

# **ABSTRACTS OF PAPERS**

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### ABSTRACTS

THE SPECIFICITY OF ELISA FOR STRAINS OF TMV. Edward B. Adams, & Arthur V. Allison. Del Oro High School, 3301 Taylor Rd., Loomis, CA 95650

The enzyme-linked immunosorbent assay (ELISA) technique was evaluated for its ability to detect various strains of Tobacco Mosaic Virus. The standard sandwich test using TMV-U1 I<sub>g</sub>G demonstrated positive assays to various strains of TMV including 5 strains isolated from orchid. The various strains differed in the extent of the dilution to which they would yield a positive visual reaction. In a reciprocal test using a TMV-orchid strain I<sub>g</sub>G the reaction was positive only with the homologous virus. The indirect test using TMV-orchid I<sub>g</sub>G yielded a positive visual reactions for all the TMV-orchid strains assayed and with TMV-U1.

ENZYME-LINKED IMMUNOSORBENT ASSAY (ELISA) AS A RAPID METHOD FOR SCREENING FOR THE PRESENCE OF CYMBIDIUM MOSAIC VIRUS & ODONTOGLOSSUM RING SPOT VIRUS. Arthur V. Allison, Edward B. Adams, & Lane Steingel. Del Oro High School, 3301 Taylor Rd., Loomis CA 95650

Serologically specific electron microscopy (SSEM), enzyme-linked immunosorbent assay (ELISA), negatively stained leaf dip preparations for the electron microscope (EM) were compared for sensitivity in detecting both Cymbidium Mosaic Virus (Cymbidium MV) and Odontoglossum Ring Spot Virus (ORSV) in serial dilutions of purified virus. Cymbidium MV could be detected at 10 fold greater dilutions by both SSEM & ELISA than by EM dips. ORSV could be detected at the same dilution by all 3 methods. It is concluded that the ELISA technique is at least as sensitive and in some cases more so than either SSEM or EM dips. Plant material screened by EM dips was tested using ELISA; both tests yielded identical results.

FACTORS INFLUENCING SUSCEPTIBILITY OF LEMONS TO GEOTRICHUM CANDIDUM. A.B.A.M. Baudoin and J.W. Eckert, Department of Plant Pathology, University of California, Riverside, CA 92521.

Injection of 5 µl spore suspension of G. candidum, 2.5 mm deep into the peel of lemon fruits, produced either a rapidly advancing soft rot or an arrested, dry lesion. Infections that did not develop into active lesions within 5-6 days at 25 C rarely did so thereafter. Differences in expansion rate of the soft rot were small. Susceptibility was expressed as the percentage of active lesions 5 days after inoculation or as the inoculum concentration producing 50% active lesions (ED<sub>50</sub>). Susceptibility differences between the lemon cultivars Lisbon and Eureka were minor. Susceptibility increased with color change from light-green to yellow and with duration of storage. Treatment with ethylene accelerated this increase. Water uptake or water loss (2-10%, changing the peel water potential by 0.6-3.0 bars), respectively, reduced or increased the ED<sub>50</sub> by a factor 3-30x. Lemons picked at 8 a.m. or after rainfall were more susceptible than those picked at 2 p.m. or during a dry period.

DISEASE ASSESSMENT MODELS. W. J. Bloomberg, Canadian Forestry Service, Pacific Forest Research Centre, 506 West Burnside Road Victoria, British Columbia, V8Z 1M5, Canada

Three approaches to crop disease assessment by disease progress curves, regression analysis, and disease simulation are compared with respect to disease prediction, epidemic analysis, and disease management. Examples of crop disease simulation models are examined for their relevance to these aspects of crop loss. Desiderata for disease simulation models are suggested with special reference to relevant host crop biology, incorporation of disease management options, and usefulness to practitioners.

THE ROLE OF VIRULENCE OF PHOMA LINGAM STRAINS IN CABBAGE BLACKLEG EPIDEMICS. J. M. Bonman, R. L. Gabrielson, Western Washington Research & Extension Center, Puyallup, WA 98371; P. H. Williams, and P. A. Delwiche, Dept. of Plant Pathology, Univ. of Wisconsin, Madison, WI 53706

Seedling response to wound inoculation and pigment production *in vitro* were used to differentiate two strains of P. lingam. Isolates of each strain were tested for virulence in seed bed and transplant experiments in Wisconsin. The strain which caused expanding tissue collapse in the seedling test, and did not produce pigment, spread from inoculated to noninoculated plants in seed beds and damaged transplanted cabbage grown to maturity. The strain which caused only tissue darkening and limited tissue collapse in the seedling test and produced pigment did not spread significantly in the seed bed and caused only superficial lesions on transplanted cabbage grown to maturity. The latter strain is most commonly isolated in the Pacific Northwest and is probably insignificant in cabbage blackleg epidemics. Others have suggested a similar conclusion based only on greenhouse studies.

INTEGRATED CONTROL OF FUSARIUM ROOT ROT AND SCLEROTINIA WILT IN BEANS. D. W. Burke and D. E. Miller, USDA SEA/AR, IAREC, Prosser, WA 99350.

Fusarium root rot (F. solani f. sp. phaseoli) in beans (Phaseolus vulgaris) is counteracted by frequent irrigations. Contrarily, this practice favors Sclerotinia wilt (S. sclerotiorum). In 1979 Fusarium-resistant beans and seedbed chiseling to reduce soil compaction were used to promote rooting and reduce irrigation requirements. In one experiment plots were sprinkled daily at rates from total to zero replacement of evapotranspiration (Et). With total replacement, Sclerotinia wilt was severe. In Fusarium-resistant beans, ½ down to 1/3 replacement of Et gave optimum yields, with negligible Sclerotinia. In another experiment 16 bean selections were compared when sprinkler irrigated at 10- vs. 5-day intervals. Five-day but not 10-day intervals favored Sclerotinia wilt. In both Fusarium-infested and noninfested fields, Fusarium-resistant beans in chiseled plots produced near optimum yields with either 5 or 10 days between irrigations.

SUPPRESSION OF MELOIDOGYNE INCOGNITA WITH DIFFERENT LEVELS OF MACROCYSTIS PYRIFERA (KELP) IN SAND AND SOIL. Lynn Carta and Edward K. Mercer, Department of Biology, California State Polytechnic University, Pomona, CA 91768.

Foliar sprays and soil amendments of dried, powdered kelp were tested on 3-week old Tropic VF tomatoes in the greenhouse. One thousand second stage M. incognita larvae were pipetted to each of ten plants per treatment in sterile sand or soil. After six weeks, the equivalent of 250 pounds per acre kelp in soil but not sand, 500 pounds per acre kelp in sand but not soil, and 0.3% but not 1% foliar kelp significantly (5%, 5%, 2% levels) reduced root galls per plant. Top weight reduction was noted on nematode infested plants with 3-day pretreatments of 1% foliar kelp or 500 pounds per acre kelp in sand. In sand, 500 pounds per acre kelp applied both with and before nematodes showed 93% and 97% reductions in larvae extracted per gall, and significant increases in root browning compared to the nematode control. The radish cotyledon bioassay showed cytokinin activity in the tested kelp dosages. Hormones, chelators, and phenolic compounds in kelp may be important in the above results.

A COMPARISON OF THREE ELISA TECHNIQUES FOR SENSITIVITY IN DETECTING VIRUS ANTIGEN. Wesley W. Chee, & Arthur Allison; Del Oro High School, 3301 Taylor Rd., Loomis CA 95650

Three variations of enzyme-linked immunosorbent assay (ELISA) technique, direct, indirect, and sandwich, were compared for

sensitivity in detecting virus. Purified virus preparations and infected tissue of two viruses in the Potexvirus group, Cymbidium Mosaic virus and Clover Yellow Mosaic virus, and Odontoglossum Ring Spot Virus of the Tobamovirus group were utilized. All three methods were essentially equal in their ability to detect virus antigen.

PRODUCTION OF INDOLEACETIC ACID IN *PSEUDOMONAS SAVASTANOI* IS A PLASMID CODED FUNCTION. Luca Comai and Tsune Kosuge, Dept. of Plant Path., Univ. of California, Davis, CA 95616.

*Pseudomonas savastanoi*, a pathogen of olive and oleander, induces gall formation by producing indoleacetic acid (IAA). Production of this secondary metabolite in the bacterium is achieved through two enzymatic steps converting tryptophan into IAA via indoleacetamide. Tryptophan monooxygenase, the first enzyme of the pathway, also detoxified the inhibitory analogue 5-methyl-tryptophan. Thus, growth in the presence of 5-methyl-tryptophan was used as a qualitative assay for this enzyme activity and production of IAA. Efficient curing of IAA production was obtained by acridine orange treatment followed by subculturing in King's B broth. Cured IAA strains lacked a  $34 \times 10^6$  molecular weight plasmid, which was always present in IAA cells. Further, IAA isolates had also lost indoleacetamide hydrolase, the enzyme converting indoleacetamide into IAA. Transformation of IAA strains with the IAA plasmid was detected by cotransformation of RSF 1010, a small R factor. Transformed cells regained the capability of producing IAA.

AN AGROGIN MUTANT OF *AGROBACTERIUM RADIOBACTER* K84 AND BIOLOGICAL CONTROL OF CROWN GALL. D.A. Cooksey and L.W. Moore, Dept. of Bot. and Plant Path., Oregon State Univ., Corvallis, 97331.

Biological control of crown gall by *A. radiobacter* K84 is correlated with the production of agrocin 84. However, agrocin 84 has never been isolated from inoculated plant wounds. To determine whether agrocin 84 is the sole mechanism of control, an agrocin mutant of K84 was developed by mitomycin C curing of the 30 megadalton bacteriocinogenic plasmid. When coinoculated with *A. tumefaciens* K24 to wounded tomato stems, the wild-type K84 completely prevented galling, but the agrocin mutant allowed 100% infection. However, when the K84 mutant was inoculated to wounds 24 hr before K24, galling was reduced to 35%. In addition, infection by agrocin-resistant *A. tumefaciens* B6 was reduced to 40-50% when either K84 or the K84 mutant was inoculated to the wound site 24 hr before B6. The data suggest that a physical blockage of infection sites is also involved in biological control by K84.

FEASIBILITY OF USING MEAN ORCHARD TEMPERATURE FOR TIMING PEAR FIRE BLIGHT SPRAY IN WASHINGTON. Ronald P. Covey, Washington State University Tree Fruit Research Center, Wenatchee, WA 98801

Orchard temperature, relative humidity and incidence of fire blight have been monitored in various Washington pear orchards since 1972. Epiphytic populations of *Erwinia amylovora* in pear blossoms and on pear leaves have been monitored since 1973. Even in the presence of oozing cankers *E. amylovora* was not detected when mean temperatures were below 15°C. Blossom infection was rare during periods when the bacterium had not been detected by monitoring, and disease frequently failed to develop during periods when the bacterium was detected. The occurrence of high epiphytic populations and/or disease was not necessarily related to either rainfall or high humidity, but was more clearly related to temperature in excess of 15°C. During the regular pear blossom season these temperatures are seldom achieved and most infection occurs on secondary blossoms. A position effect has been noted with more infections occurring in the top third of the trees than in the bottom third.

HISTOLOGICAL ASSESSMENT OF THE *STEMPHYLIUM BOTRYOSUM*:*MEDICAGO SATIVA* HOST-PARASITE INTERACTION. W. A. Cowling and D. G. Gilchrist, Dept. Plant Path., Univ., Calif., Davis, CA 95616.

The interaction of 3 isolates of *Stemphylium botryosum* differing in virulence and 3 clones of alfalfa differing in resistance to *Stemphylium* leafspot was evaluated histologically. Pathogen virulence and host resistance did not affect conidial germination or germ tube growth. For all host-pathogen combinations, growth of the fungus was restricted to the site of penetration throughout symptom development. More virulent isolates penetrated all clones more frequently than less virulent isolates, and more frequently affected cells further than 0.1 mm from the hypha. This distance corresponded to the minimum lesion radius subsequently measured on a susceptible

clone. Host resistance was manifested as faint chlorotic spots, whereas necrotic lesions formed on the susceptible clones. The minimum and average lesion areas produced by all isolates were the same, independent of the number of lesions which were produced. Therefore, pathogen virulence and host resistance in this disease appear to be distinct phenomena.

PARTIAL PURIFICATION OF FUNGITOXIC SUBSTANCES FROM TOMATO PLANTS INOCULATED WITH *FUSARIUM OXYSPORUM* f. sp. *LYCOPERSICI*. S.J. Danko and M.E. Corden, Dept. Botany and Plant Pathology, Oregon State University, Corvallis, OR 97331.

Substances toxic to *Fusarium* were extracted with acetone from the xylem of wilt disease resistant tomato plants (cv. Jefferson) inoculated with race 1 of the pathogen. The amount of fungitoxic material in the extracts was influenced greatly by environmental factors including water availability. Bioassayed extracts were most fungitoxic at pH 4.5, but ineffective at pH 6.0 and above. Highly fungitoxic substances in the extract were soluble in water, acetone, and ethyl acetate; other slightly fungitoxic materials were soluble in acetone but not water. Thin layer chromatography on silica gel resolved four fungitoxic compounds. Two large peaks and four smaller peaks of fungitoxicity were resolved by chromatography on Sephadex LH-20. Preliminary tests indicated that these fungitoxics are polyphenolic and may contribute to disease resistance.

EVALUATION OF ALDICARB FOR VERTICILLIUM WILT SUPPRESSION OF POTATO: VERTICILLIUM DAHLIAE STEM COLONIZATION AND RELATIONSHIP TO NEMATODE POPULATIONS. J.R. Davis, W.B. Jones, & G.S. Santo. Univ. of Idaho Research & Extension Center, Aberdeen, ID 83210 & Washington State Univ.-IAREC, Prosser, WA 99350.

Sidedress treatments of either aldicarb or phenamiphos at time of planting (3.4 kg/ha a.i.) significantly reduced *Verticillium* wilt severity (*Verticillium dahliae* Kleb.) of Russet Burbank potato and increased yield by 8.2 to 6.6%. When aldicarb was reevaluated in the same field at 2 application rates (3.4 and 6.7 kg/ha a.i.), aldicarb was shown to reduce populations of *Pratylenchus* and *Helicotylenchus* spp by 66 to 70%. Differences between application rates were not significant. Populations of either genus correlated ( $P=.01$ ) with wilt and *V. dahliae* colonization of potato stem tissue, and *Helicotylenchus* counts were negatively correlated ( $P=.01$ ) with emergence, petiole NO<sub>2</sub> levels, and yield. Among these plots aldicarb treatments reduced *Verticillium* wilt and degree of colonization in potato stem tissue by *V. dahliae* ( $P=.01$ ). Nematode interactions with *V. dahliae* are implicated.

CUCUMBER MOSAIC VIRUS ISOLATES SEEDBORNE IN *PHASEOLUS* BEANS: RELATIONSHIPS, CURRENT SIGNIFICANCE. Robert F. Davis and R. O. Hampton. USDA SEA-AR. Department of Botany and Plant Pathology, Oregon State University, Corvallis 97331

Three isolates of cucumber mosaic virus (CMV) from New York, Spain, and France, reported since 1974 to be seedborne in beans (*Phaseolus vulgaris*), were compared. The isolate from France has been independently determined to be a member of the CMV-serotype DTL of Devergne and Gardin. The New York and Spanish isolates were antigenically indistinguishable from the French isolate by gel double-diffusion serology and presumably belong to the DTL serotype also. Isolates differed only slightly in virulence on selected hosts. Plants of strategic bean breeding materials in Idaho, Washington, and Oregon were assayed for such CMV isolates on CMV-sensitive hosts and/or by ELISA. Plant Introduction *Phaseolus* accessions from selected geographic origins were also tested for seedborne CMV. No CMV was detected in these materials, indicating that this pathotype has not yet become established in the Northwest bean seed industry or in selected accessions of *Phaseolus* germplasm.

AN APHID TRANSMITTED VIRUS OF CARDAMOM IN GUATEMALA. J. E. Dimitan, Department of Biological Sciences, California State Polytechnic University, Pomona, CA 91768

Although cardamom, *Elettaria cardamomum* Maton (Zingiberaceae), has been grown commercially in Guatemala since the 1920s, Cardamom Mosaic has only recently become a major problem. Foliar symptoms include mild chlorosis with green and yellow mottling. New shoots frequently show downward bending, reduced growth rate, and yellow and green blotching. Flower spikes may show such blotching. The virus is not seed, soil or mechanically transmitted and it was not transmitted by *Cuscuta* sp., several species of nematodes, or green peach aphid, *Myzus persicae*. It

was transmitted by banana aphid, *Pentalonia nigronervosa* and *Toxoptera* sp. Aphids are nonpersistent vectors transmitting after a 1- to 1½-hour acquisition, and becoming noninfectious after 1 hour of feeding on healthy plants; symptoms appear in 40-45 days. Natural infection may reach 83% within 6 months of planting in a new field. Nurseries and new fields can be kept clean by sanitation practices, shading, roguing and aphid control.

DYNAMICS OF DRYLAND BEAN ROOT GROWTH IN RELATION TO FUSARIUM ROOT ROT. Paul Dryden and N. K. Van Alfen, Dept. of Biology, UMC 45, Utah State University, Logan, UT 84322

Root length, soil inoculum levels, and soil water contents were measured at 15 cm depth intervals (up to 105 cm) and at three monthly intervals during the 1979 growing season. Root growth occurred throughout the season at all depths, but was greatest in the 15-45 cm interval. Decrease in soil water corresponded to areas of high root densities. *Fusarium solani* inoculum levels correlated positively to root densities. Although lesions were not easily distinguished on feeder roots, isolations of the pathogen from them showed a high frequency of recovery (average of 0.85 colonies/cm root) and a high positive correlation with inoculum density in the soil. These findings, coupled with other observations, indicate that the impact of the causal agent on the feeder roots must be considered in measuring disease severity or in developing control measures.

BEET WESTERN YELLOWS VIRUS ISOLATED FROM POTATOES WITH THE LEAF ROLL SYNDROME. James E. Duffus, USDA SEA-AR, U. S. Agricultural Research Station, Salinas, CA 93915.

Beet western yellows virus (BWVY) has been isolated from potato stocks with typical potato leaf roll (PLR) symptoms. Isolates of BWVY differing in host reaction and serological characteristics have been found in individual potato plants indicating a complex etiology for the PLR syndrome. In addition to potato, and other solanaceous hosts, one isolate has been transmitted to and recovered from species in the Boraginaceae, Chenopodiaceae, Compositae, Cruciferae, Leguminosae, Malvaceae and the Portulacaceae. The BWVY isolates induce primary leaf roll symptoms in PLRV free and virus free potato cultivars, indicating that these isolates might easily be confused with "typical" PLRV. Preliminary serological data indicate several serotypes of BWVY in potato that differ from each other and from PLRV in serological reactions. This evidence suggests that serological testing for PLRV occurrence would probably give misleading information. The broad host range of these BWVY isolates raises questions about the re-infection of virus free potato stocks and the origins of PLRV.

THE DISCOVERY AND CHARACTERIZATION OF A POTATO YELLOW DWARF VIRUS ISOLATE OCCURRING NATURALLY IN CALIFORNIA. B. W. Falk and L. G. Weathers, Department of Plant Pathology, University of California, Riverside, CA 92521

A severe disease of periwinkle (*Vinca rosea*) was observed at various locations in California. External symptoms consisted of a yellow mosaic followed by a general yellowing and dwarfing. Electron microscopic studies of infected plants revealed virus-like particles typical of plant rhabdoviruses. The virus was mechanically transmitted by rubbing to *Nicotiana debneyi*, *N. rustica*, *N. cleavelandii* and *N. cleavelandii* X *N. glutinosa*. In agar diffusion tests this virus reacted with antiserum to the SYDV isolate of potato yellow dwarf virus (PYDV) (kindly provided by Dr. Hei-ti Hsu). Spurs formed between California PYDV and SYDV when sonicated virions or soluble antigens from virus infected tissues were reacted with antiserum to either isolate in agar diffusion plates, suggesting a difference in the two isolates. Polyacrylamide gel electrophoresis of virion proteins showed no detectable differences between California PYDV and SYDV.

ULTRASTRUCTURAL AND METABOLIC ACTIVITY ASSOCIATED WITH INHIBITION OF SCLEROTIAL FORMATION BY PHENYLTHIOUREA IN *SCLEROTINIA SCLEROTIUM* AND *SCLEROTIUM ROLFSSII*. John K. Fellman, Duane Le Tourneau and David L. Stiers. Dept. of Bacteriology and Biochemistry, University of Idaho, Moscow, ID 83843.

In synthetic liquid culture, 1mM PTU (1-phenyl-2-thiourea) inhibits sclerotial formation in *S. sclerotiorum* and *S. rolfssii* while permitting continued mycelial growth. Ultrastructural studies on both organisms grown in the presence of the inhibitor indicate that an alteration of membrane systems is a primary effect. In *S. rolfssii*, PTU stimulated formation of intracytoplasmic vesicular structures. Compared to controls, micrographs of PTU-treated *S. sclerotiorum* hyphae showed increased cyto-

plasmic disorganization manifested by the accumulation of lipid material. Metabolic studies conducted with labelled substrates in the presence and absence of PTU reinforced the ultrastructural data. Increased oxygen consumption was observed in PTU-treated *S. sclerotiorum*. Conductivity measurements showed little change in membrane permeability upon PTU treatment of either organism.

CROP LOSS IN SUGARBEETS DUE TO LATE SEASON OUTBREAKS OF POWDERY MILDEW IN WYOMING. John A. Fernandez, Division of Plant Science, University of Wyoming, Laramie, WY 82071.

The effect of 1 triadimefon and 3 sulfur treatment regimes on sugarbeet powdery mildew was studied in a commercial sugarbeet field near Torrington, Wyoming, in 1979. Powdery mildew developed in mid-August and disease severity remained at moderate levels (<70% mature leaf area diseased) in nontreated controls until harvest (early October). Although some chemical applications substantially reduced disease severity, none significantly increased yields over nontreated controls. The economic desirability of late season control of sugarbeet powdery mildew is discussed.

SEASONAL ACQUISITION OF X-DISEASE AGENT (CHERRY BUCKSKIN) FROM CHERRY BY THE LEAFHOPPER VECTOR, *COLLADONUS MONTANUS*. Karen Gonot and A. H. Purcell, Depts. of Plant Pathology and Entomology, University of California, Berkeley, CA. 94720.

Seasonal variation in leafhopper acquisition of the X-Disease agent from infected cherry was assessed by subsequent leafhopper transmission to celery. In 1978, groups of 600 non-infective *Colladonus montanus* were given 1-wk acquisition access feeding on X-Disease infected 'Bing' cherry (Mazzard rootstock) in a commercial orchard near Stockton, CA. Transmission rates were 0.0%, 4.6%, 4.8%, 25.0% and 19.8% beginning in April and terminating in September. The shortest median latent period occurred following acquisition feeding in August, reflecting a possible increase in titer in the diseased cherry trees during this period. Two-thousand non-infective *C. montanus* were given 1-wk acquisition access feeding periods on X-Disease infected peach trees. No transmission occurred. These results support previous field observations that peach does not serve as a major source for further spread of X-Disease, whereas cherry may provide inoculum for field spread.

THE INFLUENCE OF NH<sub>4</sub>CL WITH KCL ON ANTAGONISM BETWEEN FLOURESCENT PSEUDONONADS (FP) & GAEUAMANNOMYCES GRAMINIS VAR. TRITICI (GGT) ON THE WHEAT RHIZOPLANE. M. Halsey & R. Powelson, Dept. of Bot. & Plt. Path., Oregon State Univ., Corvallis, OR 97331.

Chloride fertilizers have been implicated in suppression of take-all of wheat, incited by GGT. In a growth chamber study, NH<sub>4</sub>Cl+KCl (.23+.12 g/115mm pot, resp.) was banded in the seed zone of infested soil (fertilized infested, FI soil), maintained at near field capacity. Controls were unfertilized infested (UI) & unfertilized unfested (UU) soils. Winter wheat was planted at 0, 2, & 4 wk after initial soil treatment. Root rot & rhizoplane FP populations were estimated 5 wk after planting. Root rot was less in FI soil than in UI soil and decreased in both soils with delay in planting. Fertilizer &/or GGT increased the number of FP isolated. The greatest number of FP was from roots grown in the FI soil at the 4th wk of planting. FP colonies were tested for *in vitro* antagonism of GGT. Antagonism was greatest in those isolates from roots grown in FI soil, as estimated by zones of GGT inhibition. Greater populations of FP with enhanced antagonism may be involved in NH<sub>4</sub>Cl+KCl suppression of take-all root rot.

THE ROLE OF THE DOUGLAS-FIR BEETLE IN ACCELERATING SAPWOOD DECAY. T.C. Harrington and C.G. Shaw, Dept. of Plant Pathology, Washington State Univ., Pullman 99164, and M.M. Furniss, US Forest Service, Moscow, Idaho 83843.

Hymenomyces often decay most of the sapwood of fire or insect-killed Douglas-fir trees before timber salvage can be completed. Accelerated decay associated with bark beetle galleries has been attributed to vectoring or provision of infection courts by the beetles. Hymenomyces isolations were attempted on semi-selective media from pre-, in-, and post-flight Douglas-fir beetles (DFB), *Dendroctonus pseudotsugae*. Eighty adult DFB reared from Douglas-fir bolts without exposure to the airflora (pre-flight) yielded no Hymenomyces. In contrast, 178 of 222 DFB collected in flight yielded Hymenomyces; *Fomitopsis pinicola* was isolated from 169, *Cryptoporus volvatus* from five, and other species from 31. Only 6 of 122

post-flight adults removed from egg-galleries yielded these fungi. Airborne basidiospores acquired during the beetle flight may be significant in accelerating sapwood decay.

DELIMITATION OF *TILLETIA CONTROVERSA* AND *T. CARIES* BASED ON DISCRIMINANT ANALYSIS OF TELIOSPORE MORPHOLOGY. J. A. Hoffmann, L. Haggas, and R. L. Hurst. USDA-SEA and Dept. of Applied Statistics and Computer Science, Utah State Univ., Logan, 84322.

Definitive identification of *Tilletia controversa* teliospores is of critical importance in assessing bunt contamination in grain exported to The People's Republic of China. Identification is sometimes difficult because of the morphological similarities of this species to other reticulate-spored *Tilletia* spp. Morphological characteristics of *T. controversa* and *T. caries* teliospores were quantified to determine the best criteria for species separation. In general, measurements were larger and exhibited greater variability in *T. controversa* than in *T. caries*. Computed areas of species overlap under normal distribution curves based on single criteria indicated a classification error of 21% to 75%. Discriminant analysis utilizing several criteria provided better species separation than any single criterion. Several linear models were derived that reduced the probability of misclassification to about 10%.

COMMON ROOT ROT OF BARLEY IN UTAH. Rastri Dey Kidambi and N.K. Van Aifen, Department of Biology, UMC 45, Utah State University, Logan, UT 84322

Surveys of barley fields in Utah indicate root rot caused by *Helminthosporium sativum* is a serious problem. A time course study of disease initiation, development and progress was made throughout the growing season. Disease initiation began between 25-30 days after planting and reached maximum levels at ca. 60 days. Soil inoculum levels were determined by the flotation viability method and the pathogen was found to be present universally although variable in population level. Disease index ratings were made on 20 different varieties (8 commercial and 12 breeding) at 6 locations. Yield loss determinations were made on the basis of dry weight of kernels. Significant reductions in dry weight of kernels (mean gm/kernel) were found to be correlated with disease index. The effects of Baymeb, Dyrene, Topsin M, CGA 64251 on control of the disease were examined.

LETTUCE BIG VEIN DEFIES RIDOMIL®. Demetrios G. Kontaxis and D. S. Teakle, Univ. of California, Coop. Ext., 960 East St., Pittsburg, CA. 94565, and Univ. of Queensland, Australia, resp.

Ridomil® 5G, N-(2,6-Dimethylphenyl)-N-(Methoxyacetyl)-alanine methyl ester, (0.98 kg/ha) was spread on 15 m-long lettuce beds and incorporated 2 cm into the soil before the first irrigation, in Imperial Valley, California during Oct. 1978. The treatments were randomized and replicated six times in 14 fields. All plots were sprinkler- or furrow-irrigated and received commercial cultural practices. An average of 44 percent of the plant population in both treated and non-treated plots developed big vein symptoms. The chemical was not phytotoxic. Zoospores of *Olpidium brassicae*, the vector of big vein disease, in 0.05 M glycine solution were mixed with Ridomil® 5W to 25 ppm (w/v) a.i. and a pot of Monterey lettuce seedlings was drenched with the suspension. Another similar pot was drenched with the zoospore suspension only and served as control. Big vein symptoms appeared in both treated and non-treated pots. *Olpidium* zoospores remained mobile in a 25 ppm a.i. Ridomil® solution for at least 20 min at 20°C temperature.

GROWTH RESPONSES OF CORN AND APPLE TO VESICULAR-ARBUSCULAR MYCORRHIZAE, PHOSPHORUS AND ARSENIC. H. J. Larsen, R. P. Covey, and B. L. Koch. Tree Fruit Research Center, 1100 N. Western Ave., Wenatchee, WA 98801.

Inoculation with *Glomus mosseae* alone or in combination with *G. microcarpus* increased growth of corn and apple in soil with a high P fixing capacity, but *microcarpus* by itself had no effect on growth. Corn inoculated with *mosseae* alone or in combination with *microcarpus* had growth comparable to that of uninoculated or *microcarpus*-inoculated plants that were given 100 ppm additional P. Apple with no additional P and inoculated with *mosseae* alone or in combination with *microcarpus* had 388% and 478% more growth, respectively, than uninoculated or *microcarpus*-inoculated trees given 400 ppm additional P. Addition of As decreased corn growth regardless of inoculation treatment, but growth decreases were smaller for *mosseae*- and combination-inoculated plants. Addition of up to 400 ppm As to this soil had no effect on apple growth regardless of inoculation

treatment. In a second experiment using this soil, growth response by uninoculated apple occurred only after addition of 600 ppm P.

DETECTION OF ILAR VIRUSES (SUBGROUP B) USING THE ELISA METHOD. J.P. McMorran and H.R. Cameron, Oregon State University, Corvallis, Oregon, 97331.

Fifteen strains of subgroup B ILAR viruses were tested by the enzyme-linked immunosorbent assay (ELISA) against eight subgroup B antisera. Three virus serogroups were detected: (1) Rose Mosaic, Apple Mosaic, and Hop A, (2) Almond Calico, Cherry Rugose, Danish Plum Line Pattern, and Prunus Necrotic Ringspot, and (3) Prune Dwarf. Although other workers have observed weak Ouchterlony reactions between groups 1 & 2, such heterologous combinations produced negative ELISA results. Homologous combinations produced positive ELISA results at plant sap dilution as high as 1:1000 - 1:2000. All 15 strains could be detected in a single assay by combinations of the most sensitive antisera from each of the three groups. The ability to detect these ILAR strains by ELISA declined as plant tissues matured in late summer, causing some "false negative" results (failure to detect infected trees).

PERSISTENCE OF THE TOXIC EFFECTS OF SMOKE. J.D. Mihail and J.R. Parmeter Jr., Dept. of Plant Pathology, University of California, Berkeley, CA. 94720.

Persistence of the toxic effects of cereal straw smoke on germination of bean rust (*Uromyces appendiculatus*) uredospores was investigated. A suspension of spores was sprayed on glass microscope slides which had been exposed to 0-10 minutes of smoke 0-8 days prior to the test. Germination of spores was inhibited for at least 8 days. Persistence of the protective effects of smoke against infection by bean rust and snapdragon rust (*Puccinia antirrhini*) was investigated during an 8 day period after exposure of plants to smoke. Suspensions of bean rust or snapdragon rust uredospores were sprayed on bean or snapdragon plants exposed to 0-4 or 5 minutes of smoke respectively. Compared with unsmoked controls, infection was significantly reduced for 4-8 days after exposure to smoke. At low fuel loads (250g/5 min., 500g/5 min.) and shorter exposures protective effects lasted only 4 days, while at higher fuel loads protective effects often lasted 8 days.

RELATIONSHIP OF VARIABLE INFECTION TYPE TO SLOW LEAF RUSTING. R. C. Miller and R. F. Line. Washington State University, Pullman, WA 99164.

Sixty-two winter wheat cultivars, which appeared susceptible but had moderate to low percentages of leaf rust (caused by *Puccinia recondita*) in field plots for five years, were compared with five very susceptible cultivars in the greenhouse. Seedlings, midtillering plants, and flag leaves were inoculated with uredospores. Infection types based on size of pustules and lesions were determined on the first seedling leaf 12, 14, and 16 days after inoculation and on later leaves after the pustules had developed to maximum size. Pustules on two cultivars were less than 0.5mm long, indicating a high degree of hypersensitive resistance. A range in size of pustules and lesions occurred on 47 cultivars at one or more growth stages, but was most evident on the flag leaves. Large pustules developed on the remaining 13 cultivars. Of the 47 cultivars with a range in infection types, 37 had a common ancestor, Gros Bleu (PI 340700). This suggests that these cultivars may also have a common mechanism of resistance.

ANTIFUNGAL ACTIVITY OF A FLUORESCENT PIGMENT PRODUCED BY FLUORESCENT PSEUDOMONADS. I. J. Misaghi, R. G. Grogan, L. C. Spearman, and L. J. Stowell. 1st, 3rd, and 4th authors, Plant Pathology Dept., Univ. of Arizona, Tucson 85721, 2nd author, Plant Pathology Dept., Univ. of California, Davis, CA 95616.

We have found that a fluorescent pigment, produced by fluorescent pseudomonads, inhibits the growth of a number of pathogenic fungi by chelating iron from the media. The sensitive fungi include *Geotrichum candidum*, *Rhizoctonia solani*, *Sclerotinia sclerotiorum*, *Phymatotrichum omnivorum* and *Phytophthora megasperma*. A direct correlation was established between concentration of the partially purified pigment in the media and the level of inhibition. We are currently attempting to establish whether or not the pigment is produced, under certain conditions in the rhizosphere, in sufficient quantities to interfere with the growth and development of soil-borne pathogens. So far as we know this is the first report of the antifungal activity of the fluorescent pigment.

EFFECT OF APPLE CULTIVAR ON VENTURIA INAEQUALIS ASCOSPORE EMISSION, AND EFFICACY OF AUTUMN UREA IN REDUCING PERITHECIAL INOCULUM IN CALIFORNIA. W. J. Moller and L. C. Hendricks (University of California, Davis, CA 95616).

Six apple cultivars growing in the interior region of California were compared for spring ascospore productivity from infected leaves following an unexpected epidemic in 1978 when most cultivars became severely infected. There have been no previous studies of the ascospore emission period in this region. There were distinct differences between cultivars in spring ascospore productivity; the period of emission only lasted 4-5 wk and was virtually complete before any of the cultivars reached full bloom. In late October, heavily infected trees were hand-sprayed with either 5% or 6% urea plus zinc sulfate. An equal number of diseased leaves were then collected from each treated tree, weighed, and stored beneath the tree under nylon mesh. The same leaves were retrieved again 5 mo later, weighed, then tested for ascospore emission. Leaf weight was not significantly different between treatments, however, the urea plus zinc spray reduced ascospore productivity by approximately 70%.

NONINFECTIOUS HAIRY ROOT OF APPLE SEEDLINGS. L.W. Moore and M.A. Aichle, Department of Bot. and Plant Path., Ore. St. Univ., Corvallis, OR 97331; 2015 S. 1st St., Yakima, WA 98903.

Apple seedlings produced in central Washington often have prolific root development similar to published reports of trees with hairy root disease (*Agrobacterium rhizogenes*). Such seedlings are culled and destroyed. Although *Agrobacteria* were isolated readily from the roots of these seedlings from 1975--78, none of the bacterial strains (over 600) were pathogenic in repeated inoculations of tomato seedlings and carrot slices. In contrast, *A. rhizogenes* A4 caused prolific root development on carrot slices, but not on tomato plants. Because host specificity might explain failure of the 600 strains to infect carrot or tomato tissues, 175 selected strains were each inoculated to wounded apple and sugar beet (a reported host for *A. rhizogenes*) seedlings. After 4 months, none of the apple or sugar beet seedlings had hairy root symptoms, except the apple seedlings inoculated with *A. rhizogenes* 15834. We conclude that the root proliferation on apple seedlings in Washington corresponds to Siegler's description of "noninfectious hairy root" (Am. Nurseryman LXXI:7).

EFFECT OF CROWN GALL ON BOYSENBERRY PRODUCTION. L.W. Moore and L.W. Martin, Dept. of Bot. and Plant Path., OSU, Corvallis, OR 97331; N. Willamette Exp. Sta., Rt. 2, Aurora, OR 97002.

The effect of crown gall on vigor and yield of boysenberries was tested in Western Oregon from 1974-79. Rooted cuttings from virus-free plants were divided randomly into three groups. Plants were either wounded and inoculated with *Agrobacterium tumefaciens* (Group A) or uninoculated (Group B), or inoculated with the biocontrol agent *A. radiobacter* K84 (Group C), and then planted in a Latin Square design. Mean number of fruiting canes per plant in 1976 and 1978 was: 8, 11 and 11, respectively, and 25, 58 and 59, respectively. Mean yield in tons/hectare for groups A, B and C in 1977 and 1978 was: 3.5, 9.4 and 13.6, respectively, and 2.7, 4.9 and 6.9, respectively. The plants were dug and examined for galls in 1979. Plants from Group C were the most vigorous and least infected (15%). Thirty-three percent of the plants from Group B were galled and 10% were dead, whereas 91% of the plants from Group A were galled and 45% dead. These data show that crown gall can limit boysenberry production and that treatment with K84 was beneficial.

SOME ANATOMICAL CHARACTERISTICS OF WHEAT CULMS ASSOCIATED WITH RESISTANCE TO *PSEUDOCERCOSPORELLA HERPOTRICHOIDES*. T.D. Murray and G.W. Bruehl, Department of Plant Pathology, Washington State University, Pullman, Washington 99164.

Disease indices were determined for 10 winter wheats with varying degrees of resistance to *P. herpotrichoides*, the causal agent of strawbreaker footrot. Samples for anatomical study were collected prior to boot stage, at the watery-ripe stage, and at full maturity. Anatomical characteristics of the lowest elongated internode were measured. Negative correlations between hypodermal width and number of hypodermal cell layers, versus disease indices were significant ( $r=-0.88$  and  $r=-0.87$ , respectively). Correlations between epidermal cell wall thickness and stem diameter, versus disease indices were not significant ( $r=-0.47$  and  $r=0.19$ , respectively). Maximum anatomical development was completed before the watery-ripe stage. Cappelle-Desprez and VPM-1, the most resistant wheats, developed wider hypodermal layers (111.4  $\mu$ m and 111.1  $\mu$ m, respectively), and thicker, more heavily-lignified cell walls. Sprague, the most susceptible wheat, had the thinnest hypodermis (47.2  $\mu$ m).

AN ENZYME-LINKED IMMUNOSORBENT ASSAY (ELISA) FOR DETECTION OF PIERCE'S DISEASE BACTERIA IN PLANT TISSUES. Nome, S. F. & D. Docampo (U. Nacional de Cordoba, Argentina), A. C. Goheen, (SEA/AR), B. C. Raju & G. Nyland (Univ. of Calif., Davis, CA 95616).

Pierce's disease bacteria (PDB) were harvested from pure cultures by centrifugation, and washed several times with phosphate buffer saline (PBS). Antisera were prepared against these, having a reciprocal titer of 4096. The immunoglobulins of the antisera were purified, conjugated, and used in ELISA for detecting bacteria in host plant tissues. The ELISA was useful for detecting  $10^4$  PDB in 1 ml of PBS. Petioles, leaf veins, or shoots (1.0-2.5 g) from healthy and affected grape, almond, and weedy host plants were ground with extraction buffer (EB). The homogenates were filtered through cheesecloth and centrifuged at 25,000 g for 15 min. The pellets were resuspended in EB, sonicated, and used as antigens in ELISA tests. ELISA readily detected the bacterium in homogenates from plants that were infected but tests were negative with healthy plants.

AN EPIDEMIC OF PEACH YELLOW LEAF ROLL (X-DISEASE) IN NORTHERN CALIFORNIA: ASSOCIATION WITH PEAR ORCHARDS. G. Nyland, B. C. Raju, Dept. of Plant Pathology, Univ. of Calif., Davis, CA 95616; and A. H. Purcell, Dept. of Entomological Sciences, Univ. of Calif., Berkeley, CA 94720.

A peach yellow leaf roll (PYLR) epidemic of unprecedented intensity was present in Yuba, Sutter, and Butte counties in 1979. A sharp increase in the number of infected peach trees was apparent in 1978. All commercial cling peach orchards in the "Peach Bowl" area centered around Marysville and Yuba City, CA were mapped in 1979 by the California Cling Peach Advisory Board. No cultivar resistance to PYLR was evident. Trees in orchards less than 4 years old did not have PYLR symptoms, nor did comparable age replants even in orchards where spread was intensive (>10%). Over 35,000 trees were diagnosed as having PYLR. With rare exceptions, all heavily infected orchards were near commercial pear orchards. Gradients of disease spread suggest considerable primary spread of PYLR from pear orchards.

MAIZE DWARF MOSAIC VIRUS IN HAWAII. Jeri J. Ooka and Mamoru Ishii, Department of Plant Pathology, Univ. of Hawaii, Honolulu, Hawaii 96822.

A virus disease of maize was epidemic on Molokai, Hawaii, early in 1980. Although infection was near 100% in all fields examined, aphids were not observed in the fields. Plants infected ranged in development from the 5-6 leaf stage to milk stage. In older plants a mild mosaic with some stunting are generally seen. Mosaic and stunting were more severe on younger plants and seedling death was frequent. Sap of infected plants was expressed in 0.05 M pH 7.2 borate buffer and tested serologically with antisera of Maize Dwarf Mosaic Virus (MDMV) strains A and B. After 18 to 24 hours incubation at 25+3 C all maize samples produced strong precipitin bands with MDMV-B antiserum. No reaction occurred with MDMV-A antiserum. Millet and sorghum exhibiting mosaic symptoms also only reacted with MDMV-B antiserum. Electron microscope examination of leaf dip preparations of infected maize showed flexuous rods of 750 nm.

COMBINATION, SINGLE, AND ALTERNATE APPLICATIONS OF FUNGICIDES FOR CONTROL OF *SEPTORIA APICOLA* ON CELERY. A. O. Paulus, H. Otto, and J. Nelson, Plant Pathology Department, University of California, Riverside, CA 92521.

*Septoria* leafspot of celery (*Septoria apicola*) seriously afflicts celery in California during heavy rainfall seasons. Results of three years of trials show that Ciba Geigy 64251 or 64250; benomyl + either chlorothalonil or anilazine; or alternate sprays of benomyl-chlorothalonil-benomyl provided excellent control of *Septoria* leafspot. Chlorothalonil or anilazine used alone gave intermediate control. Combination treatments of chlorothalonil + anilazine or benomyl + mancozeb gave fair control. Poor control was obtained with copper salts of fatty and rosin acids (CitCop) or dichlone (Quintar 5F) fungicide applications.

TRANSMISSION BY INJECTED LEAFHOPPERS OF SPIROPLASMA ISOLATED FROM PLANTS AFFECTED BY ASTER YELLOWS. A. H. Purcell, B. C. Raju, and G. Nyland, Department of Entomological Sciences, University of California, Berkeley 94720 and Department of Plant Pathology, University of California, Davis 95616.

Spiroplasma isolated from surface-sterilized *Plantago major* and aster plants infected with greenhouse-maintained strains of aster yellows (AY) were subcultured 3 to 5 times in liquid media, pelleted, resuspended in 10% sucrose ( $> 10^9$  dilution of original inoculum), and injected into *Macrosteles fascifrons*. Three isolates were transmitted to test plants, causing typical AY symptoms; 36 isolates were not transmitted; 9 isolates, including 3 from AY-infective *M. fascifrons*, produced syndromes that were atypical of aster yellows. All such "mild" strains had no phyllody or proliferation. Spiroplasma were isolated readily from such plants but less frequently from plants with typical AY symptoms. Noninfective *M. fascifrons* transmitted typical strains but not atypical strains by feeding acquisition.

TRANSMISSION BY INJECTED LEAFHOPPERS OF SPIROPLASMA ISOLATED FROM PLANTS WITH X-DISEASE. A. H. Purcell, B. C. Raju and G. Nyland. Department of Entomological Sciences, University of Calif., Berkeley 94720 and Department of Plant Pathology, University of Calif., Davis 95616.

Spiroplasmas originally isolated from celery and peach with the peach yellow leaf roll strain of X-disease (XD), were injected with microneedles into *Colladonus montanus* leafhoppers. Three isolates that had been subcultured 3 to 5 times before injection (representing greater than  $10^9$  dilution of original inoculum) produced typical XD symptoms in celery beginning 4 to 5 weeks after exposure to injected leafhoppers. Two isolates were also transmitted by injected *Scaphytopius nitridus* leafhoppers and produced atypical symptoms of XD after a 8 to 10 week incubation period. Serologically indistinguishable spiroplasmas were reisolated from experimentally-infected plants. Plants with "mild" (atypical) strains were not killed by XD. "Typical" strains killed plants in 8 to 12 weeks. Twenty-four spiroplasma isolates were not transmitted.

SEROLOGICAL RELATIONSHIPS OF RICKETTSIA LIKE BACTERIA IN DISEASED PLANTS. B. C. Raju, G. Nyland & A. C. Goheen (SEA/AR, & Univ. Calif., Davis, CA 95616); S. F. Nome, (U. Nacional de Cordoba, Argentina); J. W. Wells & D. J. Weaver, (SEA/AR, Byron, GA 31008), & R. F. Lee (Univ. Florida, Lake Alfred, FL 33850).

Pierce's disease bacteria (PDB) were cultured *in vitro* from grape from California, Florida, Texas, Costa Rica, and Mexico and from almond and alfalfa from California. Antisera against 7 representative isolates from grape, almond and alfalfa were produced in rabbits. An antiserum against phony peach (PP) was obtained from W. J. French. Agglutination, ring precipitation, ELISA, and agar double-diffusion tests were used to compare serological relationships of the PDB with morphologically similar, xylem-limited bacteria associated with PP, plum leaf scald (PLS), and young tree decline of citrus (YTD), using bacteria from root extracts as antigens. Serologically the PDB and the rickettsialike bacteria (RLB) associated with PP, PLS, and YTD are closely related. Antisera used in these tests were specific only for xylem-limited RLB.

EFFECT OF PLANT NUTRIENTS ON TAKE-ALL OF WHEAT. E. M. Reis, R. J. Cook, and B. L. McNeal. USDA, SEA, AR, 367 Johnson Hall, Washington State University, Pullman, WA 99164.

A deficiency [i.e. 1/2 the amount in normal (1 H) Hoagland's] of phosphorus, potassium, magnesium, copper, iron, manganese, or zinc in wheat seedlings growing in silica-sand, and with all other nutrients at 1 H, increased incidence and severity of take-all caused by *Gaeumannomyces graminis*. Lowering the amount of nitrogen to 1/2 H had no significant effect on take-all. Doubling (2 H) the amount of any one nutrient, or of nitrogen as nitrate, and with all other nutrients at 1 H, resulted in less take-all. Calcium and sulfur, at either 1/2 or 2 H, had no effect on take-all. Nutrients that reduced take-all also promoted root development on the wheat. Copper and zinc decreased take-all as foliar applications, confirming that the effect was through plant nutrition. Take-all was reduced in one field trial by zinc or copper, and in another by zinc or zinc + phosphorus; in the latter trial, disease control was significant at two lower but not at two higher levels of disease intensity.

INCREASED TAKE-ALL WITH LIMING RESULTS FROM INCREASED pH AND NOT FROM INCREASED CALCIUM OR MAGNESIUM. E. M. Reis, R. J. Cook, and B. L. McNeal. USDA, SEA, AR, 367 Johnson Hall, Washington State University, Pullman, WA 99164.

Wheat plants were grown with inoculum of *Gaeumannomyces graminis* var. *tritici* in silica sand at five pH values (4.5, 5.5, 6.5, 7.5, and 8.5) in all combinations with three levels of calcium (200, 400, and 600 ppm) or magnesium (48, 96, and 144 ppm) by modifying standard Hoagland's solution to simulate, respectively, the effects of calcitic and dolomitic limestones. Take-all increased with increasing pH but not with increasing calcium. Increasing pH in combination with magnesium did not increase take-all as much as with calcium, probably because magnesium is among the plant nutrients helpful in control of take-all. Plant uptake of copper, iron, manganese, and zinc, and also the rate of new root formation, were significantly less at pH 7.5 and 8.5 compared with lower pH values. Apparently the increased pH produced deficiencies of certain micro-nutrients in the host, thereby favoring take-all. The pH range most favorable to new root formation by the host was 5.5 to 6.5, whereas greatest disease severity was at pH 7.5.

PREDICTING CROP LOSS FROM DISEASE SEVERITY. Mary Ann Sall, Department of Plant Pathology, Univ. of Calif., Davis, CA 95616.

Models for relating crop losses to disease severity have had moderate success in predicting losses in grain and potatoes. These models have been of three main types: single point, multipoint, and integrated disease progress. The former two have correlative structures which relate crop loss to one or more measurements of disease severity. The latter is an analytical model which is based on the assumption that yield loss is proportional to the amount and duration of disease as described by the area under the disease progress curve. Progress in this area has been limited because of the tedious nature of the experimentation and the large quantities of data required to formulate such models. Built into each of the currently used disease loss models is the assumption that a given level of disease produces or is correlated with a certain level of yield loss. Yet many factors may invalidate this assumption. Consequently these models are of limited predictive ability. Realistic models which reflect the mechanisms of yield loss are needed.

A NEW RACE OF FUSARIUM OXYSPORUM F. SP. APII IN CALIFORNIA. R. W. Schneider and J. L. Norelli, Dept. of Plant Pathology, University of California, Berkeley, California 94720.

This study determined that a new race of the pathogen is responsible for a recurrence of Fusarium yellows of celery in California. Isolates were obtained from France, where susceptible cultivars predominate, from the American Type Culture Collection (ATCC), which were collected before the recent development of Fusarium yellows, and from several diseased and healthy celery plants in California. The cultivars Golden Detroit and Fordhook, susceptible and resistant, respectively, to Fusarium yellows in a test conducted in 1933, and Tall Utah 52-70 were used as differential hosts. Golden Detroit was highly susceptible to all isolates. Fordhook was highly resistant to one of two ATCC isolates, highly susceptible to three French isolates, and moderately resistant to recent California isolates. Tall Utah 52-70 was highly resistant to the ATCC and French isolates but highly susceptible to most recent California isolates. Thus, race 1 attacks Golden Detroit and Fordhook but not Tall Utah 52-70, while the new race 2 attacks all three varieties.

IDENTIFICATION OF BARLEY YELLOW DWARF VIRUS STRAINS PRESENT IN EASTERN WASHINGTON. L. J. Seybert and S. D. Wyatt. Department of Plant Pathology, Washington State University. Pullman, Washington, 99164.

Aphids were collected from wheat, barley, oats and volunteer grasses in Eastern Washington in 1977 and 1978. Of the 1977 collection, 42% were viruliferous, and of the 1978 collections, 54% were viruliferous. *Rhopalosiphum padi*, *R. maidis*, *Macrosiphum avenae* and *Schizaphis graminum* were tested for their ability to vector barley yellow dwarf virus (BYDV). Serial transmission tests were used to distinguish between isolates that could be transmitted non-specifically by more than one vector species and a mixture of several vector-specific strains. Transmission patterns suggest that vector-specific strains of BYDV were not present in 1977 and 1978. Serial transmission tests and a vector efficiency study indicate that the species can be ranked in descending order of efficiency as follows: *R. padi*, *S. graminum*, *M. avenae*, and *R. maidis*.

SENSITIVITY OF *MONILINIA LAXA* TO CARBENDAZIM AND TO POTENTIAL FUNGICIDES FOR ITS CONTROL. E. Shabi and Talma Katan, Div. Plant Pathology, Agric. Res. Organization, The Volcani Center, Bet Dagan, Israel.



Eighty *Monilinia laxa* isolates were obtained from almond, apricot, peach and plum orchards in Israel where benomyl and triforine are recommended for *Monilinia* disease control. Conidia of the tested isolates were plated on agar media supplemented with these and other potential fungicides for sensitivity testing. All isolates were sensitive to carbendazim and triforine and to the experimental fungicides biloxazol, CGA 64251, fenarimol, imazalil, iprodione, nuarimol, phenapronil, triadimefon and vinclozolin. Large numbers of conidia from an isolate never exposed to benomyl or iprodione were used to compare the selection pressure of these two fungicides for resistance. No carbendazim-resistant mutants were detected from ca  $10^8$  conidia. At  $15 \mu\text{g/ml}$  spontaneous iprodione-resistant mutants were detected at  $10^{-5}$  frequency. Single conidial isolates resistant to iprodione produced sporulating colonies at up to  $150 \mu\text{g/ml}$  vinclozolin or procymidone.

THE NEED FOR DISEASE AND CROP LOSS INFORMATION. S. H. Smith, Dept. of Plant Pathology, The Pennsylvania State University, University Park 16802.

Reliable estimates of crop losses caused by diseases are a necessary prerequisite to the development of rational plant protection strategies and efficient allocation of resources. Some progress has been made in quantifying losses due to individual diseases. To determine crop losses, an understanding is needed of the interaction of the host with its environment and multiple loss factors such as diseases, insects, weeds and nematodes. Crop loss estimates derived by the simple addition of the effects of individual loss factors without recognition of their interactions with each other, the host and the environment are of questionable value. There is a need to understand the interaction of crop loss factors and to develop reliable methodology for their assessment and quantification. There is also a need to develop an understanding of the confidence limits associated with crop loss methodology and the data generated.

AGROCIIN RESISTANCE READILY DEVELOPS IN VIRULENT *AGROBACTERIUM TUMEFACIENS* WITHOUT LOSS OF pTi PLASMID. S. Soule & C. I. Kado Univ. of California, Davis, CA 95616.

Exposure to agrocin 84 yields many *A. tumefaciens* resistant mutants (>80% of the population) that still retain virulence. Some mutants are semi-sensitive requiring higher doses of agrocin to show sensitivity. Both mutant types were virulent. Sensitive strains readily absorbed [ $^{32}\text{P}$ ]-agrocin whereas resistant strains did it feebly. pTi transferred to sensitive strains acquired agrocin resistance and lacked agrocin uptake. pTi transferred from agrocin-sensitive strains conferred sensitivity and high agrocin uptake ability. No differences in pTi restriction fragments were observed between wild type and agrocin resistant mutants. Agrocin sensitive revertants were obtained from resistant mutants, indicating point or insertional but not deletion mutations have resulted. Thus pTi genes are essential for agrocin uptake and uptake defective mutants retain virulence. This clearly complicates the concept of biological control using *A. radiobacter* 84.

OXALIC ACID IS PRODUCED BY *SCLEROTIUM CEPIVORUM* DURING THE INFECTION OF ONIONS. H. E. Stone and V. N. Armentrout, California State Polytechnic University, Pomona, California 91768

*Sclerotium cepivorum* Berk. produces oxalic acid in culture and in infected onion tissue. Oxalic acid was precipitated from culture filtrates or acid extracts of onions by calcium supplied as calcium chloride-sodium acetate buffer at pH 4.5. Precipitate was shown to be oxalic acid by paper chromatography. Quantification was by titration with  $\text{KMnO}_4$ . The fungus grown on sodium polypectate medium for 16 days produced 2.7 mg oxalic acid per ml of culture filtrate. Onion sets sampled at 11, 16, and 20 days after inoculation were found to have 4.2, 9.2, and 11.1 mg oxalic acid per gram dry onion respectively. Heat killed onions contained 20.3 mg oxalic acid per gram dry onion 16 days after inoculation. Oxalic acid was not detected in healthy onion tissue.

EVALUATION OF CORKY BARK AND STEM PITTING SYMPTOMS IN 18 GRAPE ROOTSTOCKS IN AGUASCALIENTES, MEXICO. D. Téliz P. Valle and A. C. Goheen. CIAN. Apdo. Postal 247, Torreón, Coah. México, and USDA, SEA/AR, Department of Plant Pathology, Univ. of California, Davis, CA. 95616.

Eighteen virus-free rootstocks obtained from the foundation vineyard of the University of California at Davis were planted

in 1968, at the Pabellon experimental station in Pabellon Aguascalientes, México. Several of the rootstocks are showing symptoms of corky bark (CB) and stem pitting (SP) diseases. The eighteen plants of each rootstock were individually examined in february 1980, using a rating system on a scale of 0 to 10 where 0= healthy, 5= SP symptoms on the trunk base or CB symptoms in one to three canes, 10= SP symptoms on the trunk base and on the arms or CB symptoms on 4 or more canes. LN-33 had a disease rating of 10.0 for SP and 8.89 for CB, 1613-C had 5.67 and 1.0 respectively, St. George had 2.33 and 0, Pinot St. George, Harmony, 1616-C and Ganzin 1 had a rating of less than 1.0 for both diseases. No symptoms were observed in 1202-C, S04, Salt Creek, 3309-C, 420-A, 33-EM, 110-R, 5-A, 99-R

SELECTIVE SUPPRESSION OF VERTICILLIUM DAHLIAE STRAINS IN CINNAMOMUM CAMPHORA BY STEM INJECTIONS WITH 2-(2-DIETHOXY) ETHYL-BENZIMIDAZOLE CARBAMATE (DEBC) AND OXYCARBOXIN. W. D. Thomas, Jr. and Gerald F. McLaren, P.O. Box 745, Lafayette, CA 94549.

Field trials between 1973 and 1980 to suppress *Verticillium dahliae* in *Cinnamomum camphora* with 2-(2-diethoxy) ethyl-2-benzimidazole carbamate (DEBC) and oxycarboxin applied as stem injections by the Mauget method selectively suppressed different strains of the pathogen. Two annual applications of DEBC at 7 mg ai/basal circumference inch effectively suppressed symptom expression over 3 years, eliminating a strain of the pathogen which produced sparse microsclerotia; recurrence of symptoms the fourth year yielded a strain producing abundant microsclerotia. Applications of oxycarboxin at 14 mg ai/basal circumference inch suppressed this strain, which could not be reisolated from trees 4 months after treatment. Recurrence of symptoms after 5 years was associated with the first strain. Complete remission has been evident since. The heavy microsclerotial strain apparently was subdominant and resistant to DEBC. Reinfection the fifth year was attributed to re-entry from soil by the DEBC-susceptible strain.

ROLE OF BACTERIA IN CROWN ROT OF ALFALFA IN UTAH. V.A. Turner and N.K. Van Alfen, Dept. of Biology, UMC 45, Utah State Univ., Logan, Ut. 84322

*Fusarium* spp. have been shown to be weak pathogens causing a slow decay of alfalfa crowns. However, large numbers of white gram negative bacteria and fluorescent Pseudomonads can be isolated from rotted crowns. Isolates of white bacteria from Utah alfalfa and similar isolates obtained from Montana State Univ. (shown to be pathogenic in sainfoin) were inoculated into 2 month old 'DuPuit' alfalfa crowns in the greenhouse. Plants were harvested 6 weeks later, split open, and disease development assessed. The crowns inoculated with bacteria exhibited heavy reddish-brown streaking emanating from the inoculation point and extending greater than 20mm into the taproot. Controls inoculated with water did not exhibit this streaking. Bacteria were reisolated in large numbers from inoculated crowns. Physiological and biochemical test results were identical for Utah and Montana isolates indicating that bacteria involved in sainfoin are also involved in alfalfa crown rot.

UV-INDUCED LOW VIRULENT, WHITE COLONIES FROM ENDOTHIA PARASITICA: THEIR RELATIONSHIP WITH TRANSMISSIBLE HYPOVIRULENCE. N.K. Van Alfen, K. Gillies, J.R. Simmons, and J.T. Bowman, Dept. of Biology, UMC 45, Utah State University, Logan, UT 84322

European type hypovirulent colonies of *Endothia parasitica* are white and sporulate poorly. Such cultures are either low in virulence or avirulent. Colonies of this description can be obtained in high frequency (1-5%) when conidia of virulent *E. parasitica* isolates are irradiated with UV light. It has been postulated that such colonies may be the result of induction of the hypovirulent factor which has otherwise been latent within the fungal cell. Results to date suggest that these UV-inducible colonies, while phenotypically similar to hypovirulent colonies, do not contain the transmissible hypovirulent factor since transmission of the white colony type is not detectable using auxotrophic mutants. Also, these UV-induced colonies contain no ds RNA. Transmissible hypovirulent colonies have always been found to contain ds RNA.

ICE NUCLEATION BY PSEUDOMONAS SYRINGAE ASSOCIATED WITH CANKER PRODUCTION IN PEACH. D. J. Weaver, USDA, SEA/AR, Kearneysville, WV 25430; and C. F. Gonzales and H. English, Department of Plant Pathology, University of California, Davis 95616

Five isolates of *Pseudomonas syringae* varying in syringomycin (SR) production and ice nucleation (IN) capability were compared

for their effect after inoculation into actively growing peach seedlings, dormant trees grown in 20-cm pots, and excised twigs from dormant field-grown trees. Dormant trees and twigs were kept at 15°C for 10 days after inoculation; some were then frozen at -10°C for 24 hr. Seedlings were maintained on a greenhouse bench at 23-28°C. Typical light tan bark cankers were induced on active and dormant tissue by isolate B3A from peach and isolate B15+ from almond; both were positive for SR production and IN. Isolate B15-, a SR- negative strain of B15+, was positive for IN and induced typical cankers in dormant twigs but had no effect on actively growing seedlings. Typical cankers were not induced by isolate HS 191 (SR-positive) from millet and its cured (SR-negative) form A0 111; both were negative for IN. Results suggest that IN by isolates of *P. syringae* may play an important role in the bacterial canker disease of peach.

COMPREHENSIVE EVALUATION OF VARIABLES AFFECTING PEA SEED YIELD. M. V. Wiese, R. K. Steinhorst, M. Heikkinen and M. Grube. Departments of Plant & Soil Sciences and Ag. Econ. & Applied Statistics, University of Idaho, Moscow, Idaho 83843.

Crop yield is an expression of the collective impact of numerous production variables. It may be possible, therefore, to evaluate crop performance in a systems context. In 1979, a project with this objective focused on dryland spring seed peas in the Palouse where 96 pea fields in a 5-county area were studied. In each field, more than 50 items of information were collected, many at biweekly intervals, to describe crop development, soil, pests, practices, weather and yield. The collected information was summarized for distribution to cooperators and used to identify yield constraints. Using multiple regression techniques, a subset of 12 variables (5 derived from principal component analyses) was identified that explained 82% of the variability in seed yields. Estimates of each variable's relative impact on yield were reflected by the contribution of each variable to an overall yield model and by the difference between each variable's measured and optimal values.

LOCALIZATION OF PATHOGENS CAUSING APRICOT JACKET ROT. C. E. Yarwood, Dept. of Plant Pathology, University of California, Berkeley, California 94720.

Apricot jacket rot or green rot in California is caused primarily by *Sclerotinia sclerotiorum* and/or *Botrytis cinerea* in seasons of much rain during the March bloom. On apricot *B. cinerea* causes a darker rot than *S. sclerotiorum*. Surveys for these organisms as well as for *Monilinia fructicola* and *M. laxa* from 1944 to 1980, were conducted by collecting healthy-appearing as well as diseased blossoms, and incubating them in petri dish moist chambers. Of 1856 blossoms collected in coastal areas (Berkeley, Oakland, Alvarado, Alviso, Stinson Beach, etc.) the numbers with *B. cinerea*, *Monilinia*, and *S. sclerotiorum* were 972, 117 and 25, respectively. Of 5600 blossoms from interior areas (Hollister, Brentwood, Livermore, Patterson, Manteca, etc.) the corresponding numbers were 2188, 352, and 1252. The important finding is the abundance of these fungi on healthy blossoms and in disease free seasons, and the greater proportion (22% vs. 1.3%) of *S. sclerotiorum* in the interior areas than in the coastal areas.

THE OCCURRENCE OF *THIELAVIOPSIS BASICOLA*. C. E. Yarwood, Dept. of Plant Pathology, Univ. of California, Berkeley, CA. 94720

*T. basicola* (syn. *Chalara elegans*) is of current interest as a root pathogen, as a cause of replant failure, as a stimulant of plant growth, as a carrier of virus, and as a host of amoeba. When field soil was applied to carrot root slices which were then incubated dry in petri dishes, *T. basicola* was usually the only fungus which developed. This "dry" method is fast and almost free of contamination. *T. basicola* also developed on cut surfaces of lemon, apple and pear fruits, sweet potato roots, Irish potato tubers, and celery petioles. It was abundant in the apparent absence of disease in many cultivated and a few virgin areas, but most collections were free of the fungus. Of some 206 genera of higher plants from which the soil was assayed, 139 were positive in at least one test. Genera with which the fungus was most frequently or most heavily associated in nature or in cultivation were: *Betula*, *Daucus*, *Geranium*, *Humulus*, *Hypochoeris*, *Malva*, *Phaseolus*, *Prunus*, and *Rhus*. The fungus was abundant in California, Arizona, British Columbia, Alberta, England, and Moscow, Russia.