The American Phytopathological Society

PACIFIC DIVISION

Annual Meeting

June 18-20, 1990

Hilo, Hawaii

ABSTRACTS

Alphabetized by first author's last name.

DECAY OF DATEPALM WOOD BY BASIDIOMYCETOUS FUNGI. J. E. Adaskaveg, R. L. Gilbertson, and R. A. Blanchette, Departments of Plant Pathology, Univ. of California, Davis, 95616, Univ. of Arizona, Tucson, 85721, and Univ. of Minnesota, St. Paul, 55108, respectively.

Many pathogenic basidiomycetous fungi have been reported on economically-important palms, however, their wood decay abilities on the woody monocots are unknown. Using an in vitro vermiculite-block method, wood from trunks of datepalm (Phoenix sp.) was decayed by white-rot (Ganoderma zonatum, G. colossum, Trametes versicolor, Phanerochaete chrysosporium, or Scytinostroma galactinum) or brown-rot fungi (Wolfiporia cocos, Gloeophyllum trabeum, or Fomitopsis pinicola). Weight loss of wood ranged from 36% (Sg) to 81% (Gc) for white-rot fungi and from 31% (Gt) to 35% (Fp) for brown-rot fungi. Chemical analyses indicated that all fungi removed starch, holocellulose, and lignin. Selective delignification was caused by Gz, Pc, and Sc. Ultrastructurally, both white- and brown-rot fungi decayed vascular bundles and parenchyma cells; within bundles, vascular elements were decayed more than fibers (some vascular cell walls were completely removed). In wood decayed by Gz, Pc, and Sc,fibers adjacent to vascular tissue were delignified.

FIELD STUDIES ON THE EFFECT OF WETNESS DURATION ON BROWN ROT BLOSSOM BLIGHT AND FRUIT ROT OF PEACH. J.E. Adaskaveg, J.M. Ogawa, and B.T. Manji. Department of Plant Pathology, University of California, Davis, 95616.

In 1989 and 1990, peach blossoms (Elegant Lady) were inoculated with conidia (25,000/ml) of Monilinia fructicola, air-dried, and exposed to wetness periods (0, 12, 24, 36, or 48 hrs) using a mist generator. After 1 wk, anther infection increased from 0%/0 hr to 53%/48 hr wetness periods (no infection of hypanthia or peduncles). Blossom blight developed within 2 wk and increased from 0%/0 hr to 5%/48 hr. In another test, inoculated blossoms were kept wet in plastic/paper bags. Infection of hypanthia was 0%/0, 4%/24, & 35%/48 hr in 1 wk, while blossom blight was 0%/0, 2%/24, & 13%/48 hr in 2 wk. Sporulation was observed on infected anthers and blighted blossoms. In 1989, fruit were misted for 0, 4, 8, 12, & 16 hr. In field evaluations of Elegant Lady, Fay Elberta, and Loadel, fruit infection increased from 0%/0 hr to 4%/16 hr. When fruit were harvested and incubated (20 C, 90% RH) for 72 hr, infection increased from 0%/0 hr to 70%/16 hr. In all studies, no rain occurred. Misting blossoms and fruit simulated conditions suitable for development of brown rot of peach in California.

RESISTANCE IN SPRING WHEAT TO THE VARIOUS DISEASES CAUSED BY COCHLIOBOLUS SATIVUS. Aftabuddin Ahmed, D. E. Mathre, and A. L. Scharen, Dept. Plant Pathology, Montana State University, and USDA-ARS, Bozeman, MT 59717.

Sixteen spring wheat lines/cultivars were tested for their reaction to the various diseases caused by Cochliobolus sativus. Four isolates from Montana, one from Turkey, and four from Bangladesh were used in whole plant inoculations under greenhouse and growth chamber conditions. Ten lines/cultivars were resistant to common root rot, eight were resistant to foliar spot blotch, and six were resistant to kernel black point. A number of lines/cultivars showed differential reaction to the various diseases. Six lines/cultivars were resistant to all the diseases. Isolates obtained from roots were able to infect foliage and heads, and vice versa. Some lines/cultivars were resistant to all the isolates tested.

USE OF MONOCLONAL ANTIBODIES TO STUDY THE EPIDEMIOLOGY OF BACTERIAL BLIGHT OF ANTHURIUM. A.M. Alvarez, R.L. Lipp, and A.A. Benedict. University of Hawaii, Honolulu, HI 96822.

Populations of the anthurium blight pathogen, *Xanthomonas campestris* pv. *dieffenbachiae* (*Xcd*) were characterized with a panel of monoclonal antibodies (mAbs) that differentiated 323 strains into twelve serotypes and distinguished anthurium strains from those on other aroids. The mAbs were used to map the distribution of distinct *Xcd* populations in Hawaii. The variation of serotypes within farms and cultivars of anthurium is evidence that these populations may have spread from separate loci. A high mutation rate to account for this pathogenic variation was unlikely because these antigens were stable through repeated transfers in culture. Using semiselective media and mAbs, low numbers of *Xcd* were recovered from plants with symptoms of anthracnose, heat stress, and injury. Approximately 10% of symptomless plants were contaminated with *Xcd*. We conclude that this pathogen is widespread even in shadehouses that show little evidence of blight.

FUSARIUM CROWN ROT AND BLIGHT OF AGLAONEMA IN HAWAII. M. Aragaki and J. Y. Uchida, Department of Plant Pathology, University of Hawaii, Honolulu, HI 96822.

An outbreak of a severe disease of aglaonema occurred on Oahu and Hawaii in 1987. Petiole and crown rots resulting in wilting and general chlorosis of older leaves followed by collapse and leaf rot typified this new disease. A foliar blight was also associated with the disease. Isolations from leaves, petioles, and lower stems yielded a Fusarium, tentatively identified as F. subglutinans which was previously unrecorded on aglaonema. The crown rot and foliar blight were reproduced, confirming pathogenicity of this organism. Earliest symptom of crown rot was chlorosis of older leaves in 14-21 days, followed by toppling of the plant. Leaf spots appeared in approximately 10 days following inoculation. Translucent (water-soaked) and chlorotic spots gradually became brown necrotic spots (20-30 mm diam.) with broad chlorotic borders.

LOPHODERMIUM TWIG BLIGHT OF CRANBERRY: ASCOCARP MATURITY AND THE ONSET OF THE INFECTION PERIOD. P. R. Bristow and G. E. Windom. Wash. State Univ., Puyallup, 98371.

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

Ascospores of Lophodermium oxycocci infect new upright growth during a single period of susceptibility in summer. The onset of this period varies from year to year making it difficult to time the start of a protectant fungicide program. A method of predicting the onset of infection based on ascocarp development was devised. Ascocarps from leaves of blighted uprights, collected weekly from early May through August, were examined for the presence of mature ascospores. To determine when new growth becomes infected, different plots were placed on or removed from a fungicide (mancozeb) spray program every two weeks during the summer. Fungicidal protection was first needed after an interval of 33±5 days from the time when 50% of the ascocarps contained spores. As a part of an IPM program in Washington, ascocarp development is monitored and growers are alerted as to when to begin the fungicide program for twig blight control.

BIOLOGICAL CONTROL OF BOTRYTIS CINEREA ON ROSE. J.C. Broome, J.J. Marois, J.D. MacDonald. Department of Plant Pathology, University of California, Davis, CA 95616.

Exophilia jeanselmei, a black yeast, and a Coryneform bacterium isolated from healthy roses were tested for their ability to control Botrytis cinerea on greenhouse roses. The antagonists reduced the incidence of diseased rose petals from 20% to 10%. The population dynamics of the pathogen and the yeast antagonist were studied on detached rose petals. B. cinerea increased from 11 cfu/petal 24 hours after application to 68 cfu/petal after 72 hours. When the yeast antagonist was applied with the B. cinerea, there were only 16.7 cfu/petal after 72 hours. When applied alone, the yeast increased from 97,000 cfu/petal after 24 hours to 230,000 cfu/petal after 72 hours. When B. cinerea was applied with the yeast, the yeast population was only 140,000 cfu/petal after 72 hours. On detached petals, the application of the yeast reduced disease from 32.4 to 22 lesions per petal.

SEMI-QUANTITATIVE DNA HYBRIDIZATION ANALYSIS OF TEN WHITEFLY-TRANSMITTED GEMINIVIRUSES. **J.K. Brown and B.T. Poulos. Dept. of Plant Pathology; Univ. of Arizona, Tucson, AZ 85721.**

Ten whitefly-transmitted (WFT) geminiviruses were analyzed in dot hybridization assays using sulfonated DNA probes for a panel of geminiviruses. Dilutions of virus-infected or healthy plant sap were applied to nylon membranes. Duplicate membranes were hybridized to each probe, and processed using a standard protocol. Either NBT/BCIP or pNPP substrate yielding insoluble and soluble reaction products, respectively, was added to one membrane in each duplicate pair. The NBT/BCIP filters were scored visually, and pNPP reaction products were assessed spectrophotometrically (405nm). Diagnostic conclusions were identical for both enzyme-substrate combinations, and the results were reproducible. Several clusters of geminiviruses were delineated based upon relative degrees of cross-hybridization with A-component probes, whereas B-component probes were virus specific in all cases. These data indicate the utility of sulfonated DNA probes for WFT geminivirus detection and identification.

SEASONAL VARIATIONS IN SUSCEPTIBILITY OF APPLE ROOTSTOCK TO THREE PHYTOPHTHORA SPP. IN EXCISED SHOOTS AND INTACT TREES. G.T. Browne, S.M. Mircetich, and H.D. Willamowski, USDA ARS, Dept. of Plant Pathology, University of California, Davis 95616

Susceptibility of apple rootstock EMLA 106 to species of Phytophthora was evaluated in excised-shoot and orchard-tree assays over 23 mo. For both assays, successive sets of host tissue were inoculated at monthly intervals with disks from V-8 agar cultures of Phytophthora spp. Susceptibility was measured as length of bark necrosis after 5 days of incubation in the excised-shoot assay and as area of bark necrosis after 2 wk in the orchard-tree assay. In both assays, P. cactorum (PCC) and P. cambivora (PCM) caused negligible necrosis during tree dormancy (Dec-Feb) and as trees resumed growth (Mar). Susceptibility, however, increased greatly in late spring (May). Maximum necrosis and subsequent decline in susceptibility occurred 2-3 mo later in the orchard-tree assay (Aug.-Oct.) than in the excised shoot assay (May-Aug.). In contrast to PCM and PCC, P. cryptogea caused greatest excised-shoot necrosis during tree dormancy. Apparently, susceptibility of apple varies not only with seasonal host physiology but also with Phytophthora sp. and method of assay.

SYMPTOMATOLOGY OF PHYTOPHTHORA ROOT AND STEM CANKER DISEASE OF NOBLE FIR IN THE PACIFIC NORTHWEST. G. A Chastagner[1], P. B. Hamm[2], and R. S. Byther[1], [1]Wash. State Univ., Puyallup, 98371 and [2]Oregon State Univ., Corvallis, 97331.

Various Phytophthora spp. are causing root and stem cankers which result in 20-30% mortality in some Noble fir Christmas tree plantations in the Pacific Northwest (PNW). Stem cankers originating below ground, sometimes from a single root, typically extend upward 20 to 50 cm in a narrow band. Branches are killed by the advancing canker and trees are killed when the basal portion of the stem is girdled by the expanding stem canker. Similar symptoms also occur on White pine, Shasta and Fraser fir. This disease is most common on trees in areas with high soil moisture within 3-4 years of planting. Three Phytophthora spp. commonly associated with root rot in PNW bareroot conifer nurseries (P. cryptogea, P. cambivora, and a P. gonapodyides-like isolate) and P. cinnamomi were isolated from symptomatic trees in four plantations in Oregon.

SUSCEPTIBILITY OF ABIES SPP. TO SEVEN PHYTOPHTHORA SPP. G. A Chastagner[1], K. L. Riley[1], and P. B. Hamm[2]. [1]Wash. State Univ., Puyallup, 98371 and [2]Oregon State Univ., Corvallis, 97331.

Phytophthora causes root and stem canker on Noble fir Christmas trees in the Pacific Northwest (PNW). To determine host susceptibility and pathogen virulence, 11 Abies spp. were grown in soil infested with seven Phytophthora spp. known to cause root rot in PNW bareroot conifer nurseries. Shasta, Noble and White fir had significantly higher mortality than Korean, Silver and Japanese fir. P. cinnamomi and P. cryptogea were more virulent than P. cambivora, P. megasperma, P. cactorum, P. pseudotsugae, and P. gonapodyides-like isolates. To determine the ability of Phytophthora to cause cankers, stems of 60-80 cm tall field-grown Noble fir trees were inoculated. The development of cankers, branch and tree mortality varied among Phytophthora spp.; P. cactorum, P. cambivora, P. cinnamomi and P. cryptogea were more virulent than P. megasperma, P. pseudotsugae, and P. gonapodyides-like isolates.

DEVELOPMENT OF A DEMOGRAPHIC POPULATION GROWTH MODEL FOR UNCINULA NECATOR ON A MICROCOMPUTER SPREADSHEET. Dan O. Chellemi and James J. Marois. Plant Pathology Dept., University of California, Davis CA 95616

Age-specific survival and fecundity rates were used to develop an empirical model for population growth of Uncinula necator on Vitis vinifera. The model was constructed on a microcomputer spreadsheet program and used to examine the influence of various environmental and physical parameters on population growth. Maximum population growth occurred at 24 C, where an initial population of 100 conidia resulted in a population of 3188 colonies after 30 days. An interaction between temperature and free moisture on population growth was observed; at 24 C moisture reduced the population size by 49%; at 20 and 30 C moisture reduced population size by 81% and 86%, respectively. A 10 day delay in the arrival of initial inoculum had a greater affect on population growth than an 80% reduction in initial inoculum.

TWO NEW PATHOGENS OF ARTICHOKE IN CALIFORNIA. S. Colbert[1], J. C. Correll[2], and A. H. McCain[1]. [1]Dept. of Plant Pathology, Univ. of California, Berkeley, CA 94720 and [2]Dept. of Plant Pathology, Univ. of Arkansas, Fayetteville, AR 72701.

Erwinia chrysanthemi and Verticillium dahliae have been isolated from artichoke (Cynara scolymus L.) with stunt, wilt, and crown and taproot rot symptoms in the Castroville region of California's central coast. Symptoms are most commonly observed following periods of warm weather. Inoculation in the greenhouse of wounded plants with recovered E. chrysanthemi isolates produced the stunt, wilt, and crown rot symptoms. Inoculation of artichoke and eggplant seedlings with V. dahliae isolates resulted in stunting, wilt, chlorosis and necrosis symptoms, but no rot. Surveys of 100 random plants in fields in the Castroville region of California found up to 41 percent infection with V. dahliae. The two recovered pathogens have been described as causing serious diseases of artichoke in Europe, but have not previously been reported from artichoke in the United States.

ACCUMULATION OF COPPER BY STRAINS OF *PSEUDOMONAS SYRINGAE* PV. *TOMATO* CARRYING THE COPPER RESISTANCE OPERON (*COP*). D. A. Cooksey, J.-S. Cha, and H. R. Azad. Department of Plant Pathology, University of California, Riverside, CA 92521.

Copper-resistant strains of *P. syringae* pv. *tomato* carrying the plasmid-determined *cop* operon form blue colonies when grown on media containing high levels of cupric sulfate. The amount of accumulated copper, as measured by atomic absorption spectrophotometry, increased over time and with increasing copper concentrations; up to 4.4 mg of copper/g dry weight of

bacterial cells was accumulated when the bacteria were grown for 48 hrs in the presence of 1.2 mM cupric sulfate. When the cloned *cop* operon was conjugated to a copper-sensitive strain of *P. syringae*, the transconjugant consistently accumulated more copper than the parent strain when exposed to subinhibitory levels of cupric sulfate. This suggests that the *cop* operon plays an active role in copper accumulation as a resistance mechanism.

VARIABILITY IN BIOLOGICAL CHARACTERISTICS, ISOZYME PATTERNS AND VIRUS TRANSMISSION AMONG POPULATIONS OF *BEMISIA TABACI* IN ARIZONA. H.S. Costa[1] and J.K. Brown[2]. [1]Dept. of Entomology and [2]Dept. of Plant Pathology; Univ. of Arizona, Tucson, AZ 85721.

Oviposition rates and offspring survival varied among *Bemisia tabaci* colonies reared on poinsettia, cotton, and pumpkin. Pumpkin plants exposed to poinsettia-reared whiteflies exhibited greater leaf mortality and developed whitened, etiolated stems (WS+). The WS+ response was not observed when pumpkin was exposed to *B. tabaci* derived from pumpkin or cotton colonies, suggesting a population-specific insect-plant interaction. Characteristic isozyme (esterase) patterns were observed by PAGE for each population. Patterns for pumpkin- and cotton-derived whiteflies were similar, but differed from those of poinsettia-derived insects. Individual adults from the colonies showed no difference in their ability to vector watermelon curly mottle virus. These data suggest that host-associated differences may impact whitefly-host plant interactions, potentially affecting the spread of whitefly transmitted plant viruses.

DEVELOPMENT OF A SEMISELECTIVE AGAR MEDIUM FOR CLAVIBACTER MICHIGANENSIS SUBSP. SEPEDONICUM. A.R. dela Cruz, N.W. Schaad, and M.V. Wiese. Plant Pathology Division, PSES, Univ. of Idaho, Moscow, ID 83843.

A semi-selective agar medium, NCP-88, was developed for the isolation of Clavibacter michiganensis subsp. sepedonicum (CMS) from potato plant parts. Essential selective components of this medium are mannitol, polymixin B-sulfate, nalidixic acid, and cycloheximide. NCP-88 allows better CMS recovery and inhibition of saprophytes than other available semiselective media. Most saprophytic bacteria inhibitory to CMS growing on NBY medium do not grow on NCP-88, thus allowing isolation of CMS from potato stems, roots, and symptomless tubers. Surface sterilization with 95% ethanol improves the isolation of CMS from plant tissues. Compared to NBY, average recovery of CMS from infected potato stems on NCP-88 is 156%, and 83% of saprophytic bacterial colonies were inhibited. NCP-88 shows promise as an additional diagnostic tool for potato ring-rot.

CHERRY LEAF ROLL VIRUS AND ELDERBERRY CARLAVIRUS IN CULTIVATED SAMBUCUS IN CANADA AND THE UNITED STATES P. E. Ellis[1], R.H. Converse[2], and R. Stace-Smith[1], [1]Agriculture Canada Research Station, 6660 NW Marine Dr., Vancouver, BC V6T1X2; [2]USDA ARS Hort. Crops Res. Unit, Corvallis, OR 97330.

Ten elderberry (Sambucus canadensis) cvs obtained from nurseries, commercial plantings and public agencies in Canada and the U.S. were evaluated for virus content by sap inoculation, ELISA, and electron microscopy. Plants tested negative for arabis mosaic, cucumber mosaic, tobacco mosaic, tobacco ringspot, tobacco streak, tomato blackring, tomato bushy stunt, and tomato ringspot viruses. Most clones of all cvs were infected with elderberry carlavirus, and some clones of all but three cvs were infected with cherry leaf roll virus, both first reports in edible elderberry in North America. Infection of elderberry cvs by both viruses was often accompanied by leaf mottling.

EVALUATION OF PYTHIUM NUNN AS A POTENTIAL BIOCONTROL AGENT AGAINST PHYTOPHTHORA ROOT ROT OF AZALEA AND SWEET ORANGE. J. G. Fang and P. H. Tsao, Department of Plant Pathology, University of California, Riverside, CA 92521.

Pythium nunn (Pn), a mycoparasite reported by R. Baker's group in Colorado, parasitized hyphae and spores of 3 Phytophthora (Phy) spp. Its effectiveness in suppressing root rot of azalea (Rhododendron sp.) caused by P. cinnamomi or P. parasitica and root rot of sweet orange (Citrus sinensis) caused by P. citrophthora or P. parasitica was evaluated in UC Mix [peat/sand (1:1)] amended with 1% ground rolled oats in greenhouse tests. Pn at 300 propagules/g (ppg) did not suppress root rot of either azalea or sweet orange. At 1000 ppg, it reduced the incidence and severity of sweet orange root rot caused by P. parasitica, but not by P. citrophthora. Pn at 300 ppg was not pathogenic to azalea or sweet orange, but slightly reduced sweet orange growth at 1000 ppg. Populations of Pn and the 3 Phy spp. in UC mix (without plants), monitored up to 8 wk, declined unless 1% oats was added. Phy populations were reduced in the presence of Pn, with or without oats, in some but not all tests.

FACTORS AFFECTING THE SUSCEPTIBILITY OF CORN TO FUSARIUM EAR ROT. J. J. Farrar and R. M. Davis, Department of Plant Pathology, University of California-Davis, Davis, CA 95616.

Treatment of corn varieties susceptible to Fusarium ear rot (Fusarium moniliforme) with acephate at greensilk stage significantly reduced both the intra-ear populations of Western flower thrips at brown silk and the incidence and severity of Fusarium ear rot at harvest. Treatment with benomyl at greensilk did not significantly reduce thrips populations at brown silk or disease when compared to the non-sprayed control. Comparisons of silk longevity and husk tightness, in fifteen commercial varieties with a range of Fusarium ear rot susceptibilities, indicate that husk tightness at brown silk is correlated (r=0.72) with intra-ear thrips populations at brown silk and is also correlated (r=0.76) with disease rating at harvest.

IN VITRO PATHOGENIC VARIATION AMONG ISOLATES OF PHOMA MEDICAGINIS VAR. MEDICAGINIS. J. A. Fernandez, F. A. Gray, and J. L. Horton. University of Hawaii at Hilo, Hilo, HI 96720, and University of Wyoming, Laramie, WY 82071.

Detached trifoliolate leaves of alfalfa (Medicago sativa) were inoculated in vitro with 35 isolates of Phoma medicaginis var. medicaginis. Isolates varied significantly (P = 0.05) in the ability to produce leaf spot, petiole blight, and leaf chlorosis symptoms. There was a small (r = 0.33) but significant (P = 0.05) relationship between the ability to produce leaf spots and petiole blight, but not between the ability to produce chlorosis and petiole blight or leaf blight. No association between the severity of symptoms and quantity of spores produced in vitro was observed.

HISTOPATHOLOGY OF ORCHARDGRASS INOCULATED BY RHYNCHOSPORIUM ORTHOSPORUM. Jesus Perez Fernandez and Ronald E. Welty, USDA ARS, National Forage Seed Production Research Center and Oregon State University, Corvallis 97331-7102.

Penetration, colonization, and conidia production in orchardgrass by Rhynchosporium orthosporum were investigated by light, fluorescent, and scanning electron microscopy. R. orthosporum conidia germinated to produce an appresorium and penetrated directly through adaxial or abaxial leaf surfaces. After penetration the fungus formed intercellular subcuticular mycelium. Hyphae became intracellular after disintegration and death of mesophyll cells. Conidia were produced on intact leaf surfaces from subcuticular mycelia on short conidiophores that extruded through stomata and between epidermal cells. The fungus is not systemic in orchardgrass leaves and during early stages of tissue colonization, masses of conidia develop and mature on and above intact cuticle. Subcuticular mycelia remain protected from adverse conditions for most of the period of spore production.

IMMUNO-TRAPPING FOR ISOLATION OF *ERWINIA CAROTOVORA* SUBSP. *ATROSEPTICA*. R.L. Forster and J.W.L. van Vuurde. Plant Pathology Div./PSES, Univ. of Idaho, Kimberly, 83341 and Res. Insti. for Plant Protection (IPO), Wageningen, the Netherlands.

Cell suspensions (480-700 cfu/ml) of three strains of Erwinia carotovora subsp. atroseptica (*Eca*) were incubated for one hr at 4 or 27 C in polystyrene petri dishes previously treated with homologous antiserum or normal serum or non-treated. Suspensions were decanted and replaced with molten trypticase soy agar. After incubation, colonies developing from trapped cells were counted. The mean trapping efficiency (TE, number of colonies on solid phase•100/number of cells in the test suspension) on homologous antiserum at 4 and 27 C was 26 and 34%, respectively. The TE for normal antiserum and non-treated polystyrene was ca. 0.1%. In a second test, cells of a pink saprophyte (S) from potato (Solanum tuberosum) and *Eca* (P) and mixtures of S and P (0.2, 1.7, and 19.3 S/P) were tested. The TE's for the mixed S and P on the homologous antiserum were 72 and 26%, respectively. High TE's were also found for S on non-treated polystyrene and normal serum. Additional work is needed to block nonspecific binding of the saprophyte.

AERIAL TRANSMISSION OF PYTHIUM APHANIDERMATUM BY SHORE FLIES (SCATELLA STAGNALIS). N. P. Goldberg and M. E. Stanghellini. Department of Plant Pathology, University of Arizona, Tucson, Arizona 85721.

This study documents, for the first time, aerial transmission of Pythium aphanidermatum by shore flies (Scatella stagnalis) and shows that these flies, which were thought only to feed on blue-green algae, also feed on roots colonized by the fungus. Microscopic observation revealed that 97% of the 1st and 2nd instar larvae, 20% of the pupae/3rd instar larvae and 10% of the adult flies were carrying mature oospores in their gut. Oospores excreted by larvae and adults were capable of germinating. Successful transmission of P. aphanidermatum to healthy cucumber plants was achieved using naturally infested larvae and adult flies. Pythium-infested flies may account for pathogen introduction and spread within commercial greenhouse facilities.

IN SEARCH OF RESISTANCE IN SAINFOIN, ONOBRYCHIS VICIIFOLIA, TO THE NORTHERN ROOT-KNOT NEMATODE, MELOIDOGYNE HAPLA. F.A. Gray[1], J.E. Kazimir[1], D.S. Wofford[2], T. Aung[1], [1]University of Wyoming, Laramie, WY 82071-3354 and [2]University of Florida, Gainesville, FL 32611.

The northern root-knot nematode, Meloidogyne hapla, has been identified as a major contributor to stand decline in sainfoin, Onobrychis viciifolia. Our present studies addressed the selection for resistance within the cultivars Nova and Remont, the evaluation of full-sib families of surviving plants, and the evaluation of plant introductions of exotic species of Onobrychis for possible higher levels of resistance for use in intraspecific hybridization with O. viciifolia. Only nine plants of Remont and none of Nova of 4,500 plants were alive 6 months after inoculation with M. hapla. Full-sib families of the two surviving plants had greater shoot and root biomass and greater plant survival in the presence of M. hapla than the parent cultivar. Several introductions produced relatively high shoot biomass despite heavy root galling, as well as, greater plant survival.

INFLUENCE OF TEMPERATURE ON COLONIZATION OF SPRING BARLEYS BY VESICULAR ARBUSCULAR MYCORRHIZAL FUNGI. W. E. Grey, Dept. Plant Pathology, Montana State University, Bozeman, MT 59717.

Effects of three soil temperatures on growth of spring barleys (Hordeum vulgare L.) and root colonization by vesicular arbuscular mycorrhizal (VAM) fungi from Montana or Syria agricultural soils at different inoculum dilutions were tested in the Plant Growth Center. Shoot dry weight was reduced by inoculation with high concentration of VAM fungi from Montana or Syria at 15 to 18 C. Number of mycorrhizal plants or proportion of mycorrhizal roots colonized increased with higher temperatures. VAM fungi from Montana, primarily Glomus macrocarpum, were cold tolerant at 11 to 13 C while those from Syria, primarily G. hoi, were heat tolerant at 26 to 28 C. Inoculum potential of Montana VAM fungi was higher than Syria VAM fungi in cool soils. Harmal, selected from Syrian barley landraces, had the highest mycorrhizal colonization of the cultivars tested.

OVERWINTER SURVIVAL OF *PEZICULA MALICORTICIS* IN INFECTED APPLE FRUIT. G.G. Grove and R.J. Baird, Washington State University Tree Fruit Research and Extension Center, Wenatchee, WA 98801.

Investigations on the overwinter survival of *Pezicula malicorticis* (causal agent of perennial canker and bull's eye rot of apple) in infected apple fruit were conducted in eastern Washington in 1987-88 and 1989-90. During both years of the study, infected Golden Delicious fruit were placed in wire mesh cages, stored on the orchard floor in September, and retrieved in late March. Stromata and conidia of *P. malicorticis* were observed on 100 and 95% of fruits retrieved in 1988 and 1990, respectively; the fungus was isolated on semi-selective medium from 90 and 87% of the fruit, respectively. Isolate pathogenicity was subsequently verified by inoculation of apple fruit. Results indicate that *P. malicorticis* can overwinter in infected fruit on the orchard floor.

OVERWINTER SURVIVAL OF *PODOSPHAERA LEUCOTRICHA* CLEISTOTHECIA IN EASTERN WASHINGTON. G.G. Grove and N.B. Roberts, Washington State University Tree Fruit Research and Extension Center, Wenatchee, WA 98801.

Cleistothecia of *Podosphaera leucotricha* survived winter on apple twigs (cv. Rome) in eastern Washington. Microscopic observation of cleistothecia harvested from twigs at bud burst, pink, and full bloom indicated that 32.8, 22.1, and 18.7%, respectively, contained viable ascospores. The viability of ascospores was verified by vital staining with europium chelate and fluorescence microscopy. Cleistothecia collected from twigs at silver tip, green tip, tight cluster, and pink and full bloom and suspended above glass slides released 0.6, 263, 338, 258 and 214 ascospores/twig, respectively. Cleistothecia placed upon or suspended over apple leaf disks resulted in the development of typical *P. leucotricha* colonies. Germinating ascospores were observed on epidermal peels of inoculated leaves. Results indicate that cleistothecia are a potential source of primary inoculum for apple powdery mildew epidemics in eastern Washington.

REGULATION OF A HOST ENCODED PROTEIN KINASE BY TMV INFECTION. J. Hu and D. A. Roth. Dept. PS&IS, University of Wyoming, Laramie, 82071-3354.

Plant virus and viroid infection stimulates the activity of a host encoded Mr 68,000 (p68) dsRNA dependent protein kinase. The temporal regulation of p68 activity by virus infection or dsRNA was assayed in a protoplast system. Protoplasts, isolated from Nicotiana tabacum, were electroporated with TMV, TMV-RNA, viral dsRNA or poly(I)·poly(C) and incubated for 0, 1, 3, 6, 9, 12 and 24 hrs. Enzyme assays indicate that p68 activity in mock inoculated treatments is 4-10-fold less than in infected or dsRNA treated protoplasts. Peak enzyme activity is found 6-9 hr post-treatment. The implications of p68 moderated protein phosphorylation in pathogenesis will be discussed.

The effect of low oxygen stress on growth of cork oak and development of Phytophthora root rot. K. A. Jacobs and J. D. MacDonald. Department of Plant Pathology, University of California, Davis 95616.

Phytophthora cinnamomi causes a severe root and crown rot of cork oak in landscaped plantings where they are exposed to excessive irrigation. High soil moisture can create an anaerobic environment. The objectives of this study were to identify oxygen levels inhibitory to oak root growth, and how anaerobic stress affects susceptibility to P. cinnamomi. Acorns of cork oak, blue oak, and valley oak were germinated and transplanted into mini-rhizotrons. Root growth and morphology was examined before and after incubation at 0 to 21% O_2. Root growth of all species was unrestricted at oxygen levels $\geq$ 10%, and decreased significantly below 6% O_2. Blue oak was most sensitive to hypoxia. Cork oak roots were inoculated with zoospores before exposure to the oxygen treatments. Colonization was greatest at the low oxygen levels (3-4%).

CONTROL OF DRY SEED DECAY OF WHEAT WITH VARIOUS SEED TREATMENTS. R. H. Johnston and D. E. Mathre, Dept. Plant Pathology, Montana State University, Bozeman, 59717.

Four soils were collected from cereal fields in Montana where wheat is produced under semi-arid conditions. These soils were air dried and moisture was added to develop water potentials below that necessary for seed germination. In one test, spores of a Penicillium sp. previously isolated from wheat seed showing dry seed decay were used to infest the soil. Pondera wheat seed was treated with various commercial formulations and added to these dry soils and incubated for 5 weeks at 22 C. Untreated seed showed a diminished emergence and more infection by Penicillium spp. that did treated seed. Although formulations containing imazalil were superior in controlling the growth of Penicillium on the seed, all the formulations tested reduced the amount of Penicillium infection and significantly increased emergence. The four soils varied in the amount of dry seed decay that developed.

HOST RANGE OF THE ASCOCHYTA BLIGHT PATHOGEN OF CHICKPEA. W. J. Kaiser, USDA, ARS, Regional Plant Introduction Station, Washington State University, Pullman, WA 99164-6402

Ascochyta blight of chickpea (Cicer arietinum) caused by Ascochyta rabiei is important in eastern Washington and northern Idaho. The teleomorph, Mycosphaerella rabiei, a heterothallic fungus, develops on infested chickpea residue that overwinters on the soil surface. Isolations were made in June-July of 1988 and 1989, from surface sterilized (5 min in 5% NaOCl) tissues of several plant species growing in blight-infected chickpea plantings or from fields where debris from blighted chickpeas remained on the soil surface over winter. A. rabiei was isolated from Amaranthus albus, Convolvulus arvense, Descurainia sophia, Galium aparine, Lamium amplexicaule, Lens

culinaris, Medicago sativa, Pisum sativum, Solanum nigrum, Thlaspi arvense, and Triticum aestivum. Pycnidia of A. rabiei formed in necrotic tissues of inoculated M. sativa and Melilotus alba. The teleomorph developed on overwintered tissues of M. alba and P. sativum inoculated with a conidial suspension of compatible isolates of the fungus.

Bacterial leaf spot of celery caused by Pseudomonas syringae pv. apii in California. S. T. Koike[1] and A. L. Bishop[2]. [1]Univ. of Calif. Coop. Ext., Salinas 93901, [2]Calif. Dept. Food and Agric., Sacramento 95814.

Pseudomonas syringae pv. apii was recovered from necrotic leaf spots and petiole lesions on celery, Apium graveolens, collected from transplant nurseries and production fields in four counties comprising the major celery growing regions of California. Incidence ranged from undetectable to 80% in production fields, and from undetectable to approximately 90% in blocks of affected nurseries. Severity varied among cultivars; greater disease severity was apparently associated with overhead irrigation. Severe trimming of hearts required to eliminate necrotic foliage resulted in some production losses. P. syringae pv. apii was not recovered from weeds adjacent to nurseries or production fields. Preliminary attempts to recover the pathogen from seed were not successful. This is the first report of P. syringae pv. apii in California.

NATURALLY OCCURRING CROWN GALL OF ALFALFA. F. F. Laemmlen[1], D. A. Cooksey[2], and D. C. Erwin[2]. [1]University of California Cooperative Extension, Imperial County, CA 92250, and [2]Dept. of Plant Pathology, Univ. of California, Riverside, CA 92521.

Galls were observed in two Imperial Valley, CA alfalfa fields in 1986 and again in 1990. Galls were found only in the crown of alfalfa plants; they were irregular, off-white, beige or light green when actively growing. A nondestructive survey of 20 randomly-selected m^2 plots in a 20-hectare field of 20-month-old CUF 101 alfalfa showed a 2% infection frequency. Preliminary tests indicated *Agrobacterium tumefaciens* to be the causal agent. Field-collected gall tissues contained nopaline, which is diagnostic for galls induced by certain *A. tumefaciens* strains. *A. tumefaciens* biovar 1 was isolated in high numbers from young galls using selective medium D1M; the bacteria were positive for the production of 3-ketolactose. This is the first report of crown gall occurring naturally on alfalfa in California.

SHORT PRE-SOWING FALLOW FAILS TO INFLUENCE RECOVERY OF RHIZOCTONIA SOLANI OR REDUCE ROOT ROT ON WHEAT SEEDLINGS GROWN IN NATURALLY INFESTED SOIL. G. C. Mac Nish, Department of Agriculture, Esperance, 6450, Australia.

Two pot experiments tested the hypothesis that wheat sown after a short fallow would have less infection by patch-forming strains of R. solani and less root rot than wheat sown immediately after pasture. Naturally infested undisturbed soil cores were sown to Medicago polymorpha and/or Lolium rigidum pasture. These were desiccated with a herbicide to give 8, 4 or 0 weeks of pre-sowing fallow. Wheat seedlings grown in the cores were assessed for root rot and isolations made for R. solani. Soil organic matter levels were determined in one experiment. In both experiments fallow had no effect on recovery of R. solani, but there was a trend towards less root rot in the 0 fallow. The amount of organic matter (>2mm) followed the expected pattern (0>4>8 weeks of fallow) but the recovery of R. solani was not affected by the treatments. The hypothesis was not supported by these experiments.

PECTIC ZYMOGRAM CHARACTERISATION USED TO DEMONSTRATE THAT EACH RHIZOCTONIA BARE PATCH IN CEREALS IS DOMINATED BY A SINGLE STRAIN OF R. SOLANI. G.C. Mac Nish and M.W. Sweetingham, Department of Agriculture, Esperance, 6450, Australia.

Undisturbed soil cores were removed from six patches over a period of 12 months. Rhizoctonia spp. isolated from wheat seedlings grown in these cores were characterised using electrophoresis in pectic acrylamide gels. The zymogram patterns demonstrated that with one exception, each patch was dominated by a single patch - forming strain (either ZG1-1 or ZG2) of R. solani. The exception contained both ZG1-1 and ZG2 but evidence is presented to show that the patch was a coalescing of two patches each dominated by ZG1-1 or ZG2. Survey sampling of a further 27 patches showed each was dominated by ZG1-1, ZG1-2, ZG1-4 or ZG2. All these strains belong to AG8 and therefore cannot be separated using anastomosis.

CONTROL OF SNAPDRAGON RUST(PUCCINIA ANTIRRHINI) WITH SYSTEMIC FUNGICIDES. A. O. Paulus, M. Vilchez, and K. Robb, Plant Pathology Dept., University of California, Riverside, CA 92521

Rust of snapdragon(Antirrhinum majus), resulting from infection by Puccinia antirrhini, is a common disease in California. In experiments to control rust on snapdragon in southern California, plots were replicated 6 times and plants were sprayed 3 times at 2-week intervals. In the first trial, myclobutanil, terbuconazole, metsulfovax, flusilazole, diniconazole, and triadimenol gave excellent control while oxycarboxin resulted in fair control. All treatments were significantly better than no treatment. After the second application of metasulfovax a medium to severe yellowing of the foliage appeared. In the second trial, myclobutanil, terbuconazole, flusilazole, triadimefon, oxycarboxin and metsulfovax gave excellent control, thiophanate-methyl + mancozeb resulted in moderate control and triforine provided only fair control. Reducing the rate of metasulfovax eliminated the yellowing of the foliage noted in the first trial.

DECREASED INJURY TO STONE FRUIT HEAT TREATED IN WATER CONTAINING SUCROSE. Douglas J. Phillips, USDA, ARS, HCRL, 2021 South Peach Avenue, Fresno, California 93727

Heating peaches in water at 46 to 55 C to control rot caused by Monilinia fructicola and Rhizopus stolonifer may cause visible injury on the fruit. The treatment may also result in increased susceptibility of the fruit to pathogens when the heat-treated fruit is contaminated. In a study of ways to decrease this injury, sucrose was added to hot water. When fruit was treated for 5-10 min in water at 52 C with sucrose at 171 g/l, there was no visible injury. When the fruits were treated at 45, 50, and 55 C for 5, 10, and 20 min and held for 2 weeks at 1 C, there was little damage to fruit treated at 45 C for 5, 10 or 20 min or 50 C for 5 min, moderate damage at 50 C for 10 and 20 min, and severe damage at 55 C for 5, 10 or 20 min. When held for an additional 7 days at 20 C, rot caused by Penicillum sp. developed on fruit earlier observed with moderate to severe visible injury. Sucrose concentrations of 342 g/l differed little from 171 g/l in protecting fruit.

QUIESCENT INFECTIONS OF MONILINIA FRUCTICOLA ON IMMATURE FRUIT OF FRENCH PRUNE. B.T. Manji, J.M. Ogawa, R.P. Buchner, and K. Sawamura. Dept of Plant Pathology, University of California, Davis 95616.

Quiescent infections are small lesions (usually <1 mm) on immature fruit that do not develop until conditions are favorable. In 1978 and 1989, high incidences of quiescent infections were observed on immature prunes in orchards where fogs are common. In both years, M. fructicola was isolated from lesions on the fruit surface. In 1989, fruit were collected, surface sterilized, and lesions were placed on acidified PDA every 2 wk from shortly after the appearance of symptoms (5/30) to harvest (9/5). Over the sampling period, average percent isolation of the fungus (50 lesions/fruit) decreased from 70 to 11%. At each sampling time, 112 fruit, (28/tree) were surface sterilized and incubated at 20 C, 90% RH for 10 days. As fruit matured, the percent of incubated fruit that developed brown rot increased from 0 to 86%. In field studies, quiescent infections were reproduced by inoculating immature fruit with a conidial suspension (100,000/ml) of M. fructicola and re-isolation completed Koch's postulates.

PROBLEMS AFFECTING PLANT DISEASE CLINICS AND SERVICES IN DEVELOPING TROPICAL ASIA. Michael R. Mann, Box 29, Chiang Mai, Thailand 50000, and M. F. Stoner, California State Polytechnic Univ. Pomona, CA 91768.

The research used questionnaires for farmers and technical personnel, and on-site interviews and observations. Developing areas of China, India, Indonesia, Nepal, Pakistan, the Philippines, and Sri Lanka were mail-surveyed, with northern Thailand used as a focal area for extensive field studies. Problems were analyzed by four categories: system organization and bureaucracy; clinical facilities and functions; needs of farmers; and social and cultural factors. Major problems included shortages of funds, clinics, and qualified phytopathological staff; lack of integrated disease management strategies; poorly educated farmers; in some cultures, superstitions about disease and crop management; unguided diagnosis and control by farmers themselves; incomplete or incorrect clinical diagnoses and recommendations; diminished trust in slow or unreliable services; remoteness and travel problems; language, social, and cultural barriers; and need for advisory literature and visual aids.

SEASONAL VARIATION IN SUSCEPTIBILITY OF CITRUS ROOT TISSUE TO PHYTOPHTHORA CITROPHTHORA AND P. PARASITICA. M. E. Matheron and J. C. Matejka, Yuma Agric. Center, Univ. of Arizona, Yuma, AZ 85364

For 24 consecutive months, root pieces 8 cm long and 8-15 mm in diameter were collected from field-grown Lisbon lemon (C. limon) trees established on C. aurantium, C. jambhiri or C. volkameriana rootstocks. Root segments were wounded, inoculated with P. citrophthora or P. parasitica, and incubated for 96 hr at 24C in moist chambers. Root pieces of all three rootstocks inoculated with P. citrophthora (in addition to root pieces of C. aurantium, but not C. jambhiri and C. volkameriana, inoculated with P. parasitica) developed smaller lesions during Jan-Feb than during Jul-Oct. Apparently, seasonal variation in the susceptibility of citrus rootstocks does occur, although this phenomenon is influenced by the particular combination of citrus rootstock - Phytophthora species.

PHYTOPHTHORA CITRICOLA, P. PARASITICA, AND P. CACTORUM CAUSE CROWN, ROOT, AND FRUIT ROTS OF STRAWBERRY IN CALIFORNIA. S.M. Mircetich, G.T. Browne, H.D. Willamowski, and W.D. Gubler, USDA ARS, Dept. of Plant Path., UC Davis, Davis CA, 95616

Phytophthora cactorum (Pc), P. citricola (Pcit), and P. parasitica (Pp) were isolated from strawberry plants affected with crown and root rot ("vascular collapse") and fruit rot ("leather rot") in California's commercial fields. Pc was the most-frequently recovered whereas Pcit was usually isolated from sites with a high incidence of dead strawberry plants due to crown and root rot. In greenhouse experiments, strawberry cvs. 'Yolo' and 'J-8', when grown in artificially infested soil with either fruit rot or crown rot strawberry isolates of Pc, Pcit, or Pp, developed crown, root, and fruit rots regardless of the isolate or Phytophthora sp.. Pcit isolates were significantly more virulent to strawberry than isolates of either Pc or Pp. This is the first record to implicate Pcit in root and crown rot of strawberry. Apparently, three different Phytophthora spp. are causing root, crown, and fruit rots in commercial strawberry fields of California.

FUNGI ASSOCIATED WITH SEED AND SEEDLING BLIGHT OF SHRUNKEN-2 SWEET CORN IN IDAHO. S.K. Mohan, and D.O. Wilson Jr. University of Idaho R & E Center, Parma, ID 83660.

Laboratory and field studies were conducted on 50 randomly selected commercial seedlots of "supersweet" shrunken-2 sweet corn hybrids to determine the fungi associated with poor germination and seedling blight. In laboratory tests of surface sterilized samples, *Penicillium oxalicum* was detected in 100% of the lots (5-77% seed infected, mean 29%), *Rhizopus* spp. in 98% of the lots (0-87% seed infected, mean 38%) and *Fusarium* spp. in 92% of the lots (0-31% seed infected, mean 7%). Mean stand counts in the field 30 days after planting ranged from 7-88% and were inversely related to mean seedling disease severity (r=-0.43) and with incidence of one of the *Rhizopus* spp. (r=-0.36) in seed. Blighted seedlings showed mainly scutellar rot, necrosis and girdling of primary root and mesocotyl, and internal brown discoloration of crown. Isolations from symptomatic tissues of seedlings from all the seedlots yielded mostly *F. moniliforme* and *P. oxalicum*. Inoculations confirmed pathogenicity of *P. oxalicum*, but results with *F. moniliforme* were variable.

CHARACTERISTICS OF FAST- AND SLOW-GROWING ISOLATES OF *PSEUDOCERCOSPORELLA HERPOTRICHOIDES* FROM WINTER WHEAT WITH EYESPOT IN WASHINGTON AND OREGON. T. D. Murray, Dept. of Plant Pathology, Washington State University, Pullman, WA 99164.

P. herpotrichoides was isolated from winter wheat collected in eastern Washington and Oregon that had symptoms of eyespot. Of 275 isolates from 62 fields, 9 isolates from 5 fields had a reduced growth rate (slow-growing), uneven colony margins and light pigmentation on potato dextrose agar (PDA), compared to the faster-growing isolates with smooth colony margins and dark pigmentation. On corn meal agar (CMA) under continuous near-uv light at 15 C, slow-growing isolates produced a brown-pigmented, feathery mycelium with uneven colony margins, thus resembling rye-type isolates described elsewhere. However, fast-growing isolates produced a sparse, cream- to olive-pigmented mycelium with smooth margins and resembled wheat-type isolates. Isolates with intermediate growth rate and morphology were apparent on CMA but not PDA. It is not known if the fast- and slow-growing isolates differ in pathogenicity to wheat, barley, and rye.

TRANSPIRATION STRESS SYNDROME - A NEW DISORDER OF COTTON IN IMPERIAL VALLEY. E. T. Natwick, F. F. Laemmlen, C. C. Chu, and B. Deeter. Cooperative Extension, University of California, Imperial County, CA 92250.

Cotton fields in Imperial Valley, CA were plagued by an unusual disorder in 1989. Virtually every field or portions of fields in the valley not treated with aldicarb granular insecticide/nematicide displayed symptoms of increased heating of terminal foliage, leaf yellowing, and leaf burn (appearing as browning and silvering of the palm of affected leaves). Shedding of squares on affected plants resulted in substantial crop loss. These symptoms were due to reduced transpiration which results in overheating of the foliage. Analysis of shoot and root tissues revealed no association with nematodes or pathogenic fungi or bacteria. Insects and mites were also not consistently associated with the transpiration stress syndrome (TSS). Field observations suggest aldicarb-treated plants had a more extensive fine root system. Studies to determine the cause of TSS have been initiated.

BIOLOGICAL CONTROL OF PHYTOPHTHORA PALMIVORA ON PAPAYA FRUIT. K. A. Nishijima, J. H. Taniguchi, H. M. Couey (retired), USDA-ARS, Trop. Frt. & Veg. Res. Lab, P.O. Box 4459, Hilo, HI 96720

An unidentified bacterium, Wa-60, isolated from Carica papaya leaves, produced an antibiotic compound which inhibited Phytophthora palmivora zoospore germination in in vitro tests and symptom development on artificially inoculated papaya fruit. In broth media containing peptone, NaCl, yeast extract and a carbohydrate source, the antibiotic was produced with 2% dextrose, maltose, fructose, galactose and lactose, but not sucrose. Cell-free extracts of the bacterium incubated for 2, 4, 6, 8 or 10 days in broth medium containing dextrose were not significantly different in antibiotic strength. In other in vitro tests, the unpurified, heat-stable antibiotic was fungitoxic to ungerminated and germinated zoospores. In fruit inoculation studies, control treatment had 78% infection compared to 3, 0 and 3% infection in 2-, 6- and 10- day-old cell-free extract treatments, respectively.

GROWTH AND SURVIVAL OF RHIZOMONAS SUBERIFACIENS ON LETTUCE AND BARLEY LEAVES. R. Douglas O'Brien, Ken N. Jochimsen and Ariena H. C. van Bruggen. Dept. of Plant Pathology, UC Davis 95616.

Rhizomonas suberifaciens (causal agent of corky root of lettuce) spreads rapidly, possibly from epiphytic leaf populations. Growth chamber populations of R. suberifaciens, Escherichia coli (a poor leaf epiphyte), and Pseudomonas syringae (a common leaf colonizer) were 4.0-4.8 log cfu/g fr wt after atomization on both lettuce and barley leaves. After 72 hours near 100% RH, populations of P. syringae increased slightly more than E. coli or R. suberifaciens (6.7 vs 6.2 and 5.3 log cfu/g fr wt, respectively). After a further 72 hours at 50% RH, all populations declined, but P. syringae maintained populations 200 and 3100 times higher than E. coli and R. suberifaciens, respectively. Populations of E. coli were somewhat higher (15 times) than R. suberifaciens. R. suberifaciens grew best on lettuce. E. coli and P. syringae grew best on barley. The similarity in epiphytic ability of R. suberifaciens and E. coli suggests that R. suberifaciens on leaves may not be a significant inoculum source.

POPULATION DYNAMICS OF RHIZOMONAS SUBERIFACIENS ON ROOTS. R. Douglas O'Brien and Ariena H.C. van Bruggen, Department of Plant Pathology, University of California, Davis, CA 95616.

Four plant spp and cv were dip inoculated with Rhizomonas suberifaciens (causal agent of corky root of lettuce) at 5.0 log cfu/ml and planted in pots in growth chambers. Six, 12, 18 and 24 d after planting, roots were blended and dilution plated to estimate populations of R. suberifaciens. At 3 dates, barley (corky root immune) had lower populations than all other plants. Wild lettuce, Lactuca serriola, and the resistant lettuce cv '440-8' had equal populations at all but one harvest date. At all harvest dates, the susceptible lettuce cv 'Salinas' had higher populations than all other plants. Average populations were 3.22, 3.89, 4.10 and 4.68 log cfu/g for barley, wild lettuce, 440-8 and Salinas, respectively. In a field experiment, (1 x 2 m microplots infested with R. suberifaciens) 60% of Salinas vs 10% of 440-8 roots were positive for the bacterium in an ELISA test one month after planting. Throughout the season, populations on Salinas and 440-8 ranged from 4.1-5.6 and 3.7-5.3 log cfu/g root, respectively.

POSTHARVEST DECAY ORGANISMS OF FUJI APPLES AND DISEASE CONTROL WITH IPRODIONE. J. M. Ogawa, A. J. Feliciano, B. T. Manji, and J. E. Adaskaveg. Department of Plant Pathology, University of California, Davis, CA 95616.

In the central valleys of California, over 1000 hectares of Fuji apples are currently in production. In surveys for organisms causing decay of Fuji apples in storage (0 C for 4 months) at four packing houses, Penicillium expansum and Alternaria alternata were the predominant organisms isolated. Other fungi isolated from decaying fruit included: Mucor piriformis, Stemphylium vesicarium, Botrytis cinerea, and an unidentified yeast. Most decay originated from surface injuries of fruit, however, decay caused by M. piriformis generally developed from the fruit core area. Postharvest pathogenicity tests at 20 C indicated that all fungi caused decay of healthy ripe fruit when inoculations were made in a puncture wound. In fruit inoculated with conidial suspensions of P. expansum, A. alternata, or B. cinerea and then treated (dip or spray) with iprodione (Rovral 50W at 2.4 g/L), decay was completely suppressed for 14 days at 20 C.

NEW MAIZE VIRUS DISEASE IN HAWAII. J. J. OOKA, Department of Plant Pathology, University of Hawaii, Kapaa, HI 96746, B.E. Lockhart and R.J. Zeyen, Department of Plant Pathology, University of Minnesota, St. Paul, MN 55108.

A maize virus disease was observed in seed fields on Kauai, Hawaii, in late 1989. Infected plants were in the 5-8 leaf to milk stage. The youngest infected plants were stippled and mottled similar to feeding damage caused by thrips. Symptoms on older plants ranged from a mild mosaic to a severe chlorosis with marginal necrosis of leaf tips. Severely affected plants were stunted and generally had some malformation of the tassels. Crude sap of infected plants reacted in immunodiffusion tests with antiserum of Maize Chlorotic Mottle Virus (MCMV). The Hawaiian MCMV isolate appears to be more like the Peruvian than the Kansas strain. Seventy percent of these samples also reacted with Maize Dwarf Mosaic Virus (MDMV) A and B antisera. The combination of MCMV and MDMV produce the Corn Lethal Necrosis syndrome.

BLACK LEAF OF ANIGOZANTHOS HYBRIDS. Robert D. Raabe*, Becky B. Westerdahl and Cynthia Anderson. University of California, *Berkeley, CA 94720 and Davis, CA 95616.

The leaves of Australian tissue-cultured plants of Anigozanthos 'Mini Pearl' (A. humilis x A. flavidus) and 'Mini Prolific Red' (a hybrid between A. humilis x A. flavidus and A. bicolor x A. flavidus) became very dark and eventually died. In the early stages, the discoloration appeared as a streaking, usually starting in the centers of the leaf blades. These discolored areas turned purple, then black and extended in both directions. Free-hand sections revealed the presence of a parasitic nematode, identified as Aphelenchoides fragariae. Inoculations were made by clipping pieces of infected leaves to leaves of non-infected plants and placing them in a mist chamber for 24 hours. Within 3 weeks, symptoms began to show and nematodes were found in the inoculated leaves. Two weeks after a single application of oxamyl as a foliar spray, no living nematodes were found in the infected leaves.

DELAYED DEVELOPMENT OF VENTURIA INAEQUALIS ASCOSPORES IN UTAH. K.M. Shotwell*, C.M. Becker**, S.V. Thomson*, and T.J. Burr**, Dept. of Biology*, Utah State Univ., Logan, UT 84322-5305, and Cornell University**, NYSAES, Geneva, NY 14456.

Ascospore maturation in Venturia inaequalis was examined in relation to climate and apple phenology in New York, and in Utah, where apple scab seldom occurs. Scab-infected leaves from New York and Utah were overwintered in a Utah orchard in 1988 and 1989. A parallel study was conducted in New York. Ascospore maturity was evaluated biweekly the following spring. Under the much drier Utah conditions, ascospores from both New York and Utah leaves matured two to four weeks later than in New York. Due to this late spore maturation, and because apples in Utah bloomed one month earlier than in New York, peak ascospore release in Utah coincided with 1-inch fruit, instead of green tip stage as in New York. Ascospores in Utah matured later in the season, when environmental conditions are generally unfavorable for infection.

PEPPER MILD MOTTLE VIRUS ON GREENHOUSE-GROWN PEPPERS. R. Stace-Smith, Agriculture Canada Research Station, 6660 N. W. Marine Drive, Vancouver, B. C. V6T 1X2, and G. Grant, B. C. Ministry of Agriculture and Fisheries, 32916 Marshall Road, Abbotsford, B. C. V2S 1K2.

Symptoms indicative of pepper mild mottle virus (PMMV) infections were observed for the first time on greenhouse-grown peppers in British Columbia in the spring of 1990. A mild mottling of the foliage was seen on the cultivar Delfin but the grower did not become aware of the problem until fruit symptoms appeared. By that time the virus was evident on approximately 1900 plants in a 2.0 hectare planting. Leaf dip preparations revealed tobamovirus particles and reactions on a range of indicator plants indicated that the virus was PMMV. Serological tests confirmed the identity of the causal virus.

MACROPHOMINA PHASEOLINA ASSOCIATED WITH MORTALITY OF SALICORNIA IN AN ESTUARY ON THE SEACOAST OF THE STATE OF SONORA, MEXICO. M.E. Stanghellini, S.L. Rasmussen, and B.C. Turner. University of Arizona, Tucson, AZ 85721.

In July 1988, several wilted Salicornia bigelovii plants, about 5 months old, were observed in a native stand located in an estuary on the seacoast of the state of Sonora, Mexico. By October 1988 about 80 % of the plants in the stand (approximately 800 plants) had died. Pure cultures of Macrophomina phaseolina were consistently isolated from wilted and dead plants and microsclerotia of the fungus were observed in root and lower stem tissues of infected plants. Pathogenicity trials, conducted under saline conditions in the greenhouse, showed that the fungus was the cause of the disease. The environmental factors favoring the onset and severity of this unusual disease are currently being investigated.

FEASIBILITY OF SPRAYABLE POLYMER MULCHES FOR SOIL SOLARIZATION AND SOIL SEALING APPLICATIONS. J. J. Stapleton, Statewide IPM Project, University of California, Cooperative Extension, 733 County Center III, Modesto, CA 95355

Sprayable latex and starch/resin polymer mulches were evaluated for soil temperature elevation and effect on numbers of soilborne Pythium spp. in the San Joaquin Valley. At concentrations applied, none of the sprayable, water soluble materials raised temperatures of moist soil as much as transparent, polyethylene film (PE). Numbers of Pythium spp. were decreased (P=0.01) after solarization for 3 mo. with PE, black latex or clear latex by 98%, 90%, and 79%, respectively. Solarization with clear starch/resin mulch did not have a significant effect on Pythium spp. Sprayable polymers may provide an effective and convenient alternative to use of PE for soil solarization. Other soil-sealing applications, such as spraying planting beds to prevent fruit rots resulting from soil/fruit contact, may be facilitated with these materials.

RESPONSES OF CALLUS AND CELL CULTURES OF GINGER DURING EARLY INTERACTIONS WITH *PSEUDOMONAS SOLANACEARUM*. N. Thaveechai, A. Akarapisan, W. Kositratana, and N.W. Schaad. Dept. Plant Path., Kasetsart Univ., Bangkok 10900, Thailand and Harris Moran Seed Co. ,San Juan Bautista, CA 95045.

Interactions between callus and cell cultures of susceptible ginger cv. Yuak(S) and tolerant cv. Phed (T) and avirulent(A) and virulent(V) strains of *Pseudomonas solanacearum* were investigated. Responses of cell cultures were rated by electrolyte loss and cell death whereas callus cultures were rated by electronmicroscopy (SEM) and cell death. Within 3-5 hrs after inoculation, incompatible(I) reactions between S and A, T and A or T and V combinations resulted in a electrolytic loss of 150-250 uS In contrast, the compatible (C) reaction between S and V resulted in a loss of only 100 uS. Percentage of cell death in C combinations became > 6 hrs after inoculation. SEM study revealed a much larger amount of bacteria and fibrous material on callus cell surfaces of I combinations then in C ones. Compatible combinations resulted in a much larger number of dead callus cells. The results suggest that callus and cell culture can be used for resistance screening.

ILARVIRUSES: SPREAD AND YIELD EFFECT IN CLING PEACH TREES. Jerry K. Uyemoto and Wesley K. Asai, USDA-ARS and Cooperative Extension, respectively, Dept. Plant Pathology, Univ. California, Davis, 95616.

In the second-growth year, a 64-tree peach (Prunus persica cv Carson) plot was serologically and biologically assayed and found to contain 17 peach stunt diseased (PSD) trees caused by prune dwarf and Prunus necrotic ringspot viruses. A year later, repeated ELISA detected 12 new infections and Shirofugen assays confirmed all 29 ELISA positives. However, among 35 ELISA negatives, 9 were Shirofugen positive, suggesting that virus had spread in the first and second bloom periods. Cumulative peach yields (2 years) were 38.5 kg for PSD trees (12,700 kg/ha) and 75.3 kg for non-PSD trees (24,850 kg/ha); projecting a net loss of $2900.00/ha (at a price/907 kg of $218.00). Thus a serious economic loss of peach yield was caused by PSD.

GRAFT TRANSMISSION EFFICIENCY OF WESTERN X-DISEASE IN CHERRY AND PEACH TREES. Jerry K. Uyemoto and Carl F. Luhn, USDA-ARS, Dept. Plant Pathology, University of California, Davis, CA 95616.

Buds from X-diseased sweet cherry (Prunus avium cv Bing) and cling peach trees (P. persica cv Loadel) were collected. Twenty buds from each of four symptomatic Bing trees were grafted onto 80 healthy Bing/mahaleb trees. Similarly, 20 buds each from two symptomatic peach trees were grafted onto 40 healthy peach trees. Also, collections of healthy Bing and Loadel were grafted onto their indicator trees. After a 12-month incubation, 9 of 80 cherry trees became infected. With peach inocula, 22 of 40 trees developed symptoms. All control trees appeared healthy. These results suggest that distribution of the pathogen is erratic in cherry and less so in peach.

DEVELOPMENT OF A MONOCLONAL ANTIBODY SPECIFIC FOR RHIZOMONAS SUBERIFACIENS, CAUSAL AGENT OF CORKY ROOT OF LETTUCE. A.H.C. vanBruggen[1], K.N. Jochimsen[1], A.A. Benedict[2], and A.M. Alvarez[3]. Dept. of Plant Pathology, University of California, Davis, CA 95616[1] and Depts. of Microbiology[2] and Plant Pathology[3], University of Hawaii, Honolulu, Hawaii 96822.

Monoclonal antibodies (MAbs) were produced to Rhizomonas suberifaciens (Rs) strain CA1. Initial screening of ascites was performed with strains CA1 and FL1 of Rs and 93 strains of other genera. One MAb (MAb-Rs 1) reacted with both strains of Rs, and was further tested for specificity with 25 strains of Rs, and 39 strains of unknown bacteria isolated from lettuce roots with corky root (CR). All strains were tested for pathogenicity on lettuce, DNA homology with CA1-DNA, and affinity to Mab-Rs 1 and a polyclonal antibody (CA1-Ab1) in direct and indirect ELISA tests. Only strains of Rs tested clearly positive with MAb-Rs 1. The indirect test was more sensitive than the direct test. CA1-Ab1 reacted with several bacteria that had <5% homology with strain CA1.

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