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1980-1981

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OREGON TREE FRUIT AND NUT RESEARCH ABSTRACTS
1980-1981

(Supplement to Oregon Agricultural Experiment Station Special Reports 341, 355, 417, 461, 512, and 598)

Compiled by M. N. Westwood
Professor of Horticulture

INTRODUCTION

The index which follows is complete through 1981 and includes all the abstracts from Special Reports 341, 355, 417, 461, 512, and 598 plus items 654 through 731 of the attached supplement. For best use of this abstract supplement, it should be attached to Special Reports 341, 355, 417, 461, 512, and 598.

As was done with the earlier compilations, full reprints of papers 654 through 731 will be filed under the same numbers in the libraries of the Branch Stations at Hood River and Medford and in the Horticulture Department library at Corvallis. This is done for the convenience of Extension workers and others who might need to study the full report from which the abstract was taken.

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PAPER ABSTRACTS

654. MacSwan, I. C. 1980. Fungicide-Bactericide Test Results. Dept. of Bot. and Pl. Path., OSU, Corvallis, OR--This report is a compilation of the results of some of the fungicide tests conducted in 1980. The tests on tree fruits were conducted at the Field Laboratory, Botany and Plant Pathology Department, Oregon State University, Corvallis, and one strawberry test was conducted at the North Willamette Experiment Station at Aurora in cooperation with Lloyd Martin, Superintendent. Much of the work involved in the tests on tree fruits was done by Lewis Tate, Experimental Biological Technician, assisted by Don Kirby. Ray Ethel, Experimental Biological Technician, applied fungicides and Karen Learfield, Experimental Biological Aide, supervised the harvest for the strawberry fruit rot tests conducted at the North Willamette Experiment Station. The winter wheat foot rot test was conducted in cooperation with the Tucker ranch in Umatilla County. The corn head smut research was conducted on the Vegetable Crops Farm in Corvallis. Potato research with Vapam was conducted near Pasco, Washington and tests with Botran and Benlate were conducted in cooperation with the Gene Kerby-Glen Chowning Farm. The snap bean grey mold research was conducted in cooperation with the General Foods Farm near Woodburn, Oregon. Research on Eastern filbert blight of filberts was conducted at a LaCenter, Washington orchard.

655. MacSwan, I. C. 1981. Fungicide-Bactericide Test Results. Dept. of Bot. and Pl. Path., OSU, Corvallis, OR--This report is a compilation of the results of some of the fungicide tests conducted in 1981. The tests on tree fruits and blackberries were conducted at the Field Laboratory, Botany and Plant Pathology Department, Oregon State University, Corvallis, and one strawberry test was conducted at the North Willamette Experiment Station at Aurora in cooperation with Lloyd Martin, Superintendent. Much of the work involved in the tests on tree fruits and blackberries was done by Lewis Tate, Experimental Biological Technician, assisted by Don Kirby. Ray Ethel, Experimental Biological Technician, applied fungicides and supervised the harvest for the strawberry fruit rot tests conducted at the North Willamette Experiment Station (Inconclusive data). The onion white rot research was conducted in cooperation with Del Hemphill at the North Willamette Experiment Station in Aurora, Oregon. The winter wheat stripe rust, leaf rust, and Septoria blotch tests were conducted at the Hyslop Agronomy Farm near Corvallis. The winter wheat foot rot research was conducted on wheat ranches of D. Fowler (Nugaines) and Dewall (Stephens) in cooperation with Frank Kinnaman and Jim Tergison, Pendleton grain growers.

656. Spotts, R. A., J. A. Traquair, and B. B. Peters. 1981. d'Anjou pear decay caused by a low temperature basidiomycete. Plant Disease. 65:151-153.--In 1979, a basidiomycete caused significant loss of d'Anjou pears in controlled atmosphere storage at Hood River, OR. By monokaryon-dikaryon pairings, the basidiomycete was shown to be conspecific with a Coprinus species in the urticicola complex that causes winter crown rot of alfalfa. Maximum radial mycelial growth was at 10 C. Tests were positive for extracellular polyphenoloxidase and hydrogen cyanide. Of 23 fungicides tested in vitro, sterol inhibitors and dithiocarbamates at 10 μg/ml significantly reduced mycelial growth. Ziram, applied to trees 10 days before harvest, provided significant control in stored fruit. This is the first report of pear fruit decay caused by a basidiomycete and the first record of this low temperature basidiomycete in the United States.

657. Spotts, R. A. and B. B. Peters. 1980. Chlorine and chlorine dioxide for control of d'Anjou pear decay. Plant Disease. 64: 1095-1097.--The effects of chlorine and chlorine dioxide on germination of Botrytis cinerea, Mucor piriformis, and Penicillium expansum and on d'Anjou pear decay were studied under laboratory and commercial packinghouse conditions. Chlorine at 50 μg/ml significantly reduced conidial germination of all decay fungi after 0.5-min treatment and at 2.5 and 5.0 μg/ml reduced M. piriformis and P. expansum germination after 5 min. A 0.5-min treatment with chlorine dioxide at 10 μg/ml significantly reduced germination of all decay fungi but did not affect conidial germination at 0.1, 0.5, and 1.0 μg/ml. Treatment with chlorine (50 μg/ml) or chlorine dioxide (10 μg/ml) significantly reduced fruit decay, but decay was not controlled when conidia were treated with chlorine dioxide at 0.1, 0.5, or 1.0 μg/ml or chlorine at 0.5, 2.5, or 5.0 μg/ml. Immersion of inoculated fruits in chlorine or chlorine dioxide in commercial packinghouse flumes did not reduce decay. Use of chlorine dioxide for control of pear fruit decay does not presently appear economically feasible.

658. Spotts, R. A., R. P. Covey, and I. C. MacSwan. 1981. Apple powdery mildew and scab control studies in the Pacific Northwest. Plant Disease. 65:1006-1009.--The sterol-inhibiting fungicides bitertanol, triadimefon, fenapanil, and CGA 64251 were all effective in the control of apple mildew and scab. Factors influencing the occurrence of these diseases in the major fruit-growing areas of the Pacific Northwest are discussed.

659. AliNiazee, M. T. 1981. The obliquebanded leafroller and the winter moth: Two new pests of Oregon filberts. Proc. Oreg. and Wash. Nut Growers Soc. 66:101-103.--Life history, damage and sampling methods for the obliquebanded leafroller and the winter moth are discussed. The timing for application of proper control methods is also discussed.

660. AliNiazee, M. T. 1981. Biology and control of the filbertworm, Melissopus latiferreanus. Proc. Oreg., Wash. and B.C. Nut Growers Soc. 66:98-100.--The filbertworm is still the most important pest of filberts. Studies conducted previously showed that adult flight, mating and egg laying is dependent upon the prevailing temperatures during early evening hours. A pheromone trap has been developed and is now available for field use. The application of pheromone traps in determining proper timing for application of insecticide sprays will greatly improve the control of this pest.

661. Van Kirk, J. R. and M. T. AliNiazee. 1981. Determining Low-Temperature Threshold for Pupal Development of the Western Cherry Fruit Fly for Use in Phenology Models. Environ. Entomol. 10: 968-971.--Three methods were used in determining the low-temperature threshold for pupal development of the western cherry fruit fly, Rhagoletis indifferens Curran. The standard x-intercept method using regression analysis of all data points (13.0, 15.5, 17.0, 19.5, 21.0, 22.0, 25.5°C) yielded a threshold of 10.2°C. A modified method using only median data points increased the threshold to about 13°C. A third method using one-way analysis of variance and taking into consideration the relative number of occurrences in the field of the various temperatures used as treatments in the experiment yielded a base threshold of 8.3°C. A comparison of effectiveness of the three proposed thresholds (8.3, 10.2, 11.7°C) indicated that least variation in predicted emergence was noticed by using an 8.3°C threshold.

662. AliNiazee, M. T. and R. L. Penrose. 1981. Apple Maggot in Oregon: a Possible New Threat to the Northwest Apple Industry. Entomol. Soc. of Amer. 27(4):245-246.--The apple maggot, Rhagoletis pomonella (Walsh), is a serious pest of apples in the northeastern United States and adjacent portions of southeastern Canada. Indigenous to this region, it is thought to have originally used native hawthorne (Crataegus spp.) berries for larval development, undergoing a host transference to Malus after its introduction into the New England area (Dean and Chapman 1973). Bush (1966) reports that this host shift was relatively recent, since this species was first described in 1867 (Walsh 1867), ca. 200 years after the apple was brought to our country from Europe. Host diversification has continued, and R. pomonella is currently known to infest a number of introduced rosaceous plants, including cultivated plum in Florida (Herrick 1920), sour cherry in Door County, Wis., and a small area in northwestern Michigan (Shervis et al. 1970), and recently, rose hips in southern New England (Prokopy and Berlocher 1980). Adult flies have also been reared from apricot (Lienk 1970) and pear (Prokopy and Bush 1972), although permanent populations were never established in these fruits. Apple and hawthorne infesting races are now generally distributed over the eastern half of the contenent, extending

from New York south to Florida and west to North Dakota and eastern Texas. Another disjunct population is known to occur in the highlands of central Mexico. The apple race does not extend as far north as the hawthorne race. Southward it follows the Appalachian Mountains into northern Georgia. No apple infesting forms are known from the remaining tier of southern states (Bush 1969). Western apple production, concentrated in the Pacific coastal states of California, Oregon, and Washington, is very important to the economy of this region, contributing over $2 billion annually. Historically, the pest complex of this region has been composed of a single key species, the codling moth, Cydia pomonella L., which directly attacks the fruit, and a number of secondary pests, including scale insects, aphids, leaf hoppers, and spider mites (Hoyt and Burts 1974). The establishment of the apple maggot in the Pacific Northwest region may, however, seriously complicate existing control strategy by necessitating additional cover sprays. The immense damage potential of this tephrytid when uncontrolled has recently been documented in New York by Glass and Lienk (1971), who demonstrated a 78 to 100% loss of fruit in orchards where pesticide application was discontinued. This destructive potential, ineffectiveness of cultural and biological controls, and opportunity for future host race formation provided by a diversity of new, unexploited fruit habitats suggests that the apple maggot might pose a serious threat to apple growers of the Northwest. Its occasional utilization of pear also presents a political if not a biological problem. Pest potential data are currently being gathered. Soil samples collected from two sites where apple maggot adults were trapped during the past year and checked by a wet sifting method (AliNiazee 1974) showed the presence of a large number of the diapausing pupae. This indicates that R. pomonella is capable of sustaining viable populations in western Oregon.

663. AliNiazee, M. T. and J. E. Cranham. 1980. Effect of Four Synthetic Pyrethroids on a Predatory Mite, Typhlodromus pyri, and Its Prey, Panonychus ulmi, on Apples in Southeast England. Environ. Entomol. 9:436-439.--A field trial on apples in southeastern England showed that pre-bloom "pink bud" sprays of 4 synthetic pyrethroids-permethrin, cypermethrin, fenvalerate, and decamethrin, were all highly toxic to the predatory mite Typhlodromus pyri, but had no appreciable toxicity to the dominant spider mite species, Panonychus ulmi. The virtual elimination of the predatory mite at this growth stage of apples led to a marked population increase of P. ulmi later in the same season. The use of these pyrethroids for insect control is incompatible with integrated mite management on apples using T. pyri. Laboratory data supported the field results.

664. Westigard, P. H., P. B. Lombard, R. B. Allen, and J. G. Strang. 1980. Pear Psylla:Population Suppression Through Host Plant

Modification Using Daminozide. Environ. Entomol. 9:275-277.--Two applications of the plant growth regulator daminozide at 2000 ppm, timed approximately 30 and 50 days following full bloom of Bartlett pears, resulted in reduced terminal shoot growth and subsequently in lowered pear psylla (Psylla pyricola Foerster) nymphal densities, and in reduced honeydew fruit damage. Over a 3-yr. period shoot growth was reduced an average of 33%, psylla nymph density and damaged fruit were reduced 35 and 57% respectively, compared to the untreated check.

665. Westigard, P. H., R. B. Allen, and L. J. Gut. 1981. Pear Psylla: Relationship of Early-Season Nymph Densities to Honeydew-Induced Fruit Damage on Two Pear Cultivars. J. Econ. Entomol. 74:532-534.--The relationship of early-season densities of nymphs of Psylla pyricola Foerster to honeydew-induced fruit russet was measured on D'Anjou and Bosc pear cultivars in southern Oregon. Overall fruit injury ratings based on percent downgrading caused by psylla honeydew indicated D'Anjou to be ca. fivefold more susceptible to damage induced by equivalent nymph densities than Bosc. An average nymph density of 1.0 per leaf resulted in ca. 2.5 and 17% downgrading on the Bosc and D'Anjou varieties, respectively. This difference was attributed to the nature of the pear cultivars, with damage being more apparent on the clear-skinned D'Anjou compared with that on the normally russeted Bosc.

666. Jorgensen, C. D., R. E. Rice, S. C. Hoyt, and P. H. Westigard. 1981. Phenology of the San Jose Scale (Homoptera:Diaspididae). Canad. Entomol. 113:149-156.--San Jose scale (Quadraspidiotus perniciosus (Comstock)) phenological events associated with its control in deciduous tree fruit orchards of the western United States was modeled, using the Predictive Extension Timing Estimator (PETE). The model closely simulated adult male activity and first crawler emergence, although spring male emergence was too variable to rely entirely on accumulated degree days from 1 Jan. for management decisions. Pheromone monitoring of spring males improves timing for control of subsequent crawlers when a biofix of 275°D from 1 Jan. is used.

667. Zwick, R. W. 1980. Review of some recent research on entomological pests of the Mid-Columbia area. Proc. Ore. Hort. Soc. 71: 52-57.--Seasonal control of pear psylla with newly registered insecticides is discussed and seasonal effects of intensive psylla programs on beneficial species is compared to an integrated program. Alternative codling moth control programs using trapping out of males and insect growth regulators are reviewed.

668. Zwick, R. W. and G. J. Fields. 1980. Rain Beetle Grub Control in Orchards of the Mid-Columbia, Oregon, Area: Summary of 1974-75 Field Fumigation Tests. Ag. Exp. Sta. Bul. 684. 9pp.--A general review of the distribution and life history of rain beetles

(Pleocoma spp.) injúrious to deciduous fruit trees in the Mid-Columbia, Oregon, area is given with a summary of control attempts with several pesticides and fumigants. Field tests conducted during 1974-75 with the fumigant methyl bromide and Telone using caged Pleocoma grubs indicated effective control can be obtained with methyl bromide in orchard replant sites under dry soil conditions if the proper procedure is followed in fumigant infection and sealing. Growers are advised to consult with local fieldmen and familiarize themselves with current labeling on fumigants before fumigating tree replant sites.

669. Fields, G. J., R. W. Zwick, and H. R. Moffitt. 1981. A Bibliography of Psylla (Homoptera:Psyllidae) on Pear Trees. USDA-SEA Bib. and Lit. of Ag. No. 17. 13pp.--The jumping plant lice or psyllids of the genus Psylla are probably the most important pest of pear fruit trees throughout the world. Three species, Psylla pyricola Foerster, P. pyri L. and P. Pyrisuga Foerster, originated in Europe or Asia Minor. The fourth species, P. hexastigma Hovarth, known to infest pear trees is found in eastern Siberia and Japan. This bibliography covers only the first three species. P. pyri (known as the pear sucker, pear leaf sucker, pear flea, or large pear psylla) and P. pyrisuga (called the common pear psylla or pear psylla) are important European species. P. pyricola is the primary species in southern France and Asia Minor and the only species infesting pear in North America where it has the approved common name of pear psylla. Some reference may be made to P. simulans Foerster; however, determination in 1934 proved this species to be the winter form of P. pyricola (see Lal, 1934). This bibliography consists primarily of work from North American authors, although authors from the following countries are included: Bulgaria, Denmark, France, Germany, Great Britain, Hungary, Israel, Italy, The Netherlands, Poland, Spain, Sweden, Switzerland, the U.S.S.R., and Yugoslavia among others. A two-letter abbreviation, in parenthesis at the end of the citation, is used to indicate the language - other than English - in which the original article is published. The language abbreviation is used only when the language of publication has been indicated in the indexing sources or otherwise confirmed. The language abbreviations are as follows: BU-Bulgarian; CR-Croatian; DA-Danish; DU-Dutch; FR-French; GR-German; HU-Hungarian; IT-Italian; PO-Polish; RU-Russian; SP-Spanish; SW-Swedish; EN-English. If an article has an English summary, one of these abbreviations may be followed by the notation "EN Sum." If an article has been printed in two languages, both abbreviations are given. Foreign citations are difficult to interpret, and we trust the translations presented here are accurate. A complete current and partial retrospective computer search, conducted through the USDA, SEA Current Awareness Literature Service, has been used to review the following indexing sources back through 1970: Biological Abstracts (BA), Bio-Research Index (BRI), Chemical Abstracts (CAO, CAE), National

Agricultural Library Catalog (CAIN), and Commonwealth Agricultural Bureaux (CAB) back through 1976 only. Additional sources include the USDA Library Bibliography of Agriculture (1943-69), various State experiment station publications, journal article citations, and published proceedings of several State horticultural societies.

670. Kirk, D. E., L. C. Jensen, and D. E. Booster. 1980. To Measure Tree Trunk Movement During Mechanical Cherry Harvest. Agr. Eng. 16(11):15-17.--Orthoganally mounted accelerometers were clamped to sweet cherry tree trunks just above the mechanical shaker clamp to measure the direction, extent and frequency of the motion imparted to the tree trunk. Signals from the accelerameters were processed through rectifiers and double integrators to give vector acceleration and displacement. The signals were displayed as a Lissajous figure on an oscilloscope for immediate viewing by the shaker operator in the field and were stored on magnetic tape for later study in the laboratory. Data analysis demonstrated significant inverse correlations between trunk displacement and fruit damage during harvest.

671. Badenhop, A. 1981. Technological problems of fruit juice concentrates. Oregon Agric. Experiment Station Report, 40 pages.--This 40-page report contains the proceedings of a 2-day symposium, with 9 participants from the U.S. and one from Germany. (There is a charge for this report.)

672. Wrolstad, R. E., C. J. Cornwell, J. D. Culbertson, and F. G. R. Reyes. 1981. Establishing Criteria for Determining the Authenticity of Fruit Juice Concentrates. Quality of Selected Fruits and Vegetables. 7:77-93.--The glucose, fructose, sorbitol, and sucrose contents of apple, pear, grape, cherry, plum, peach, strawberry, blackberry, red raspberry, and black raspberry fruit were compiled from the literature and analyzed statistically. The different fruits show characteristic sugar patterns with only moderate variation when considering the differences in geographic origin, variety, maturity, and method of analysis. Investigations in our laboratory utilizing GLC and HPLC reaffirm that sorbitol content and the glucose:fructose ratio are useful screening indices. Sucrose content shows considerable variation due to invertase activity and/or chemical hydrolysis, particularly in processed products. There is considerable quantitative variation in nonvolatile acid composition due to variety and maturity effects. Certain qualitative differences such as tartaric acid in grapes and lactoisocitric in blackberries are of practical use in detecting adulteration in certain cases. The free amino acid and anthocyanin pigment patterns are characteristic of individual fruits but changes in their composition which occur during processing and storage confound their utility in adulteration investigations.

673. Akhavan, I. and R. E. Wrolstad. 1980. Variation of Sugars and Acids During Ripening of Pears and in the Production and Storage of Pear Concentrate. J. Food Sci. 45(3):499-501.--Major sugars (fructose, sorbitol, glucose, and sucrose) and acids (malic, citric, phosphoric, and quinic) of pears were isolated by ion exchange and quantitated by gas chromatography (GC) of their trimethylsilyl derivatives (TMS) during ripening and in the production and storage of pear concentrate. Ripening pears attained maximum sugar content (13.5%) and acidity (6 meq) at a flesh firmness of 6 lb. Apart from a small loss of sucrose at depectivization and concentration stages little change occurred during pear concentrate production. Accelerated storage (16 wk, 36°C) of the concentrate resulted in brown color development and 6% sugar loss. Sucrose hydrolysis and Maillard browning of reducing sugar account for this sugar loss.

674. Cornwell, C. J. and R. E. Wrolstad. 1981. Causes of Browning in Pear Juice Concentrate During Storage. J. Food Sci. 46(2):515-518.--Pear juice was treated with cation exchange resin, PVPP, XAD-4, oxygen, and various resin combinations. Samples were concentrated and increases in browning measured during storage at 37°C. Analytical determinations included α-amino nitrogen, total phenolics, metal ions, ascorbic acid, and dehydroascorbic acid. While XAD-4 and PVPP were more effective in lowering phenolic content and reducing initial color, cation exchange treatment removed amino acids and was most effective in preventing browning and providing flavor stability. Addition of glycine of cation-exchange treated samples restored browning rates. Reductone formation during storage resulted in an apparent increase in ascorbic acid. It was concluded that Maillard browning reactions predominated during storage.

675. Cornwell, C. J., R. E. Wrolstad, and F. G. R. Reyes. 1981. Effect of Sucrose Addition on the Sugar and Sorbitol Composition of Frozen Sweet Cherries and Their Derived Concentrates. J. Food Sci. 47(1):281-283, 290.--Glucose, fructose, sucrose, and sorbitol contents of Van and Black Republican varieties of sweet cherries were determined by high performance liquid chromatography (HPLC) and enzymic analytical procedures. Samples analyzed included frozen fruit, fruit packed as 3.6 parts fruit plus 1 part added sucrose, and cherry juice concentrates derived from the sugar-packed fruit. Cherry fruit showed invert patterns of glucose and fructose and contained trace amounts of sucrose, and 2.6-3.9 g sorbitol/100 g. Sucrose was either not detected or found in trace amounts in samples to which sucrose had been added. There is evidence that sucrose hydrolysis was caused by presence of invertase. The percent sorbitol content could be used to detect addition of sucrose. Results for sugar and sorbitol content as determined by HPLC or enzymic methods were very similar.

676. Wrolstad, R. E. and R. S. Shallenberger. 1981. Free Sugars and Sorbitol in Fruits-A Compilation from the Literature. J. Assoc. Off. Anal. Chem. 64(1):91-103.--The glucose, fructose, sucrose, and sorbitol content of apple, pear, plum, cherry, grape, strawberry, raspberry, blackberry, and peach fruit was compiled from the literature; their range, mean, standard deviation, and percent coefficient of variance were calculated. The individual fruits have characteristic patterns relating to their sorbitol content, glucose: fructose ratio, and sucrose content which are influenced to only a small degree by variety, season, or geographic origin. Processing in many cases has a marked effect on sucrose content.

677. Akhavan, I., R. E. Wrolstad, and D. G. Richardson. 1980. Relative effectiveness of ion-exchange and lead acetate precipitation methods in isolating pear sugars and acids. Jour. of Chrom. 190:452-456.--In investigating the changes of sugars and acids in pears during ripening and processing, a method was needed for their separation, identification, and quantitation. Several workers have used a procedure based on the precipitation of acids as their lead salts from ethanolic fruit extracts followed by recovery of sugars from the residual supernatant; sugars and acids are subsequently analyzed as their trimethylsilyl (TMS) derivatives by gas chromatography (GC). Wagener et al. found the method to be unsatisfactory for quantitation of grape acids and Weissberger et al. reported similar results for cocoa beans. This note compares the effectiveness of lead acetate precipitation and ion-exchange procedures in the analysis of pear sugars and acids.

678. Crabtree, G. D. 1981. Surfactant Interactions with Plant Growth Regulators. Acta Hortic. 120:243.--NAA and daminozide interactions with surfactant concentrations were evaluated in sensitive test systems. Biological activity of these two plant growth regulators was increased with increasing concentrations of X-77. Concentrations of X-77 of 0.05% and greater were supraoptimal in the NAA/cowpea test, possibly as a result of leaf tissue injury.

679. Crabtree, G. D. 1981. Calibration of Sprayers and Dusters. Proc. Ore. Hort. Soc. 72:214-216.--Pesticide application equipment can be easily calibrated by measuring output on a measured area and relating this measurement to output on a standard area (acre, hectare). Output can be measured directly by catch or replacement procedures or can be measured per unit time and related to area by a time/area ratio. This method is useful for application of any formulation type of pesticide.

680. Crabtree, G. D. and M. J. Bukovac. 1980. Studies on Low-volume Application of Plant Growth Substances; Part 1: Ethylene Production, Induced by 1-Naphthylacetic Acid, as a Means of Evaluating Spray Parameters. Pestic. Sci. 11:43-52.--The evolution of ethylene, induced by 1-naphthylacetic acid (NAA), was studied as

a means of evaluating spray parameters using cowpea [Vigna sinensis (Torner) Savi] under defined conditions as a test system. The dose-response curve was linear over the range of 1.4-14 μg per leaf. The marked production of ethylene following treatment with an active auxin, 2,4-D (2,4-dichlorophenoxyacetic acid), and the absence of its production following treatment with an inactive analogue (3,5-dichlorophenoxyacetic acid), established that ethylene production was hormonally induced. The effect of application volumes of 10-100 μl and of droplet sizes of 1-10 μl were evaluated using a constant dose (5 μg NAA per leaf); NAA was more effective when delivered to the leaf in the larger volumes but in the smaller droplet sizes.

681. Brainerd, K. E., L. H. Fuchigami, S. Kwiatkowski, and C. S. Clark. 1981. Leaf Anatomy and Water Stress of Aseptically Cultured 'Pixy' Plum Grown under Different Environments. HortScience 16(2):173-175.--This study examined the leaf anatomy and water stress of Prunus insititia L. cv. Pixy grown in aseptic culture before and after transfer to the greenhouse and grown in a layerage bed in the field. The depth of palisade cells was significantly less in aseptically cultured plantlets than in greenhouse transferred plants, and less in greenhouse transferred than in field-grown plants. Percent mesophyll air space was greater in plantlet than in plant leaves. Upper or lower leaf epidermal cell length of plantlets of field grown plants was not significantly different. Stomatal frequency for plantlet leaves was significantly less (about 150 stomata per mm^2) than that of plant leaves (300 stomata per mm^2). Excised plantlet leaves lost greater than 50% of total leaf water content within 30 min; excised greenhouse leaves lost 50% after 90 minutes.

682. Timmis, K. A., L. H. Fuchigami, and R. Timmis. 1981. Measuring Dormancy: the Rise and Fall of Square Waves. HortScience 16(2): 200-202.--Attempts to measure and interpret the attenuation of electrical square waves in red-osier dogwood (Cornus serica L.) and apple (Malus sp.) indicate that the difficulties of interpreting and obtaining reproducible quantitative data makes them of little value as criteria of dormancy in woody plants.

683. Kobayashi, K., L. H. Fuchigami, and K. E. Brainerd. 1981. Ethylene and Ethane Production and Electrolyte Leakage of Water-stressed 'Pixy' Plum Leaves. HortScience 16(1):57-59.--Ethylene and ethane production and electrolyte leakage were determined during water stress of leaves of asceptically-cultured plum (Prunus insititia L. cv. Pixy). Ethylene production increased to a maximum at about 50% leaf water loss and decreased as water deficit increased. Ethane production and electrolyte leakage were highly correlated, increasing only after 50% water loss to a maximum at about 72% water loss, indicating an increase in cell injury and death.

684. Brainerd, K. E. and L. H. Fuchigami. 1981. Acclimatization of aseptically cultured apple plants to low relative humidity. J. Amer. Soc. Hort. Sci. 106(4):515-518.--Aseptically cultured Malus domestica (Borkh.) cv. Mac 9 plants were exposed to 30-40% relative humidity (RH) for 0 to 6 days. The relative water content (RWC) and percent stomatal closure were measured on leaves excised from plants exposed to low humidity and from greenhouse acclimatized controls. Both RWC and percent stomatal closure successfully monitored acclimatization. The RWC of excised leaves exposed to low RH for 0 or 1 day was significantly higher than that of leaves exposed for 4.5 days or of greenhouse-acclimatized plants. Speed of stomatal closure upon leaf excision increased with the duration of plant exposure to low humidity. The rate of water loss from excised apple leaves was linearly related to the stomatal closure. Aseptically cultured plant (ACP) leaves consistently lost more water than greenhouse leaves at corresponding percentages of stomatal closure. These results indicated that ACP leaves can be acclimatized to low humidity within 4 to 5 days of exposure to 30 to 40% RH and that low humidity acclimatization involved development of an accelerated stomatal response.

685. Fuchigami, L. H., T. Y. Cheng, and A. Soeldner. 1981. Abaxial transpiration and water loss in aseptically cultured plum. J. Amer. Soc. Hort. Sci. 106(4):519-522.--Scanning electron microscopy was used to investigate leaf epicuticular wax of Prunus instititia L. 'Pixie' from aseptically cultured plants before and after acclimatization to the greenhouse. Leaves from plants acclimatized for 2 weeks in the greenhouse had more adaxial wax than those from non-acclimatized (culture flask-grown) plants. Acclimatized plants had more adaxial than abaxial wax. No abaxial wax was observed on leaves of non-acclimatized plants. Stomata were present on the abaxial leaf surface only of both acclimatized and non-acclimatized plants. Epicuticular wax layers surrounded guard cells of acclimatized plant leaves but were not present on non-acclimatized plant leaves. Weight changes in non-acclimatized plant leaves coated with silicon rubber on adaxial, abaxial, and both surfaces indicated that excised leaf water loss occurred only through the abaxial surface. Water loss from plants during the acclimatization process thus may be due to abaxial cuticular and stomatal transpiration.

686. Crabtree, G., D. Richardson, and M. Westwood. 1980. Preharvest sprays for sweet cherries. HortScience 15(3):62.--A two year study of the effects and interactions of preharvest sprays for sweet cherries was conducted to evaluate materials applied for reducing rain cracking and as a harvest aid, Ethephon, antitranspirant and lime were included factorially in a series of treatments sprayed on cherry trees 10-14 days before harvest. When fruit removal force, soluble solids, fruit size, firmness, resistance to cracking, brined fruit quality factors, and water

relations in leaves and fruit were measured, the most significant response was an increase in susceptibility to rain cracking by fruits harvested from trees sprayed with an anti-transpirant. The study also showed a substantial benefit from lime spray for crack prevention without loss of fruit quality.

687. Decker, B. R., D. G. Richardson, and L. W. Martin. 1980. Survival, vigor, and injury of cold-stored strawberry nursery stock in the northwest. HortScience 15(3):67.--Strawberry runner plants of the cultivars "Olympus" and "Totem" were dug through the winter and early spring, stored at 28°F and planted on two dates in late spring. Plants were evaluated for survival and vigor in the field. No differences were observed in the field between the cultivars or among digging dates on the May 1 planting date. On the June 4 planting date there was a marked decline in the survival and vigor of "Totem" from the later digging dates, with a 30% loss on the April 20 digging date. Starch and sugar levels in the crowns and roots at digging declined from Jan. to Feb. then rose as the digging season progressed. Other plants from the same digging dates were grown in the greenhouse and evaluated for root initiation, vigor, apical injury, and crown discoloration (winter injury). Early-dug plants set in the greenhouse showed excellent root initiation and vigor, with no apical damage. Late dug plants showed poor root initiation and vigor with high incidence of apical damage. No correlation was found between the extent of crown discoloration and vigor, survival, size of plant or cultivar.

688. Andersen, P. C. and D. G. Richardson. 1980. A rapid method to estimate water status of fruit. HortScience 15(3):75.--Varieties of cherries, peaches, apples, and grapes were subjected to refractometric (soluble solids) and thermocouple psychrometric (osmotic potential) comparisons. Correlation coefficients generally exceeded -.95. The specific relationship between the two was dependent upon species and cultivar. After a calibration curve is established for a range of maturities, osmotic potential can be estimated from soluble solids. Turgor pressure can be calculated by subtracting the osmotic equivalent of soluble solids from total water potential determined with a pressure bomb. Thus osmotic, total and pressure potentials can all be determined within minutes.

689. Chen, P. M., W. M. Mellenthin, and D. G. Richardson. 1980. A comparative study of 'd'Anjou' and 'Bosc' pears in relation to maturity and postharvest life. HortScience 15(3):94.--A comparative study between 'd'Anjou', a long storage-life pear, and 'Bosc', a shorter storage pear in Hood River Valley, revealed that 'd'Anjous' had higher concentrations of ethanol insoluble matters, titratable acids, and soluble solids than 'Boscs' during preharvest and the postharvest period. 'Bosc' pears had higher levels of internal ethylene and water content compared with 'd'Anjous'. Late har-

vested 'Bosc' were capable of ripening after 10 days storage at -1.1°C. Later harvested 'd'Anjou' required 30 days storage to develop ripening capacity. Early harvested 'Bosc' ripened after 20 days storage while early harvested 'd'Anjou' required 60 days storage to ripen. The development of ripening capacity for both 'Bosc' and 'd'Anjous' was related to the increase in internal ethylene during cold storage which was estimated as 0.3-0.5 ppm for 'Bosc' and 1.5-2.0 ppm for 'd'Anjou'. Internal ethylene of 'Bosc' increased rapidly from 0.02-0.10 ppm to 24-47 ppm after 90 days storage, while 'd'Anjous' increased gradually to 2.4-6.5 ppm. The rapid accumulation of internal ethylene of 'Bosc' during storage might account for the shorter storage life.

690. Chen, P. M. and W. M. Mellenthin. 1981. Effects of harvest date on ripening capacity and postharvest life of 'd'Anjou' pears. J. Amer. Soc. Hort. Sci. 106(1):38-42.--'D'Anjou' pears (Pyrus communis L.) were harvested at weekly intervals for a 3-week period beginning at the start of commercial harvest in the Hood River Valley, Oregon. Late-harvested fruit at flesh firmness of 5.9 to 5.4 kg ripened with fair to good quality following 30 days storage at -1.1°C. Fruit harvested at optimum flesh firmness of 6.4 to 6.1 kg required 60 days of postharvest chilling to ripen with quality. The development of ripening capacity corresponded to the increase in internal ethylene to 1.5-2.0 ppm during cold storage. Dessert quality of late-harvested fruit declined after 90 days of storage while quality of optimum-harvested fruit continued to improve until 150 days in storage. Flesh firmness and ethanol-soluble matters indicated that fruit harvested over the 3-week period were of different maturities. Concentrations of titratable acids and soluble solids varied among different harvest groups.

691. Chen, P. M., W. M. Mellenthin, S. B. Kelly, and T. J. Facteau. 1981. Effects of low oxygen and temperature on quality retention of 'Bing' cherries during prolonged storage. J. Amer. Soc. Hort. Sci. 106(5):533-535.--'Bing' sweet cherries (Prunus avium L.) harvested at commercial maturity were commercially packed and stored in 6 low-O_2 controlled atmospheres (CA) at -1.1°C for 35 days and in a second study were stored in either 1.5% O_2 and 0.8% CO_2 or 12% O_2 and 10% CO_2 at 5.6°, 3.3°, or 1.1°C for 23 days. Fruit stored at 0.5-2.0% O_2 with 0.03% CO_2 maintained a higher percentage of very green stems, brighter fruit color, and higher levels of titratable acids than those stored in air at -1.1°C for 35 days. High CO_2 atmospheres conserved fruit brightness and TA level but did not prevent stem discoloration. The only effect of lowering temperature from 5.6° to 1.1° was a slight increase in fruit firmness after storage.

692. Mellenthin, W. M. and P. M. Chen. 1981. Softening and ripening of 'd'Anjou' pears as influenced by simulated transit temperatures.

J. Amer. Soc. Hort. Sci. 106(1):35-38.--'d'Anjou' pears (Pyrus communis L.) harvested at optimum maturity with flesh firmness of 6.4 kg were stored at -1.1°C for 3 months before being subjected to different intermittent and simulated transit temperatures. Fruit held for 3 days at 1.7 or 7.2°C did not soften significantly at transit temperature of -1.1°C for 4 weeks, whereas fruit held for 3 days at 12.8°C softened from 6.0 kg to 4.0 kg after 4 weeks at -1.1°C. After 4 weeks at 1.7°C, fruit held for 3 days at all intermittent temperatures softened 5.0-3.5 kg. Simulated transit temperatures above 7.2°C casued softening to less than 2.5 kg within 3 weeks. The additive effects of brief intermittent and 4-week simulated transit temperatures indicated that the higher the temperature, the more softening of 'd'Anjou' pears occurred. Fruit held for 3 days at 1.7, 7.2, or 12.8°C and 4 weeks at -1.1 or 1.7°C softened rapidly to 1 kg within 8 days in the ripening environment at 20°C, in conjunction with accelerated rates of respiration and ethylene production. However, softening preceded climacteric rises in ethylene and respiration of fruit kept 4 weeks at -1.1°C.

693. Mellenthin, W. M., P. M. Chen, and S. B. Kelly. 1980. Low oxygen effects of dessert quality, scald prevention, and nitrogen metabolism of 'd'Anjou' pear fruit during long-term storage. J. Amer. Soc. Hort Sci. 105(4):522-527.--'d'Anjou' pears (Pyrus communis L.) harvested at optimum maturity, 6.4 kg flesh firmness, were stored in 0.5, 1.0, 1.5, 2.0, 2.5 and 5.0% O_2 with CO_2 concentration were maintained at 0.01 to 0.03%. Other samples were stored in commercially recommended concentrations of 2-2.5% O_2 and 0.8-1.0% CO_2 (i.e., regular CA), and conventional air storage. Temperatures of -1.1°C (30°F) were maintained in all cabinets throughout the 8 month storage. Oxygen concentration below 1.5% maintained the dessert quality of fruit and reduced the incidence of superficial storage scald after 8 months of storage. Fruit stored at 1.0% O_2 for 8 months did not develop scald even after returning to air storage for 30 days. Oxygen concentration above 2% without CO_2 had no beneficial effect on dessert quality or scald control. Regular CA storage also maintained dessert quality, but had only slight effect on scald control. Fruit stored below 2% O_2 softened slower, lost titratable acids and free amino acids more slowly, and accumulated protein more slowly than samples stored at higher O_2 levels for 8 months. Regular CA fruit changed similarly to those from the 1.0% and 1.5% O_2 treatments. Overall fruit metabolism in 0.5% O_2 was markedly retarded during the 5 to 8 month storage period.

694. Facteau, T. J. and K. E. Rowe. 1981. Response of sweet cherry and apricot pollen tube growth to high levels of sulfur dioxide. J. Amer. Soc. Hort. Sci. 106(1):77-79.--Pollen tube growth of 'Tilton' apricot (Prunus armeniaca L.) was reduced by exposure to SO_2. An empirical model, based on modified spline functions,

described the decrease in pollen tube growth due to increasing dose (hours exposure x concentration of SO_2) expressed on logarithmic scale. The response curve, based on this analysis, was "S-shaped" with a decrease from 98.5% pollen tube growth (PTG) for unexposed pollen tubes, based on percent of the style that the longest pollen tubes had grown to 91.6% at ℓn dose 4.0. These was then a very sharp decrease in PTG to about 45% at ℓn dose 5.7, then a gradual curvilinear response to <1% PTG at the maximum ℓn dose of 7.7. There data strongly indicate that there is a threshold response to SO_2 with respect to PTG. Response of 'Van' PTG in 'Napoleon' sweet cherry (P. avium L.) styles was similar to apricot, but not as definitive because of greater within year variation and differences between years. In one year (1979), a spline function model of PTG in cherry suggested a threshold value at about ℓn dose of 2.1, while in another year (1978), there was a nearly linear decrease in PTG with increasing ℓn dose.

695. Lombard, P., J. Hull, Jr., and M. N. Westwood. 1980. Pear cultivars of North America. Frt. Var. Jour. 34(4):74-83.--Origin of pear cultivars grown in the U.S., pear production in various parts of the U.S. and by cultivars, and the utilization, harvest and storage characteristics of major cultivars are presented. Description of major cultivars and new cultivars are described.

696. Lombard, P., K. Smith, and J. Struck. 1981. Weed control in pome fruit orchards. Ore. Hort. Soc. Proc. 75:5-10.--Reasons for weed control are to prevent soil water and nutrient competition, to prevent flower competition during bloom, improve ground radiation to lessen frost, to aid rodent control, and to replace cross cultivation in close plantings. Discussed various methods of weed control in orchards plus advantages and disadvantages. Considerations of herbicide method to control weeds are: 1) delegate a responsible person to plan program, 2) plan and calibrate sprayer, 3) confine program to small acreage at beginning, 4) follow up with contact herbicides, and 5) use proper equipment. Results of a study comparing the cost and tree performance on young pear trees of herbicide vs. cultivation program indicated $145 to $173 respectively in annual cost per acre and 64% yield increase to the advantage of the herbicide program. Herbicide program was designed for first year and non-bearing orchards and established orchards with comparative herbicide cost.

697. Lombard, P. B. 1980. Production of quality Bosc pears. Ore. Hort. Soc. Proc. 71:18-22.--Bosc is susceptible to fireblight, pear scab, stony pit virus, winter damage, storage rot, frost damage, difficult to train, harvested late, and prone to alter-

nate cropping. But Bosc is precocious, sets well, does not show fruit marking, handles well, and requires less pruning than Bartlett and no fruit thinning. Southern Oregon produces about 70% of the western U.S. production. Seedling rootstocks of Calleryana, Bartlett, and Winter Nelis beside the OH x F rootstocks have performed very well. Bosc require about twice the rate of N (200-250 lbs. per acre) than Bartlett trees. Bosc fruit should be harvested 140-165 days after bloom at a range of 18 to 14 pounds pressure. Stop-drop sprays of NAA at 25 grams per acre is effective for 14-21 days. Bosc store very well for 180 days at 30°F with a relative humidity of 90 to 94%. Pre and post harvest fungicides are necessary for long storage. CA storage at 2% to 2.5% O_2 and .8% to 1% CO_2 at 30°F can extend storage for another 2 months.

698. Lombard, P. B., P. H. Westigard, R. W. Zwick, W. M. Mellenthin, and G. C. Martin. 1981. Effect of prebloom oil applications on pear fruit set and the possible mode of action. HortScience 16(1):54-55.--Dilute sprays of 4, 8 and 16% Volck Supreme oil at dormant and repeated at delayed dormant to mask pear trees against psylla, Psylla pyricola (Foerster), oviposition delayed bloom slightly, while 2% applications in the field advanced bloom less than 1 day. Dormant pear branches dipped under laboratory conditions in oil at concentrations of 8% and higher caused injury to vegetative buds and slight injury to flowering buds. Single and repeat field applications of oil at 2, 4 and 8% caused no reduction of fruit set or cropping of 'Anjou', 'Bartlett', 'Comice', 'Bosc', and 'Seckel' pear trees, and in some cases increased fruit set on 'Anjou' trees. Hormonal analysis of oil-treated buds indicated a slight increase of gibberellin (GA) and a reduction of abscisic acid (ABA) levels.

699. Lombard, P. B., J. Wolfe, and M. D. Collins. 1980. Evaporative cooling as an Oregon alternative in frost protection system of pears. Agric. Exper. Station Circular of Information 681.--Oregon trials in evaporative cooling for bloom delay for frost avoidance of pears indicated that the cheapest is a spray or impact sprinkler system designed for .15 inches/hour or 50-60 gal/min/acre. These systems could serve also for icing for frost protection and summer irrigation. The system should be operated intermittently 1 & 1/2 to 2 minutes every 5-minute period to obtain 20 gal/min/acre for proper evaporative cooling. The cooling should begin at a base temperature of 45°F controlled thermostatically from Jan. 15 to Apr. 15 to delay bloom for 14 days. Other methods or systems tried, i.e., growth regulators and white latex paint, have been less effective for bloom delay. Factors affecting bud temperature depression with evaporative cooling were, in order of decreasing importance, air temperature, vapor pressure deficit, wind velocity and least, solar and net radiation. Bloom delay affected several components of tree

performance. Low tree yields occurred the year after bloom delay due to poor return bloom. The bloom reduction was caused by the higher seed content in fruit from late blooming trees. Fruit maturity was delayed only 2 & 1/2 days while fruit size was delayed 8 days for every 14 days in bloom delay. Misting and sprinkling delayed pear psylla egg laying and lowered leaf N. More importantly, delayed bloom increased the chance of fireblight infection if bloom occurs when daily mean temperature exceeds 60°F. Because of poor tree performance and increased fireblight infection, bloom delay is not a recommended practice for avoiding frost hazards in pear production.

700. Strang, J. G., P. B. Lombard, and M. N. Westwood. 1980. Effects of tree vigor and bloom delay by evaporative cooling on frost hardiness of 'Bartlett' pear buds, flowers, and small fruit. J. Amer. Soc. Hort. Sci. 105(1):108-110.--Controlled freezing tests showed no hardiness differences between comparable floral developmental stages on weak and vigorous 'Bartlett' (Pyrus communis L.) pear trees. Bloom delay through evaporative cooling resulted in a loss of hardiness beyond that found earlier in the season on non-misted trees for similar stages of development, although a certain degree of frost protection was gained through bloom delay.

701. Strang, J. G., P. B. Lombard, M. N. Westwood, and C. J. Weiser. 1980. Effect of duration and rate of freezing and tissue hydration on 'Bartlett' pear buds, flowers, and small fruit. J. Amer. Soc. Hort. Sci. 105(1):102-107.--Freezing studies on 'Bartlett' pear (Pyrus communis L.) bouquets of buds, flowers, and small fruit showed injury increased with decreasing temperature, increasing developmental stage, and increasing duration of frost. At the minimum temperature, 30 and 60 minutes of frost exposure in all stages increased injury, however, in the small fruit stage injury at -2°C increased for up to 2 hours exposure. The effect of freezing rate was dependent on minimum temperature and dry florets were injured slightly more than florets misted just prior to freezing.

702. Strang, J. G., P. B. Lombard, and M. N. Westwood. 1980. Effect of simulated frost injury on fruit development in three pear cultivars. J. Amer. Soc. Hort. Sci. 105(1):63-65.--Simulated frost injury to ovaries at intervals after full bloom significantly increased fruit malformation, reduced fruit weight, and increased fruit drop in 'Bartlett', 'Bosc', and 'Comice' pear (Pyrus communis L.). Time of injury did not affect fruit weight and malformation in most cases, but did significantly affect fruit drop. Significant positive correlations were found between fruit weight and seed content, while negative correlations were found between fruit malformation and seed content for all cultivars.

703. Bukovac, M. J., M. N. Westwood, and D. G. Richardson. 1979.

Effect of temperature on biological activity of ethephon as indexed in sweet cherry. HortScience 14(3):83.--Effect of temp on biological activity of ethephon was assessed by following inhibition of bud expansion of excised terminal shoots and by reduction of fruit removal force (FRF) of detached 'Napoleon' fruit. Inhibition of bud expansion was progressively greater with increasing temp over the range of 15 to 30°C at concn of 10 to 250 mg L^{-1}. Similar results were obtained for promotion of gummosis in excised terminal shoots. The effect of temp was greater during the post-absorption than absorption (24 hr through cut shoot surface) period. FRF of field-treated (500 mg L^{-1}) fruit was significantly decreased as incubation temp (15-30°C) was increased. Ethylene evolution from ethephon-treated shoots and fruit increased significantly with an increase in temp. The apparent energy of activation was about 30 and 33 kcal $mole^{-1}$ from shoots and fruit, respectively.

704. Chaplin, M. H. and M. N. Westwood. 1980. Nutritional status of 'Bartlett' pear on Cydonia and Pyrus species rootstocks. J. Amer. Soc. Hort. Sci. 105(1):60-63.--The nutritional status of 'Bartlett' pear growing on P. communis seedling, Old Home x Farmingdale (OH x F), and several Pyrus species seedling rootstocks was compared to those growing on Bartlett seedling rootstock at 3 locations over a 2-3 year period. Few significant differences were found in leaf element content of scions growing on Bartlett seedling rootstock and those on the rootstock clones or other Pyrus seedlings. Nitrogen was higher in the scions on 5 of the OH x F rootstocks but did not seem related to yield efficiency. Generally the leaf element content of Mg and Mn was lower and Fe higher in leaves of trees growing on the OH x F clonal rootstocks when compared to trees on Bartlett seedling. Nutrient uptake and passage through graft unions appeared unrelated to the degree of graft compatability, based on the similarity of nutrient levels of 'Bartlett' scions grafted directly on quince rootstock and those with an Old Home interstem. Root system genetics seems to be the controlling factor of nutrient uptake rather than the interstock.

705. Westwood, M. N. and H. O. Bjornstad. 1981. Winter injury to apple cultivars as affected by growth regulators, weed control method, and rootstocks. J. Amer. Soc. Hort. Sci. 106(4):430-432.--Effects of cultivars, rootstock, and long-term growth regulator and herbicide treatments on above-ground tree damage from a December 1972 freeze were recorded soon after the freeze and again 7 years later. Ultimate injury was greatest with 'Jonared' and least with 'Golden Delicious' apple (Malus domestica Borkh.) in the growth regulator plot, while in the herbicide plot it was opposite for the 2 cultivars. There was not a good relationship between injury to specific plant parts (flower buds, spurs, leaders, and lower trunks) observed soon after the freeze, and

ultimate tree mortality. Growth regulator treatments significantly increased freeze damage to flowers and spurs, but ultimate tree mortality was reduced by daminozide sprays. Clean cultivation increased flower and spur mortality but did not reduce yield or increase tree mortality compared to the sod treatment. Trees on Malling (M) 5, M 7 and M 9 rootstocks showed greater initial turnk injury than those on seedling roots, but only those on M 9 showed significantly greater ultimate mortality.

706. Roberts, A. N. and M. N. Westwood. 1981. Rootstock studies with peach and Prunus subcordata Benth. Frt. Var. Jour. 35(1):12-20.--The first study was with clones of Prunus subcordata Benth. on seedling roots of peach, myrobalan plum, Marianna plum, and P. americana Marsh. After four years, trees on peach root were the largest and those of P. americana were smallest; however after 10 years the trees on all of the plum stocks were larger than those on peach. Fruit yield per tree and yield efficiency after 10 years was somewhat better on peach and P. americana than on myrobalan or Marianna roots. The second study was with peach cultivars on rootstocks of peach and several types of plum, with interstems of P. subcordata clones and of Yellow Kroos plum. Tree size was largest with peach and St. Julien A roots and smallest with P. tomentosa Thunb. and Myrobalan B plum. Tree size as related to P. subcordata interstems was largest with L-IX clone and smallest with K-I clone. Yield efficiency was highest for peach and P. amercana rootstocks and lowest for Myrobalan B. Mineral nutrient content of peach leaves was generally high with peach and St. Julien A stocks and notably low with Marianna.

707. Westwood, M. N. 1981. A history of pear growing in Oregon and the Northwest. Acta Horticulturae 124: .--Pear growing in the Pacific Northwest is a young industry, relative to western Europe. When Alexander MacKenzie traversed the Canadian Rockies and "discovered" the west coast of North America in 1793, there were no pears of any kind growing here, nor were there any white settlers. Likewise, when Lewis and Clark overwintered in western Oregon in 1805, the situation was unchanged. By 1825, Dr. McLoughlin, chief factor for the Hudson's Bay Company, was planting fruit trees at Fort Vancouver, Washington. Probably pears were among them. Young David Douglas was at that time collecting wild fruit species and other plants of the Northwest on behalf of the Royal Horticultural Society of London. In 1836 and shortly after, Dr. Marcus Whitman established pears and other fruits at his Christian mission near Walla Walla, Washington, and four years later, the father of J. H. Stewart of Medford brought pear trees from Hannibal, Missouri to establish the first pear orchards in the Rogue River Valley of Oregon. In 1847, the Lewelling fruit tree nursery was established just south of Portland, and in 1850, Henry Settlemier established a nursery at Tangent, Oregon, just east of Corvallis. These nurseries soon made available pear

trees in sufficient numbers to plant many commercial orchards in western and southern Oregon. The Oregon Agricultural College was established in 1868, and in 1872 listed the first classes in fruit growing. The Oregon Agricultural Experiment Station was established in 1888 and the first bulletin on pear and fruit culture was published by E. R. Lake in 1889. Research on pear culture has continued since that time.

708. Westwood, M. N. 1980. Regional and national interstem and rootstock studies with apple. Compact Fruit Tree 13:102-103.--Research is underway in North Central regional project (NC-140) in which ultimately twenty-six states and informally two Canadian provinces will participate. The International Dwarf Fruit Tree Association is cooperating in these rootstock research projects. The first test involving Millerspur Delicious and Empire cultivars with Malling (M. 9) interstems on three rootstocks (MM 111, Ottawa 11 and Antonovka) were established in ten states in 1976. The second and third trials to be planted in 1980 and 1983 respectively, will consist of a spur mutant of Delicious on twenty-five different rootstocks. Not only will they include the new East Malling - Long Ashton (EMLA) stocks, but also new ones developed in Poland (P series), Canada (Ottawa series), Michigan (MAC series), New York (CG series), Ohio (AL 800), Missouri (C 6), Oregon (OAR 1) and Russia (Budagovsky series). These trials will be established at research stations in all the major apple regions of the U.S. and Canada. These trials will run for ten years, during which precocity, production efficiency, disease resistance, hardiness, anchorage, and dwarfing will be evaluated. Also propagation techniques will be developed for the best of these rootstocks.

709. Westwood, M. N. and H. O. Bjornstad. 1980. Mineral nutrient content of leaves of several apple (Malus) species. Compact Fruit Tree 13:67-71.--Malus species are indigenous to Europe, Asia Minor, Asia and North America. Most of the rootstocks used in North America, however, are derived from domestic cultivars or from Malus sylvestris Mill. the European wild apple. While such stocks have provided considerable diversity, e.g. in dwarfing, percocity and pest resistance, the wealth of worldwide genetic material of Malus in general has not been used to its potential in solving certain persistent problems related to rootstocks. One such problem is that of providing the tree with essential mineral nutrients under a variety of soil and climatic conditions. The present study was done to determine differences in nutrient element content of species from Europe, Asia and North America grown at the same site. Such a study could indicate solutions to problems of both deficiency and excess for specific elements. Major cations (K, Ca, Mg) tended to be highest in Asiatic species and lowest in North American species, while the minor cations (Mn, Fe, Cu, Zn) were generally highest with European types and lowest with those of North America.

710. Westwood, M. N. 1980. Oregon's pear research program. HortSci. 15:698.--The history of pear research in Oregon for the past 70 years is briefly reviewed, including general comments on pear rootstocks, pear species, and pear decline studies.

711. Westwood, M. N. 1980. 'Autumn Blaze' ornamental pear. HortSci. 15(6):830-831.--Since the release of Pyrus calleryana Dcne. cv. Bradford by the U.S. Department of Agriculture (4) this species has become popular as a street tree and in landscapes in areas where it is hardy. Because of problems in maturing 'Bradford' trees in the nursery, with subsequent problems of dieback in storage and poor transplanting success, some nurseries have sought selections of P. calleryana with all of the good characteristics of 'Bradford' but with better growing and handling traits. Also in some climates 'Bradford' does not exhibit red leaf coloration in the fall, and a number of selections have been made that are more colorful. With the need for an early maturing, hardy red-leafed P. calleryana in mind, testing began in 1972 with Oregon Pear Rootstock (OPR) 250, a clone observed in 1969 to show striking fall leaf coloration, even on vigorous nursery trees. This clone, now named 'Autumn Blaze' was patented (Patent Number 4591) by Oregon State University in 1980.

712. Westwood, M. N. 1981. Horticulture for the 1980s: A balanced approach. Oregon Horticultural Society Proc. 72:54-59.--One of the foremost general goals of the farmer is to maintain or increase net profit. That's easy to say, but how can it be done? Currently production costs are rising faster than prices. For most crops, about 80% of production costs are fixed and do not vary whether production is 1 ton or 10 tons per acre. That being the case, the most dramatic way to increase profit is to increase yield per acre, because that markedly reduces costs per ton of produce. Thus recently all segments of horticulture have tried more intensive culture, involving higher plant densities and more critical use of such factors as irrigation, fertilizers, herbicides, pest control and mechanization. Using apple as an example, it was shown that increasing yield per acre greatly reduced cost of production and thus increased net returns. As an extreme example, one Hood River apple grower in 1979 produced more than 50 tons of fruit per acre on a small acreage, using intensive culture. The fruit was of high quality and the price was high, giving the grower a phenomenal net profit of about $30,000 per acre. The concept of limiting factors is discussed, followed by a stepwise procedure for optimizing the cropping system.

713. Westwood, M. N. 1981. Graft compatibilities of pear with several related rootstock genera. Compact Fruit Tree 14:151-152.--Various degrees of graft compatibilities have been reported among Pome genera of the subfamily Pomoideae, some such trials being reported by the early Greeks more than 2000 years ago. Recently, in Oregon, we started studies with both seedling materials and

clonal lines. This is a brief progress report of what we have learned during the first two years. In this study, the least compatible combinations were Crataegus and Cydonia, Crataegus and Malus, Pyrus and Cydonia, and Malus and Cydonia. However, the combinations that look satisfactory at two years might fail as the plants age. Ultimately, we will probably have to select clones among these genera to obtain rootstocks of uniform behavior. The use of clonal apple stocks for pear was also tested. Winter Banana apple was used as an interstock because it has been reported by nurserymen and propagators to be more compatible with pear than other apples. Prior to this trial, we grew Comice grafted to Winter Banana on M. 2 rootstock. After seven years, this tree is fruiting normally, even though it is in low vigor and very dwarfed. Note that trees on M. 9 were smaller than those on EMLA 9. Judging from both tree size and survival rate, EMLA 111 was less compatible than any other apple rootstock tried. The largest and most vigorous trees were on EMLA 26 stock. In comparing Comice with and without the Winter Banana interstock, the trees with the interstock were nearly twice as large as those without the interstock. Yet, the survival rate was high for both. At this stage, we can only say that Winter Banana interstock shows a beneficial influence. These studies are being continued and will be reported in full after several more years.

714. Westwood, M. N. 1981. Pear germplasm of the new national clonal repository: Its evaluation and uses. Acta Horticulturae 124: .--Populations of all of the world's Pyrus species are represented, plus more than 1000 cultivars and rootstock clones. Studies and observations indicate that genes exist within the genus for resistance to: pear decline, fire blight, bacterial canker, Fabraea leaf spot, crown gall, Phytophthora root rot, pear psylla, pear leaf blister mite, wooly pear aphid, codling moth and root lesion nematodes. Also found were genes for tolerance to lime-induced chlorosis, wet soils, dry soils, acid soils, cold winters and warm winters. Other genetic traits in the collection regulate bloom date, bud-chilling requirement, leaf margin and shape, tree size (dwarfing), fruit skin color, fruit stone cells, deciduous calyx, carpel number, and fruit size. Some work has been done on the relation of leaf polyphenols to pest resistance and to the taxonomy of the genus. Rootstock efficiency and mineral nutrient uptake have been the subject of intensive study with this germplasm collection.

715. Thompson, Maxine. 1981. Filbert breeding - grower participation. Proc. Nut Growers Soc. Ore., Wash., and B.C. 66:94-97.--The importance of new filbert cultivars for expansion of the industry is stressed and the objectives of the breeding program are reviewed. A program for grower participation in advanced selection trials as well as in the planting of untested hybrid seedlings is explained.

716. Thompson, Maxine M. 1981. Hazelnut culture in Oregon, U.S.A. J. New Zealand Tree Crops Assn. 6(3):20-32.--This paper presents an overview of the hazelnut (filbert) industry in Oregon, including production figures, climatic requirements, soils, propagation, rootstocks, varieties, flowering and pollination, planting, care of young trees, weed control, pruning and training, fertilizer requirements, diseases, pests, and harvesting.

717. Thompson, Maxine. 1980. New filbert cultivars and the potential for micro-propagation. Proc. Nut Growers Soc. Ore., Wash., and B.C. 65:98-102.--The scope and progress of the breeding program is described. Participation of grower-cooperators for advanced selection trials and for hybrid seedlings was solicited. Detailed information is given on one very promising selection, W4-6. The potentials of microculture as a method to rapidly multiply new selections was discussed.

718. Thompson, Maxine M. 1981. Utilization of fruit and nut germplasm. HortScience 16(2):132-135.--This paper was part of a symposium on utilization of germplasm. First, a brief historical review of the National Fruit and Nut Germplasm Repository system was given. Numerous examples are discussed of the types of studies both applied and basic science that have been made on the Pyrus germplasm collection in Oregon. These serve as an example of the multiple functions, aside from breeding per se, that are possible when a good plant germplasm collection is available. The other example, which demonstrates the value of a wide diversity of germplasm is the 35 year apple scab resistance breeding program (Purdue-Rutgers-Illinois) which utilizes exotic, non-edible species of Malus as sources of resistance. The importance of the availability of as wide array of genetic diversity as possible was stressed as a necessary requisite for the development of fruit and nut varieties adapted for future needs.

719. Chaplin, M. H. and M. N. Westwood. 1980. Effects of Pyrus species and related genera rootstocks on mineral uptake in 'Bartlett' pear. Journal of Plant Nutrition 2(3):335-346.--Variability of leaf element content of 'Bartlett' pear growing on 15 different pyrus species and related genera rootstocks was not great and did not vary appreciably from that expected from intraspecific rootstocks under the soil and environmental conditions of the experiment. The genetics of the scion seemed to be the determinant in leaf element content of the scion, although it is possible that under greater acidic or basic soil Ph conditions than the 6.1 Ph of the experiment, the rootstocks could have more or less of an effect. The data also suggested that nutrient passage through the graft union was unrelated to the degree of compatability between rootstock and scion in pear.

720. Lagerstedt, H. B. and M. M. Thompson. 1980. Characteristics and performance of 'Ennis' and 'Butler' filberts. Proc. Nut Growers Soc. Ore., Wash., and B.C. 65:73-82.--Of 5 "Grower Selections", Ennis and Butler appear to be the best as regards yield when compared to Lansing, Jemtegaard No. 5, and Ryan. The latter three are no longer recommended for propagation whereas Ennis and Butler are being considered for expansion. Ennis is a large nut for the inshell trade with over 50% in the 2 largest size grades as compared to the standard, 'Barcelona', which averages 12% in these grades. Butler is designed to replace the standard pollinizer, 'Daviana', a cultivar that is poor yielding and very susceptible to the big bud mite and eastern filbert blight.

721. Lagerstedt, H. B. 1980. Filbert pollination, propagation, and rootstocks. Proc. Nut Growers Soc. Ore., Wash., and B.C. 65: 103-112.--There was an unusually long period of cold weather during November and December of 1978 and January of 1979 resulting in delayed filbert flowering . Of the 82 days of these 3 months, 72 recorded below freezing temperatures. February was very wet and warm resulting in a male bloom period that preceded the female bloom. The implication of these events is discussed and compared to other, more normal pollination seasons. An update type report is given on various propagation being researched: Cuttage, grafting and budding. The history of developing a non-suckering filbert rootstock is covered along with the place such a rootstock might occupy in the future.

722. Lagerstedt, H. B. 1980. Orchard sanitation methods to contain eastern filbert blight. Proc. Nut Growers Soc. Ore., Wash., and B.C. 65:116-120.--Heavy pruning of limbs expressing symptoms of eastern filbert blight (EFB), and removal of severely infected trees, failed to stop the spread of this disease to non-infected trees in the orchard. The grower selections, Ennis, Butler, J-5, and Lansing were all shown to be susceptible to EFB. Tree kill trials indicated that the simplest method involved making axe frills around the trunk of the tree and spraying or painting concentrated glyphosate into the frills. Treatments made during November, December, and January were more effective than those made in February.

723. Lagerstedt, H. B. 1980. 'Ennis' and 'Butler' filberts. HortScience 15(6):833-835.--'Ennis' and 'Butler' are the first filbert (Corylus avellana L.) introductions to be made from the Pacific Northwest in over 40 years. Cultivars more recently introduced from the northeastern U.S. and Canada have not proved to be satisfactory in Oregon and Washington. About 85% of the U.S. filbert production comes from a single cultivar, 'Barcelona', introduced from Europe in 1885. Another 10% of the production comes from 'Daviana', a cultivar which functions primarily as a pollinizer for 'Barcelona'. 'Ennis' is being introduced as a

main crop cultivar to replace 'Barcelona' for the in-shell trade. 'Butler' is introduced as a pollinizer to replace 'Daviana'. The new introductions will, in part, be described by comparing them to the cultivars they are expected to replace.

724. Lagerstedt, H. B. 1981. The dynamic filbert industry in the Pacific Northwest. Proc. Nut Growers Soc. Ore., Wash., and B.C. 66:92-93.--Filbert production trends during the past 50 years indicate a healthy industry and modest annual growth. Future projections indicate that this growth may increase more rapidly and that yields will also increase. Current propagation methods place a limit on speed of expansion and eastern filbert blight looms as a threat to the industry. These are just two of many areas of research needed to aid the anticipated increase.

725. Lagerstedt, H. B. 1981. Filbert tree training and pruning. Proc. Nut Growers Soc. Ore., Wash., and B.C. 66:70-79.--This paper covers the basic principles involved in pruning and training and more specifically how they relate to the filbert tree. A brief history of filbert pruning is presented along with recent research and efforts to mechanize filbert pruning. Detailed tree growth results and flowering habits have a strong influence on how the trees should be trained and pruned. Height of tree heading has been increased in recent years to aid mechanization processes and orchard travel. Filberts should receive minimal pruning during their first 3 years in the orchard; sufficient only to train. Until age 10 to 12, convenience pruning only should be adequate. After 12 to 15 years of age, filberts should be pruned to stimulate new wood on which large crops will ultimately be borne.

726. Lagerstedt, H. B. 1981. Ennis - A large filbert. Fruit Var. J. 35:107-109.--'Ennis' is a high yielding cultivar that bears a majority of its nuts on small sized flower clusters recurring on catkin peduncles. 'Ennis' is designed to replace 'Barcelona' as a large in-shell nut. 'Ennis' not only has a greater yield, but it has far fewer blanks and a higher percent kernel.

727. Lagerstedt, H. B. 1981. Butler - A filbert pollinizer. Fruit Var. J. 35:109-111.--'Butler' is introduced to replace 'Daviana' as a pollinizer for 'Barcelona'. 'Daviana' is low yielding, partly due to its susceptibility to big bud mite and partly to predation by birds and rodents that harvest it selectively due to its thin shell. 'Butler' corrects these faults of 'Daviana'. In addition 'Butler' appears to be exceptionally hardy, has high tree vigor, is easy to propagate, and has a very clean kernel.

728. Lagerstedt, H. B. 1981. A new device for hot-callusing graft unions. HortScience 16:529-530.--The hot-callusing device involves a length of 2" PVC pipe with transverse slots cut to receive graft unions. The pipe is heated by internal cables and

escape of warmed air is retarded by a strip of foam rubber placed on top of the pipe covering the slots and unions. The uniqueness of the system lies in the fact that heat is localized at the graft union only. Scion buds remain at ambient air temperatures as do the root systems which are healed into sawdust to keep them moist. The hot-callusing device has proved to be an excellent aid to dormant season grafting.

729. Stebbins, Robert L. 1981. Filbert orchard design as it affects pruning. Proc. Nut Gr. Soc. Ore. and Wash. 66:90-91.--No abstract submitted.

730. Stebbins, Robert L. 1980. Orchard spacings for cherry and peach. Proc. Ore. Hort. Soc. 71:200-203.--No abstract submitted.

731. Stebbins, R. L. 1981. A review of rootstocks for stone fruits. Proc. Ore. Hort Soc. 72:23-30.--Usually desirable and usually undesirable qualities of available rootstocks and selected new rootstocks not yet available were listed for sweet cherry, sour cherry, prune, and peach. Available rootstocks were: for sweet cherry; P. avium (mazzard) seedlings, mazzard clone F-12-1, mahaleb seedlings, sour cherry clones 'Stockton Morello', 'North Star', for sour cherry; mahaleb seedlings, mazzard seedlings, for plum; peach seedling, myrobalan seedlings, myro. 29C, marianna 4001, marianna 2624, P. cistina, P. tomentosa, for peach, seedlings from Halford, seedlings from Lovell, 'Siberian C', 'Nemaguard', P. tomentosa, P. besseyi, P. americana, clones 'St. Julien A', 'St. Julien X'. Stocks not yet available included; M x M stock, OCR 2, M x M 14, M x M 97, 'Colt', for prune, 'Pixie', Myrobalan 2-7.