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ABSTRACTS

INFLUENCE OF AGE ON THE SUSCEPTIBILITY OF TOMATO PLANTS TO *LEVEILLULA TAURICA*. S. M. E. Abdel-Ghafour and S. V. Thomson, Department of Biology, Utah State University, Logan, Utah 84322.

The influence of plant age on the susceptibility to powdery mildew (*Leveillula taurica*) was studied using tomato cultivar 'Del Monte 71-24.' Three ages of tomato plants were used; 17, 15, and 13 weeks. These plants were transplanted to the field with alternate rows of plants infected with *L. taurica* serving as inoculum. Disease severity was determined on 8 and 24 August and 15 September by counting the number of chlorotic lesions per plant. The number of dead leaves per plant was also counted on 15 September. There were significantly more chlorotic lesions on older plants. However, on 15 September the oldest plants had significantly more dead leaves whereas there was no significant difference in the number of chlorotic lesions. Susceptibility to *L. taurica*, as measured by symptom expression, increases with plant age. Evaluation of disease severity must also consider necrosis of leaves in addition to chlorotic lesions.

***ATHELIA ARACHNOIDEA* (BERK.) JULICH, THE SEXUAL STATE OF *RHIZOCTONIA CAROTAE* RADER.** Gerard Adams, Bradley Kropp* and R. G. Grogan, Dept. of Plant Pathology, University of California, Davis, CA 95616 and *Dept. of Botany and Plant Pathology, Oregon State University, Corvallis, OR 97331.

This is the first report of the connection between *Rhizoctonia carotae* and its sexual state *Athelia arachnoidea*. The discovery of the sexual state adds much to the understanding of the epidemiology, geographic distribution and source of soil-borne inoculum of Crater Rot of carrots caused by *R. carotae*. *A. arachnoidea* occurs on decaying leaves in deciduous forests in cold wet weather. In December 1982 hymenia of *A. arachnoidea* were abundant in forests surrounding Corvallis, Oregon. Isolations from hymenia, grown on agar medium and hyphal tipped, consistently yielded cultures morphologically identical to *R. carotae*. *A. arachnoidea* caused Crater Rot on carrots stored at 3°C for 2 months. *A. arachnoidea* has a temperature growth curve similar to ATCC type strains of *R. carotae* and anastomoses with them. Di-mon pairings between *R. carotae* and monokaryons of *A. arachnoidea* are in progress.

CONTROL OF SCAB OF WINTER WHEAT BY FOLIAR FUNGICIDES. Louis Anzalone, Jr., Dept. of Plant Path. and Crop Physiol., La. Agr. Exp. Sta., La. State Univ. Agr. Ctr., La. State Univ., Baton Rouge, LA 70803.

Scab of winter wheat was epidemic in Louisiana during 1983 in fields where wheat was planted following corn. Fungicides were evaluated on three cultivars of wheat for scab control in field plots at Louisiana State University, Baton Rouge. Leaf rust resistant wheat cultivars Coker 797, Coker 916 and Florida 301 were used in the experiment to minimize disease interaction with the *Fusarium* scab pathogen. Differences were found for fungicide treatments. Two applications of mancozeb or chlorothalonil significantly reduced the incidence of *Fusarium* on wheat grain as determined by culturing random composite samples of 1000 kernels from each treatment, increased grain weight, and improved yield per acre. Average frequency of isolating *Fusarium* sp. from unsprayed plots and plots sprayed with mancozeb and chlorothalonil were 26.6%, 13.5% and 14.3%, respectively. Occurrence of *Fusarium* on grain samples corresponded with disease ratings made in the field.

VERTICILLIUM WILT PRONENESS OF POTASSIUM DEFICIENT PISTACHIO TREES. L. J. Ashworth, Jr., University of California, Berkeley, CA 94720.

A 12 year old planting of pistachio trees with a *Verticillium dahliae* ID of <0.05 microsclerotia/g soil suffered a major increase in amount of infection in 1982 following a change from

overall irrigation to dripper irrigation in 1981. Infection in 1981 was 3 percent and was 13.7 percent in 1982. Most infections during 1982 were associated with unthrifty trees, found to be potassium (K) deficient. Results of soil analyses substantiated results of leaf analyses. Soils wet by drippers were recharged with exchangeable K by injecting KCl solutions through the dripper system at rates of 3.3 and 6.6 pounds of K/tree. Infection of untreated trees increased from 13.7 percent in 1982 to 23.0 percent in 1983. Infection of treated trees in 1983 was reduced by 44 percent and 56 percent in, respectively, the 3.3 and 6.6 pound K/tree treatments. Vegetative growth of trees was not affected by K treatments during the first year (1983) although leaf K became normal and nut yields increased 23 percent in the 6.6 pound K/tree treatment.

OVERWINTERING OF *PSEUDOMONAS SYRINGAE* ON TWO GRASS SPECIES USED AS COVER CROPS IN THREE PACIFIC NORTHWEST NURSERIES. Steve Baca and L. W. Moore, Dept. of Botany and Plant Pathology, Oregon State University, Corvallis, Oregon 97331

Leaf isolations made in the fall from infected sudan grass (*Sorghum sudanense*) used as a cover crop at three nurseries in the Pacific Northwest, contained high populations (10^8 cfu/g) of fluorescent pseudomonads, 50% of which were identified by their LOPAT reactions as *P. syringae*. Over 50% of these *P. syringae* strains induced a hypersensitive response in tobacco leaves and were ice nucleators at -5°C. Populations of pathogenic ice nucleation active *P. syringae* increased to 10^7 cfu/g after the sudan grass was killed by frost. From fields of young rye grass (*Secale cereales*), planted immediately to tilled fields of infected sudan grass, leaf samples contained nearly pure populations of *P. syringae*, approaching 10^6 cfu/g. Roadside grasses around these mixed sites were also colonized by 10^6 cfu/g of mixed fluorescent pseudomonads, 50% of which were also *P. syringae*. In contrast, few pseudomonads ($0-10^3$ cfu/g) were recovered from roadside grasses in areas removed from nursery production, and only 10% of these were *P. syringae*.

HYPHAL INTERACTION OF *TRICHODERMA HARZIANUM* AND *HELMINTHOSPORIUM SATIVUM*. C. L. Biles and J. P. Hill Colorado State University, Fort Collins, Co. 80523.

Hyphae of *Helminthosporium sativum* and *Trichoderma harzianum* were placed on opposite sides of 9 cm petri dishes and allowed to grow together. The petri dishes contained potato dextrose agar (PDA) or water agar (WA) which was covered with cellophane. After 3 to 8 days, hyphal interaction was observed using light, phase-contrast, and Nomarski differential interference microscopy. Wheat seedlings with *H. sativum* leaf lesions were sprayed with a 4×10^7 *T. harzianum* conidial suspension. After 2 days in a saturated environment, the lesions were excised and placed in petri dishes containing moist filter paper to induce *H. sativum* conidiophore formation and germination of *T. harzianum* conidia. Three days later, the fungi were stained and observed using light microscopy. Inhibition of *H. sativum* hyphal growth was observed on PDA, WA, and the leaf surface, while coiling of *T. harzianum* hyphae was found on WA and the leaf surface.

MYCOFLORA OF PISTACHIO FRUIT GROWN IN CALIFORNIA. H. A. Bolkan, J. M. Ogawa, and B. T. Manji. Department of Plant Pathology, University of California, Davis 95616.

During the 1983 growing season, more than 20 genera of fungi were associated with pistachio fruit grown in California. Regardless of the location studied, *Alternaria alternata*, *Cladosporium herbarum*, *Epicoccum purpurascens*, and yeasts were the predominant fungi isolated; for certain locations they accounted for 95% of all fungi recovered. Benomyl, captafol, fixed copper and etaconazole applied twice when the female trees were at 50-60% bloom and of full bloom significantly

*Student paper competition

reduced the total number of fungal colonies associated with developing pistachio fruit. Although the relative abundance of each fungal genus isolated differed with each fungicide tested, all genera commonly associated with non-sprayed control fruits also were found on fruit sprayed with different fungicides. The fewest genera of fungi were isolated from fruits sprayed with captafol and etaconazole in Madera County and the greatest diversity of fungi was obtained from fruits sprayed with benomyl in Kings County.

THIELAVIOPSIS BASICOLA ROOT ROT OF PEAS, CHICKPEAS AND LENTILS. R. L. Bowden, M. V. Wiese, and J. E. Crock, Dept. of Plant, Soil and Entomological Sciences, Univ. of Idaho, Moscow, ID 83843.

Thielaviopsis basicola root rot of peas (*Pisum sativum*) was found for the first time in the Palouse region of northern Idaho and eastern Washington. In the greenhouse, 6 isolates were tested for pathogenicity to chickpea (*Cicer arietinum*) cv. 'UC-5', lentil (*Lens culinaris*) cv. 'Chilean 78', and pea cv. 'Alaska'. Root rot scores were significantly higher for chickpeas than for peas or lentils. Lentil epicotyls were significantly less susceptible than those of pea or chickpea. No significant isolate or isolate x species effects were found. When 12 lines each of chickpeas and lentils were inoculated with *T. basicola*, responses in both species ranged from susceptible to partially resistant. White-seeded kabuli type chickpeas were significantly more susceptible than dark-seeded desi types. *T. basicola*, previously unreported as a pathogen of chickpeas and lentils, may limit the usefulness of these crops in rotations with peas in the Palouse.

TWO WHITEFLY-TRANSMITTED VIRUSES OF MELONS IN THE SOUTHWEST. J.K. Brown and M.R. Nelson. Dept. of Plant Pathology, University of Arizona, Tucson, AZ 85721

Two distinct virus-like disease agents were identified as the incitants of yellows and leaf curl diseases, respectively, in Arizona melons (Cucurbitaceae) during 1982-84. Identifications were based upon host range, visualization of virus-like particles by electron microscopy and transmission by *Bemisia tabaci* Genn. Long flexuous rods (1700-2000nm) were isolated from yellows infected melons and the disease agent had a host range like that of the lettuce infectious yellows virus (LIYV). The second virus incited dramatic leaf curl symptoms in many hosts and paired particles (18x30nm) were isolated from infected plants. The symptomatology and presence of geminate particles in leaf curl infected plants were reminiscent of the squash leaf curl virus (SLCV), but the Arizona isolate (tentatively SLCV-A) infected most cucurbitaceous hosts and was sap transmissible, neither of which characterizes SLCV. This is the first report of these two diseases in Arizona.

MYRIOSCLEROTINIA SNOW SCALD OF TURF IN THE COLORADO ROCKY MOUNTAINS. W.M. Brown, Jr., L. Saunders, L. Perotti, C. Rasmussen-Dykes, and C. Baretta Walker. Department of Botany and Plant Pathology, Colorado State University, Fort Collins, CO 80523.

Myriosclerotinia borealis (Bub. & Vleug.) Kohn. (syn. *Sclerotinia borealis* Bub. & Vleug.) was found attacking bluegrass (*Poa* spp.) plantings in Breckenridge, CO (9000 ft.) and the surrounding area. The fungus caused grey patches up to 16 cm in diameter. Dull black sclerotia that are spherical, oval, or flakelike and measuring 1.0-8.0 mm long were observed embedded in and on the surface of diseased leaves at the ground level. This disease has only been reported from northern North America, the Nordic countries and northern Asia. This is the first report of the disease in Colorado.

EFFECTS OF FLOOD DURATION ON SEVERITY OF APPLE ROOT AND CROWN ROT CAUSED BY THREE PHYTOPHTHORA SPP. G. T. Browne and S. M. Mircetich, USDA, ARS, Department of Plant Pathology, University of California, Davis, CA 95616.

Six-week-old Red delicious apple seedlings (*Malus pumila*) were transplanted into artificially infested or noninfested soil on tension plates and grown for 12 wk at soil temperatures of 18-25 C. A -20 millibar (mb) soil matric potential (ψ_m) was maintained constantly or was interrupted once every 2 wk by 4-, 12-, 24-, or 48-hr flood intervals ($\psi_m = 0$). At constant $\psi_m = -20$ mb, *P. cambivora* caused severe root and crown rot and growth reduction compared to controls in the noninfested soil at $\psi_m = -20$ mb, but *P. cactorum* and *P. cryptogea* caused no disease. As flood interval duration lengthened from 4 to 48 hr, severity of growth reduction and root and crown rot caused by *P. cryptogea* increased from mild to severe. In the same flood

treatments, severity of disease caused by *P. cactorum* and *P. cambivora* was moderate and severe, respectively, and did not change as flood duration increased.

UTILIZATION OF OPINES BY FLUORESCENT PSEUDOMONADS. Marilyn L. Canfield, James A. Boe and Larry W. Moore. Dept. of Botany and Plant Pathology, Oregon State University, Corvallis, OR. 97331

Plants infected by *Agrobacterium tumefaciens* develop tumors that produce unusual amino acids called opines which can be utilized by the agrobacteria as a carbon and/or nitrogen source. In the past, this opine environment was considered to be an exclusive niche for the agrobacteria, giving them a competitive advantage over other soil bacteria for continued growth. There have recently been reports of utilization of the opine, octopine by pseudomonads isolated from soil and galls. The purpose of the present study was to test the ability of pseudomonads isolated from apple roots and galls to utilize any one of the three opines, octopine, nopaline or mannopine. Pseudomonads were purified and spotted onto a minimal salts plus opine medium solidified with Gelrite. To rapidly screen a large number of strains, a method for measuring the amount of growth was developed using image analysis with a black and white video interfaced with an Apple computer. Of 76 strains tested, 14 used octopine, 40 used nopaline and none used mannopine.

INFLUENCE OF ATMOSPHERIC HUMIDITY AND FREE WATER ON GERM-TUBE GROWTH OF BOTRYTIS CINEREA PERS. D. D. Carre and D. L. Coyier, Dept. of Botany and Plant Pathology, Oregon State University, Corvallis, OR 97331; and USDA-ARS, 3420 NW Orchard Ave., Corvallis, 97330

Germinated conidia of *Botrytis cinerea* Pers. were exposed to different relative humidities to determine whether germ-tube growth occurred in the absence of free water. Dialysis membranes soaked in a 1% glucose solution were dried, dusted with conidia, and placed in distilled water for 4, 5, 8, and 12 hr to promote development of germ-tubes. Following initial germination, the conidia were placed in a humidity chamber enclosed in an insulated chamber held at 20C. Insulation was necessary to prevent condensation caused by temperature fluctuation; any condensate was detected with hygroscopic ink dust. Conidia were exposed to relative humidities of 70, 90, 94, and 98% maintained with sulfuric acid solutions. Germinated conidia placed at the various humidities showed no further growth when measured after intervals of 12, 24, 36, and 60 hrs. It was concluded that free water was needed for growth of germ tubes.

MOISTURE STRESS LEVELS IN DOUGLAS-FIR CHRISTMAS TREES DURING OUTDOOR STORAGE IN WASHINGTON AND AT RETAIL LOTS IN CALIFORNIA. G. A. Chastagner, Washington State University, Puyallup, WA 98371.

The level of postharvest moisture stress in cut Douglas-fir Christmas trees significantly affects their ability to rehydrate and the rate of needle loss during display. Trees are damaged at a threshold xylem ψ of about -35 bars. Xylem ψ measurements taken at commercial shipping yards and during simulated storage in Washington showed that trees had ψ 's above the threshold of -35 bars. During a survey of 57 retail lots in California between December 14 and 20, 1982, ψ measurements were taken on 458 trees. The number of trees at or below the threshold ψ varied with lot location, environmental conditions and handling practices. About 40% of the trees examined had ψ 's at or below -35 bars and trees with ψ 's below this threshold were found at 68% of the lots.

EFFECT OF POSTHARVEST MOISTURE STRESS ON THE KEEPING QUALITY OF DOUGLAS-FIR CHRISTMAS TREES. G. A. Chastagner, Washington State University, Puyallup, WA 98371.

The effect on tree quality of drying cut Douglas-fir Christmas trees to xylem ψ 's of -20, -30, -40 and -50 bars before re-cutting and placing their bases in water was studied. After drying, trees were displayed for 28 days at 20 C and 40-50% RH. The ψ 's of trees dried to -20 or -30 bars increased to about -10 bars within 24 hr and then gradually decreased to -60 bars. Limited needle loss occurred during display. Allowing trees to dry to ψ 's of -40 or -50 bars impaired rehydration. Only 90% and 75%, respectively, of the trees rehydrated when placed in water and ψ 's increased to -15 to -35 bars. About 50% of the rehydrated trees exhibited severe loss of fresh appearing needles within a few days of rehydration. Thus, Douglas-fir has a threshold ψ between -30 and -40 bars. Allowing trees to dry to or below this threshold significantly reduces their quality.

TECHNIQUES FOR INOCULUM PRODUCTION AND INOCULATION OF LILY LEAVES WITH *BOTRYTIS ELLIPTICA*. R. P. Doss, G. A. Chastagner and K. L. Riley, USDA, ARS, Horticultural Plants Research Unit and Washington State University, Puyallup, WA 98371.

Sporulation by selected isolates of *Botrytis elliptica* occurred readily on potato dextrose agar under ultraviolet light at 20 C. Microconidia were present after 12 days under the same conditions. Application of conidial suspensions to the undersides of detached *Lilium longiflorum* cv. 'Ace' leaves, followed by incubation for 48 hr at 100% relative humidity and 20 C, was nearly optimum for infection and lesion development. Probit analysis indicated that a concentration of 10,000 spores/ml should result in lesion formation in about 50% of the treated leaves. Uninjured leaves became infected only when spores were applied to the underside. Germ tubes did not penetrate the upper leaf cells. Incidence of infection of 'Ace' lily leaves did not vary with plant age or leaf position. Sufficient information is now available to allow development of procedures for screening of *Lilium* spp. for resistance to *B. elliptica*.

INFLUENCE OF SITE, SOIL, AND ENVIRONMENT ON DWARF SMUT OF WHEAT. D.A. Clark and R.L. Powelson. Dept. of Botany and Plant Path. Oregon State University, Corvallis, OR 97331.

Soils were collected from four winter wheat fields with histories of either a high or low incidence of dwarf smut caused by *Tilletia controversa* Kuhn. Each soil was inoculated with 0.02, .2, 2 or 20g of teliospores per 45kg of soil. Seed was covered with a 2.5cm layer of inoculated soil. Additional treatments included a 2.5cm covering of vermiculite to simulate snow cover. Microplots were established in two wheat producing locations in eastern Oregon. One site (Flora) was considered favorable to dwarf smut with 80 days of snow cover during the 1982-83 crop year versus 10 days of snow cover at the less favorable site (Pendleton). Results indicated that growing site was more significant than soil source for disease development. Disease incidence ranged from 0 to 7 percent at Pendleton and 0 to 45 percent at Flora. Vermiculite reduced disease incidence in the presence or absence of a snow cover. At Flora, the lowest incidence of disease was found in the Flora soil and indicated the possible involvement of a suppressive soil factor.

NATURAL SPREAD OF TOBACCO STREAK VIRUS IN RED RASPBERRY. R. H. Converse, USDA-ARS, Dept. of Botany & Plant Pathology, Oregon State University, Corvallis, OR 97331.

The rate and pattern of spread of tobacco streak virus (TSV) were determined in field plots of red raspberry (*Rubus idaeus* cv. Willamette) in Corvallis, OR. Four rows of Willamette plants previously found to be free of TSV were planted adjoining an established planting of *Rubus ursinus* cv. Boysen that was 63% infected with TSV. After 56 months, ELISA tests for TSV revealed a gradient of infection in the Willamette rows, ranging from 35% in the row nearest to the Boysen plants to 2% in the fourth row, 12 m away. Annual deflowering of the second Willamette row away from the Boysens did not markedly reduce TSV incidence (31%). Statistical analysis of the distribution patterns of TSV within individual Willamette rows after 56 months supported the hypothesis that infection along each row had occurred at random. Natural spread of TSV has not previously been reported to occur in red raspberry. TSV spread, known to be flower-associated in black raspberry and in Boysen, appears not to be flower-associated in Willamette but to be strongly influenced by the proximity of TSV-infected *Rubus* plants.

STABILITY OF VERTICILLIUM WILT RESISTANCE OF POTATO TO STRAINS OF VERTICILLIUM DAHLIAE FROM DIFFERENT VEGETATIVE COMPATIBILITY GROUPS D. L. Corsini, J. R. Davis, and J. J. Pavek, USDA-ARS and University of Idaho, P.O. Box AA, Aberdeen, Idaho 83210.

The verticillium wilt resistance of potato (*Solanum tuberosum* L.) breeding clone A66107-51 was stable when tested against a number of strains of *V. dahliae* from different vegetative compatibility groups. Strains PW, and BB (North America), PR (Eurasia), and 207 (Australia) were isolated from potato, and strain T9 (North America) from cotton. All were highly virulent on eggplant. A66107-51 showed no wilt and had 5 cfu *V. dahliae*/g of stem tissue when inoculated with the group-4 strains PW and BB. In contrast, verticillium wilt susceptible cv. Russet Burbank (RB) was very susceptible to strains BB and PW from group-P4, with severe wilt and 500 to 2000 cfu *V. dahliae*/g stem respectively. RB was moderately susceptible to strain 207 from group-P3 with slight wilt and 150 cfu *V. dahliae*/g stem tissue, but was not susceptible to strain T9 from group-P1, nor to non-reactor strain PR.

DEVELOPMENT OF BARLEY COMPOSITE CROSS GERMLASM TOLERANT TO BARLEY YELLOW DWARF VIRUS. J.M. Crosslin*, T.W. Carroll*, E.A. Hockett**, and S.K. Zaske*. *Plant Pathology Dept., and

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A six-row spring barley male sterile-facilitated recurrent selection population (MSFRSP) has been developed having tolerance to barley yellow dwarf virus, BYDV (=BYD-luteovirus). Four sources of the Yd2 gene for BYDV tolerance have been included. Parents consisted of Composite Cross (CC) XXXIII-A and B, a BYDV tolerant MSFRSP; CC XLIII, a scald and net blotch resistant MSFRSP; and Manchuria msg 10 X Sutter (CI 15475) F2, a BYDV tolerant hybrid. A mixture of CC XXXIII and XLIII was crossed with Manchuria-Sutter. Resulting seed was planted in Arizona. Seed set on male sterile plants was harvested and planted in Bozeman. After inoculation with the MT-PAV type of BYDV, highly symptomatic plants, comprising about 16% of the population were rogued. After harvest the lightest 20% of the seeds were removed. Heavier selection pressure will be applied to the population in 1984.

IDENTIFICATION OF BACTERIA ISOLATED FROM LEAVES OF CRUCIFEROUS CROPS AND WEEDS WITH POTENTIAL FOR BIOLOGICAL CONTROL OF BLACK ROT OF CRUCIFERS. M. Derie and N. W. Schaad, Dept. of Plant, Soil and Entomological Sci., Univ. of Idaho, Moscow, ID 83843.

Leaves of *Brassica campestris* L., *B. kaber* (O.C.) Wheeler, *B. oleraceae* L. var. *italica* Plenck, and *B. oleraceae* L. var. *botrytis* were collected from central, coastal California and washed on a shaker for 20 min at 2-4 C in separate flasks containing 100 ml cold (2-4 C) sterile, 0.85% NaCl plus one drop of Tween 20. The washings were concentrated to 2 ml by centrifugation and immediately assayed on nutrient glucose agar (NGA) and in seedling bioassay (SBA) chambers to identify bacteria able to colonize roots and/or cotyledons of cauliflower seedlings. Between 9-12 dominant colony types were present/plate of NGA at 10^{-3} . Twelve root, 10 cotyledon, and 7 root and cotyledon colonizing bacteria were identified in SBA chambers. Of these, 2 root and 2 root and cotyledon colonizers prevented *Xanthomonas campestris* pv. *campestris* from colonizing roots and roots and cotyledons, respectively.

EFFECT OF TIME OF APPLICATION AND ROOT VERSUS LEAF ABSORPTION OF METALAXYL IN THE CONTROL OF PHYTOPHTHORA INFESTANS ON POTATO. G. D. Easton and M. E. Nagle, Washington State University, Department of Plant Pathology, Irrigated Agriculture Research and Extension Center, Prosser, WA 99350.

At Mt. Vernon, WA, root absorption of metalaxyl in potato, cv. White Rose, was found more effective than leaf absorption for control of *Phytophthora infestans*. It was controlled in plots where metalaxyl sprayed on the foliage, .25 lb ai/A, was washed into the soil by rain and sprinkler irrigation within 18 hr after application. However, less effective control was obtained in plots previously covered with 4 mil plastic tarps to prevent most entry of metalaxyl into the soil. Control was better and yields were significantly more in tarped and untarped plots sprayed prior to rather than after the appearance of late blight. Results indicate that control of *P. infestans* with metalaxyl is best when the chemical is applied to foliage prior to appearance of symptoms and washed into the soil by rain or sprinkler irrigation.

AXENIC CULTURE OF *PRATYLENCHUS THORNEI* ON CARROT DISKS. D.J. Eschen and H.S. Fenwick, Dept. of Plant, Soil, & Ent. Sci., Univ. of Idaho, Moscow, ID 83843

An improved axenic culture method of *P. thornei*, (Sher & Allen) on carrot disks is described. *P. thornei* (P.t.) were mist extracted from roots of field grown winter wheat and identified morphologically. Sterile 2% H₂O agar (50 ml) with 200 ug/l streptomycin sulfate was added to sterile one-pint mason jars covered with foil and allowed to cool. Carrots from a local market were washed, the leaves removed, and the roots dipped in 95% ETOH and flamed. Four disks 2 cm thick were removed aseptically and placed onto the agar of each jar. P.t. larvae were transferred through a series of five 30 min baths containing 1 mg/l streptomycin sulfate and 20 ug/l malachite green. After rinsing twice in sterile distilled H₂O, 50 P.t. larvae were pipetted beneath one of the disks. Jars were incubated in the dark at 25 C and larvae increased up to 20,000/jar in 3 mo. Inoculations of less than 25/jar or incubation below 20 C regardless of inoculum quantity resulted in inconsistent and lower recovery of P.t. after 3 mo.

POTATO GERMLASM AND VIRUS ISOLATE REPOSITORY MAINTAINED IN AXENIC TEST TUBE CULTURE. C.J. Farrell, P.E. Thomas and M.W. Martin, IAREC, P.O. Box 30, Prosser, WA 99350.

A potato germplasm and virus isolate repository was initiated

at Prosser, WA in 1981, in association with the Northwest Potato Improvement program and the USDA virology and germplasm enhancement program. Its functions are to (1) maintain a bank of the valuable genetic characteristics in clones of exotic and domestic potatoes, (2) render clones free of disease agents, (3) maintain and propagate them *in vitro*, safe from reinfection, (4) catalog and distribute germplasm, and (5) maintain and distribute useful potato virus isolates in *in vitro* potato plantlets. The repository has functioned well on a limited scale. It has restored many valuable clones to disease-free condition. It has supplied a broad base of parental germplasm and eliminated annual disease indexing and field increase under disease exposure. Funds were recently granted for a building and assistance to greatly expand the capacity of the repository.

REDUCED YIELD OF WINTER WHEAT DUE TO *TILLETIA* CONTROVERSA. H. S. Fenwick, D. J. Eschen, and C. N. Thornburg. Dept. of Plant, Soil and Entomological Sciences, Univ. of Idaho, Moscow, ID 83843.

In 1982 and 1983, 12,346 winter wheat plants (cv Stephens) from 90 1-m² reps from inoculated or non-inoculated plots were categorized as non-smutted (NS), partially smutted (PS) and totally smutted (TS). The % plants and the % NS, PS and TS spikes of all plants in each category were recorded. Means of spikes/plant (S/P), mean yields/plants (MY/P) for NS and PS plants and % loss were tabulated. The % NS, PS and TS plants was 86.3, 12.1 and 1.6, respectively, but 93.6% of all spikes were NS, 1.3% PS and 5.1% TS. Of the PS plants, 65.6% of the spikes were NS, 5.3% PS and 29.1% TS. Mean S/P for NS and PS plant were 3.2 and 4.3, and MY/P were 3.7% and 3.0 g. Loss was 3.3%. Although 13.7% of all plants were smutted (S), only 6.4% of all spikes were S, and 94.9% of all spikes contributed to total yield. The increased number of S/P produced by PS plants prevented excessive yield loss.

EFFECTS OF *TILLETIA* CONTROVERSA ON TILLERING OF WINTER WHEAT PLANTS. H. S. Fenwick, D. J. Eschen AND C. N. Thornburg. Dept. of Plant, Soil & Entomological Sci., Univ. of Idaho, Moscow, ID 83843.

A total of 12,346 winter wheat plants (cv Stephens) were removed from 90 1-m² reps from inoculated or non-inoculated plots in 1982 and 1983 and separated into categories of non-smutted (NS), partially smutted (PS) and totally smutted (TS). The means of spikes/plant (S/P) in each category were tabulated. With the PS plants the means of NS, PS and TS S/P also were determined. NS plants produced a mean of 3.2 S/P. PS plants produced a mean of 4.3 S/P consisting of 2.7 (NS) 0.4 (PS) and 1.2 (TS) S/P. TS Plants produced a mean of 2.2 S/P. These data indicate PS plants produced more but TS plants produced fewer S/P than NS plants.

POTATO LEAFROLL VIRUS (PLRV) DETECTION AND DEVELOPMENT OF NET NECROSIS IN POTATO TUBERS AS RELATED TO TIME OF INOCULATION. Lee Fox, P. E. Thomas and C. J. Farrell. USDA Agricultural Research Laboratory, 3706 W. Nob Hill Blvd., Yakima, WA, 98902 and Irrigated Agriculture Research and Extension Center, Prosser, WA, 99350.

Individual potato plants grown under cubic meter size field cages were inoculated at various plant growth stages with PLRV using green peach aphids (GPA). Tubers from each plant have been divided into four sub-samples, each of which will be removed from storage (45°F; 90% humidity) at two month intervals and examined for net necrosis and the presence of PLRV in tuber phloem tissue using the ELISA Test. With the final sub-sample yet to be examined, present results indicate that early (June 10) and late inoculation (September 6) produced clean tubers free of PLRV and net necrosis. Four of five plants inoculated July 5 and one of five inoculated August 1 resulted in detection of PLRV in 67% of the tubers and 43% with net necrosis.

ASSOCIATION OF STALK ROT FUNGI AND WESTERN CORN ROOTWORM BEETLES IN COLORADO. R. L. Gilbertson, W. M. Brown, and E. G. Ruppel. Dept. of Botany and Plant Pathology, Colorado State University and USDA, ARS, Crops Res. Lab., Fort Collins, CO 80523.

Western corn rootworm (*Diabrotica virgifera*) beetles were abundant on corn ears in 1982 and 1983 in eastern Colorado. Isolations from beetles collected from one site in 1982 and two sites in 1983 consistently yielded the stalk rot fungi *Fusarium moniliforme* and *F. moniliforme* var. *subglutinans*, even after surface disinfection. In 1983, isolations were made from beetles collected at different times from corn and squash,

and from ladybird and picnic beetles associated with corn plants. In 1982 and 1983, varied levels of beetles were established on corn ears at either green or brown silk stage. Levels were maintained by placing a fine nylon mesh bag over ears. Kernels from ears with highest beetle levels showed greatest contamination by stalk rot fungi. Rootworm beetles may be important in the spread of stalk rot fungi to corn ears and kernels, contributing to inoculum build-up in corn fields.

DISCOVERY OF RESISTANCE TO INFECTION AND TRANSLOCATION OF TOMATO YELLOW TOP VIRUS (TYTV) IN LYCOPERSICON PERUVIANUM AND SOME OF ITS TOMATO HYBRIDS. Sher Hassan and P.E. Thomas, USDA, ARS, IAREC, P.O. Box 30, Prosser, WA 99350.

Green peach aphids (*Myzus persicae*, Shulz.) could not recover tomato yellow top virus (TYTV) from *Lycopersicon peruvianum*, PI 128655, and some of its tomato hybrid progenies after aphid inoculation but routinely recovered TYTV from the same plants after graft inoculation. This resistance to aphid inoculation was expressed in a glasshouse in direct sunlight but not in translucent fiberglass houses. Virus could be recovered from plants, aphid-inoculated in a glasshouse, soon after they were transferred to a fiberglass house. The transfer could be delayed at least 8 wk without affecting eventual recovery of virus. Evidently tolerant plants are not resistant to infection by aphid inoculation. Rather they are resistant to systemic translocation of the virus into upper growing points from the base or roots of plants inoculated in direct sunlight or in a glasshouse.

WOOD-ROT DISEASES IN IDAHO ORCHARDS. A. W. Helton, Richard Dilbeck, and A. A. Thostenson, Dept. of Plant, Soil and Entomological Sciences, University of Idaho, Moscow, ID 83843.

All orchard trees grown in Idaho are susceptible to wood-rot infection, but these diseases are most damaging in stone-fruits where they are commonly associated with the *Cytospora* canker disease, the result of which is severe die-back and tree death. Three species of *Polyporus* (*P. hirsutus*, *P. tittius*, *P. versicolor*), three species of *Fomes* (*F. applanatus*, *F. ignarius*, *F. pinicola*), *Daldinia concentrica*, and *Lenzites trabea* are involved, sometimes singly but usually in complex associations with each other that result in simultaneous decay of heartwood and sapwood. Pathogenicity has been established via artificial bore-hole infections in young peach trees (*Prunus persica*), where internal decay has continued even though infection wounds have healed normally at the surface. Earliest symptoms in apple orchards (*Malus domestica*) usually are streak-cankers in the bark zone, over which the epidermal layer loosens to form a papery light-brown covering that soon begins to shred.

PHYTOPHTHORA COLLAR-ROT IN IDAHO ORCHARDS. A. W. Helton, R. Dilbeck, and A. A. Thostenson, Dept. of Plant, Soil and Entomological Sciences, University of Idaho, Moscow, ID 83843.

The following species of *Phytophthora* have been identified in orchard-tree tissue: *P. cactorum*, *P. cambivora*, *P. citricola*, *P. cryptogea*, *P. megasperma*, and *P. syringae*. Species obtained from orchard soils were *P. cactorum*, *P. citricola*, *P. cryptogea*, and *P. syringae*. Surface irrigation waters have yielded *P. cactorum*, *P. cambivora*, *P. cinnamomi*, *P. citricola*, *P. cryptogea*, *P. lateralis*, *P. megasperma*, *P. parasitica*, and *P. syringae*. Other species obtained from host tissue and/or water supplies remain to be identified. All surface waters in the major orcharding districts of Idaho (canals, drain ditches, reservoirs, lakes, rivers, and all streams to altitudes above food-plant agriculture) were found to be contaminated with *Phytophthora* fungi. Irrigation wells were not contaminated. Preliminary artificial-infection studies with *P. cactorum* and *P. cambivora* have shown them to be ready invaders of the commonly used apple rootstocks (MM-106, MM-111, EM-7a, EM-26, and apple seedling).

SYSTEMIC-CHEMICAL CONTROL OF PHYTOPHTHORA COLLAR-ROT. A. W. Helton, A. A. Thostenson, and Richard Dilbeck, Dept. of Plant, Soil and Entomol. Sciences, Univ. of Idaho, Moscow, ID 83843.

Pre-infection tests were conducted in a greenhouse in which MM-106 apple liners were treated with 200, 400, 600, or 2500 ppm a.i. of Alette, with 2500 ppm of thiabendazole (Mertect), or with 50, 500, or 2500 ppm of metalaxyl (Ridomil) or Terrazole and artificially infected with *P. cactorum* 10 days later. All materials significantly suppressed disease development at all test concentrations. Post-infection tests were conducted in which MM-106 liners were artificially infected with *P. cactorum* or *P. cambivora* and treated 10 days later. The 500 and 2500 ppm concentrations of etridiazol (Terrazole)

achieved significant suppression of existing-disease development for *P. cambivora* but not *P. cactorum*. These results suggest that prevention of *Phytophthora* infections is easier than curing them, and that while existing disease can be suppressed, this effect will depend on the infecting species as well as the chemical applied.

CONTROL OF NATURAL SPREAD OF CHERRY RUGOSE MOSAIC DISEASE BY A SYMPTOMLESS STRAIN OF PRUNUS NECROTIC RINGSPOT VIRUS. W. E. Howell and G. I. Mink, Washington State University, Department of Plant Pathology, Irrigated Agriculture Research and Extension Center, Prosser, WA 99350.

Cherry rugose mosaic disease is caused by strains of Prunus necrotic ringspot virus (PNRSV) and is characterized by small twisted leaves, light fruit set, and delayed fruit maturity of sweet cherry (*Prunus avium* L. cv. 'Bing') in Washington State. Another strain which produced no detectable symptoms in cherry trees occurred in most commercial orchards. Cherry bud tissue infected with either strain produced strong reactions in enzyme linked-immunosorbent assay with antiserum against Fulton's G isolate. The pattern of spread of these two strains over the past 4 years suggests that the symptomless strain restricted the spread of cherry rugose mosaic disease. Protective inoculation of healthy trees with the symptomless strain is being evaluated as a practical method to control spread of the disease in commercial orchards where control by tree removal has been unsuccessful.

EFFECT OF SOIL FUMIGANTS ON INCIDENCE OF SCLEROTINIA STEM ROT OF POTATO. Wm. G. Hoyman, 215 N. Underwood, Kennewick, Washington 99336

Observations on the incidence of Sclerotinia stem rot of potato were made over an 8-year period on a 10,000 acre farm in Morrow County, Oregon. Potato planted in soil previously fumigated with Vapam (sodium methyl dithiocarbamate), Soilbrom (ethylene dibromide) and D-D (1,3-dichloropropene, 1,2-dichloropropane, 3,3-dichloropropene, 2,3-dichloropropene and other related chlorinated hydrocarbons) had considerably more stem rot than that planted in nonfumigated soil. Various crop rotations including corn, alfalfa and wheat were of no significance affecting the amount of stem rot. Terr-o-cide (ethylene dibromide and chloropicrin (trichloronitromethane)) and Telone (1,3-dichloropropene) applied on other Columbia Basin farms increased the incidence of stem rot.

THE POTENTIAL SPREAD OF THE COTTON FUSARIUM WILT PATHOGEN IN GIN TRASH AND PLANTING SEED. D. P. Jeffers, S. N. Smith, R. H. Garber and J. E. DeVay, Department of Plant Pathology, University of California, Davis, CA 95616 and USDA, SEA/AR, US Cotton Research Station Shafter, CA 93263.

Fusarium wilt of cotton was first described in the San Joaquin Valley of California in 1959. The pathogen *Fusarium oxysporum* f. sp. *vasinfectum* (Fov) has been isolated recently from diseased cotton plants growing in sandy soils. Fov was isolated from cotton seed and gin trash from cotton fields showing moderate to severe fusarium wilt symptoms in 1982 and 1983. Seed infection by Fov was between 0.24-0.33% and high levels of the pathogen were present in gin trash. The production of clean planting seed and proper sanitation measures should aid in slowing the spread of Fov to noninfested cotton fields. Gin trash is often used as a soil amendment for sandy soils where the disease may be more prevalent. Possible sanitation procedures to eradicate Fov from gin trash based on heat or other sterilization methods will be discussed in relation to thermal sensitivity of Fov.

CHEMICAL CONTROL OF ASCOCHYTA LENTIS IN INFECTED LENTIL SEEDS. W. J. Kaiser and R. M. Hannan, USDA, ARS, Regional Plant Introduction Station, Washington State University, Pullman, WA 99164

Ascochyta lentis, a potentially serious seedborne pathogen of lentil (*Lens culinaris*), was isolated from seeds of several imported accessions in the USDA lentil germplasm collection at Pullman, WA. Seed infection alone frequently reduced shoot and root growth by 24-54% and seed yields by >25% in an environment that did not favor disease spread. The efficacy of chemical and therapy treatments in controlling seedborne infection of *A. lentis* was tested on lentil seeds naturally infected (>70%) with the pathogen. The most effective seed treatment fungicides of 12 tested were thiabendazole (TBZ) and CGA 64251 which reduced the incidence of *A. lentis* from 80.5% in nontreated seeds

to 0 and 3%, respectively. In greenhouse trials using sterile and nonsterile soil, emergence of infected seeds treated with TBZ was increased by 10-52%. At rates required to control *A. lentis* in infected seed, TBZ was not phytotoxic to lentil, but CGA 64251 was. Treatment of infected seeds with aerated steam or hot water at 45-65 C for 30 min did not control *A. lentis*.

OCCURRENCE OF ASCOCHYTA RABIEI ON IMPORTED CHICKPEAS IN EASTERN WASHINGTON. W. J. Kaiser* and F. J. Muehlbauer**, USDA, ARS, *Regional Plant Introduction Station and **Grain Legume Genetics and Physiology Research, Washington State University, Pullman, WA 99164

Blight of chickpea (*Cicer arietinum*) caused by *Ascochyta rabiei* was observed in germplasm evaluation trials at Pullman, WA in July, 1983. *Ascochyta* blight affected 77 of 125 lines in eight yield and adaptation trials. Disease incidence ranged from a trace to severe. Cool, wet weather in June and July favored infection and spread of the disease. Apparently, the pathogen was introduced on seed imported from Syria and/or India. Blight was not detected in commercial chickpea plantings in the Palouse region, or in the USDA chickpea germplasm collection maintained by the Regional Plant Introduction Station, Pullman, WA. Measures taken to prevent spread and survival of *A. rabiei* included burning of plant debris, deep plowing, destruction of all seeds, and crop rotation. This is the first report of *Ascochyta* blight of chickpea in the United States.

EFFECT OF BACTERIALIZATION ON CONTROL OF VERTICILLIUM DAHLIAE IN POTATO. S. D. Leben and G. D. Easton, Washington State University, Department of Plant Pathology, Irrigated Agriculture Research and Extension Center, Prosser, WA 99350.

Pseudomonas fluorescens, strain M-4, previously shown to be antagonistic against *Verticillium dahliae* in potato, was used in pot culture to study inhibition of *V. dahliae* and plant growth promotion. *V. dahliae* was introduced into uncultivated desert soil and a soil previously cropped to potatoes. Strain M-4 was dusted on potato seedpieces at 10^4 and 10^8 CFUs/ml at planting. In both soils, when M-4 colonized the roots, wilt was decreased and fresh weight was increased significantly. However, fresh root and tuber weights were not consistently increased. In pasteurized treatments of both soils with no *V. dahliae*, dusting with M-4 failed to increase growth, even though M-4 colonized roots significantly more than in non-pasteurized soil. It appears that plant growth enhancement by M-4 colonization was due to reduction of *V. dahliae* infection in the potatoes.

SEASONAL VARIATIONS IN SUSCEPTIBILITY OF JUGLANS HINDSII AND PARADOX WALNUT ROOTSTOCKS TO PHYTOPHTHORA CITRICOLA. M. E. Matheron and S. M. Mircetich, USDA, ARS, Department of Plant Pathology, University of California, Davis, CA 95616

Phytophthora citricola is causing crown rot and death of English walnut trees on *Juglans hindsii* and Paradox (*J. hindsii* X *J. regia*) rootstocks in California. Ten trees of each rootstock, from 9- to 20-month-old, were flooded each month for 48 hr in water artificially infested with *P. citricola*. Disease severity was assessed 14 days after commencement of flooding. The incidence of crown rot in *J. hindsii* rootstock was highest in June (60%) and lowest in January (3%) and mean canker length was 38 mm and 1 mm respectively. The incidence of crown rot in Paradox was highest in June (50%) with a mean canker length of 10 mm, and lowest from October through May, when no crown rot was observed. Apparently, *J. hindsii* and Paradox rootstocks possess seasonal differential susceptibility that is important for proper evaluation of walnut rootstocks for resistance to *Phytophthora* spp. and timely applications of control measures.

EFFICACY OF MANCOZEB (DITHANE M-45) IN CONTROLLING PRUNE LEAF RUST (*TRANZSCHELIA DISCOLOR*) IN CALIFORNIA ORCHARDS. Themis J. Michailides and J. M. Ogawa, Department of Plant Pathology, University of California, Davis, CA 95616.*

Prune rust (*Tranzschelia discolor*) defoliates prune trees causing problems during harvest. Wettable sulfur (5.5 g a.i./L) and mancozeb (1.44 g a.i./L) applications on French prunes at the Davis plot were compared. Disease levels were determined by counting rust lesions on leaves. Nonsprayed trees had 44%, while wettable sulfur- and mancozeb-sprayed trees 21% and <1% rusted leaves, respectively. *In vitro* uredospore germination on acidified PDA amended with 5, 10, and 15 mg a.i./L of wettable sulfur or mancozeb was 89, 67, and 62% and 3, 3, and 3% respectively in comparison with the control. Both field and laboratory experiments provide evidence that mancozeb is more effective than wettable sulfur in controlling prune

rust. In a commercial prune orchard, two mancozeb sprays provided three months protection from rust infections.

NUMBER OF GENES CONTROLLING DURABLE RESISTANCE TO STRIPE RUST IN THREE PACIFIC NORTHWEST WHEATS. Gene Milus and Roland F. Line. Dept. of Plant Pathology, Wash. State Univ. and USDA-ARS, respectively, Pullman, WA 99164.

Gaines, Nugaines, and Luke winter wheats have adult-plant, temperature-sensitive resistance to *Puccinia striiformis*. Parental, F1, F2, and backcross populations from reciprocal crosses between resistant cultivars and crosses with a susceptible line were evaluated in the field. Rust intensity data on each of 8,000 plants were recorded three times and transformed to area under the disease progress curve (AUDPC). Three different quantitative formulas predicted that AUDPC was controlled by 2-3 genes in Nugaines and Luke. The proportion of parental and intermediate phenotypes in the F2 and backcross populations was used to develop Mendelian models. Based on the models, inheritance of AUDPC was explained by two independent genes in each cultivar with epistasis and partial dominance for susceptibility; Gaines and Nugaines have one gene in common and different alleles at the other locus; and genes in Luke are different from those in Nugaines.

COMPARING FUNGICIDES AND THEIR TIME OF APPLICATION FOR THE CONTROL OF PHYTOPHTHORA INFESTANS ON POTATO. M. E. Nagle and G. D. Easton, Washington State University, Department of Plant Pathology, Irrigated Agriculture Research and Extension Center, Prosser, WA 99350.

Near Mt. Vernon, WA, systemics Ridomil MZ58[®], San 518, San 371 plus Bravo 500[®] were compared with protectant Bravo 500, for control of *Phytophthora infestans* on White Rose potato. The systemics were applied on two schedules, 1) preventive: 3 foliar sprays starting before visual symptoms, 2) curative: 2 foliar sprays starting after visual infection symptoms had appeared. Bravo 500 biweekly sprays were started before symptoms appeared. The preventive schedule resulted in significantly lower disease index readings and higher yields. Ridomil MZ58 gave significantly better foliar control and higher yields under both schedules. San 518, San 371 plus Bravo 500 and Bravo 500 were equally effective, but not equal to MZ58 in their control. All of the fungicides, except Bravo 500, controlled late blight tuber rot at harvest.

DITYLENCHUS DIPSACI, A PEST OF DESERT NON-DORMANT ALFALFA. Edward L. Nigh, Jr., Dept. of Plant Pathology, Univ. of Arizona Yuma Valley Agr. Res. Ctr., Yuma, AZ 85364.

The alfalfa stem nematode, *Ditylenchus dipsaci* (Kuhn) Filipjev, is a seasonal pest of non-dormant alfalfa, *Medicago sativa* L., in Arizona. In the desert valleys, the crop grows continuously and the nematode populations are influenced by the high summer and cooler winter temperatures. Damage to the crop is therefore limited to periods from October thru November and again from February thru March, depending upon available moisture. Overhead irrigation provides required water to prolong periods of reproduction. Yield reductions include two cuttings of hay and the possibility of serious stand decline the first year of infection. Alfalfa cultivars previously considered resistant now support economic thresholds of the stem nematode. These levels require chemical control. Cultural practices are also important in reducing losses and preventing spread of the pest.

THE INFLUENCE OF PRESSURIZED IRRIGATION SYSTEMS ON THE DISTRIBUTION OF THE CITRUS NEMATODE, *TYLENCHULUS SEMIPENETRANS*, IN ARIZONA CITRUS. Edward L. Nigh, Jr., Dept. of Plant Pathology, Univ. of Arizona, Yuma Valley Agr. Res. Ctr., Yuma, Arizona 85364.

Pressurized irrigation systems deliver water to localized areas of the citrus root system. The feeder roots increase in these areas and highest populations of the citrus nematode, *Tylenchulus semipenetrans* Cobb, are recovered in proximity to the emitter sites. Nematode numbers decrease as sample sites increase in distance from the point of water emission. This concentration of roots and nematodes around emitter sites provides an area for delivery of pesticides to the specific areas of maximum control benefit. This phenomenon decreases the nematode damage level used to establish the economic threshold for desert cultured citrus because treatment costs are reduced. Under flood irrigation, the root system and nematode population are more extensive and random, greater quantities of chemicals are needed for control and the damage threshold is increased.

WATER AS A SOURCE OF INOCULUM OF ERWINIA CAROTOVORA PV. CAROTOVORA IN STEM SOFT ROT OF POTATOES. M. Powelson and J.

Apple, Department of Botany & Plant Pathology, Oregon State University, Corvallis, OR 97331.

The relative importance of water strains of *Erwinia carotovora* pv. *carotovora* (Ecc) as primary inoculum for potato plant infection was assessed under field conditions. Ecc was isolated from surface irrigation water that was applied to the crop. Seed tubers from two Russet Burbank seedlots planted in one field were naturally contaminated with Ecc. Ecc was also recovered from soil samples taken during the growing season. Ecc strains isolated from symptomatic stems were identified serologically with antisera produced against water strains and seed tuber strains. Sixty-one percent of the water strains were serologically different from seed tubers serogroups. In two seedlots 37 and 24% of the stem strains were the same as the water serogroups as were 33% of the soil strains. Surface water must be considered a potentially important source of Ecc for stem soft rot disease and soil infestation.

CORN LEAFHOPPER TRANSMISSION OF CORN STUNT SPIROPLASMA FROM CALIFORNIA. A. H. Purcell and K. S. Suslow, Dept. of Entomological Sciences, Univ. of California, Berkeley, CA 94720.

The experimental transmission of several 1981 California isolates of corn stunt (CS) spiroplasma (CSS) by the corn leafhopper (*Dalbulus maidis*) after injecting the leafhoppers with *in vitro* cultures of CSS or feeding them on CS-diseased plants was similar to a CSS isolate from the 'Rio Grande' type of CS (provided by L. R. Nault, OARDC, Wooster, Ohio). Nearly all individual male or female *D. maidis* fed for 24 hrs on California or 'Rio Grande' CS source plants transmitted CSS to maize after a median latent period of 16 to 18 days at 27°C. Three spiroplasma isolates from field plants with CS symptoms that were serologically indistinguishable from "honeybee" spiroplasma (ATCC 29416) were not transmitted to maize after leafhopper injection. Epidemic CS in California appears to be caused by CSS with leafhopper transmission and symptoms in maize closely similar to the 'Rio Grande' type of CS.

PATHOGENICITY OF *PUCCINIA STRIIFORMIS* WEST. A. Qayoum and Roland F. Line. Dept. of Plant Pathology, Washington State University and USDA-ARS, respectively, Pullman, WA 99164.

Stripe rust of wheat was first recognized in the United States in 1915. Two races of *Puccinia striiformis* were reported in northwestern United States and adjacent parts of Canada in the early 1930's. There were no further reports on races until the severe epidemics in the late 1950's and early 1960's. From 1960 to 1968, 4 races were identified. Since 1968, 28 new races have been identified, 6 were identified in 1983. These 32 races identified since 1960 were the predominant races in the region, but they may not be the only races. They represent shifts in pathogen virulence, primarily caused by introduction of new resistant cultivars. Most new races appeared within 3 years after release of cultivars that were highly resistant to existing races. Some had the combined virulence that enabled them to attack cultivars with different genes for resistance. New races were more predominant in some regions. This may be because of the selective pressure of local cultivars, influence of other hosts, and/or favorable environment for rust in the regions.

IDENTIFICATION OF PYTHIUM SPECIES ASSOCIATED WITH PYTHIUM BLIGHT OF TURF IN COLORADO. C. Rasmussen-Dykes and W.M. Brown, Jr. Department of Botany and Plant Pathology, Colorado State University, Fort Collins, CO 80523.*

Four *Pythium* species were recovered from a southern Colorado bentgrass/annual bluegrass golf course putting green that has recurrent outbreaks of *Pythium* blight, a destructive turfgrass disease. They were *Pythium aphanidermatum*, *P. myriotylum*, *P. torulosum*, and a *Pythium* sp. thought to be an aberrant isolate of *P. ultimum*. *P. ultimum* was isolated from diseased turf in northern Colorado. All species are known pathogens of turfgrass. The aberrant isolate of *P. ultimum* was shown to be pathogenic on perennial ryegrass (*Lolium perenne* L.) and creeping bentgrass (*Agrostis palustris* Huds.) grown in sterile soil at 30° C + 2° C. Previously only *P. aphanidermatum* and *P. ultimum* had been reported on diseased turf in Colorado.

OCCURRENCE AND SURVIVAL OF *XANTHOMONAS CAMPESTRIS* PV. *CAMPES TRIS* IN WESTERN WASHINGTON CRUCIFER SEED FIELDS. Tom Schultz and R. L. Gabrielson, Western Washington Research and Extension Center, Puyallup, WA 98371

The crucifer black rot pathogen *Xanthomonas campestris* pv. *campestris* has recently been reported for the first time in crucifer seed lots produced in western Washington. The occurrence, survival in residues and host colonization this pathogen was investigated under field conditions in western Wash-

ington. The pathogen was not found in over 22 crucifer seed fields surveyed over three growing seasons. Pathovar *campestris* was recovered from buried, artificially infected, cabbage residues for as long as residues persisted. Extrapolation of the data predicted this pathogen would survive for 507 days in residues. Pathovar *campestris* was able to colonize leaves of cabbage, radish and wild turnip under field conditions. Although plants generally remained symptomless, pv. *campestris* was found to be internally and externally associated with leaves up to 10⁷ colony forming units/40 cm² of leaf area.

CONTROL OF STRIPE AND LEAF RUST OF WHEAT IN WASHINGTON WITH STEROL-INHIBITING FUNGICIDES. Randolph B. Scott and Roland F. Line, USDA-ARS, Washington State Univ., Pullman, WA 99164.

Bayleton (triadimefon), a sterol-inhibiting, systemic fungicide, was first used extensively to control wheat rusts in the Pacific Northwest in 1981. Two sterol-inhibiting fungicides, Bayleton and Tilt (propiconazole), were evaluated for control of stripe and leaf rust at various rates and application schedules (based on stage of plant growth and rust intensity) in Washington in 1981-1983. Both fungicides provided excellent control of both rusts. Single applications were most effective when applied before rust intensity exceeded 5% (usually at jointing to boot stages for stripe rust and boot to heading stages for leaf rust). Applications after rust exceeded 20% on the flag leaves or after the milk stage were usually not beneficial. If rust begins to increase early in the spring, an application at jointing when rust was <5% followed by an application at boot to anthesis when rust began to increase (when the chemicals were no longer effective) provided better control than one application.

BOTRYTIS BLOSSOM BLIGHT AND FRUIT ROT OF SWEET CHERRY (*PRUNUS AVIUM*) AND THEIR CONTROL USING FUNGICIDES. K. M. Shotwell and J. M. Ogawa, Department of Plant Pathology, University of California, Davis, California 95616.*

In spring 1983, cool temperatures and frequent rainfall promote the first recorded epidemic of blossom blight in sweet cherries caused by *Botrytis cinerea*. A survey of nine cherry orchards in California's San Joaquin county showed a range of 17 to 92% of blossoms with symptoms of *Botrytis* infections. Destruction of the developing fruitlet occurred when it was infected through the pedicel or, less frequently, through the style. *Botrytis* was found sporulating on dead cherry buds in the orchard. In spring 1984, artificial inoculations of blossoms on trees resulted in hypanthium lesions (typical of those associated with natural infection) from which *B. cinerea* was isolated. The fungicide iprodione inhibited *Botrytis* sporulation on inoculated blossoms in laboratory tests. In addition, iprodione effectively controlled postharvest *Botrytis* decay in laboratory and packinghouse treatments, and moved systemically in ripe cherries.

TANZANIAN STRAIN (T-1) OF BEAN COMMON MOSAIC VIRUS

M. J. Silbernagel, L. J. Mills, and Wei-Young Wang, USDA-ARS Research Plant Pathologist, WSU Research Technician, WSU Graduate Student, Washington State Univ. Irrig. Agric. Res. & Ext. Center, P.O. Box 30, Prosser, WA 99350.

A culture of Bean Common Mosaic Virus (BCMV) isolated from seed of *Phaseolus vulgaris* L. grown in Tanzania, is very similar pathogenically and serologically to severe "necrotic" strains found in Europe, and recently in Michigan. The Tanzanian strain (T-1) produces typical mosaic mottle on recessive I gene cvs. (most U.S. dry bean cvs.); but causes lethal system: necrosis on many dominant I gene cvs. (most U.S. snap bean cvs.). The combination of the dominant I gene with recessive bc 22 gives complete protection to either mosaic mottle or to necrosis induced by T-1 and all other known strains of BCMV. Suggestions for breeding strategies, screening methods, and industry-wide containment of the new strains are discussed.

EFFECTS OF CULTURAL PRACTICES ON SNAP BEAN SEED PRODUCTION IN COMPACTED ROOT ROT CONDUCTIVE SOIL. M. J. Silbernagel and Lynn J. Mills, USDA-ARS and Washington State University, Irrigated Agric. Research & Extension Center, Prosser, WA 99350.

Field studies showed that irrigation, deep chiseling, and row spacing affect root rot severity and/or production of snap bean seed. Reducing row spacing from 56 to 28 cm increased population density 7% and yield by 427 kg/ha, but had no effect on root rot rating. Although root rot was more severe at 60% than at 50% soil moisture replacement, irrigation did not affect yield. Deep (50 cm deep beside each row) chiseling increased yield by 707 kg/ha and did not affect root rot rating. The combination of deep chiseling and narrow rows averaged 1134 kg/ha more seed than conventional 56-cm row spacing and no chiseling. Narrow row spacing with deep chiseling would be ideal for seed harvest with the rubber-belt Seed Bean Harvester (no mechanical damage), because this new concept in harvesters can harvest bean seed crops directly by stripping pods from standing mature plants in any row spacing arrangement.

ELECTRON MICROSCOPIC OBSERVATION OF HOP DOWNY MILDEW ZOOSPORE FORMATION. C. B. Skotland and L. Santo, Washington State University, Department of Plant Pathology, Irrigated Agriculture Research and Extension Center, Prosser, WA 99350.

Hop (*Humulus lupulus*) leaves with non-sporulating lesions of Hop Downy Mildew (*Pseudoperonospora humuli*) were incubated at 19-20°C in 100% humidity. After 24 hrs, the sporangia were placed in distilled water and an aliquot was removed at 5 and 15 min. intervals, fixed in glutaraldehyde and osmium tetroxide, dehydrated and embedded in epoxy resin. Ultrathin sections were cut with a LKB Diatome diamond knife using the Porter-Blum MT-1 Ultramicrotome, stained with uranyl acetate and lead citrate and observed with a Zeiss EMS 9 Electron Microscope. Initially, the sporangia showed a multi-nucleated "functional" cytoplasm and vesicles enclosed within a thick wall. Subsequently, vesicular activity increased, together with the appearance of flagella, usually on the periphery of the sporangial cytoplasm. The vesicles aligned and eventually coalesced to separate the cytoplasm, forming the individual mono-nucleate zoospores. Then the zoospores were released.

THE INHIBITING EFFECT OF GLUCOSE ON GROWTH INITIATION IN *FUSARIUM OXYSPORUM* SPORULINGS. Shirley N. Smith, James E. DeVay and Daniel Jeffers, Department of Plant Pathology, University of California, Davis, CA 95616.

Germination of conidia and growth of germtubes of most *Fusarium* sp. were delayed on defined inorganic media containing 0.2-4.0% glucose or sucrose compared to that on the same media without glucose or sucrose or on water agar. In *Fusarium oxysporum* this "glucose effect" or delayed growth was more pronounced in the ubiquitous non-pathogenic soil isolates than in the wilt producing *formae speciales*, e.g., *F. oxysporum* f. sp. *vasinfectum*, *tracheiphilum*, *lycopersici*, *medicaginis*. Furthermore, a positive correlation was observed between the capacity of isolates to copiously produce conidia and the inhibition of their growth and germination by glucose. Additions of small amounts of biotin negated this "glucose effect" in *Fusarium oxysporum* and all other *Fusarium* tested.

CHARACTERIZATION OF A MEMBRANE PROTEIN COMPLEX OF STRAINS OF *XANTHOMONAS CAMPESTRIS* PV. *CAMPESTRIS* FROM THAILAND. N. Thaveechai and N. W. Schaad, Dept. Plant, Soil & Entomological Sci., University of Idaho, Moscow, ID 83843.

A liCl extracted membrane protein complex (MPC) of 35 strains of *X. campestris* (XC) from Thailand was characterized by serology and SDS-PAGE. In Ouchterlony double diffusion (ODD) antisera (AS) to MPC of seven strains resulted in a major line of precipitin (LP) and none to three minor LPs, depending upon the strain when tested against homologous MPC. Two to four immunogens were identified in immunoelectrophoresis with the major LP being neutral. Using the major LP, the strains from Thailand were typed into three serovars, I, I-A, and II. All strains were immunofluorescent (IF) positive. None of 15 other xanthomonads or 11 other species reacted with the seven AS by ODD or IF staining. However, four strains of *X. vesicatoria* were IF positive and cross-reacted in ODD. SDS-PAGE profiles of XC were distinct from all the other bacteria tested. These results suggest that the MPC is useful for identification and taxonomy of XC.

ISOLATION OF AN *argF* GENE FROM *PSEUDOMONAS SYRINGAE* PV. *PHASEOLICOLA*. Roger F. Thom, Nickolas J. Panopoulos, and Richard C. Peet, Dept. of Plant Pathology, Univ. of Calif., Berkeley, CA 94720.

A cosmid library of *Pseudomonas syringae* pv. *phaseolicola* has been constructed using the broad host range cosmid pLAFR1. Cosmids containing the *argF* gene coding for ornithine carbamoyltransferase (OCTase, EC2.1.3.3) were selected on the basis of their ability to restore *argF* mutants of other bacteria to arginine prototrophy (*argF*+). A cosmid, designated pOCT2029, carrying *argF* was further characterized by restriction endonuclease cleavage and Tn5 insertion mutagenesis. The plasmid contained a single *EcoRI* insert, ca. 20 kilobasepairs in size. Transfer experiments established co-inheritance of tetracycline resistance (a vector marker) with arginine prototrophy. A transposon Tn5 insertion that resulted in inactivation of the cloned *argF* gene in pOCT2029 was obtained. This insertion completely inactivated the *argF* gene in cell-free extract assays for OCTase. Two other Tn5 inserts elsewhere on pOCT2029 did not inactivate *argF* gene function. Colorimetric OCTase assays using crude cell-free extracts in the presence and absence of phaseolotoxin indicated that the *argF* gene carried by pOCT2029 coded for the toxin sensitive form of the enzyme.

SELECTION FOR RESISTANCE TO BEET CURLY TOP VIRUS OF BEANS IN AN ARTIFICIAL ENVIRONMENT. P.E. Thomas and D.W. Burke, IAREC, P.O. Box 30, Prosser, WA 99350.

Beet leafhoppers (vector of beet curly top virus) were reared uncaged on young sugarbeet plants on one side of a growth room, and emerging bean seedlings in flats were placed on the other

side. Leafhoppers swarmed to the beans when lights over the beets are switched "off" and those over the beans "on". After 4 days the leafhoppers are attracted back to the beets by reversing the lights and the beans were moved to a 32 C glass-house 2 days later. Typical BCTV symptoms appeared on trifoliolate leaves of some cultivars. However, symptoms developed on seedlings of other susceptible cultivars only if at least one primary leaf was removed. In these later cultivars, we believe the virus moves from sites of insect inoculation to the seedling roots. Removal of primary leaves promoted movement of photosynthate reserves from roots to tops, carrying the virus with it. Refinements of this testing method and studies on resistance of beans to curly top virus are in progress.

DETECTION OF *TILLETIA CONTROVERSA* IN WHEAT SEEDLING TISSUE. C.N. Thornburg and H.S. Fenwick, Dept. of Plant, Soil, and Entomological Sci., University of Idaho, Moscow, ID 83843.

A modified method of one developed in 1982 on sugarcane (Sinha et al. Plant Dis. 66:932-933) was developed for detection of *Tilletia controversa* (Kuehn) in wheat tissue. Imbibed wheat seeds (cv. Fielders) were held at 21 C for 36 hr to permit germination, 250 seeds were inoculated by spraying with a 5 ml suspension of germinating teliospores (2.9×10^8 spores/ml H₂O), and incubated in vermiculite at 5 C with a 12 hr light cycle (3455 lux). Apical meristem and surrounding leaf tissues from inoculated seedlings were excised after 15 and 25 days, heated at 70 C for 10 min then held at 21 C for 4.5 hr in a 1:1 mixture of 6% NaOH and 0.1% trypan blue. Tissue samples then were dehydrated 2 min in 80% EtOH, boiled for 5 min in lactophenol to remove excess stain, mounted in lactophenol on a slide, crushed under a coverslip and observed at 200X. Wheat tissues were lightly tinted. Hyphae appeared irregular, knotty and dark blue. This method permits rapid histological detection of *T. controversa* in lab and field grown wheat tissues.

EFFECTS OF SELECTED FUNGICIDES ON CYTOSPORA CANCKER OF STONE-FRUIT. A. A. Thostenson, A. W. Helton and R. Dilbeck, Dept. of Plant, Soil and Ent. Sci., Univ. of ID, Moscow, ID 83843.*

One-year-old President plum (*Prunus domestica*) trees were artificially infected with *Cytospora cincta* on June 23 and treated 7 days later with thiophanate-methyl (Topsin-M) or triadimefon (Bayleton). Thiophanate-methyl paints at 500 or 5000 ppm a.i. in a bentonite slurry were most effective in reducing canker expansion after 35 days (90.0 and 91.0%, respectively); a 5000 ppm triadimefon spray was next most effective (71.0% reduction) after 42 days. When artificially infected Monarch peach (*P. persica*) trees were sprayed with 5000 ppm triadimefon 10 days after infection in the fall (50% leaf drop when treated) or in both fall and spring (5 mm leaves), the spring treatment did not add significantly to the disease-control effect of the fall treatment (59.2% reduction in canker expansion rate by June 21 vs. 62.7% for the fall-plus-spring treatment). Disease progress was not halted in the President trees, but canker activity in the Monarch trees was permanently arrested.

BIOCIDAL EFFECT OF THE RIBOFLAVIN-METHIONINE REACTION IN CONTINUOUS LIGHT ON PHYTOPATHOGENIC FUNGI AND BACTERIA. D. D. Tzeng and J. E. DeVay, Department of Plant Pathology, University of California, Davis, CA 95616.

Riboflavin in combination with L-methionine or its derivatives in continuous light is biocidal. The biocidal activity was detected on a variety of phytopathogenic fungi and bacteria at the concentrations of riboflavin and methionine less than 1.33 μ M and 0.5 mM, respectively. With the exception of *Agrobacterium tumefaciens*, the presence of light appears to be essential for the riboflavin-methionine reaction and biocidal effect on all the tested fungal and bacterial isolates. The biocidal effect generally can be detected about 30 minutes after light exposure. *A. tumefaciens* showed exceptional sensitivity to the riboflavin-methionine reaction; cells were killed in the solution even in total darkness. The biocidal activity was greatest at approximately pH 4 but when the pH was raised to 7 or higher no biocidal activity was detected. Addition of Mn⁺⁺ and Fe⁺⁺ salts or the addition of α -tocopherol, β -sitosterol or sodium azide can greatly reduce the biocidal activity.

ELECTRON MICROSCOPIC STUDIES ON THE CORKY BARK AND LEAFROLL VIRUS DISEASES OF GRAPEVINES. H. L. Tzeng and A. C. Goheen, Department of Plant Pathology, University of California, Davis, CA 95616.

Vitis vinifera vines affected by corky bark or leafroll viruses were verified by graft-indexing tests in comparison with healthy vines at Davis, California. By electron microscopy, closterovirus-like particles were consistently detected in the phloem tissue (mainly companion cells) of both corky bark and leafroll-infected Cabernet Franc. These particles were elongated, flexuous rods typical of closterovirus morphology, confined in

the phloem tissue and formed typical virus aggregates. Malformation and disorganization of mitochondria, chloroplasts and endoplasmic reticulum and the accumulation of characteristic virus vesicles, starch granules, tannic material, and osmophilic globules were consistently associated with symptom development. Membrane-bound virus aggregates were usually first detected inside the nucleus of the companion cells in which other cell organelles still remained intact. The study indicates that closterovirus is a probable causal agent of both diseases.

USE OF A FLUORESCENT BRIGHTENER TO STUDY THE INFLUENCE OF TRIFLURALIN ON CHLAMYDOSPORE GERMINATION OF *FUSARIUM SOLANI* F. SP. *PHASEOLI* IN SOIL. Cynthia Baretta Walker and Jack Altman, Department of Botany and Plant Pathology, Colorado State University, Fort Collins, CO 80523.*

A technique using a fluorescent brightener, enhanced the observation of chlamydospore germination of *Fusarium solani* f. sp. *phaseoli* in herbicide-amended soil. An aqueous solution of 0.3% Calcofluor White M2R containing 1.0% formaldehyde was applied to soil containing chlamydospores and amended with water (control) trifluralin or a trifluralin formulation blank at rates equivalent to soil concentrations at field rates. This technique permitted direct observation of the effect of the herbicide on *F. solani* f. sp. *phaseoli* chlamydospores in soil under simulated field conditions.

PRODUCTION OF HYBRIDOMA LINES SECRETING SPECIFIC ANTIBODIES TO BEAN COMMON MOSAIC VIRUS (BCMV) STRAINS. Wei-Young Wang, G. I. Mink, M. J. Silbernagel and W. C. Davis, Dept. of Plant Pathology, Wash. State Univ., Irr. Agri. Research and Extension Center, Prosser, Washington, 99350.

A total of 254 hybrid cell lines that produce BCMV-specific antibodies were prepared by somatic cell fusion between mouse myeloma cell line X63.653 and BALB/c mouse spleen cells. Among the 254 cell lines, 26 were from mice immunized with a mixture of purified BCMV strains NL-3, NL-5 and TA-1 (Serogroup A); 228 were from mice immunized with a mixture of purified BCMV strains US-1, US-2, US-3, US-9 and PR-1 (Serogroup B). The antibodies produced by hybridoma lines were different in specificity in ELISA against a range of 22 BCMV strains in either serogroup A or B, but some cell lines produce antibodies that cross react with members from both serogroups. Only one of the 254 hybrid cell lines (bc-197) has a reciprocal ELISA titer of 10^4 against all 22 BCMV strains. This cell line was selected for single cell cloning and monoclonal antibody production.

DETECTING *ACREMONIUM COENOPIHALUM* IN SEEDS OF TALL FESCUE. R. E. Welty, G. M. Milbrath, D. Faulkenberry, M. D. Azevedo, and L. Meek, USDA ARS, Corvallis, 97331; Oregon Dept. Agric., Salem 97310; and Oregon State Univ., Corvallis 97331.

An endophyte fungus, *Acremonium coenophialum*, of cool-season grasses is seedborne in tall fescue (*Festuca arundinacea*). Cattle grazing infected plants or eating infected hay suffer from a disease called "summer syndrome." Detection of the fungus in seeds was compared by microscopic examination & enzyme-linked immunosorbent assay (ELISA). Both methods were satisfactory for seed lots with 20% or more infection; microscopic examination was more accurate for seed lots with < 10% infection. ELISA gave false positive readings for several seed lots when microscopic examination revealed 0% infection. When probability models were tested to compare single, double, & sequential subsampling, fewer seeds were examined by the sequential method in accepting lots as having 5% or fewer infected seeds. Microscopic examination using sequential subsampling is recommended as a reliable method for detecting low levels of seedborne *A. coenophialum*.

AGAR MEDIUM FOR SELECTIVE ISOLATION OF *XANTHOMONAS CAMPESTRIS* PV. *CAROTAE* FROM CARROT SEEDS. R. E. Williford and N. Schaad, Dept. Pl., Soil and Ent. Sci., Univ. of Idaho, Moscow, ID 83843

A semiselective agar medium for isolation of *Xanthomonas campestris* pv. *carotae* (XC) from contaminated carrot seeds was developed by modifying KM-1 medium (Kim, H. K. et al., Phytopathol. 72:936). Recovery of 13 strains of XC on KM-1, a semiselective medium for *Xanthomonas campestris* pv. *translucens*, was 88% to 100% of that on nutrient agar (NA), but differentiation of XC colonies from seed saprophytes was difficult on KM-1 due to similar morphologies and lack of yellow pigmentation. The yellow coloration of XC was enhanced and growth improved, however, by increasing yeast extract from 0.03 g to 0.5 g/l. Numbers of yellow pigmented saprophytes also increased, but most were inhibited by adding 0.5 mg/l vancomycin. This modified KM-1 medium resulted in recovery rates of 78% to 103% of 3 strains of XC and a reduction in seed flora of 74% to 99% for 5 seed lots, as compared to NA. The modified medium is an improvement over KM-1 primarily because of improved differentiation of XC.