Abstracts of the Fifty-Sixth Annual Meeting of the Pacific Division of The American Phytopathological Society

Host-virus relationships of pea seed-borne mosaic virus in aphid and mechanical inoculation tests. A. I. E. AAPOLA & J. E. KNESEK (Wash. State Univ., Irrig. Agr. Res. Ext. Center, Prosser). The host range of pea seed-borne mosaic virus (PSbMV) was determined by aphid and mechanical inoculation tests. Ninety-seven plant species belonging to 20 families were tested, and 42 were susceptible to PSbMV. The virus was transmitted to 36 species by *Myzus persicae* and to 31 by *Acyrthosiphon pisum*. Only 30 species became infected when mechanically inoculated with infectious crude juice or partially purified virus. PSbMV was readily transmitted to and recovered from *Pisum sativum, Chenopodium foetidrum, C. urbicum, Lathyrus odoratus, Lens culinaris*, and all 16 species of *Vicia* tested by aphid or mechanical inoculations. It was readily transmitted to *Chenopodium botrys* and *Petunia hybrida* only by aphids, and to four additional *Chenopodium* species only mechanically. In contrast to the above plant species, infectivity was rarely recovered from alfalfa, sugar beet, and other hosts either by aphids or mechanically. Symptoms were expressed only on highly susceptible legume and *Chenopodium* species. On the legumes, the most pronounced symptoms were moderate to severe leaf roll and stunting. Symptoms on some *Chenopodium* spp. consisted of chlorotic and necrotic local lesions on inoculated leaves, whereas on other species a chlorotic mottle developed only on new growth.

Association of resistances to three yellows type diseases of Phaseolus vulgaris. BARBARA BALLANTYNE (Dep. Agr., Rydalmere, N.S.W., Australia). The field reactions of over 100 lines of snapbeans, stringed, and dry beans to two diseases known only in Australia, summer death (SD) (leafhopper-transmitted) and clover stunt (CS) [aphid-transmitted clover (subterranean) stunt virus (CSSV)] were compared with their reported reactions to curly top (CT) occurring in the USA. Lines resistant to CT in the USA were resistant to SD and had the highest resistance to CS. Of the lines susceptible to CT, those also susceptible to SD showed least resistance to CS, and those resistant to SD showed intermediate resistance to CS. The resistance to SD in snapbean varieties bred for resistance to CT has rarely been overcome by field exposure to large numbers of infective vectors. However, resistance to CS in these varieties has been overcome in some seasons when large numbers of infective vectors have been present or growing conditions have been unfavorable.

Characterization of some yellows diseases in Australia. J. W. BOWYER (Univ. Calif., Riverside). Pathogens of legume little leaf, tomato big bud, and mild alfalfa witches'-broom diseases were distinguished by differential symptomatology and incubation periods in tomato (*Lycopersicon esculentum* 'Grosse Lisse') and common thornapple (*Datura stramonium*), under controlled light and temperature conditions in a growth chamber, at the Univ. of Queensland, Australia. No differences among mycoplasmalike bodies associated with the respective diseases could be detected by thin-section electron microscopy of host plant tissue. Little leaf and big bud agents were transmitted by the leafhopper *Orosius argentatus*, in which the respective latent periods of the agents were similar. Attempts to transmit the mild strain of the witches'-broom agent by this species were unsuccessful. Various plants (four genera of Leguminosae and two of Compositae) with yellows disease symptoms were collected from northern and southern Queensland, Australia. The pathogens were transmitted by *O. argentatus* to thornapple. From symptoms produced in this host, the various isolates were characterized as either of the original little leaf or big bud reference types. A severe strain of alfalfa witches'-broom pathogen was transmissible by *O. argentatus*, and caused symptoms in thornapple identical to those of little leaf disease.

Reciprocal exposure of beans and peas to root pathogens accumulated in the field on each crop species. D. W. BURKE & J. M. KRAFT (ARS, USDA, Irrig. Agr. Res. Ext. Center, Prosser, Wash.). Dry beans (*Phaseolus vulgaris*) and peas (*Pisum sativum*) were planted in both an old bean field and an old pea field where root pathogens had accumulated during 15 and 6 years of monoculture of the respective crops. They were also planted in a control field where neither crop had been grown. Prevalent pathogens of both crop species in both monocultured fields were *Pythium ultimum, Thielaviopsis basicola,* and *Rhizoctonia solani. Fusarium solani* f. sp. *phaseoli* was prevalent only in the bean field, and *F. solani* f. sp. *pisi* only in the pea field. The control field had no pathogen populations detectable on selective media. Root pruning and reduction in root weight by *Pythium ultimum* were evident in 2- and 6-week-old bean and pea plants from both infested fields. However, plant vigor and yields of dry beans and fresh peas were excellent in the fields previously monocultured to the opposite host and drastically reduced in their respective home fields. Evidently, the host-specific form of *F. solani* was the most essential member of the root rot complex on both beans and peas.

Effects of soil compaction and temperature on growth of bean plants in Fusarium-infested and disinfested field soil. D. W. BURKE & D. E. MILLER (ARS, USDA, Irrig. Agr. Res. Ext. Center, Prosser, Wash.). Red Mexican beans (*Phaseolus vulgaris*) were planted in loose soil in 5-cm diam × 15-cm plastic tubes. These tubes extended 5 cm into 10-cm diam × 25-cm plastic tubes that had been filled with sandy loam soil compacted to various known volume weights. The soil in the two tubes was the same, either infested or disinfested, or in combinations, where one tube contained soil infested by *Fusarium solani* f. sp. *phaseoli* and the other tube contained soil disinfested with methyl bromide. An interaction between Fusarium root rot and soil volume weight was demonstrated. One month after planting, bean roots had extensively penetrated disinfested soil compacted to volume weights of 1.2 to 1.5 g/cm^3. They also readily penetrated *Fusarium*-infested soil at soil volume weights of 1.2 to 1.3 g/cm^3. However, greater compaction usually severely restricted root growth in the infested soil. At temperatures of 21-26 C, the depressing interaction of soil compaction and *Fusarium* infestation on root growth was less than at 16-21 C. When root growth was restricted by compact soil in the large tube, it was increased in the small tube. Whether or not the soil in the small tube was infested had much less influence on total root development than the infestation status of the soil in the larger tube.

Pisatin induction in the foot region of pea seedlings by pathogenic and nonpathogenic clones of Fusarium solani. J. A. CHRISTENSON & L. A. HADWIGER (Wash. State Univ., Pullman). The production and accumulation of pisatin in the foot region of pea plants in the presence of four clones of the foot rot pathogen, *Fusarium solani*, was studied. Two of the clones were pathogenic to peas, and two were nonpathogenic. Plants were grown in pots of nonsterilized soil with or without the addition of chlamydospores of the fungus. Replications were provided for each of the four clones and for two different soil types. Rate of accumulation and total

pisatin content in the foot region at intervals of 9, 10, 12, 14, 16, 21, or 28 days after planting were compared for peas challenged separately by the four clones of the fungus. Nonpathogenic clones of *F. solani* induced more rapid formation of phytoalexin than did pathogenic clones. Generally, up to about 200 μg pisatin/g fresh wt of tissue accumulated in sections of the foot region cut from near the region of cotyledon attachment. A maximum of 411 μg/g was found. Sections above cotyledon attachment contained lower levels of pisatin, and sections below attachment contained only minute quantities of phytoalexin. The pisatin-inducing potential of the two noninoculated control soils differed. This difference was apparently related to differences in the microflora of these soils.

Comparison of near ultraviolet from sunlamp and "Black Light" lamp for the detection of Drechslera oryzae, Pyricularia oryzae, and Trichoconis padwickii on rice seed. C. CHUAIPRASIT, S. B. MATHUR, & P. NEERGARRD (Ore. State Univ., Inst. Seed Pathol., Copenhagen, Denmark). Seed-borne *Drechslera oryzae, Pyricularia oryzae,* and *Trichoconis padwickii* can be easily detected when sporulation is induced by exposure of rice seed to near ultraviolet (NUV) radiation. Experiments were conducted to compare the effectiveness of NUV emitted from a fluorescent sunlamp (310-nm peak) with that from the commonly used "Black Light" fluorescent lamp (360-nm peak). Exposing rice seed directly in opened petri dishes to one sunlamp at a distance of 41 cm for times ranging from 5 to 30 min each day for 7 days was sufficient for detecting *D. oryzae* and *P. oryzae*, but not *T. padwickii*. In closed petri dishes, *T. padwickii* required a daily exposure of 12 hr for 7 days to record a maximum count. This also increased considerably the counts of *D. oryzae* and *P. oryzae*. In comparison, somewhat higher counts of these three fungi were obtained by exposure to 1 or 2 "Black Light" lamps under the standardized conditions used in routine seed health testing; i.e., daily exposure to 12-hr NUV alternative with 12 hr darkness.

Heterothallism in the apple powdery mildew, Podosphaera leucotricha. D. L. COYIER (USDA, Hood River, Ore.). Single conidial isolates of *Podosphaera leucotricha* were maintained on young apple (*Malus sylvestris*) seedlings in special growth chambers. The chambers were constructed of lightweight plastic and supplied with filtered air of 3-μ pore size. The exit of air from the chambers was restricted to create positive pressure which supported the chambers and prevented contamination by airborne conidia. Temperature and relative humidity ranged from 21 to 25 C and from 30 to 35%, respectively. Illumination (ca. 5,400 lux measured at plant level) was provided by fluorescent and incandescent lamps during a 12-hr period each day. Twelve cultures were selected from apple seedlings; and two, from pear seedlings. None of the single spore isolates developed cleistothecia during a period of 4 months. Four of 18 paired, single conidial isolates developed ascocarps; one pair was an apple × pear isolate, and three pairs were apple × apple isolates. Cleistothecia were observed on the pear × apple pair 24 days after inoculation; and in 30-42 days, on apple × apple pairs. Noninoculated apple seedlings maintained in the isolation chambers remained without contamination by powdery mildew for 6 months. These relationships suggest that *P. leucotricha* is heterothallic on *M. sylvestris*.

Factors influencing chlamydospore formation by Phytophthora lateralis. L. ENGLANDER & L. F. ROTH (Ore. State Univ., Corvallis). In laboratory studies, the number, rate of formation, and maturity of chlamydospores were influenced by sterol nutrition, temperature, and light. The number of chlamydospores formed in V-8 broth increased exponentially as Beta-sitosterol concentrations were increased from 0 to 1, 2, 10, and 20 ppm. At higher concentrations (100 and 200 ppm), fewer chlamydospores were produced. At the optimum concentration tested (20 ppm), chlamydospores were roughly 10 times more numerous and formed more quickly than in unsupplemented medium. Accordingly, media in subsequent work contained sterol. When colonies were grown between 10-30 C at termperature intervals of 2-3°, the greatest number of chlamydospores formed at 22-24 C, just below the upper limit of growth. Also, an increase in spore size and wall thickness was observed as temperature increased to 24 C. Light inhibited chlamydospore formation. In total darkness, about 7 times more chlamydospores were formed than under continuous or 12 hr diurnal illumination (combination cool white and near-ultraviolet fluorescent, ca. 2,200 lux). At light intensities of 270, 540, 1,080, and 2,160 lux, about 1/3, 1/4, 1/15, and 1/15 as many chlamydospores, respectively, formed as in darkness.

Effect of temperature and pH on growth of a mycoplasmalike organism associated with stubborn of citrus. A. E.-S. A. FUDL-ALLAH & E. C. CALAVAN (Univ. Calif., Riverside). A mycoplasmalike organism was cultured from stubborn-diseased citrus. Subcultures were incubated on cell-free agar media for 10 days at temperatures of 9, 12, 15, 18, 21, 24, 27, 30, 33, 36, and 39 C. Colonies of the "fried-egg" type appeared only at 27, 30, and 33 C. Colonies at 30 C had conspicuous, dense round centers, a finely granulated surface, and an average diameter of 200 μ. Centers were less clearly defined in most colonies at 27 C. Number and average diameter of colonies were largest at 30 C, and were larger at 27 than at 33 C. Colonies at 9, 12, 15, 18, 21, 36, and 39 C were few, about 50-μ average diameter, translucent, and irregular in shape, with margins and central spot poorly defined. Similar results were obtained at 24 C, except the colonies were denser and about 60 μ in diameter. Effect of pH was studied by seeding the organism in liquid media at pH values of 4, 5, 6, 7, 8, and 9 and incubating at 30 C for 7 days. Relative amounts of growth were determined by sedimentation under low-speed centrifugation and electron microscopy of pelleted material. There was no growth at pH 9 and poor growth at pH 4 or 5. Good growth occurred at pH 6 to 8, with optimal growth at pH 7.

Control of Sclerotinia sclerotiorum in cabbage seed fields with aerial application of benoyml and ground application of cyanamide. R. L. GABRIELSON & W. C. ANDERSON (Wash. State Univ., Puyallup, Mt. Vernon). White blight (*Sclerotinia sclerotiorum*) has seriously affected cabbage seed production in western Washington for many years. Cyanamide has provided effective control, but its cost has nearly doubled and its use requires wide row spacing and hand tying of plants. Benomyl was applied aerially at 1.12 kg active plus 117 ml Biofilm spreader-sticker in 93.5 liters water/hectare (1 lb. plus 1.6 oz in 10 gal/acre). First application was at first petal fall on 14 May. A 2.2-kg rate was applied by the making of a double pass. Two strips were treated in each field. Additional applications were made on one of these strips 28 May and 12 June. Cyanamide was applied at 1,122 kg/hectare (1,000 lb./acre) at first petal fall. Numbers of main stem infections in 45.7 m (150 ft) on 17 July were: untreated, 53; 1.12 kg single application, 6; 2.24 kg single application, 0; 1.12 kg three applications, 1; 2.24 kg three applications, 0; and cyanamide, 3. Seed yields were increased by all treatments, and seed viability was not

affected. Apothecia were not observed. Cyanamide, which provides no protective action against airborne inoculum, provided effective control near heavily infected untreated areas. This indicates that airborne inoculum did not spread far from its source.

Characterization of a virus isolated from a cultivated cactus, Zygocactus sp. L. GIRI & M. CHESSIN (Univ. Montana, Missoula). A previously unreported virus has been found in the cultivated Christmas cactus, *Zygocactus* sp. The virus infected *Atriplex hastata, Chenopodium quinoa, C. giganteum, C. polyspermum, C. album,* and *C. urbicum*. It did not infect *Datura stramonium, Gomphrena globosa, Nicotiana glutinosa, N. rustica, N. sylvestris,* and *Phaseolus vulgaris*. In crude sap, the thermal inactivation point was 75-80 C for 10 min. The dilution end point fell between 1.0×10^5 and 1.0×10^7 on *C. quinoa*. Sap diluted 1:10 in 0.01 M pH 7 phosphate buffer showed a longevity of 6-7 days at 30-34 C. Virus was purified by a combination of butanol-ether treatment and ultracentrifugation in 0.05 M borate buffer at pH 7.5. Purified virus was highly infectious and gave a typical nucleoprotein ultraviolet absorption spectrum with a minimum at 240 mm and a broad maximum around 260 mm. Electron microscopy revealed elongated, slightly flexuous particles with an NML of 464 nm. By ring and precipitin tests, the virus was found to be serologically related to cactus virus X and potato virus X, but not to Casper's *Zygocactus* virus. Although more detailed tests are in progress, we tentatively conclude that the virus is a new member of the "X" group.

Interaction of Meloidogyne hapla and Ditylenchus dipsaci on root knot-resistant alfalfa. G. D. GRIFFIN (USDA, ARS, Utah State Univ., Logan). *Meloidogyne hapla* and *Ditylenchus dipsaci* are often found in association on alfalfa. Germinated seed was inoculated singly and in combination with 200 *M. hapla* and 25 *D. dipsaci* larvae and grown at 16, 20, 24, and 28 C for 6 weeks. A combination of *M. hapla* and *D. dipsaci* did not increase galling over plants inoculated singly. There were 0, 0, 3, and 12 galls/plant at 16, 20, 24, and 28 C when seeds were inoculated with *M. hapla*, and 0, 0, 4, and 12 galls/plant from a combination of *M. hapla* and *D. dipsaci* at the same temperatures. Similar results were obtained when 8-week-old plants were inoculated singly with 1,000 *M. hapla* larvae, and with a combination of 1,000 *M. hapla* larvae and 100 *D. dipsaci* at 22 ± 4 C. None of the plants inoculated with only *M. hapla* was galled, and only 5% inoculated with a combination of *M. hapla* and *D. dipsaci* were galled (two galls/plant). However, when *D. dipsaci*-infected alfalfa plants, inoculated in the germinated seed stage with 25 *D. dipsaci*, were inoculated at 8 weeks of age with 1,000 *M. hapla* larvae, *D. dipsaci* was able to predispose root knot-resistant alfalfa to *M. hapla*. There were 26% of the plants galled (4 galls/plant) 6 weeks after inoculation with *M. hapla* at 22 ± 4 C.

Bacterial rot of onion and the relation of irrigation water to disease incidence. R. D. IRWIN & E. K. VAUGHAN (Ore. State Univ., Corvallis). A bacterium morphologically and physiologically similar to *Pseudomonas cepacia* has been consistently isolated from diseased plants in the field and from bulbs in storage, and has been detected in onion field soil and surface drainage water. Injections of either surface drainage water or suspensions of bacteria into healthy onion plants has failed to elicit symptoms, although the bacterium was recovered from leaves of inoculated plants. However, when excised leaves of inoculated plants were incubated in a moist chamber at 24 C, symptoms similar to those which occur in the field were evident after 24 to 36 hr. Surface drainage water used for irrigation has been implicated as increasing losses both in the field and in storage. In plots irrigated with surface drainage water, incidence of decay in the field was 3-8 times that in comparable plots irrigated with water from deep wells. When apparently healthy bulbs were placed in storage, incidence of decay after 16 weeks was 3-9 times as great in onions from plots irrigated with surface drainage water as in those from plots irrigated from wells.

Ultrastructural changes in sugar beet leaf cells associated with infection by beet western yellows virus. A. M. JAFRI (Wash. State Univ., Irrig. Agr. Res. Ext. Center, Prosser). Healthy and beet western yellows virus (BWYV)-infected sugar beet leaf tissue samples were collected for electron microscopy 30 days after inoculation from mature, expanding, and young leaves; fixed in glutaraldehyde; postfixed in osmium tetroxide; and embedded in Araldite 6005 or Epon 812. Virus particles could not be identified in ultrathin sections from infected tissue or in negatively stained leaf-dip preparations. The most important feature of the cells from BWYV-infected tissue was a progressive degeneration of cellular substructure. Numerous changes were observed in cytoplasm, chloroplasts, and mitochondria. Distortion and lysis of both plasmalemma and tonoplast and vesicle formation in the cytoplasm were commonly found in infected cells. Chloroplasts in cells from infected leaves undergo a complex series of changes. Among the first noticeable changes in the chloroplast substructure was the disorganization of the lamellae system. Formation of large, membrane-bound bodies with amorphous matrices within the chloroplasts occurred frequently in cells from yellow or yellow-green tissue. Presence of particles resembling phytoferritin was another prominent feature of chloroplasts from cells of infected tissue. In infected tissue, some mitochondria also showed degeneration.

Localization of virus and ultrastructural changes in sugar beet leaf cells associated with infection by necrotic strain of beet mosaic virus. A. M. JAFRI (Wash. State Univ., Irrig. Agr. Res. Ext. Center, Prosser). Ultrathin sections of healthy and beet mosaic virus (BMV)-infected sugar beet tissue samples, collected from mature, expanding, and young leaves, were examined with an electron microscope. Inclusion bodies, flexuous rods, and a progressive degeneration of the substructure of some of the organelles were the most prominent features of the BMV-infected tissue. Flexuous rods, found only in BMV inoculated plants and presumed to be virus, were observed most commonly in mesophyll cells and only occasionally in phloem cells. The flexuous rods with a mean length of 771 nm, based on the measurement of 68 particles, were also obtained from BMV-infected leaf tissue using a standard leaf-dip technique. Half of the particles measured 730 nm, which was considered to be the normal length of BMV particles. Intracellular inclusions in the form of bands, bundles, and pinwheels were commonly found in the cytoplasm of mesophyll cells, and occasionally in phloem cells. Chloroplasts in the cells from BMV-infected tissue undergo a complex series of changes. Crystal formation was one of the prominent features of some of the degenerating chloroplasts from mesophyll cells. Frequent disintegration of mitochondria was also observed in degenerated cells.

Histopathological interrelationships of Meloidogyne hapla and Heterodera schachtii on Beta vulgaris. P. JATALA & H. J. JENSEN (Ore. State Univ., Corvallis). Root samples from sugar beet plants infected with *M. hapla* alone, *H. schachtii* alone, and samples exhibiting both nematodes on one feeding site were processed for histological studies. Anatomical changes due to *M. hapla* infection were characterized by regions of hypertrophy and hyperplasia. Hypertrophied cells formed giant cells within stele, and their number varied from

four to seven/nematode feeding locus. Hyperplastic regions composed of large number of relatively small compacted cells surrounded the hypertrophic regions. Syncytia caused by feeding of *H. schachtii* became dense and multinucleate. They were typically formed within stele and were limited on the side toward the nematode by endodermis or in part by cortical cells. Histological changes in samples exhibiting both nematodes on one feeding site were characterized by presence of the pathological tissues induced by both nematodes. In most cases xylem elements separated the two pathological tissues. In some sections, a single wall separated these two pathological tissues and no dissolution of the separating wall was observed in any section. Apparently, each nematode developed normally and produced its own characteristic pathological changes of tissue independently from the other nematode.

Interactions of various nematodes with the club root organism of cabbage. H. J. JENSEN & E. K. VAUGHAN (Ore. State Univ., Corvallis). Interactions of four nematode species (*Helicotylenchus nannus, Longidorus elongatus, Meloidogyne hapla,* and *Pratylenchus penetrans*) with *Plasmodiophora brassicae* were studied on Early Jersey Wakefield cabbage. Suspension of *P. brassicae* were added to individual cabbage plants (6 weeks old) 2 weeks after transplanting into soil containing nematode inoculum. Treatments (10 plants each) included combinations of each nematode with *P. brassicae*, a control with fungus only and a noninoculated control. All plants were harvested when 12 weeks old. Lack of clubs in the noninoculated control indicated no contamination from soil and water sources. Club development on inoculated control plants indicated that the fungus was viable. When fresh weight of root systems from treatments combining nematodes and fungus were compared with the inoculated control, a synergistic response was apparent in all combinations. Comparative percentages of root weight increases (control rated 100%) in the combined nematode and fungus treatments were: *H. nannus*, 237%; *L. elongatus*, 358%; *M. hapla*, 342%; and *P. penetrans*, 338%. Dry weights of roots followed a similar trend. Comparable results were obtained in two additional replicated experiments.

Tomato ringspot virus of blueberries in Washington. F. JOHNSON (Wash. State Univ., Puyallup). In the spring of 1969, a new disease appeared in a blueberry field located adjacent to red raspberries previously known to be infected tomato ringspot virus (TmRSV). In the Bluecrop cultivar, infected plants stop growth by midsummer and lose almost all their leaves by the middle of harvest. Examination reveals small, necrotic spots in the leaves which are cupped and malformed. Necrotic spots are also present on the bark of twigs and branches. When juice from triturated tissue was rubbed over leaves of *Nicotiana tabacum*, several small, brown spots appeared on the inoculated leaves. From these lesions, inoculum was obtained which produced numerous zonate, brown spots in tobacco as well as typical symptoms of TmRSV infections in *Chenopodium quinoa* and *Cucumis sativus*. The virus was recovered only from the young, expanding blueberry leaves. Bud grafts made in summer from blueberries to healthy red raspberries of the Puyallup cultivar produced ringspot and characteristic oak-leaf patterns in the foliage the following spring. The dilution end point of the virus in expressed cucumber sap was between 1:100 and 1:1,000, whereas thermal inactivation resulted between 60 and 65 C. The isolate reacted with antiserum against a known strain of TmRSV.

Purification of pea seed-borne mosaic virus. J. E. KNESEK & R. O. HAMPTON (Wash. State Univ., Irrig. Agr. Res. Ext. Center, Prosser and ARS, USDA, Ore. State Univ., Corvallis). Pea seed-borne mosaic virus was purified from *Pisum sativum* '447' harvested 20-30 days after inoculation. Tissue was homogenized in either 0.01 M sodium diethyldithiocarbamate (NaDIECA) + .01 M cysteine HCl pH7 (for root tissue) or 0.01 M NaDIECA + .01 M cysteine HCl + .01 M (ethylenedinitrilo)-tetraacetic acid disodium salt pH7 (for leaf tissue), using 10 ml/g of tissue, for 2 min in a Waring Blendor. The homogenate was emulsified v/v with chloroform for 30 min and centrifuged 30 min at 3,000 *g*. The aqueous phase was removed and given one cycle of differential centrifugation (pellets resuspended in distilled water, pH7). The supernatant fluid was layered onto 10 ml solution containing 30% sucrose, 4% polyethylene glycol 6,000, and 0.12 M NaCl and centrifuged 2 hr at 83,100 *g* in a Spinco SW 25.1 rotor. Virus-containing pellets were resuspended in 2 ml of 2% sucrose + 1% Igepon T73 pH7 solution, and centrifuged 10 min at 10,000 *g*. Virus in the supernatant fluid was again precipitated by the above procedure. The resulting virus preparation, upon sucrose density-gradient centrifugation, produced a single visible infectious zone 24-26 mm below the meniscus. Material from this zone exhibited an E260/280 ratio of 1.14 to 1.18, and highly concentrated virus particles having a normal length of 732 nm.

A cold tolerant strain of Rhizopus stolonifer. T. T. MATSUMOTO & N. F. SOMMER (Calif. Dep. Agr., Sacramento, Univ. Calif., Davis). A cold tolerant strain of *Rhizopus stolonifer* developed during studies of spore inactivation at low temperatures. Although the optimum and maximum temperatures remained typical for the species, sporangiospores of the new strain germinated and grew in 7 to 12 days at 0 C. Linear extension of mycelium was 2.7 mm/day at 5 C, the usual minimum temperature for growth, and approximately 0.37 mm/day at 2.5 C. Well-developed lesions were present in inoculated fruits after 7 to 10 days at 5 C and after about 30 days at 2.5 C. Evidently, repeated exposure to low temperatures may result in selection for cold tolerance.

β-glucosidase from Phoma strasseri. H. A. MELOUK & C. E. HORNER (Ore. State Univ., ARS, USDA, Corvallis). *Phoma strasseri*, the causal agent of stem and rhizome rot of mints (*Mentha spp.*), produced β-glucosidase on a liquid medium containing $NaNO_3$, 3 g; KH_2PO_4, 1 g; $MgSO_4 \cdot 7H_2O$, 0.5 g; KCl, 0.5 g; $FeSO_4 \cdot 7H_2O$, 0.01 g; and 15 g of salicin/liter at pH 7.0. Saligenin (salicyl alcohol) and an unidentified compound were detected in the culture filtrate by paper and thin-layer chromatography. β-glucosidase activity was assayed by determining *p*-nitrophenol released from *p*-nitrophenyl-β-D-glucoside, and was optimum between pH 4.5 and 5.5. β-glucosidase extracted from mycelia and spores of *P. strasseri* grown on Czapek-Dox agar at 20 C was purified 15 X by precipitation with acetone, then ammonium sulfate. The purified enzyme preparation liberated glucose from cellobiose, but failed to hydrolyze α-glycosides. Extracts of peppermint rhizomes inoculated with *P. strasseri* had about 3 times more β-glucosidase activity than did noninoculated controls. Exudates which formed at the point where peppermint rhizomes were inoculated with *P. strasseri* exhibited β-glucosidase activity.

Rhizina undulata inducing a root rot of Douglas-fir seedlings. P. MORGAN & C. H. DRIVER (Univ. Wash., Seattle). *Rhizina undulata* was recently detected in western Washington areas causing heavy mortality in twelve Douglas-fir seedling plantations. Intensive studies on Rhizina root rot on an infested site indicate that the disease may be a

serious threat to the regeneration of Douglas fir on slash-burned, clear-cut sites.

Proposed roles of extracellular enzymes of Fusarium nivale and Typhula idahoensis incitants of snow mold of winter wheat. M. W. MULANAX & D. M. HUBER (Univ. of Idaho, Moscow). Snow mold of winter wheat incited by *Fusarium nivale* and *Typhula idahoensis* is characterized by tissue maceration. Field snow-molded plants have the odor of decaying fish. After snow melt, *T. idahoensis* snow-molded plants are soft and mushy, whereas *F. nivale* snow-molded plants are stringy and tough, suggesting a difference in lignin decomposition. *F. nivale* and *T. idahoensis* were incubated at 5 F on (i) Czapek's agar plus 1% Tween 20 (polyoxyethylene sorbitan monolaurate) and 0.01% $CaCl_2 \cdot 2H_2O$ (lipase specific esterase substrate); (ii) potato-dextrose agar plus 0.05% tannic acid (polyphenol oxidase substrate); (iii) Difco starch agar (amylase substrate); (iv) 1% gelatin agar (protease substrate); and (v) Czapek's agar containing 0.5% wheat straw with a cellophane disc to separate the fungus from the medium. The cellophane cultures were removed and treated with (i) phosphate buffered indoxylacetate (nonspecific esterase substrate); or (ii) aqueous catechol (polyphenol oxidase substrate). Both fungi produced lipase, amylase, and nonspecific esterase which may contribute to tissue maceration. Both produce protease which may account for decaying fish odors. Only *T. idahoensis* produced polyphenol oxidase which has been implicated in lignin decomposition and may account for differences in degree of tissue maceration of diseased plants.

Studies on mechanical transmission, extraction, and assay of a latent virus in Gynura aurantiaca. F. M. OSMAN & L. G. WEATHERS (Univ. Calif., Riverside). Buffers of varying pH and ionic strength were evaluated for efficiency in mechanical transmission, extraction, and assay of gynura latent virus from gynura to petunia. Low ionic strength buffers in the basic or neutral range were preferable to acid buffers and buffers of higher ionic strength. The most efficient transmission was obtained with low ionic strength orthoborate buffer at pH 9.0. To avoid leaf injury, extraction with 0.1 M buffer was adopted as the procedure in mechanical transmission. Extraction with 0.5 M orthoborate pH 9.0 was adopted as a procedure in purification; and the partially purified virus was finally suspended in 0.05 M orthoborate buffer pH 9.0. Optimum temperature for development of local lesions in petunia was 20 C, with an incubation period of approximately 14 days. Necrotic local lesions did not develop in petunia plants grown at 30 C or above, and only after 1 month in plants at 15 C.

The influence of temperature on production of a compound from onion roots inhibitory to Pyrenochaeta terrestris. F. L. PFLEGER (Ore. State Univ., Corvallis). Onion cultivars susceptible, moderately susceptible, and resistant to infection by *Pyrenochaeta terrestris* were grown under a 12-hr photoperiod (10,800 lux) and temperatures of 16 and 27 C for 64 and 74 days. Extracts of roots from plants grown at 16 C showed a quantitative increase in total phenols with age as determined by the Folin-Denis method, but at 27 C, no similar increase occurred. Root extracts from the cultivars were fractionated via Bio-Gel P-10. Extracts from roots of resistant cultivars contained more total phenols than susceptible ones regardless of plant age or temperature at which plants were grown. Bioassay of the fractions demonstrated that growth inhibition of *Pyrenochaeta terrestris* was correlated with phenolic content of the fractions.

Purification and partial characterization of a rod-shaped virus found in hops, Humulus lupulus. E. G. PROBASCO & C. B. SKOTLAND (Wash. State Univ., Irrig. Agr. Res. Ext. Center, Prosser). Cuttings of a Cluster hop seedling were inoculated with crude sap of *Humulus lupulus* cultivar Late Cluster containing a rod-shaped virus. After 4 weeks, tissue from inoculated plants was homogenized with polyvinylpyrrolidone (Polyclair AT) (0.5 g/g tissue) in 0.05 M $NaPO_4$ buffer, pH 8.0 (6 ml/g tissue), containing 0.2% nicotine and 0.2% ascorbic acid, strained through cheesecloth, frozen overnight at −19 C, thawed, and centrifuged 10 min at 2,340 *g*. The supernatant fluid was adjusted to pH 5.0 with 0.1% HCl, held for 0.5 hr at 4 C, and centrifuged for 10 min at 2,340 *g*. The precipitate was resuspended in one-fifteenth original volume 0.01 M $NaPO_4$ buffer, pH 8.0, adjusted to pH 6.8 with 1% NaOH, and centrifuged 30 min at 2,340 *g*. The supernatant fluid was again subjected to acid precipitation and resuspension, except that resuspension was in 3.0 ml. The final supernatant was subjected to sucrose rate zonal density gradient centrifugation at 60,000 *g* for 2 hr. One visible zone appeared 26-29 mm below the meniscus, and contained rod-shaped virus particles 610-640 nm long. The virus produced necrotic local lesions on primary leaves of *Phaseolus vulgaris* cultivar Kinghorn, was latent or produced systemic chlorotic lesions in hop seedlings, and reacted with antiserum to potato virus M.

The spread of foot rot of wheat, Cercosporella herpotrichoides, from point sources of inoculum. R. C. ROWE & R. L. POWELSON (Ore. State Univ., Corvallis). Point sources of inoculum were established in November in a field of seedling winter wheat by deposit of 30 g of colonized oat inoculum on the soil. Plants surrounding four randomly selected point sources were sampled monthly at 1-ft intervals from the inoculum source, and observations were made on the extent of lesion development and percent infection. The inoculum was removed from some plots in April. Disease gradients calculated by a plotting of the log percent infection against the log distance from the inoculum source were less than gradients calculated from a rain splash model system. The effective dispersal range of the fungus was only 3-4 ft. Plants located 3 ft from the inoculum source showed 50% infection 75 days later than those located 1 ft away. Apparent infection rates (r) were low (0.005-0.011) as compared with cereal rusts (0.100-0.500). An increase in r was noted in midspring in plots with inoculum but not in plots where the inoculum was removed. This indicates that early spring as well as late fall is an important infection period. Analysis of the data fits van der Plank's "simple interest" model, which suggests no role for secondary inoculum in the disease cycle. This is supported by field observations showing abundant sporulation on stubble and negligible amounts on new lesions.

Evaluation of chemicals to prevent Fomes annosus infection of stumps in precommercially thinned western hemlock stands. K. W. RUSSELL, J. H. THOMPSON, J. L. STEWART, & C. H. DRIVER (Wash. Dep. Nat. Res., USFS-R6, Univ. Wash., Seattle). *Fomes annosus* is known to be closely associated with intensive forest management activities throughout the USA because of its ability to colonize freshly cut stumps of many conifer species. Root grafts between infected stumps and crop trees provide infection courts and induce volume loss or mortality to crop trees. Young western hemlock stands of western Oregon and Washington are susceptible to infection by *F. annosus*. Six simulated precommercial thinnings from the Canadian border to southwest Oregon were cut, and stumps were treated

monthly. Dry borax proved effective in preventing stump infection in all thinnings. Sugar-borax solutions and a urea solution also reduced infection, but not enough for practical use. Aerial spore loads during the year were variable but usually high, except during cold months in two of the high elevation thinnings. We concluded that dry borax applied to level-cut stumps was effective in controlling *F. annosus* infection in thinned young hemlock stands. The average precommercial thinning requires 3-4 lb. borax/acre.

Changes in RNA synthesis in certain compatible and incompatible interactions between flax and Melampsora lini. SHARON VON BROEMBSEN & L. A. HADWIGER (Wash. State Univ., Pullman). Certain gene-for-gene combinations involving flax (*Linum usitatissimum*) and *Melampsora lini* were examined for changes in rates of RNA synthesis occurring in flax seedlings 6, 12, or 18 hr after inoculation. Both compatible and incompatible interactions between three isolines of flax and two races of *M. lini* were studied. Direct comparison of the syntheses rates of various species of RNA in inoculated and noninoculated tissues were made using a double-labeling method (^{14}C-orotic acid, inoculated tissue; and ^{3}H-orotic acid, noninoculated tissue) in which the RNA of both tissues was extracted together and separated by sucrose density centrifugation. Although incompatible (resistant) interactions show increased protein synthesis by 6 hr and compatible (susceptible) interactions do not, no significant changes in RNA synthesis are detectable at any of these times in either type of interaction.

Abstracts presented at the 1972 Annual Meeting of the Pacific Division of The American Phytopathological Society held at Eugene, Oregon, 15-17 June 1972.

PHYTOPATHOLOGY for September (62:943-1100) was issued 8 September 1972