Each *PDA* gene and *PHD* segregate independently and can be lost. Analysis of CHEF gels indicate that *PDA1* resides on a 1.5 Megabase (Mb) chromosome, that is not present in *PDA1*⁻ isolates. *PDA5* and *PHD* are on chromosomes that vary in size from 4.5 to 4.9 Mb in different progeny. CHEF gels also indicate that polymorphisms may be resulting from recombination and loss of chromosomes in these crosses. The loss of virulence, and the unusual segregation of *PDA* genes and *PHD* in the progeny from crosses with 34-18, may result from normal segregation events occurring together with the loss of chromosomal elements during meiosis.

ISOLATION AND IDENTIFICATION OF VESICULAR-ARBUSCULAR MYCORRHIZAL FUNGI FROM DESERT TREES. R.H. Gauer, J.C. Stutz, and C.A. Martin. Dept. of Botany, Arizona State University.

VAM fungi associated with mesquite species (*Prosopis* sp.) and blue palo verde (*Cercidium floridum*) from 12 desert locations in Arizona, New Mexico, Texas, and Sonora, Mexico were collected. Soils at all sites were low ($\leq 12.5 \text{ ug g}^{-1}$) in phosphorus with pH ≥ 7.3 and varied in texture and salinity. Mycorrhizal trap cultures were initiated from roots and rhizosphere soils for each of the locations. After four months, VAM spores were isolated using the wet seive-decant/sucrose gradient method and multispore monospecific isolates were started. We consistently isolated several species of *Glomus* including *Glomus mosseae* (Nicol. & Gerd.) Gerd. & Trappe and *Glomus intraradix* Schenck & Smith, and some unidentified species of *Glomus*.

ANALYSIS OF EXPRESSION OF A PHENAZINE ANTIBIOTIC DNA LOCUS IN CULTURE AND ON SEEDS WITH THE ICE NUCLEATION REPORTER GENE SYSTEM. Dimitrios G. Georgakopoulos, Mavis Hendson, and Milton N. Schroth, University of California, Berkeley, CA 94720.

Pseudomonas aureofaciens strain PGS12 is a seed and root-colonizing bacterium that produces three phenazine antibiotics. A promoterless *inaZ* ice nucleation reporter gene from *P. syringae* was inserted into a chromosomal locus involved in phenazine production. This strain was used to monitor the expression levels of this locus in culture and on seeds. In broth cultures, reporter gene expression was unaffected by iron, and at pH between 5.7 and 8.5. Shikimic acid and phenylalanine, but not anthranilic, favored higher expression levels. Expression was reduced in diluted King's B broth, indicating the significance of nutrient availability. On seed surfaces of various plants expression began 12 hrs after planting. The highest level of expression occurred on wheat seed. The expression was not affected by soil moisture, soil type, and seed inoculum level. Significant variability in expression levels among individual seeds was observed. In conclusion, significant accumulation of phenazine on the seed occurs only at least 24 hrs after planting, and the production is affected by the host, presumably because of the composition and level of nutrients in seed exudates.

INCIDENCE OF RHIZOCTONIA ROOT AND CROWN ROT AND PHYTOPHTHORA ROOT ROT OF SUGAR BEETS IN WYOMING. E.A. Gray and M.M. Deleo, University of Wyoming, Laramie, WY 82071-3354.

A total of 36 sugar beet fields were surveyed during 1992 for the incidence of Rhizoctonia root and crown rot (RRCR), caused by *R. solani* and Phytophthora root rot (PRR), caused by *P. drechsleri*. Incidence of both diseases was greater in fields in close proximity to the sugar factory at Worland where sugar beets have been grown for the longest period of time. The lowest incidence of disease occurred in Fremont County where sugar beets have not been grown for 20 years prior to 1988. Overall, 39% of the fields had RRCR while only 17% had PRR. Estimated mean percent plants infected with *R. solani* and *P. drechsleri*, within individual fields, was 4.8% and 2.0%, respectively, with a range of 0-50% for both. Only 4 of the 36 fields had both RRCR and PRR. Three isolates of *P. drechsleri* and one of *P. crytogeia* were equally pathogenic on seedlings of sugar beet. Seed treatment with metalaxyl (Apron®) resulted in an overall 42% increase in seedling establishment in Phytophthora-infested soil.

COMPARATIVE PATHOLOGY OF *PRATYLENCHUS PENETRANS* AND *PRATYLENCHUS NEGLECTUS* ON ALFALFA AND GRASS. G. D. Griffin, USDA ARS, Forage and Range Research, Utah State University, Logan, UT 84322-6300.

Alfalfa is an excellent host of *Pratylenchus penetrans* and a good host of *P. neglectus*. Grass is a good host of *P. neglectus* and poor to a nonhost of *P. penetrans*. In a greenhouse study, *P. penetrans* reduced the growth of both alfalfa and crested wheatgrass in an alfalfa-grass combination, but suppression of alfalfa growth was not as great as when alfalfa was planted alone. *P. penetrans* did not reduce the growth of a single grass planting. *P. neglectus* reduced the growth of both alfalfa and grass, and there were no differences in plant growth of alfalfa or grass from single or combination plantings. Reproduction of *P. penetrans* was less on alfalfa in the combination planting than when alfalfa was planted alone, whereas reproduction of *P. neglectus* on grass or alfalfa did not differ in single or combination plantings.

NATIVE AMERICAN SUNFLOWER CULTIVARS HOLD VALUABLE DISEASE RESISTANCE. T. J. GULYA, USDA Northern Crop Science Lab, PO Box 5677, Fargo ND 58105.

Twenty-eight sunflower cultivars from seven Native American tribes were evaluated for their resistance to the major sunflower pathogens of North America. Seedlings were tested in greenhouse trials for resistance to rust (*Puccinia helianthi*) and downy mildew (*Plasmopara halstedii*), and in field trials for reaction to *Verticillium* wilt and *Sclerotinia sclerotiorum* wilt. None of the cultivars showed any resistance to race 2, 3, or 4 of downy mildew. The varieties displayed a range of susceptibility to both *Verticillium* and *Sclerotinia* wilts; none were considered to have usable levels of resistance. All cultivars from the *Havasupai* tribe of northern Arizona had some plants which were immune to rust races 3 and 4, the predominant races in North America and one (PI 432512) was totally immune to both races. Cultivars from other tribes were susceptible to both rust races. This study highlights the importance of saving traditional cultivars of sunflower and other crops which were domesticated by Native Americans.

IDENTIFICATION AND PARTIAL CHARACTERIZATION OF A NEW WHITEFLY-TRANSMITTED GEMINIVIRUS AFFECTING TOMATO AND PEPPER FROM SINALOA, MEXICO. A. M. Idris, D. C. Fletcher, and J.K. Brown. Department of Plant Sciences, University of Arizona, Tucson AZ 85721.

A new disease affecting tomato plants was widespread in Sinaloa, Mexico, during the fall of 1989. A previously undescribed whitefly-transmitted (WFT) geminivirus was isolated from tomato plants with severe leaf curl symptoms, reduction in leaf size, leaf distortion, and shortened internodes. The virus was transmitted in a persistent manner by *Bemisia tabaci*, and by mechanical means from tomato to *Nicotiana benthamiana*, but not from tomato to tomato. In transmission studies, the 'B' biotype was a more efficient vector than the indigenous 'A' biotype of the whitefly. Results of a partial host range study indicate symptomatic hosts are pepper, tomato, bean, *Datura stramonium*, *Malva parviflora*, *N. benthamiana*, whereas eggplant is a symptomless host. Dot blot and Southern hybridization analysis with a mixture of DNA A-components of several well-characterized WFT geminiviruses as probes yielded a positive reaction, suggesting a WFT geminivirus. This WFT geminivirus is tentatively designated as Sinaloa tomato leaf curl virus (STLCV).

A SEMI-SELECTIVE MEDIUM FOR THE ISOLATION OF *VERTICILLIUM DAHLIAE* FROM PLANT TISSUE. P. E. Jorge¹, W. R. Chaney², and R. J. Green³. ¹Dept. of Plant Pathology, Univ. of California, Riverside, CA 92521; ²Dept. of Forestry and Natural Resources and ³Dept. of Botany and Plant Pathology, Purdue Univ., W. Lafayette, IN 47907.

A semi-selective medium to facilitate the isolation of *Verticillium dahliae* from hardwood tree species was developed. Pentachloronitrobenzene (PCNB) (0.37 g/l a.i.) and iprodione (0.1 or 0.5 g/l a.i.) were added to PDA amended with Tergitol NPX and Aureomycin. *In vitro* studies showed that growth of *V. dahliae* as well as *Alternaria* and *Rhizoctonia* spp., the primary contaminants encountered during attempts to isolate *V. dahliae*, was inhibited on the medium containing iprodione alone or in combination with PCNB; however, *V. dahliae* was inhibited the least. Addition of PCNB and iprodione (0.5 g/l a.i.) to the medium improved the isolation and recognition of *V. dahliae* from stems of elm, maple and ash seedlings and provided satisfactory inhibition of *Alternaria* and *Rhizoctonia* spp. compared to the basal medium.

DIDYMELLA SP., THE TELEOMORPH OF ASCOCHYTA FABAE F. SP. LENTIS, ON LENTIL STRAW. W. J. Kaiser and B. C. Hellier, USDA, ARS, Western Regional Plant Introduction Station, Washington State University, Pullman, WA 99164-6402

The teleomorph of *Ascochyta fabae* f. sp. *lentis* which incites a blight of lentil (*Lens culinaris*) was observed for the first time in March 1992 on lentil straw that had overwintered on the soil surface at two sites near Genesee, Idaho. The

teleomorph is a species of *Didymella*. Its relationship to *D. fabae*, the teleomorph of *A. fabae* which incites ascochyta blight of faba bean (*Vicia faba*), is being investigated. Single ascospores of the *Didymella* sp. from lentil gave rise to typical cultures of *A. fabae* f. sp. *lentis*. Lentils inoculated with ascospores of the *Didymella* sp. developed lesions on aerial tissues identical to those caused by conidia of the anamorph. The fungus is heterothallic with two mating types.

INTERACTION OF TOMATO ROOTS, *PSEUDOMONAS SOLANACEARUM*, AND BACTERIAL ANTAGONISTS IS MODIFIED BY CHANGES IN SOIL GASEOUS COMPOSITION. Kim, D.H. and I.J. Misaghi, Department of Plant Pathology, University of Arizona, Tucson, Arizona 85721.

Tomato seedlings were transplanted into soils infested with *P. solanacearum* (Ps) (log 7.5 cfu/g dry soil) after root-dip inoculation with a suspension (log 8 cfu/ml) of a strain of *Pseudomonas* sp. (Psp) or *P. fluorescens* (Pf). Both strains are able to reduce Ps-induced wilting in tomato seedlings inoculated with Ps. Seedlings were placed for 14 days in chambers which allowed roots to be exposed to atmospheres containing the following percentages of O₂:CO₂; 21:0.03 (ambient atmosphere), 18:3, 15:6, and 12:9. Modification of soil gaseous environment caused significant (p = 0.05) decreases in the incidence of disease in plants inoculated with Ps and Psp, with Ps and Pf but not in those inoculated with Ps alone. The decrease in disease incidence provided by Psp or Pf was more pronounced in seedlings exposed to ambient atmosphere than in those exposed to the modified atmospheres.

THE INVOLVEMENT OF A BACTERIUM IN INTERNAL RIB NECROSIS OF MATURE HEAD LETTUCE. Kim, D.H. and I.J. Misaghi, Department of Plant Pathology, University of Arizona, Tucson, Arizona 85721.

A disease of mature head lettuce, with symptoms identical to those described for internal rib necrosis, was present in commercial fields in Aguila, Arizona in 1990 and 1991. Isolation from the lesions on the leaf petioles consistently yielded a mixture of fluorescent pseudomonads. The disease was reproduced consistently within 48 h at 25 C in detached leaves of lettuce (cultivar, Salinas) that were inoculated with a suspension (log 8 cfu/ml) of one of the bacterial isolates (*Pseudomonas* sp.) in the laboratory. The disease was also induced following inoculation of intact heads of lettuce (cultivars, Salinas and Vanguard) in fields in Aguila and Wilcox, Arizona in 1991. This is a first report of the involvement of a bacterium in internal rib necrosis.

INCIDENCE OF CROWN GALL IN SEVERAL ALFALFA (*MEDICAGO SATIVA* L.) CULTIVARS IN IMPERIAL VALLEY, CA.

F.F. Laemmlein and W. Leimgruber, Univ. of Calif. Desert Res. and Extension Center, Holtville, CA 92250.

Crowns were harvested and examined for crown gall from 21 cultivars of alfalfa in a 4-year-old stand. Crowns from 2 m² from each of 4 block/variety were sampled. Cultivars XAS 61 (12.5% galled) and Maricopa (13) had significantly fewer galls than AP8660 (23). Cultivars CW-446 (14), WL87-206 (14.25), Condor (14.5), GT13R+ (14.75), WL85-299 (15.5), UC331 (15.75), Cibola (16.25), CW657 (16.5), 5929 (17.5), WL86-213 (18), UC327 (18), UC329 (18), Valiant (18.25), Mecca (18.5), NK83586 (18.5), ST87-4 (18.75), Madera (19) and CUF101 (20.75) were intermediate in % galled crowns. Some galled crowns were partially to completely dead, however, there was no correlation between the incidence of crown gall and total yield.

INDUCTION OF MILD STRAINS OF PEPPER MOTTLE VIRUS BY CHEMICAL MUTAGENESIS AND THEIR EFFICACY IN CROSS PROTECTION. A. Nadeem, M. R. Nelson, and Z. Xiong, Department of Plant Pathology, University of Arizona.

Crude sap of pepper *Capsicum frutescens* L. 'NM 6-4' infected with pepper mottle potyvirus (PeMV) was treated with nitrous acid to induce mutations. Twelve isolates were selected from two distinct types of local lesions on *C. frutescens* L. 'tabasco'. Of the twelve isolates, four produced mild symptoms on both pepper foliage and fruit. When these four mild isolates were inoculated to pepper plants and subsequently challenged with wild type PeMV, they protected the plants from the severe effect of the wild type infection. The yield and the quality of pepper fruit of the protected plants was not significantly different from fruit of uninfected pepper plants.

TARGETING OF PVY-CP INTO TOBACCO CHLOROPLASTS VIA A TRANSIT PEPTIDE: EVIDENCE OF CP CONTRIBUTION TO SYMPTOM DEVELOPMENT. M. Naderi and P. H. Berger. Div. of Plant Pathology, University of Idaho, Moscow, ID 83843.

Plant infection with poty- or tobamovirus results in physiological perturbations of photosystem II and electron transport systems. Previously, we reported that the majority of potato virus Y (PVY) coat protein (CP) found in chloroplasts was associated with thylakoid membranes. Viral RNA isolated from these organelles was infectious. A construct encoding a chloroplast stroma-specific transit peptide (TP)-CP fusion was used to transform tobacco to study the effects and fate of CP in chloroplasts. Light and electron microscopy showed cell enlargement and alteration of cell morphology in TP-CP plants. Measurable changes in fatty acid composition, disorganized membrane stacking and chloroplast development were also observed. Immunolocalization experiments confirmed that CP associated with the thylakoid membrane system. Our findings suggest that CP in chloroplasts may contribute to symptom development in PVY-infected plants. Work is underway to study the effects of PVY challenge of progeny of TP-CP transgenic plants.

DOUBLE-STRANDED RNAs IN *CHALARIA ELEGANS* (*THIELAVIOPSIS BASICOLA*) - DISTRIBUTION AND SIGNIFICANCE. Z.K. Punja, A.M. Bottacin and C.A. Lévesque, Dept. of Biological Sciences, Simon Fraser University, Burnaby, B.C., Canada V5A 1S6.

Isolates of *Chalara elegans* from Arkansas, British Columbia, California, Florida, North Carolina, Oregon, Texas, The Netherlands and Washington were compared for their dsRNA banding patterns following agarose gel electrophoresis. Among the 32 isolates, seven had no dsRNA; eight had one dsRNA band (2.8 kb); 12 had two major bands (5.2 and 5.0 kb) and some minor bands; four had 5 multiple bands (12.2 to 2.8 kb); and one isolate had 4 multiple bands. The growth rate, mycelial dry weight, sporulation, and virulence of representative isolates were measured. No correlations were apparent between the frequency of dsRNA bands and these parameters. However, one spontaneous sector which arose in culture and also in an isolate grown on amentine, both of which originally had multiple dsRNA bands, were found to contain only one band at 2.8 kb. These two isolates displayed altered morphologies, enhanced growth rate, and increased virulence. These results indicate that the presence of multiple dsRNAs in some isolates of *C. elegans* can influence their physiology and virulence.

INFLUENCE OF MOISTURE LEVEL, SOIL AMENDMENTS, CROPPING SEQUENCE AND TEMPERATURE ON SURVIVAL OF *CHALARIA ELEGANS* (*THIELAVIOPSIS BASICOLA*) IN ORGANIC SOIL. Z.K. Punja and S. Chittaranjan, Dept. of Biological Sciences, Simon Fraser University, Burnaby, B.C., Canada V5A 1S6.

The duration of survival of phialospores (endoconidia) of *Chalara elegans* in organic soil (O.M. content of 75%, pH 5.2, soil moisture holding capacity at saturation of 60%) was studied. At 55% moisture content (about -1/3 bar) and 25 C, phialospores could be recovered on semiselective medium (TB-2RBA) for up to 20 wk, while recovery was significantly ($P=0.05$) lower at 42% moisture content (about -8 bars). The presence of carrot plants did not enhance the extent of survival significantly when compared with fallow soil. However, when infested soil was planted to onions, a significant decrease in survival of *C. elegans* was apparent after 15 wk. The addition of dried plant tissues (carrot, alfalfa, rye) reduced survival significantly ($P=0.05$) only after 18 wk. When the soil was flooded and maintained at 25 C, survival of *C. elegans* was reduced significantly within 3 wk and no propagules could be recovered after 10 wk. Flooding at 4 C had no effect on survival and was similar to fallow soil at 25 C. These results suggest that crop rotation with onions or summer flooding could reduce inoculum levels of *C. elegans* under field conditions.

PHYSIOLOGIC LEAF SPOT OF WINTER WHEAT. R.W. Smiley, Dept. of Botany and Plant Pathology, Oregon State Univ., Pendleton, OR.

Physiologic leaf spot (PLS) damages winter and spring wheat in the Pacific Northwest. PLS resembles Septoria leaf blotch (SLB) and tan spot (TS) but does not appear to be caused by a fungus or bacterium. Winter wheat cultivars exhibited large differences in susceptibility. Annual wheat was more affected than wheat/pea or wheat/fallow rotations. PLS became more severe with early planting and decreasing rates of nitrogen. Leaf spot was not affected by nitrogen application times, methods, or sources. Tillage and amount of plant residue in seedbeds had inconsistent effects on PLS. Application of fungicides or burning residue of affected crops had no effect on PLS. PLS severity was reduced and grain yield increased (10-15%; 500-700 kg/ha) by a foliar application of urea + calcium chloride, but not by urea + micronutrients. Further tests with chloride sources are in progress. Regression analysis indicated that yield was damaged 10% by PLS.

MANAGEMENT OF A CEREAL CYST NEMATODE-ROOT DISEASE COMPLEX OF WINTER WHEAT. R.W. Smiley and R.E. Ingham. Dept. of Bot. and Plant Pathol., Oregon St. Univ., Pendleton and Corvallis, OR.

Wheat in eastern Oregon is damaged by a complex including *Heterodera avenae* (Ha), *Rhizoctonia solani* AG-8 (Rs), *Pythium* species (Ps), *Gaeumannomyces graminis* var. *tritici* (Gg), and others. Wheat growth, root damage, and yield were examined in replicated plots (5 x 30 m) of 11 crop sequences over five years. Annual wheat (4143-4434 kg/ha) yielded less (15d=556 kg/ha; $P=0.05$) than wheat rotated with barley, rape, pea, alfalfa, bluegrass, or summer fallow (6252-7036 kg/ha). Yield was negatively correlated with root damage by Ha and Gg. Annual wheat yields were equal in tilled (moldboard plow) and no-till seedbeds. Most root damage was by Gg, Rs, and Ps in no-till, and Ha in tilled soil. Plots were split as aldicarb-treated or untreated segments during the final year. Aldicarb reduced damage by Ha, increased damage by Rs and Ps, and did not affect grain yield. Damage to wheat by Ha was less following weed-free alfalfa than alfalfa with grass weeds.

RELATIONSHIP OF CALLOSE TO RESISTANCE OF LETTUCE TO *PLASMOPARA LACTUCAE-RADICIS*. M.E. Stanghellini and S.L. Rasmussen. Department of Plant Pathology, University of Arizona, Tucson, AZ 85721.

Resistance of lettuce to *Plasmopara lactucae-radicis*, an obligate root-infecting fungus, was attributed to rapid deposition of callose (which is primarily a B-1,3-glucan) around fungal haustoria by the host, as well as deposition of intrahyphal callose walls by the fungus. Treatment of a genetically-resistant lettuce cultivar with 2-deoxy-D-glucose, an inhibitor of callose synthesis by the plant, resulted in its susceptibility to the root pathogen. Fungal nutrient deprivation, resulting from callose deposition, was hypothesized as the specific mechanism involved in the resistance of lettuce to the pathogen.

FIVE-YEAR STUDY OF A SEVERE CASE OF VERTICILLIUM WILT OF YOUNG ALMOND TREES IN THE SAN JOAQUIN VALLEY.

J. J. Stapleton¹ and W. K. Asai², University of California, Cooperative Extension, Kearney Agric. Center, Parlier, CA 93648¹ and Modesto, CA 95355².

Epidemiology and economic effects of a severe case of Verticillium wilt (*V. dahliae*) of young almond trees (*Prunus dulcis* cvs. 'Carmel' and 'Nonpareil') were studied during 1988-1992 in two adjacent orchards (ca. 16 ha each) near Modesto, CA. Although numbers of soilborne propagules of *V. dahliae* were relatively low (3-10 propagules per g soil), ca. 90% of trees exhibited foliar symptoms during first and second leaf. 'Carmel' trees were more susceptible than 'Nonpareil,' as previously reported. Unlike previous reports, however, large numbers of trees were killed, the disease was active throughout the growing season, and the fungus could be isolated from symptomatic shoots year-around. Recovering trees gave lower nut yields than those in healthy orchards nearby. Cumulative economic loss over the tree establishment period is estimated at >\$10,000 per ha to date.

DIRECT MEASUREMENT OF ELECTRICAL CONDUCTIVITY (EC) IN GOLF COURSE HIGH-SAND-CONTENT SOILS. Larry J. Stowell¹ and Steve Davis², ¹PACE Consulting, 1267 Diamond St., San Diego, CA 92109 and ²Target Specialty Products, 17710 Studebaker Rd., Cerritos, CA 90701.

A new EC meter eliminates the need for preparing saturated soil extracts. The TDSTestr 4™ (Cole Parmer, P.O. Box 48898, Chicago, IL 60648-0898, Cat. No. 19088-30) can be probed directly into a saturated soil paste eliminating the need for vacuum filtration. To evaluate the performance of the TDS-4, thirty-two golf course greens representing six different courses were sampled. Conventional saturated soil extracts were prepared by vacuum filtration and the extract EC measured using a Horiba EC meter. The TDS-4 meter was probed directly into the soil paste prior to vacuum filtration. Regression analysis revealed a highly significant correlation between the Horiba extract and TDS-4 direct measurements ($R=0.94$, $p<0.0001$). Conversion from direct TDS-4 meter readings to equivalent soil extract values can be carried out using the following equation: saturated soil extract EC (dS/m) = $0.8 + 2.7 \cdot$ (TDS-4 EC [dS/m]). The TDS-4 meter also has been used in the field by probing the meter directly into moistened soils.

ASSESSMENT OF VEGETATIVE COMPATIBILITY AND VIRULENCE OF VERTICILLIUM DAHLIAE STRAINS FROM IDAHO POTATOES AND TESTER STRAINS. C. A. Strausbaugh, Univ. of Idaho, Kimberly, ID 83341.

Thirty-three wild-type strains of *Verticillium dahliae* were isolated from potato stems from 25 fields in southern Idaho. These strains were all assigned to vegetative compatibility group (VCG) 4 based on pairings of nitrate-nonutilizing mutants induced on medium containing chlorate. The Idaho strains and VCG 4 testers were divided into nine subgroups. These subgroups

relate to previously designated VCG 4 subgroups (Phytopathology 81:552-558) as follows: 4A = 4A1, 4A2, 4A3, 4A4, 4A5, and 4A6; 4A/B = 4A/B1; and 4B = 4B1 and 4B2. Subgroup 4A contained 29 of the 33 Idaho strains. All VCG 4A strains and most of the strains from VCGs 4A/B and 4B were pathogenic in greenhouse studies. When placed into three subgroups for analysis, the strains from VCG 4A were significantly more virulent than those from VCG's 4A/B and 4B. However, individually not all VCG 4A strains were significantly more virulent than strains in VCGs 4A/B and 4B. This continuum of virulence and genetic diversity among *Y. dahliae* strains was evenly distributed throughout potato growing areas in southern Idaho.

FUNGICIDAL MANAGEMENT OF FUSARIUM BASAL ROT OF ONIONS.

C. E. Swift¹ and H. F. Schwartz². ¹Tri River Cooperative Extension, 619 Main, Grand Junction, CO 81502-5028. ²Dept. of Plant Pathology & Weed Science, Colorado State University, Fort Collins, CO 80523.

Fusarium oxysporum f. sp. *cepae*, causal agent of Fusarium basal rot of onions (*Allium cepae*), is a soil-inhabiting pathogen in many onion growing regions. Western Colorado producers estimate that this pathogen causes up to 30% loss annually in susceptible cultivars. A study was implemented in 1992 in a commercial onion field with a history of moderate to severe losses from Fusarium basal rot and pink root (*Pyrenochaeta terrestris*) to evaluate the efficacy of three soil and seed fungicides applied at planting against the soil-borne pathogen complex. Yield data of medium and jumbo (marketable) onions from replicated plots revealed that Topsin M 5G (thiophanate methyl) at 31.4 kg/Ha and Aliette/Rovral 15G (aluminum

tris/iprodione) at 0.34 g/m row significantly improved yields 90% more than the untreated control. Ridomil PC 11G (metalaxyl) at 22.4 kg/Ha also looked promising. Seed treatments with carboxin/thiram, metalaxyl or imazalyl did not improve onion yields. Additional studies are underway to verify these results in the greenhouse and field during 1993.

EFFECTS OF LEPTOSPHAERIA KORRAE ISOLATES ON VEGETATIVE GROWTH OF THREE KENTUCKY BLUEGRASS CULTIVARS. D.C. Voltz and W.M. Brown, Jr., Department of Plant Pathology and Weed Science, Colorado State University, Fort Collins, CO 80523

Three *Leptosphaeria korrae* isolates were obtained from a collection originally isolated from naturally infected Colorado Kentucky bluegrass (*Poa pratensis*) lawns displaying necrotic ring spot symptoms. Pathogenicity trials to determine comparative virulence of the isolates were conducted in the greenhouse. Twenty-four plugs (10 cm diameter) of 7-yr-old 'A-34', and thirty-three plugs of both 'Park', and 'Baron' Kentucky bluegrass were removed from Colorado State University Horticultural Research Farm and inoculated with one of the *L. korrae* isolates. Foliar quality, root discoloration, and shoot dry weights were assessed weekly over a 10 wk period. Foliar symptoms and root discoloration were more severe on cultivar 'A-34' than on 'Park' or 'Baron'.