ABSTRACTS OF REPORTS FROM THE

48th ANNUAL WESTERN COOPERATIVE SPRAY PROJECT

Imperial Hotel, Portland, Oregon

Hilton Hotel, Portland, Oregon

January 16, 17, 18, 1974

These abstracts of progress reports on research conducted on the principal insect and disease pests of tree fruits and nuts in the states of California, Colorado, Idaho, Montana, Oregon, Utah and Washington, and the Province of British Columbia, are not intended to be recommendations of the project. Official recommendations can only be made by public service entomologists and plant pathologists from their respective areas.

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48th Annual Western Cooperative Spray Project

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S E C T I O N I

LEPIDOPTEROUS INSECTS

CODLING MOTH -- APPLES

M. T. AliNiazee

Codling moth populations in apple orchards of western Oregon were monitored by using pheromone traps baited with Codlemone. Based on the trap catches, two spray treatments were applied in a moderately infested orchard. Imidan 0.5 lb AI/100 gal., Zolone 0.38 lb AI/100 gal., Guthion 0.25 lb AI/100 gal., Gardona 0.5 AI/100 gal., Furadan 0.5 lb AI/100 gal., and Dursban (Larsban) 0.19 lb AI/100 gal. obtained good control of codling moth.

Everett Burts

Aerial applications of undiluted Guthion and Zolone EC's through Beecomist dispensers provided commercial control of codling moth while similar treatments with Phosvel allowed 5.3% infested fruits. None of these treatments caused injury to fruit or foliage. Biological control of McDaniel mite in all plots was not disrupted by these sprays.

William B. Hudson

The application of water through overtree sprinkers at the rate of 0.1 inches per hour for four hours each evening from April 26 to September 10 gave significant control of the codling moth. At harvest time, 4.3% of the apples were injured by codling moth in the sprinkled trees compared with 43% fruit injury in unsprayed check trees.

R. W. Zwick and G. J. Fields

Lorsban was about 1/2 as effective as azinphosmethyl on an active ingredient basis. On a plot sprayed with four cover sprays, Imidan and chlorphenamidine were the most effective, followed by phosalone, Phosvel and formetanate. Red delicious variety was about three times as attractive as Golden Delicious to attack.

CODLING MOTH PLUS OTHER INSECTS AND MITES -- APPLES

H. F. Madsen, H. G. Peters and J. M. Vakenti

Six orchards were studied under a pilot pest management program. Codling moths were monitored with pheromone baited traps and other pests, including San Jose scale, fruittree leafroller, *Campylomma verbasci*, white apple leafhopper and spider mites, were sampled at specific times of the season. Growers were advised on the most economical spray programs as indicated by sample counts and best estimates of population level--economic injury thresholds. Cost-benefit ratios of the programs are still being worked out, but preliminary assessments indicate fewer than normal control applications with no increase in crop loss.

CODLING MOTH -- APPLES, WALNUTS, AND PLUMS

Phil A. Phillips

Codling moth populations on apples, walnuts, and plums in Tulare County in the San Joaquin Valley of California represent distinct host races rather than simple normal variation within the species. In order to characterize these host races, characteristics of adaptive significance such as diapause induction criteria and host preference phenomena have been examined. Initiation of diapause with respect to natural field conditions of photoperiod and temperature occurs in the order of plum, walnut, and then the apple race. Host preference in oviposition isn't as strongly

(Phil Phillips, continued)

evolved as response to photoperiods. The apple race strongly prefers the apple host, while the walnut and plum races show preference to the walnut host. A possible phylogeny for these host races is suggested: the plum race has arisen from the walnut race, while the walnut race has arisen from the apple race. Thus, there is a host determined succession, with the plum race being the furthest removed from the original apple race.

CODLING MOTH -- CHERRY

Edward W. Anthon

Codling moths caged on cherries infested the fruit. Cherry fumigation experiments using methyl bromide for two or three hours on first instar codling moth larvae gave 100% control. Fumigated Lambert, Bing and Van cherries were evaluated by Dr. Mel Couey for quality and he found no noticeable injury.

R. W. Zwick and G. J. Fields

Codling moths caged on cherries successfully completed their development in about two months. Eggs were laid on leaves and fruit. The larvae gnawed on cherry pits during their development. Moths were taken in pheromone traps in cherry orchards, but no naturally occurring infestations were noted in The Dalles.

CODLING MOTH -- PEARS

John L. Joos, W. C. Batiste, C. S. Davis, A. Berlowitz

In the 1972 and 1973 codling moth seasons Volck supreme oil sprays were applied to determine the mortality rate on codling moth egg hatch. Timing for oil applications was made by the use of sex-pheromone traps and egg development in field oviposition cages.

In 1972 the first cover spray was applied after peak flight in pheromone traps at which time egg hatch was beginning in the oviposition cages. First cover oil treatments were followed by a second spray at 7 and 14 days, cover alone, and controls in separate replicated applications. The second and third cover sprays were based on peak flight activity.

Cover plus seven days gave the best results at 0.178 percent against control's 19 percent infested fruit. In 1973 tests included first, second, and third cover sprays followed with another spray seven days after each cover and checks. The oil was applied at the rate of four gallons per acre and treatments were replicated four times.

Oil has a good potential for codling moth control when its activity is primarily directed against egg stage. Optimum timing of sprays can be realized by the proper use of sex-pheromone traps and field oviposition cages.

P. H. Westigard

Only one report was received which claimed economic loss from this pest. The report was from a grower using overtree sprinklers for irrigation. There was a general shift from Guthion to Imidan for codling moth control but the change did not increase loss due to this pest. Materials tested against this pest which provided good control included: Imidan 50 w, Guthion 50 w, Zolone and Furadan.

CODLING MOTH -- PLUMS (FRESH PRUNES)

R. E. Rice

Full cover sprays of Imidan at 1 lb. 50 W, Guthion at 0.5 and 0.25 lb. 50 W, and Parathion at 1.0 lb. 25 W were applied against first brood codling moth in Casselman plums. Applications were timed using pheromone traps and the degree-day accumulation method. Results of three separate tests showed what Imidan and the higher rate of Guthion gave good to excellent control, while the lower rate of Guthion and parathion showed somewhat less, but still acceptable, control.

CUTWORMS -- TREE FRUIT

J. Franklin Howell

Blacklight traps located in six separate districts of the lower Yakima Valley caught ca. 120 species of noctuids but only ca. 15 species were common or abundant. The spotted cutworm, *Amathes c-nigrum*, was the most abundant species. There were two distinct generations of *A. c-nigrum*; adults of the first generation were flying between April 30 and July 12, the second generation between July 25 and November 1. *A. c-nigrum* was most abundant in orchards with grass and weedy-grassy ground cover. However, sizable populations were present in all orchards surveyed *A. c-nigrum* has a minimal four-day pre-oviposition period. About 35% of the females caught were unmated, the remainder had 1-9 spermatophores. There was a correlation between mating frequency and age of the population. Damage by *A. c-nigrum* to fruit trees appears to be facultative. Cases where 40% of the buds on five-year-old trees were damaged were observed. Removal of 50% of the buds did not result in crop loss. Removal of 75% of the buds caused a reduction in number of fruit but no significant reduction in the weight of the crop. A synthetic pheromone was considerably less attractive than blacklight traps. A second forumlation of the same material showed no activity.

EUROPEAN RED AND TWO-SPOTTED MITES -- NECTARINES

J. E. Dibble and J. H. LaRue

Sixteen different miticide treatments were evaluated at four and 12 days after application. On ERM - Plictran, Omite,PGSO-2 Narrow Range Oil, Carzol, Galecron and DPX-3654 provided the best control. Orthene did not look good at four days but did show very good knock down at 12 days. A mixture of Colloidal sulfur and Kelthane also performed well. On two-spotted mites the same materials were the top performers but also included Supracide.

FRUIT TREE LEAF ROLLER -- PEARS

Everett Burts

Sprays of TH6038 and TH6040 were active against larvae of all ages. Most were killed at the initial moult after treatment. Some survived to produce partial pupae which failed to moult to adults. TH6041 caused larvae to drop from trees to the ground.

LEAFROLLER

M. T. AliNiazee

The filbert leafroller *Archips rosanus*, (which is also known as European leafroller) is one of the important fests of filberts in Oregon. This pest is susceptible to many bio-control agents, particularly parasites. In unsprayed orchards, the percent parasitization was about 30%.

A. rosanus is susceptible to *Bacillus thuringiensis*. Both the laboratory and field tests indicate that *B. thuringiensis* is fairly effective against this pest, and may prove to be a very useful insecticide in filbert pest management programs.

NAVEL ORANGEWORM -- ALMONDS

J. E. Dibble and R. E. Rice

An evaluation for ovicidal activity was made with Sevin, Galecron and PGSO-2. Galecron displayed a high degree of activity with the oil showing good initial effect. Sevin was generally effective and is worthy of repeat tests.

J. E. Dibble and R. E. Rice

Tests were applied in the field for control. However, plot size, sampling techniques and counting procedure resulted in a rather low degree of confidence. The place rating of those chemicals used was possible and showed Supracide and Guthion to be superior to Sevin with Dipel (dust and spray) and Galecron of little value.

PEACH TWIG BORER -- ALMONDS

R. E. Rice

Dormant sprays of chlordimecron (8 oz. 92 SP), Supracide (1 qt. 2 E), Diazinon (1 lb. 50 W), Lorsban (1/2 pt. and 1 pt. 4 E), Dibrom (1 pt. 8 E), and Phosvel (1.5 pts. 2.7 E), in combination with 1.5 gal. Volck Supreme oil/100 gals. spray gave good to excellent (> 93%) control of peach twig borer larvae in almonds. Imidan at 1 lb. 50 W plus oil and Furadan (1 pt. 4 F) plus oil resulted in marginal control under the same conditions.

PEACH TWIG BORER -- PEACH

Edward W. Anthon

Two synthetic pheromones developed for peach twig borer on peach and almond were tested in the field, but neither pheromone attracted the male moth as effectively as the live females. Further testing is going to be conducted this coming season in cooperation with Dr. Wendell Roelofs of the Geneva Station in New York.

SPOTTED CUTWORM -- APPLE

Edward W. Anthon

Eleven materials were tested both in the greenhouse and in the field for control of cutworms. Under caged conditions in the greenhouse the following materials looked good: Thiodan, Lannate, Dursban, Toxiphene, Dieldrin, and Orothene. In the field seven baits were tested and only Stauffer N-2596 gave satisfactory control.

S E C T I O N II

Orchard Mites

PHYTOPHAGOUS MITES

W. W. Barnett and B. G. Zoller

Pear rust mite populations were estimated during Fall, dormant period, and growing season using top shoot, spur and fruit inspection techniques, respectively, in several 20-acre blocks under different spray programs. Results suggested that 1) a diligent dormant spur survey can predict heavy populations for which a cluster bud treatment may be advisable to avoid fruit damage; 2) early season populations of about 50 or more mites per fruit caused eventual damage, regardless if treatments eliminated the population before russeting was visible; and 3) control of populations in top fruit was more difficult than control on bottom fruit during the growing season.

Everett Burts

Delayed dormant aerial sprays of Diazinon plus Superior type oil applied through Beecomist dispensers provided commercial control of European red mite in two test plots.

J. E. Dibble and S. Sibbett

Carzol, Galecron and Plictran were the best materials at both five and nine days post treatment on ERM. Omite looked very good at nine days. The rust mite was equally controlled by the same materials. A low population of 2-spot did not allow a good comparison, however, it appeared that all materials except sulfur, trithion and one of the oil treatments performed well. The effect of the different materials on the predaceous mite *M. occidentalis*, showed Galecron, Plictran, Kelthane and sulfur to be the most harsh at five days. At the nine day count Carzol, Galecron, Plictran and Trithion were the most damaging.

R. S. Downing

Delayed dormant applications of endosulfan plus oil or ethion plus oil were as effective as dormant lime sulfur applications for the control of these pests.

R. S. Downing

Citrazon, Plictran, SD14114 and R28627 were all effective against European red mite and low in toxicity to predaceous mites. UC44858 was also effective against European red mite but highly toxic to predaceous species. A fungicide, TCMTB, was ineffective against European red mite.

Stan Hoyt

In an orchard with high initial populations of European red mite S15126 and Vendex failed to give control, PGP103 gave a substantial knockdown one week after treatment, but only UC44858 provided good control.

J. D. MacNeil and R. S. Downing

Diffuse reflectance spectroscopy was shown to be a useful method for measuring feeding injury by mites.

R. E. Rice

Vendex at 2 oz AI, UC-44858 at 8.0 and 16.0 oz. AI, and R-28627 at 6 oz. AI/100 gal. gave good initial and residual control of *Tetranychus urticae* over a six-week period. Phytoseiid mites were apparently not killed outright by these materials, but their populations were greatly reduced following treatment, apparently due to lack of prey and starvation. PGP-102 and PGP-103 at 3.2 oz. and 4.8 oz. AI/100 gave fair initial knockdown of 2-spotted mites, but populations re-bounded within three weeks. Phytotoxicity was also noticeable at these rates on peaches. Linseed oil at 1.0% and 2.0% and PGP-102 and PGP-103 at 1.4 oz. AI/100 did not provide acceptable control.

Pat Weddle and Dick Bethell

During mid-late May 1973, 75 pear orchards in El Dorado County, California were monitored for pear leaf rust mite, *Epitrimerus pyri* (Nal.). Tenty-five fruit were sampled from a 20-acre block and observed under a 20 X stereoscope. The presence or absence of rust mite and the level of rust mite per individual fruit were recorded. Levels of from 1-10 rust mite/fruit were considered lightly infested, 11-50 = moderately infested, and 51 or more = heavily infested. Treatment was recommended if more than ten fruit were lightly infested or if five or more fruit had a moderate or heavy infestation. A light infestation left untreated led to noticeable fruit russetting by harvest. Treatment of the light infestation prevented this damage. Immediate treatment of a moderate infestation was necessary to prevent russetting. Where heavy infestations were observed, damage had already occurred. This monitoring procedure proved to be a practical and effective tool in evaluating rust mite populations in El Dorado County pear orchards.

P. H. Westigard

Pear rust mite (eriophyid species) was the most destructive pest on pear during 1973. Prebloom application in the delayed dormant period failed to give control in many orchards and severe, down-grading russet was present on fruit by mid-May. After this period Plictran provided good control. At present, we believe the problem due to late emergence of the rust mite from overwintering quarters rather than to resistance. Studies will be conducted in 1974 on critical timing and substitute materials. New materials tested during the summer which showed good activity against the rust mite include: PG-103, Vendex and R28627.

P. H. Westigard

The most troublesome species of spidermite on pear during 1973 was the two-spotted mite. Severe defoliation occurred in a few orchards but the general use of Plictran prevented widespread injury. European red mites were well controlled with Fundal-Galecron but resurgences in two-spot population were noted where this material was used. The predator mite, *Typhlodromus occidentalis*, was scarce in pear orchards even in those where destructive pesticides were not used. Several new organo-tin acaricides were tested with Shell's Vendex, Procter-Gamble's PG-103 and Stauffer's R28627, all giving excellent control.

R. W. Zwick and G. J. Fields

Oil alone was as effective as oil + Lorsban in controlling overwintering ERM eggs. Promising new compounds against ERM were: PGP-103, UC-44858 and U 36, 059 and Vendex. The above, except U 36,059 were also effective against two-spotted mite. The addition of the activator NF-17 decreased knockdown when used with Plictran and chlorphenamidine.

R. W. Zwick and G. J. Fields

Pear rust mites are becoming a problem in Anjous even where Morestan and several chlorphenamidine applications have been used against psylla. Endosulfan as a cover spray did not reduce rust mites to low levels in August.

PREDACEOUS MITES

M. T. AliNiazee

Initial surveys were conducted to determine the relative abundance of different mite species in apple orchards of Willamette Valley. Among the most common species encountered were apple rust mite, yellow spider mite, and European red mite. Considerable numbers of McDaniel and two-spotted spider mites were also found in certain orahards. A predatory mite, *Typhlodromina arborea* was found in high numbers in almost all untreated orchards. This mite seems to be the most important biological control agent of phytophagous mites in unsprayed orchards. *Zetzellia mali* was found occasionally and only in small numbers. *Metaseiulus occidentalis* was not found in the orchards surveyed.

R. S. Downing

An organophosphorus resistant strain of *A. fallacis* from Michigan failed to survive introduction into an Okanagan Valley orchard, probably due to the dry climate.

Stan Hoyt

Applications of UC44858, Vendex, PGP103, Phosvel, K840 and Dursban allowed varying degrees of survival of *Typhlodromus occidentalis*, but S15126 appeared to be highly toxic to this predator.

R. W. Zwick and G. J. Fields

UC-44858, formetanate (3#/A), and U36,059 were toxic to predatory mites. Formetanate (1-1/4#/A), dicofol, PGP-103, chlorphenamidine, Plictran (2 oz/100) allowed predator survival and eventual resurgence three to four weeks after application. Where formetanate and azinphosmethyl were used in the first two cover sprays, predators never resurged. Imidan, Diazinon, Omite and low rates of Plictran used early allowed predators to survive and exert control over spider mites in August to September. A four-spray insecticide program on apples allowed predators to control McDaniel mites without an acaricidal application for the first time in an orchard under study for five years.

S E C T I O N III

Other Insect Pests

APHIDS -- Apples

Everett Burts

Delayed dormant aerial sprays of Diazinon plus Superior type oil applied through Beecomist dispensers gave commercial control of apple and apple grain aphids. Aerial ULV sprays of Phosphamidon produced excellent hills of apple, apple grain and rosey apple aphids. The residual control was shorter than that provided by ground sprays but aphid predators also returned sooner than they did after conventional treatments.

CAMPYLOMMA VERBASCI -- Apples

Stan Hoyt

A single application of Guthion, Thiodan, Phosphamidon, Pencap M or Sevin at petal fall gave good control of this species. Zolone and Imidan did not provide adequate control.

CHERRY FRUIT FLY

M. T. AliNiazee

Seasonal emergence of the western cherry fruit fly, *Rhagoletis indifferens*, in the Willamette Valley, Oregon was determined by placing ten three-foot square ground emergence cages in two heavily infested mixed variety cherry orchards. The first fly was caught on May 26, 1973, and the emergence continued until July 1, with a peak around June 15.

Based on the emergence data, the test chemicals were applied on June 2, 1973. Five treatments of Diazinon, two treatments of Cygon, and two treatments of Furadan were required to obtain 100% clean cherries.

COLEOPTEROUS PESTS -- Apple and Pear

R. W. Zwick and G. J. Fields

Preplanting fumigation of future tree planting sites with Telone indicated excellent kill of *Pleocoma* grubs within the disturbed soil backfilled into the hole, but little or no penetration of Telone through the undisturbed soil bordering the excavation. Methyl bromide injected under existing trees killed the trees and did not control completely the grub population.

Two generations of *Xyleborus dispar*, the Ambrosia beetle, were observed this year. The second flight occurred in late July-early August and progeny from this generation completed development and are overwintering in the galleries as teneral adults.

EUROPEAN WHITE BIRCH SHADE TREES -- Birch Leafminer

R. L. Collins

Five insecticides were applied as incorporated soil furrow treatments to the base of 10-12 feet one inch caliper birch trees as they were starting to leaf out on March 3, 1973. Leaf counts of mined leaves were made on May 24, 1973. The application rates and percent leaf miner control are listed below for each material: aldicarb 10G, 2.5 lbs AI/A, 92%; Orthene 75sp, 5.0 lbs AI/A, 60%; Orthene 75sp, 10.0 lbs/A, 70%; dimethoate 10G, 2.0 lbs/A, 80%, dimethoate 2EC, 2.0 lbs/A, 83%.

GREEN STINK BUG (new cherry disorder) -- Cherry

Edward W. Anthon

Under caged conditions in the greenhouse Carzol and Parathion plus Nu film gave good control of this insect. Handgun and speedsprayer applications of Thiodan, Parathion or the combination of these materials applied from May 3 to May 19 gave good control of green stink bugs.

PEAR PSYLLA -- Pears

Dick Bethell

During the 1972 season Guthion 50% wettable powder was applied in a three spray codling moth control program on acre-sized blocks in five Sacramento River pear orchards at rates ranging from 1 to 4 pounds in 100, 400 and 800 gallons of water per acre. The purpose was to demonstrate that codling moth, spider mite and pear psylla control could be accomplished with low rates of Guthion and low or intermediate gallonages. The dilute sprays were applied with 1% supreme oil and the concentrate sprays with 4% supreme oil. Pear psylla were monitored by counting infested shoots out of 20 top shoots collected in August and September and by taking 50 beating tray samples per block in August, September and December. Shoots with lacewing eggs and the number of lacewing per 50 beats were also recorded. The December beating sample showed that overwintering psylla numbers were greater where the heavier rates of Guthion were used. The least number of pear psylla were recovered in those blocks where the August lacewing beating tray counts were the heaviest, which were the blocks where the least amount of Guthion was applied.

J. A. Beutel, W. O. Reil, and C. S. Davis

Young pear trees on different rootstocks were subjected to varying levels of pear psylla for five years. Total shoot growth, height and trunk circumference were determined to measure the effect of psylla levels on pear tree growth. Early season psylla reduced growth twice as much as mid-season psylla. Growth reduction was proportional to psylla population. Psylla-free trees grew nearly twice as much as trees subjected to heavy (5-20 psylla/shoot) psylla population. Bartlett pear trees on *P. calleryana* rootstock were reduced most in growth by heavy psylla.

Everett Burts

U36509 and ZR777 were effective against pear psylla nymphs as summer handgun sprays on pear. ZR777 injured tender foliage, especially in shaded portions of Bartlett and d'Anjou varieties. Several other materials tested were not effective against this pest.

Aerial sprays of undiluted pesticide forumlations continued to show promise for control of pear psylla. Dormant and delayed dormant applications of Galecron, Fundal, Perthane, Thiodan or Zectran each in combination with Superior type oil were more effective applied through Beecomist dispensers than through standard boom and nozzle equipment. Summer aerial applications of Galecron or Fundal EC at 2 qts/acre were not very effective in early season but provided fair to good control later in the season during warm weather.

(Pear Psylla, continued)

G. J. Fields and R. W. Zwick

Preseason lab tests showed endosulfan (with and without oil) to be effective against overwintered adult female psyllids; however, field tests proved the opposite. U36,059 (with and without oil) proved to be slightly less effective in the field. For the first time in Hood River two applications of Perthane + Thiodan were necessary to achieve excellent control of overwintered adults. Oil applied at the delayed dormant season substantially reduced egg deposition. The best early season control of nymphs was obtained with two Perthane + Thiodan sprays followed by Morestan at pink and chlorphenamidine at petal fall. A delayed dormant of U36,059 + oil followed by U36,059 at petal fall also gave good nymph control. The most effective cover season materials were chlorphenamidine alone and in combination with Imidan or Manzate 200. Materials giving the poorest adult control were CA6900, Supracide, Phosvel, Uni-K840, CELA W524, Nexagan, Lorsban + oil and Red top oil + Diazinon premix. Poorest nymph control was from S-15126, AC99,876 and Pyrenone. The most promising new compounds tested were U36,059, UC44858, the juvenile hormone ZR777 (the most effective J. H. tested to date) and the agricultural white wash See White.

Short interval overtree irrigation as the only means of reducing honeydew damage was again tested on a small scale and produced results equal to our poorest commercial control program.

The yellow jacket, *Vespula arenaria*, caged with pear psylla on a Bartlett pear completely eradicated nymphs, adults, and eggs of psylla within several weeks. No evidence of psylla was found two months after the wasp colony died out.

R. D. McMullen

A pilot study of pest management was introduced into eight commercial pear orchards. At intervals, critical for each species, pear psylla and other insects and mites were sampled. Base upon sample counts and best estimates of population level--economic injury thresholds, growers were advised of the most economical control measures. Fewer control treatments were used by the growers than normal and insect and mite injury was less than usual. Costs, including costs of sampling were reduced.

P. H. Westigard

For the first time since the initiation of the dormant valley-wide psylla control program psylla densities reached near destructive numbers in many Rogue Valley orchards. The timing of this critical spray appeared to be good, so it may be that the pest is developing resistance to Perthane. This aspect will be evaluated this winter. Summer control of the pear psylla was obtained with Fundal-Galecron though even this material failed in some cases to prevent fruit marking. The most promising new chemicals are American Cyanimid's 36059 and Zoecon's ZR-515 and ZR-777.

SAN JOSE SCALE -- Apple

Everett Burts

Delayed dormant aerial sprays of Diazinon plus Superior type oil applied through Beecomist dispensers produced sufficient kills of San Jose scale on young apple trees to be considered as a substitute to airblast spraying when ground treatments cannot be applied.

Stan Hoyt

In an orchard with moderate to heavy populations of San Jose scale, three summer sprays of parathion were required to protect the fruit from infestation in the absence of delayed dormant sprays. Three sprays of Phosvel also provided good protection whereas similar programs of Diazinon and Pencap M did not adequately protect the fruit. Two sprays of parathion or three sprays of Diazinon, Pencap M or Phosvel gave excellent control of scale crawlers on new wood.

(San Jose Scale, continued)

Pears

P. H. Westigard

The severity of loss due to the San Jose scale decreased during 1973, but the pest still managed to take a substantial toll of late picked varieties. In addition to the prebloom sprays, growers emphasized summer control using Parathion in combination with their codling moth and mite control materials. Delayed dormant application of some materials provided economic control of San Jose scale through to the end of the first summer generation (July). Included in this group of pesticides were Supercide, Dursban, Fisons 12789, and Diazinon. Full season control with the one spray was obtained with Supercide, Supercide plus oil and Dursban.

In a second test, pesticides were applied in three summer sprays against high scale density. The materials that gave satisfactory results were Furadan and Parathion. Furadan was the only material to give outstanding control of both San Jose scale and the codling moth.

R. W. Zwick and G. J. Fields

Excellent control of overwintering scale was obtained with several oils alone and lower rates of oil with several organophosphates on cherries. Lorsban exhibited more toxicity to scale crawlers on apple fruit than azinphosmethyl.

THRIPS

R. W. Zwick and G. J. Fields

The most promising application for reducing western flower thrips damage to Golden Delicious and Newtownapple appears to be a bloom application of formetante. No undue honeybee toxicity was observed if applied when bees were not foraging. A pink or petal fall application also gave reduced fruit marking, but do not appear as effective as the bloom application.

WESTERN CHERRY FRUIT FLY

F. L. Banham

One application of dimethoate 40 EC, 10 fl. oz. per 100 al., or 200 gal. gave effective control of western cherry fruit fly for 34 days. Treatment of the lower half of cherry tree foliage was as effective as treating whole tress. Painting undiluted dimethoate EC in bands on trunks, limbs and branches gave unsatisfactory control and was also phytotoxic.

WESTERN AND BLACK CHERRY FRUIT FLIES

F. L. Banham

In a mixed population of black and western cherry fruit flies on bitter cherry, *Prunus emarginata*, Pherocon ICPY traps baited with Maggo Attractant caught about twice as many flies as unbaited Pherocon traps, yellow sticky boards and unbaited Sectar I traps. Seclur attractant increased catches by Sectar traps. Maggo Attractant was more attractive to males than females. In sweet cherries, baited and unbaited Sectar I traps caught about twice as many flies as yellow sticky boards. Seclur attractant did not increase the attractiveness of Sectar traps.

WESTERN FLOWER THRIPS

J. E. Dibble and J. H. LaRue

Evaluations made on shoot terminals showed Lannate, Cygon and Mesurol to be excellent. Very close in performance was HOE-2960 and Dursban. Those other materials showing obvious effect were Imidan and initially only Diazinon. Another test did not show Lannate to be as outstanding as reported above but did show Orthene and Carzol to be excellent with Supracide and Carzol having some possibilities.

S E C T I O N IV

Spray Residues, Compatibility, Phytotoxicity, Bee Poisoning and Pollination, Concentrate Spraying and Occupational Exposure

D. L. Coyier and S. B. Kelly

The occurrence of streptomycin-resistant strains of *Erwinia amylovora* has stimulated and renewed interest in the search for alternative bactericides for control of this bacterium in the field. An unpublished report by A. H. Epstein (Iowa State University, Ames, Iowa) stated that certain copper-containing bactericides were less phytotoxic to the fruit of the apple cultivar Jonathan when Manzate 200 (a coordination product of zinc ion and manganese ethylene bisdithiocarbamate, 80% WP, mfd. by E. I. duPont Company) was added to the spray tank.

During the 1972 growing season, we tested this combination by spraying single limbs on both Bartlett and D'Anjou pear cultivars. We used Manzate 200 at the rate of 1 1/2 lb/100 gal and a liquid copper bactericide (Citcop or TC904) supplied by Cities Service Company at the rate of 1 qt/100 gal. Sprays were applied at pink (April 5), petal fall (May 1) and two covers (June 27 and July 24). An examination of the fruit at harvest time indicated that fruit on the sprayed limbs had superior finish when compared with fruit on unsprayed limbs of the same trees. The sprayed fruit had noticeably smoother finish.

The experiment was expanded and enlarged in 1973 to include Kocide 101 (Cupric hydroxide, 56% WP), Microcop (50% metallic copper) and Dithane M-45 (equivalent of Manzate 200, but manufactured by Rohm & Haas Company). The copper compounds were sprayed on single limbs of Bartlett and D'Anjou pear cultivars, both alone and in combination with safteners. We were also interested in the effect of exposure, therefore, each treatment was applied on a limb at the cardinal points of the compass (N, S, E, & W). Sprays were applied on April 6 (pink), May 1 (petal fall), May 17 and June 8 (cover sprays). An evaluation of russet was made on July 27, 1973 by rating fruit on each limb according to a scale developed by J. A. Beutel (University of California, Extension Service, Davis, California). The rating scale was as follows: 0 = no russet, 1 = 10% lenticels of fruit russeted, 3 = 30% of lenticels of fruit russeted and 5 = 50% or more lenticels of fruit russeted. We observed no significant difference in russet due to exposure but marked differences among treatments were apparent. The results were shown in the following tables:

Table 1. The effect of various treatments on fruit lenticel russet of D'Anjou pear.

Treatment	Average Russet
Check	0.48
Manzate 200	0.75
Microcop	1.70
Kocide + Manzate 200	2.08
Citcop + Manzate 200	2.10
Microcop + Dithane M-45	2.15
Microcop + Manzate 200	2.25
Kocide	2.43
Citcop	2.53
LSD .05 =	0.49

(D. L. Coyier and S. B. Kelly, continued)

Table 2. The effect of various treatments on fruit lenticel russet of Bartlett pear.

Treatment	Average Russet
Manzate 200	0.45
Check	0.50
Microcop + Manzate 200	1.13
Microcop + Diathane M-45	1.38
Kocide + Manzate 200	1.45
Microcop	1.63
Citcop	2.05
Citcop + Manzate 200	2.30
Kocide	2.53
LSD .05 =	0.53

Fruit lenticel russet on Citcop-sprayed limbs was severe in 1973, and the addition of Manzate did not significantly reduce it. A russet rating above 0.50 is not commercially acceptable. None of the copper treatments, with or without dithiocarbamate fungicide, resulted in an acceptable level of fruit russet during 1973. The contrast between the results of the 1972 and 1973 seasons was outstanding and emphasizes the importance of environmental effects on the development of phytotoxicity due to application of copper treatments on pear fruit.

J. E. Dibble and R. E. Rice

Six different low volume sprayers and one duster were evaluated in separate tests for coverage. Since Navel Orangeworm requires special coverage factors water soluble and fluorescent dyes were used as an aid. Fluorescent dye tests showed almost all units and spray rates to be satisfactory in target surface ratings. The water soluble dyes, however, appeared to be more discriminatory. Coverage inside the split hulls was more difficult. These latter tests also showed Kinkelder, AgTec and Spraymaster to perform the best with an Air-O-Fan duster showing good possibilities.

G. J. Fields and R. W. Zwick

Two Beecomist nozzles mounted in the air stream of an Orchardmaster "32-5" sprayer delivering 4 GPA and a Windmill "350" delivering 50 GPA were compared to the full dilute (300-760 GPA) application of the Orchardmaster "32-5" for seasonal control of pear psylla. Control was virtually equal in percent honeydew damaged fruit in all comparisons. Seasonal psylla populations average higher in both types of concentrate spraying. Severe fruit damage occurred to Anjou pears closest to the discharge of the last 4 GPA application of chlorphenamidine EC. Concentrate (50 GPA) oil application at dormant was less effective against San Jose scale than the full dilute (400 GPA).

No differences in eventual spider mite control on Red Delicious apples were found between the 50 GPA and the 400-635 GPA programs. The full dilute produced slightly faster immediate knockdown.

Stan Hoyt

Five applications of Phosvel at 1 pound per 100 gallons of water to Rome apples caused extensive proliferation of the lenticels on the fruit. Three applications of Phosvel at 2 pounds per 100 gallons of water resulted in very heavy deposits on Red Delicious but no apparent damage.

R. E. Rice

A 94.5% emulsifiable formulation of linseed oil was tested at 1.0, 2.0 and 4.0 gal./100 gal. water for phytotoxic effects on Red Top peaches, Independence nectarines, Laroda plums, and Texas almonds. The 1.0% rate did not result in detectable phytotoxicity; mite control at this rate was poor. Marginal leaf necrosis, tip burn, general chlorosis, and leaf drop occurred on all varieties at the 2.0% and 4.0% rates, with symptoms most severe on plums. The smooth skinned fruit (plums and nectarines) tended to accumulate gummy oil residues on the lower fruit surfaces, while pubescent fruit (almonds) accumulated excess residues and dirt on upper fruit surfaces.

S E C T I O N V

Pheromones

H. F. Madsen -- *Archips rosanus*, apple

Archips rosanus males were attracted to traps baited with various combinations of *cis*-11-tetradecenyl acetate and *cis*-11-tetradecen-1-ol. Attractants in polyethylene caps were more effective than in rubber caps.

R. W. Zwick and G. J. Fields -- Cherry fruit fly, cherries

The Zoecon-attractant traps caught only 30% as many flies as the standard unbaited yellow sticky board traps in backyard cherry trees.

Dennis J. Culver and Martin M. Barnes -- Codling moth, walnuts; Navel orangeworm, walnuts

Our research for 1973 consisted of:

1) a field evaluation of experimental codling moth male attractant caps and experimental traps supplied by Zoecon Corp.
2) a field study with the Pherocon CM caps and Pherocon IC traps in walnuts for the purpose of indexing population levels, correlating damage with various population levels, making spray decisions, and timing of sprays for maximum effectiveness.
3) a field evaluation of various techniques for indexing the activity of populations of the navel orangeworm, which included the use of Pherocon IC traps baited with live virgin females, light traps, bait pails, on-tree nut sampling and sampling of ovipositional activity.

J. D. Eves and J. D. Chandler -- Oriental fruit moth, peaches

Oriental fruit moths and codling moths were surveyed in the lower Yakima Valley with sex pheromone traps. Over 1,000 traps were placed in 9,500 acres of apples and pears and 200 traps were placed in about 1,200 acres of peaches. Trap catches were stored on computer tape and processed through a SYMAP program which drew a map of the area and plotted the trap locations. Catch density was indicated by a symbol that become increasingly darker as the number of moths caught increased. Copies of the maps were sent to cooperating growers to be used as a guide for applying spray applications. The data was collected on Tuesday of each week and was in the growers' hands by noon Friday. The maps helped improve spray timing, pointed out areas of infestation, showed migration patterns, and indicated the effectiveness of spray applications.

D. O. Hathaway, L. M. McDonough, and D. A. George -- Codling moth

Two systematic series of derivatives of (E,E)-8,10-dodecadien-1-ol (8,10-D) were synthesized and tested in the field for their ability to inhibit attraction to the sex pheromone, 8,10-D. In field tests, the inhibitors and 8,10-D were impregnated on separate rubber septa in the same traps. Among these, the order of inhibitor potency was ethyl ether > acetate > propyl ether > propionate.

D. O. Hathaway, H. R. Moffitt, and M. Beroza -- Codling moth

An encapsulated formulation of a "mating inhibitor," the acetate of (E,E)-8,10-dodecadien-1-ol, was applied by helicopter to a 1-acre block of apples at 3 gm actual/acre and evaluated on the

basis of the response of released sterile males to pheromone or to traps baited with virgin females. In this first field test, an 83% reduction in response was observed the first day post-treatment but this effect was reduced to 23% the second day. In a second test on a 0.75-acre block, the acetate was applied at the equivalent of 6 gm/acre. A 100% reduction in response was observed for the first two days post-treatment but this fell rapidly to 69% by the third day.

J. C. Maitlen and L. M. McDonough -- Codling moth

The synthetic sex pheromone for the codling moth (E,E)-8,10-dodecadien-1-ol, is now being used in survey programs, and other research workers are investigating its usefulness in control programs. It is therefore desirable to determine conditions which will produce pheromone release rates that are optimum over a prolonged period. Determination of the degradation rates of 0.1 and 1.0 mg of the pheromone from rubber bands, plastic caps and rubber septa was investigated. Of the three materials tested, the rubber septum produced the best release rate. Field trapping tests indicated that 0.2 mg would release at an optimum rate for one month. The kind of solvent in which the pheromone is dissolved prior to applying it to the septum had an effect on the first day rate of loss.

H. R. Moffitt, D. O. Hathaway, and M. Beroza -- Codling moth

An encapsulated formulation of the codling moth sex peeromone (E,E)-8,10-dodecadien-1-ol) (8,10-D) was applied by helicopter to a one-acre block of apples at 3 gm actual/acre. Initial evaluation was on the basis of the response of released, sterile male moths to pheromone-baited (0.3 gm/trap) or female-baited (10 ♀/trap) traps. A 93% or greater reduction in response of these males to traps was observed for six days post-treatment in the treated block when compared with an untreated check. This test indicated that sexual communication had been disrupted but did not inidcate that mating had been affected.

A seond test was conducted on a 0.75-acre block at the equivalent of 3 gm 8,10-D per acre per application to determine the effect of the treatment upon mating and reproduction. A second application was made eight days after the first when trap catches indicated that the effects of the treatment had significantly diminished. In this test, fertile moths (4,000 mixed sex over a 10-day period) were released to yield data on mating and reproduction as indicated by larval entries in the fruit as well as data on the lack of response of males to traps. A 95% or better reduction in numbers of males trapped was observed for seven days after the first application and only a 64% reduction on the eighth day. The second application was made at this time and a 100% reduction in response was observed for an additional six days. When the fruit was harvested, 10% of the fruits in the pheromone-treated plot were wormy while 29% of those in the untreated check were wormy. Over 5,200 larvae were produced in the check and only 347 in the treated block. These small blocks were subject to infiltration of native moths from the remainder of the orchard.

J. M. Vakenti and H. F. Madsen -- Codling moth

Preliminary experiments on the use of the "confusion technique" to control codling moth were unsuccessful. During overwintered codling moth flight, fourCodlemone baited rubber caps were placed in each of 40 trees. During the first brood moth flight the number of trees was reduced to 20 with 8 baited rubber caps per tree. Even though pheromone baited traps in these trees failed to catch native male moths, fruit injury was not reduced compared to control trees. Caged moths in the treated trees mated as frequently as caged moths in untreated trees.

J. M. Vakenti and H. F. Madsen -- Codling moth

Experiments on the use of pheromone baited traps to determine the need for control measures against codling moth begun in 1972 were continued in 1973. Within experimental orchards, traps were deployed one for each 1-2 acres with additional traps in adjoining orchards suspected of contributing to reinfestation. Treatments were advised when trap catches exceeded two per trap per week. In the six orchards cover sprays were reduced to an average of 1.8 compared to 2.2 in 1972 with lower percent codling moth injury at harvest. The use of traps in adjoining orchards was advantageous.

J. M. Vakenti and H. F. Madsen -- Codling moth

An experiment on the use of pheromone baited traps for "trapping out" male codling moth to effect control of codling moth was conducted in an isolated 5.5 acre apple orchard. Trap density in a 3.5 acre plot was four per year. A two-acre plot separated from the other by a creek and native bush served as a control: 75 first brood males and six second brood males were trapped in thre treatment plot. Preliminary assessments indicate 0.03% injury at harvest in the treatment plot versus 0.17% in the control plot.

P. H. Westigard -- Codling moth, pear

Interpretation of pheromone trap catch data relating to potential damage is obscured due to heavy inflex from abandoned sources.

J. F. Madsen and J. M Vakenti -- Fruittree leafroller, apple

A comparison of 19 formulations of fruittree leafroller sex attractant showed that the most effective formulation was a combination of *cis*-11-tetradecenyl acetate and *trans*-11-tetradecenyl acetate plus dodecyl acetate. This combination was only slightly less attractive than baits of five virgin females and was superior to Fruitamone 2. A comparison of six trap designs baited with Fruitamone 2 gave the following results: Pherotrap 1C (spacers), 282; Pherotrap 1C (spacers, lips down), 185; Batiste metal trap, 173; Cylindrical carton, 136; Pherotrap 1 CM, 114; Sectar 1, 90.

R. E. Rice -- Peach twig borer, almonds and peaches

Season-long screening of over 40 experimental formulations of synthetic twig borer pheromone resulted in the discovery of a multiple component formulation that is quite attractive to twig borer males. The chemicals were provided by and the work done in cooperation with Dr. W. Roelofs, Cornell University. Field work with this synthetic attractant will continue in 1974, and will include combination trapping with oriental fruit moth pheromone.

R. E. Rice -- San Jose Scale, Stone fruits

Field studies in California showed that a female-produced sex pheromone is present in San Jose scale, *Quadraspidiotus perniciosus*. Immature plums and a wild gourd, *Curcurbita foetidissima* were successfully used as hosts for virgin female scales placed in sticky traps to attract flying males. Females on plums began producing pheromone at 22-23 days of age. They reached maximum pheromone production at ca. 30 days, and continued at decreasing levels up to ca. 50-55 days.

H. F. Madsen and J. M. Vakenti -- Codling moth, apple

An evaluation of codling moth pheromone trap designs, each baited with 1 mg. of Codlemone in a rubber cap gave the following results: Cylindrical carton, 40.8; Sectar 1, 36.0; Pherotrap 1 CM, 28.1; Pherotrap 1C (with spaces and ends turned up), 15.3, Pherotrap 1C (with spacers and ends not turned up), 9.9; Batiste metal trap, 11.5.

SECTION VI

Diseases of Stone Fruits

G. A. Chastagner and J. M. Ogawa

A preharvest spray of 50% captan applied one day before harvest to Le Grand nectarines, Suncrest peaches and as long as 20 days before harvest on Blenheim apricots caused the fruit to develop surface discolorations after a postharvest treatment of fungicides in wax. Laboratory studies show that similar discolorations developed only when captan-treated fruit were brushed and treated with a wax solution after or during brushing.

Ronald P. Covey and Duane Coyier

The cause of a fruit blemish known as rusty spot on certain peach varieties is unknown. Benlate (50 WP 1/2 lb per 100 gal) and Wettable Sulfur (5 lb per 100 gal) were applied at shuck fall by handgun sprayer. Three replications of five trees per treatment in a randomized block were used. Data was gathered on the center three trees in each treatment just prior to harvest. One hundred fruit per tree were inspected for rusty spot.

One application of either Benlate or sulfur was found to significantly reduce the number of fruits with rusty spot symptoms. The blemishes on fruit sprayed with Benlate appeared smaller than on either the checks or those sprayed with sulfur. A two-spray program might further reduce the incidence of rusty spot.

Treatment and Rate/100 gal	Percent Blemished Fruit
Check	71
Benlate 50 WP 1/2 lb	42
Sulfur wettable	41
LSD 5%	17

D. L. Coyier and S. B. Kelly

The incidence of powdery mildew in The Dalles, Oregon, cherry orchards has increased in recent years. We attempted to control the disease through fungicide applications. The use of sulfur for control of powdery mildew has been recommended for many years, and it is known to be effective but has certain disadvantages. Application of sulfur spray during very high temperatures may cause considerable discomfort to the applicator and may be injurious to certain cherry cultivars. In addition, sulfur is much less effective during periods of cool weather, when powdery mildew is most active.

We compared sulfur treatment with applications of Benlate at several concentrations, with and without the addition of oil. Spray applications were made to bearing trees of the cherry cultivar Black Republican. We used a randomized block design, replicated six times and applied the spray on April 30 and May 22, 1973. The incidence of powdery mildew was recorded on May 31, 1973, and the results are given in the following table.

Chemical and conc/100 gal	Percent disease control
Sulfur, 4 lb.	81
Benlate, 4 oz + 1 qt oil[1/]	68
Benlate, 8 oz (no oil)	62
Benlate, 6 oz (no oil)	55
Benlate, 2 oz + 1 qt oil	70
Check	0
	LSD .05 = 30

1/ Oil = 90 sec., PGS-02. Union Oil Company.

(D. L. Coyier and S. B. Kelly, continued)

No significant difference was indicated among the treatments, but all treatments resulted in significantly less powdery mildew than occurred on unsprayed trees. Considerable variation occurred among the replications of each treatment and was caused by differences in tree vigor. When the trees were selected for treatment, no difference in vigor was observed, but when they were rated for incidence of powdery mildew, extreme variation was evident. This was probably due to winter damage as a result of sudden temperature variation in December 1972. The test results do show, however, that powdery mildew can be effectively controlled by applications of Benlate or Benlate plus oil.

A. W. Helton

Using Idaho isolate Cy-59 of *Cytospora cincta* Fr., interanl-gummosis experiments were conducted with 1-yr-old Elberta peach *(Prunus persica* L. Batsch*)* seedlings and 6-yr-old Italian prune *(P. domestica* L.*)* trees. The peach stems were examined microscopically in the laboratory; the prune stems were visually evaluated in the field. The results show that the fungus rapidly moves into the wood from standard bark infections, that gums form in the woody tissues well ahead of the advancing canker margins and the invading fungus, that the gums restrict and often block normal flow through xylem elements, that the internal-gummosis advances more rapidly upward from cankers than downward though the differences are small, and that visually detectable gummosis in cut surfaces advances along infected stems as much as 15 inches from infection sites within three weeks. These results at least partially explain the wilting symptom commonly associated with *Cytospora* infection, particularly in peach trees, they indicate that surgical removal of infected stems as a means of controlling *Cytospora* is not likely to be effective unless cuts are made at much greater distances (ca. three feet?) below infection sites than commonly practiced, and they explain at least in part why Cytospora canker disease responds poorly if at all to conventional applications of fungicides.

Iain C. MacSwan

Brown Rot Blossom Blight *(Monilinia fructicola* and *M. laxa)*, cherry (Black Republican Sweet): Sprays were applied by handgun to single tree plots, replicated four times to mature Black Republican sweet cherry trees. Sprays were applied at popcorn (April 2), full bloom (April 19) and petal fall (April 20). Diazinon 50 WP at 1.6 lb. in 20 gallons of water per acre was applied by Kinkelder sprayer on May 31 for control of cherry fruit fly.

*Good control of brown rot blossom blight was provided by the following fungicides and rates per 100 gallons of water: two and three sprays of Topsin M 6 oz., two and three sprays of Topsin M 3 oz. plus .5 gal. Volck Supreme oil, one, two and three sprays of Benlate 8 oz., one, two and three sprays of Benlate 4 oz. and three sprays of catpan 2 lbs. plus 2 oz. Multifilm X77.

*three sprays = popcorn, full bloom, petal fall; two sprays = popcorn, full bloom; and one spray = popcorn.

Iain C. MacSwan

Brown Rot Blossom Blight (*Monilinia fructicola* and *M. laxa*), cherry (sour): Sprays were applied to single tree plots replicated four times on mature sour cherry trees at popcorn (April 10), full bloom (April 22) and petal fall (May 1). A surfactant was added to only the Microcop sprays. Diazinon 50 WP at 1.6 lb. in 20 gallons per acre was applied by Kinkelder sprayer on May 31 for insect control.

*Good control of brown rot blossom blight was provided by the following fungicides and rates per 100 gallons of water: one spray of Benlate 8 oz.; two sprays of Benlate 4 oz. and 8 oz. and RH 3928 4 oz. and 8 oz.; three sprays of Benlate 8 oz. and 4 oz., Triforine 9 fl. oz. and 12 fl. oz.; AC 200,043 1 lb. and 2 lb., Kocide 101 2 lb., Bravo 6F 1.5 pt., Citcop 4E 1 qt. plus 1.5 lb. ferbam, Citcop 4E 2 qts., tribasic copper sulfate 4 lb., Bravo 6F 3 pt., Kocide 404 3 qt. and COCS 4 lb.

*three sprays = popcorn, full bloom, petal fall; two sprays - popcorn and full bloom; and, one spray = popcorn.

Iain C. MacSwan

Dead Bud (*Pseudomonas syringae*), cherry (Royal Anne-Corum): Sprays were applied by handgun to two-row plots in a mature Royal Anne - Corum sweet cherry orchard on October 18, 1972 and January 22, 1973. Each plot contained twenty-four trees. Disease readings were made on June 15, 1973, b by assessing one hundred buds on each of six trees per plot. The buds were on wood produced in 1972. The trees were selected at random.

Citcop 4E 8 qts. provided dead bud control equal to that of the recommended bactericides Bordeaux 12-12-100 and Kocide 101 6 lbs. plus 1 pt. Volck Supreme oil.

Iain C. MacSwan

Brown Rot Blossom Blight (*Monilinia fructicola* and *M. laxa*), cherry (Royal Anne-Corum): Sprays were applied by helicopter to two mixed blocks of mature sweet cherry trees (Royal Anne and Corum with some Hoskin and Van pollenizers) on April 9 (popcorn and April 21 (late full bloom) on the Dave Massee farm near Wheatland Ferry, Oregon. Both Benlate and Topsin M were applied at the rate of one pound formulation in ten gallons of water per acre. The popcorn stage sprays were applied through a forty-five foot boom with fourteen hollow cone nozzles on each side (eleven D 8's and three D 12's). The late-full-bloom sprays were applied through a forty foot boom with forty-three hollow cone nozzles (D 8's and D 10's alternating along the boom). The difference in the equipment used was not intentional, it was a matter of what was available. The sprays were applied just above the tree tops. The helicopter flew above but between the rows of trees so that the spray from the boom would cover approximately two rows at the same time. Each plot consisted of fifty to sixty trees. Each check plot had twenty-four trees.

Results indicate the possiblility of obtaining acceptable control of brown rot blossom blight by helicopter application of Topsin M 1 lb. per acre or Benlate 1 lb. per acre. Growers with large orchards or hill orchards where spraying by ground rig is slow and difficult have a high interest in the application of fungicides by helicopter.

Iain C. MacSwan

Dead Bud (*Pseudomonas syringae*), cherry (Black Republican sweet): Sprays were applied by handgun to two-row plots of twelve-year-old Black Republican trees on October 24, 1972 and January 23, 19 1973. Each plot contained eighteen trees. Disease readings were made on June 15, 1973 by assessing one hundred buds on each of three trees per plot. The buds were on wood produced in 1972. The trees were selected at random.

Citcop 4E 8 qts. provided dead bud control equal to that of the recommended bactericides Bordeaux 12-12-100 and Kocide 101 6 lbs. plus 1 pt. Volck Supreme oil.

Iain C. MacSwan

Leaf Curl (*Taphrina deformans*), peach (Improved Elberta): Two sprays were applied by handgun to single tree plots replicated six times. The first sprays of Bravo 6F, Ferbam and Cyprex were applied on December 26, 1972 and Bordeaux, lime sulfur, Ziram, Kocide 101 and Kocide 404 on December 28, 1972. The second sprays of Bravo 6F and Ferbam (plus 12 oz. Biofilm) were applied on January 18, 1973; second sprays of Ferbam 76 WP (Plus 2 oz. Biofilm), Cyprex, Ziram and Kocide 404 were applied on January 19, 1973; and the second sprays of Bordeaux, lime sulfur and Kocide 101 were applied on January 22, 1973.

Although test fungicides provided control equal to or better than the recommended Bordeaux 12-12-100 or lime sulfur 8 gals. acceptable control was provided by ziram 3 lbs. plus 12 oz. Biofilm, ziram 3 lbs. plus 2 oz. Biofilm and ferbam 3 lbs. plus 12 oz. Biofilm.

Iain C. MacSwan

Coryneum Blight (*Coryneum biejerinckii*), peach (Improved Elberta): Sprays were applied by airblast sprayer at the rate of 350 gallons per acre to two blocks of twenty-year-old Improved Elberta trees on October 19, 1972. The Bordeaux block contained 36 trees, the Kocide 101 block 27 trees and a block of 27 trees served as check. Fifty feet of peach twigs (1972 growth) selected at random around the tree was removed from each of four trees in the unsprayed and from each of three trees in the sprayed plots on February 12, 1973. Numbers of infections per fifty feet of twigs were recorded. On December 29, 1972 the entire orchard received a spray of Difolatan 80 W 2 lbs. per 100 gallons of water for control of leaf curl.

Kocide 101 5 lbs. plus 1 gal. Volck Supreme oil provided control of Coryneum Blight equal to that of the recommended fungicide Bordeaux 8-8-100.

B. T. Manji and J. M. Ogawa

Studies were made to determine: 1) if infections in fruit can be suppressed or eradicated, and 2) the minimum dosage of chemical required to control established infections and to prevent new infections.

Nectarine and peach fruit were given postharvest treatments at a commercial packing shed at 0, 12, 24, 30, and 36 hours after inoculation. Benlate plus Botran in wax suppressed disease development. Chlorine did not suppress established infection.

Peach fruit were treated with various concentrations of Benlate, Botran or a mixture of Benlate plus Botran in wax 18 hours after inoculation. The minimum dosage required to suppress both *Rhizopus stolonifer* and *Monilinia fructicola* infections was Benlate 300 ppm and Botran 900 ppm.

W. J. Moller, W. O. Reil, M. N. Schroth, S. V. Thomson and W. H. Griggs

Table 1. Effect of chemicals on the epiphytic populations of *Erwinia amylovora* in blossoms and disease incidence in Bartlett pear trees.

Treatment	Amount applied/ acre	No. of bacteria/ blossom x 10^5	No. of infections/tree
Check	--	7.6[a]	3.2[a]
Citcop low	1 gal	6.6	1.7
Citcop high	2 gal	5.9	2.15
Streptomycin	10 oz	5.7	0.84
Terramycin	10 oz	3.6	0.81
Kocide low	0.5 lb	2.5	1.02
Kocide high	2 lb	1.2	0.43
MBR 10995 low	0.25 lb	0.86	0.4
MBR 10995 high	1 lb	0.18	0.4

[a]Correlation coefficient (r) between number of bacteria/blossom and number of infections/tree is 0.89, significant beyond the 0.1% level.

Table 2. Effect of copper and antibiotic sprays on fireblight infections and fruit russeting of Bartlett pear, Gridley orchard, 1973. (Applied with concentrate sprayer at the rate of 100 gal. per acre.)

Treatment (8 applications)	Amount material /acre/application	No. blight infections /tree May 25*	% lenticels russeted July 19*
Kocide (copper)	1/2 lb	0.86 abc	49.7 d
Kocide (copper)	2 lbs 1st & 2nd application then 1/2 lb	0.42 a	53.2 e
Kocide (copper)	1 lb	0.72 ab	47.2 cd
Kocide (copper)	2 lbs	0.36 a	56.2 e
COCS (copper)	1 lb	0.62 ab	45.5 c
COCS (copper)	1 lb first six applications	0.54 ab	41.7 b
COCS (copper)	2 lbs	0.52 ab	45.7 c
Citcop (copper)	1 gal	1.26 bc	48.2 cd
Citcop (copper)	2 gal	1.61 cd	55.3 e
Streptomycin 17%	10 oz	0.70 ab	33.7 a
Terramycin 17%	10 oz	0.68 ab	32.7 a
Control	-----	2.24 d	34.3 a

*Values followed by different letters are signficantly different at the 0.05 level.

J. M. Ogawa, I. C. MacSwan, and B. T. Manji

Prune Russet Scab also described as Lacey Scab on prunes is a superficial injury of the epidermis. The scabby area may cover over half of the fruit or the scab can be minute and very hard to see with the naked eye. The severely affected fruit are not acceptable for market as dried prunes and are diverted for juice. In years of rain during bloom russet scab has been as high as 40%. Studies on chemical control showed that full bloom sprays with captan or dichlone provided excellent control.

The possible cause of russet scab was studied. The mechanical splitting of the floral tube during the full bloom to prevent abrasion of the fruit by the dry shuck during its growth resulted in reduction of scabby and shiny fruit at harvest. The application of fungicides such as benomyl and captan during 1973 in California and Oregon showed trends indicating a benefit from fungicide sprays, with no differences in control between captan, benomyl, Difolatan, combination mixtures of captan and benomyl, Topsin M or captan filler. Although large scale test plots were established and over 208,000 individual fruit examined, the incidence of russet scab was too low and varied to make definite conclusions.

S E C T I O N VII

Diseases of Pome Fruits

J. A. Beutel and W. O. Reil

Sprays were applied by handgun to single tree plots (replicated 16 times) of nine year old Bartlett pear trees to control streptomycin resistant fireblight. Abbott ABG-1000 was used at four concentrations and various frequencies from full bloom until 50 days after full bloom. Three copper materials were applied every 4-6 days during this period. Blight strikes were counted and leaf phytotoxicity was rated May 9.

All rates (12.5-100 ppm) of ABS 1000 gave good fireblight control equal to Kocide or tribasic copper at 1/2 lb/100 gal. Leaf injury (yellow margins) was evident on all treated leaves in 25 and 50 ppm treatments and on both treated and new leaves developing the month following sprays of 100 ppm. Slight injury of leaves was noted on trees receiving 12.5 ppm every 4-6 days. Sorbacop at 1 qt/100 gal failed to provide any blight control.

Treatment/ Concentration	Interval	Blight Strikes Per Tree	Phytotoxicity
Control	---	2.3	None
ABG 1000 12.5 ppm	5 days	0.6	Slight
ABG 1000 25.0 ppm	5 days	0.25	Moderate
ABG 1000 50.0 ppm	10 days	0.2	Severe
ABG 1000 100.0 ppm	20 days	0	Severe
Kocide 1/2 lb/100	5 days	0.1	None
Tribasic Cu 1/2 lb/100	5 days	0.6	None
Sorbacop 1 qt/100	5 days	2.6	Slight

J. A. Beutel, W. O. Reil and W. J. Moller

Concentrate sprays were applied with a Hart Carter airblast sprayer for fireblight control in two different years in one pear orchard in the Sacramento Valley.

Fruit russet on Terramycin or streptomycin treated trees was about the same as the control trees receiving only insecticide sprays. The percent of fruit russet correlated well with residue of copper on leaves and fruit.

Test A:

	% Russet	ppm Copper
Kocide 1/2 lb/A	49 b	177 b
Kocide 1 lb/A	47 b	273 c
Kocide 2 lbs/A	56 c	428 d
COCS 1 lb/A	45 b	184 b
COCS 2 lbs/A	46 b	280 c
Citcop 1 gal/A	48 b	172 b
Streptomycin 10 oz/A	34 a	
Terramycin 10 oz/A	33 a	
Control	34 a	34 a

Test B:

	% Russet	ppm Copper
Kocide 1 lb/A	57 c	404 b
Kocide 2 lb/A	67 d	702 c
COCS 2 lbs/A	60 c	387 b
Tribasic Cu 2 lbs/A	60 c	476 b
Kocide 1 lb + Strep 28 oz	79 e	---
Streptomycin 28 oz/A	47 b	---
Terramycin 8 oz/A	46 b	---
Control	42 a	40 a

Ronald P. Covey, Jr.

Blackjons apple trees were sprayed by handgun at 500 psi to run-off on April 6, 17, 27 and May 11 and 23. Treatments were made on single trees in a randomized block and replicated five times. Data on terminal mildew was taken about 10 days after each spray date and mildew russet determined at harvest.

Terminal mildew data was expressed as calculated loss of terminal leaf area. This was determined by multiplying the percent mildew-infested terminals by a severity factor based on a scale of 0.1 to 1.0.

All materials tested significantly reduced the level of terminal infection. The Benlate and oil combinations gave significantly better protection of the terminals than the standard Karathane treatment. However, fruit mildew russett was better controlled by Karathane.

Summary of Calculated Loss and Percent Mildew Fruit Russet

Treatment	Rate	4/3[1/]	4/16[2/]	4/27[2/]	5/8[2/]	5/21[2/]	6/1[2/]	% Russet[2/]
Karathane 25 wp + B 1956	12.0 oz 4.0 oz	7.2	30.1	14.9	28.3	48.4	47.6	12.4
Benlate	4.0 oz	7.0	26.9	28.0	35.4	58.4	57.4	41.5
Benlate + Superior Oil	4.0 oz 32.0 oz	6.3	14.2	11.1	14.9	18.0	26.8	22.7
Benlate + Superior Oil	2.0 oz 32.0 oz	6.7	20.7	15.1	19.9	27.6	26.7	26.1
Benlate	6.0 oz	8.7	29.3	38.8	45.0	64.2	62.5	35.6
Afugan 30 EC	4.0 oz	6.6	18.3	13.9	23.1	35.4	43.4	22.2
Afugan 30 wp	2.9 oz	6.2	22.1	22.5	38.2	60.6	61.7	32.7
Check	---	6.9	29.9	24.9	63.5	83.6	85.9	37.1
LSD 1%							9.8	10.1

1/ Prespray

2/ Ten days after application.

Iain MacSwan

Scab (*Venturia inaequalis*), fruit russet - Apple (Rome): Sprays were applied by handgun to single tree plots, replicated four times, of ten-year-old dwarf Rome trees at calyx (May 7), first cover (May 25) and second cover (June 18 for NIA 28221 EC formulations and June 19 for WP formulations). Fungicides under test: NIA 28221 20 EC 9 and 16 fluid oz/100; NIA 28221 25 WP 7.2 and 12.8 oz/100 gallons of water.

Significant reduction of scab occurred in all plots but best control was provided by NIA 28221 20 EC at the rate of 16 fluid ounces per 100 gallons of spray. Lack of powdery mildew prohibited assessment of the disease.

Iain MacSwan

Scab (*Venturia inaequalis*), russet on fruit - Apple (Delicious): Sprays were applied by handgun to single tree plots replicated four times, of mature Red Delicious trees at first pink (April 10) full pink (April 24), early calyx (May 2) first cover (May 25) and second cover (June 18). A surfactant was added to only the Benlate sprays. Diazinon 50 WP was applied at the rate of 4 lbs. on April 10, 6 lbs. April 30, 4 lbs. June 21 and 4 lbs. July 9 for control of codling moth. Each spray was applied in 20 gallons of water per acre by Kinkelder sprayer.

Cyprex 65 WP .75 lb., Bravo W75 1.5 lb. and Benlate 50 WP 2 oz. plus 1 qt. Volck Supreme oil per 100 gallons provided best scab control. Bravo, both wettable powder (1.5 lb.) and flowable (1.5 pt.) formulations, produced a severe tan colored russet on the fruit. Poor scab control was obtained from sprays of Polyram 80 W 2 lb. and HOE 02873 IF 45 WP 250 gms per 100 gallons.

Iain MacSwan

Scab (*Venturia inaequalis*), fruit russet - Apple (Rome): Sprays were applied by handgun to single tree plots, replicated three times, on mature Rome trees at green tip (April 12), full pink (April 20), calyx (May 7), first cover (May 25) and second cover (June 18). Lack of powdery mildew prohibited assessment of the disease. Diazinon 50 WP was applied by Kinkelder sprayer at 4 lbs. in 20 gallons of water per acre on May 10 and May 30 for the control of codling moth.

Best control of fruit scab was obtained in the plots receiving sprays of the following fungicides and rates per 100 gallons of water: Benlate 4 oz. plus 1 qt. Supreme oil, RH 3928 8 oz., HOE 02873 (OF) 4 fluid oz., Afugan 6.7 fluid oz. plus .75 lb. Cyprex (the Afugan was applied for mildew control, the Cyprex for scab control), RH 3928 4 oz. and Cyprex .75 plus Karathane .75 lb. None of the fungicides increased fruit russet. Cyprex .75 lb. plus Karathane .75 lb. and Gulf S-15126 8 oz. plus Triton B 1956 4 oz. significantly reduced fruit russet.

Iain MacSwan

Scab (*Venturia pyrina*) - pear (Bartlett): Sprays were applied by handgun sprayer to single tree plots replicated four times of nine-year-old Bartletts at pink (April 11), calyx (April 21), post calyx (May 2), first cover (May 29) and second cover (June 19). At harvest on August 20, 1973, over 100 fruits per tree were rated as diseased or healthy (with the exception of two trees in the Gulf S-15126 + 4 oz Triton B 1956 treatment where the trees had 41 and 48 pears respectively). Disease assessment in the Bravo 6F and Cyprex plots was possible on only two of the four trees because of insufficient fruit.

Good control of scab was provided by the following fungicides and rates per 100 gallons of water: Cyprex .75 lb., Topsin M 12 oz., Gulf S-15126 16 oz. plus 4 oz. Triton B 1956, Bravo W75 1.5 lb., Bravo 6F 1.5 pt., Benlate at 8 oz. and 4 oz., Topsin M 3 oz. plus Niagara Supreme Oil and Gulf S-15126 8 oz. plus 4 oz. Triton B-1956.

J. Sisevich and B. G. Zoller

Seasonal *Erwinia amylovora* blossom populations were monitored in six adjacent orchards by plating washings of 300-blossom random samples on Miller and Schroth's selective medium (with Mannitol) and counting numbers of colonies whose types proved pathogenic to green pear fruits. When compared with hygrothermograph data, results of assays done on a daily basis before and after three streptomycin applications suggested population levels measured by these techniques may depend on orchard temperature relations more/rather than spray applications. First detection of blight bacteria in blossoms in 1973 occurred when 319 degree hours (vs. 316 degree hours in similar 1972 studies) above 65° F had elapsed since bud swell began.

B. G. Zoller, L. Hanke, and J. Sisevich

Seasonal *Erwinia amylovora* blossom populations were monitored in 34 pear orchards in four climatically distinct pear districts in California. Average blossom populations were determined by plating washings from 200-blossom random samples (collected biweekly) on Miller and Schroth's selective medium (with Mannitol) and counting numbers of colonies whose types proved pathogenic to green pear fruits. In all districts, blight bacteria were not detected in blossom samples until after the first post bloom day of 60° F average daily temperature. The occurrence of new (blossom pedicel-length) blight infections in all orchards was preceded (8-12 days before) by days of relative humidity greater than 70% at 4 p.m. and/or simultaneous occurrence of 60° F and 70% relative humidity conditions, as measured on one hygrothermograph in each district. Such conditions were not followed by significant blight in all orchards of a district, however.

D. L. Coyier and S. B. Kelly

Apple seedlings were treated weekly, beginning May 3, 1973, and evaluated for incidence of powdery mildew one week after the fourth spray application. The plants were grown in 1-gallon cans and removed from the growing area during the spray operation to eliminate cross-contamination of plants with fungicides. The treatments were applied with a handgun sprayer at 250 psi and sprayed to the "drip" stage. The position of each 10 single-tree replicates per treatment was rerandomized after each treatment to reduce position effect. Heavily mildewed apple seedlings were placed next to each group of treated plants, and the conidia were dislodged and disseminated daily with compressed air to test plants. Powdery mildew was encouraged by growing the plants under heavy shade. The disease was rated 0-50 according to severity and converted to percentage disease control.

The combination of oil and Benlate improved performance markedly over that of either material used alone. No mildew developed on plants sprayed with Benlate plus oil. Those treated with Benlate or with oil only resulted in 81.1 and 65.9 percent disease control, respectively. The liquid formulation of Afugan provided excellent control of powdery mildew at a concentration of 4 oz/100 gal. Wettable powder Afugan was not as effective as the liquid formulations. Afugan-treated plants developed very slight interveinal chlorosis of the leaves, and some leaves were slightly distorted and curled downward. We also noted a chlorotic leaf spot on the leaves of mature D-Anjou pear trees sprayed with four applications of Afugan at a concentration of 4 oz/100 gal. However, no injury to the fruit was observed. RP-23060 provided excellent control of powdery mildew on apple seedlings without phytotoxicity. A rating of 85-100% disease control is considered satisfactory performance in these tests.

Treatment and rate per 100 gallons	Powdery mildew rating (total of 10 reps)	Percent Disease control
Benlate, 50W, 4 oz + 1 qt 90 sec oil	0	100
Afugan, 30 EC, 12 oz	0	100
RP-23060, EC, 8 oz	0	100
Afugan, 30 EC, 16 oz	5	98.8
Afugan, 30 EC, 4 oz	8	98.1
Karathane, 25W, 8 oz	25	94.1
Afugan, 29W, 115 gm	55	87.0
Benlate, 50W, 4 oz	80	81.1
Oil, 90 sec, 1 qt	144	65.9
Check (water-sprayed)	345	18.3
Check (unsprayed)	422	----
LSD 0.01	36	8.5

List of Chemicals Used and Suppliers:

AFUGAN®: (Hoe 2873) 2-(o,o-diethyl-thionophosphoryl)-5-methyl-6-carbethoxy-pyrazolo-(1,5a) pyrimidine, 30% EC and 29W. American Hoechst Corp.

BENLATE®: methyl-1-(butylcarbamoyl)-2-benzimidazolecarbamate. E. I. du Pont de Nemours & Co.

KARATHANE®: dinocap, Rohm & Haas Co.

OIL: 90 sec., PGS-02, Union Oil Co.

RP-23060: 1 Methyl-5 carbamic acid butyl ester-11-dihydro-(10f, 11b) dibenzo azepinc, 1.67 lb/ gal. Rhodia Inc., Chipman Division.

S E C T I O N VIII

Diseases of Nut Crops

Iain C. MacSwan

Filber Blight (*Xanthomonas corylina*), filbert (Barcelona): Sprays were applied to randomized plots, replicated three times, of three-year old Barcelona filbert trees on September 20, 1972. Tree spacing is twenty feet on the square. Each plot consisted of three sixteen-tree rows. One hundred gallons of spray was applied by handgun to each plot. On April 16, 1973, each tree was examined and the average number of infected buds and twigs per tree recorded.

All bactericides - Kocide 101 6 lbs/100, tribasic copper sulfate 6 lbs/100 and Bordeaux 8-8-100 provdied good control of filbert blight. Volck Supreme oil was added to all sprays at the rate of 1 pt. per 100 gallons of water.

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