ABSTRACTS OF REPORTS FROM THE 39th ANNUAL WESTERN COOPERATIVE SPRAY PROJECT

Imperial Hotel, Portland, Oregon

January 13-15, 1965

NOT FOR PUBLICATION OR FURTHER REPRODUCTION

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

This report is reproduced by the Oregon State University Cooperative Extension Service and the Western Agricultural Chemicals Association.

Abstracts of Reports from the
39th Annual Western Cooperative Spray Project

T A B L E O F C O N T E N T S

INSECT AND MITE PESTS OF POME FRUITS--Section I
APPLE INSECTS AND MITES
Codling Moth 1
Orchard Mites 2
San Jose Scale 5
European Fruit Scale 6
Apple Aphid 7
PEAR INSECTS AND MITES
Pear Psylla 7
Orchard Mites 9

INSECT AND MITE PESTS OF STONE FRUITS--Section II
CHERRY INSECTS AND MITES
Cherry Fruit Fly 11
Peach Tree Borer 11
Orchard Mites 11
Black Cherry Aphid 11
San Jose Scale 12
PEACH INSECTS AND MITES
Orchard Mites 12
Green Peach Aphid 12
PRUNE INSECTS AND MITES
Orchard Mites 12
Aphids 12

INSECT AND MITE PESTS OF NUT CROPS--Section III
FILBERT INSECTS AND MITES
Filbert Aphid 13
Big Bud Mite 13
WALNUT INSECTS AND MITES
Walnut Husk Fly 13

DISEASES OF POME FRUITS--Section IV
APPLE DISEASES
Apple Powdery Mildew 15

SPRAY RESIDUES, COMPATIBILITY, PHYTOTOXICITY, BEE POISONING AND POLLINATION, CONCENTRATE SPRAYING AND OCCUPATIONAL EXPOSURE--Section V
Spray Residues 16
Phytotoxiticy 16
Concentrate Spraying 18

CONTRIBUTORS TO ABOVE ABSTRACTS 20

S E C T I O N I

INSECT AND MITE PESTS OF POME FRUITS

APPLE INSECTS AND MITES

Codling Moth

R. W. Zwick and F. W. Peifer:

Two cover sprays of DDT and malathion applied in early June and July continue to give excellent control of codling moth in a commercial block of mature Newtown and Red Delicious apple. Omission of the third cover this year produced no more stings or entries than were observed for three covers in 1963 in this block.

B. A. Butt:

A codling moth sex attractant was first extracted from the female codling moth in June 1963. The attractant is obtained from the last one or two abdominal segments of the moth and can be extracted with a number of solvents. A rapid bioassay method has been developed to determine the presence of the attractant.

In cage and field tests, living females were more attractive than crude extracts of the whole female moths. Laboratory results now indicate that extracts of female tips only are much more attractive than extracts of whole insects.

J. Franklin Howell:

A wheat-germ agar-gel medium fortified with vitamins, mineral salts, protein and carbohydrate is being used successfully to rear large numbers of codling moths. Codling moths after ten consecutive generations on the artificial medium are indistinguishable from moths reared from thinning apples; they have equal development periods, are of equal size and mating behavior appears normal. Total egg deposition is somewhat reduced, i.e., from 100 to 150/female compared with 60 to 100/female.

Fungal growth and desiccation have been serious obstacles to the successful utilization of this medium to rear the codling moth. Essentially 100 percent control of the fungi has been achieved without excessive use of fungicides and without reverting to aseptic rearing. Control of fungi and also of desiccation is a physical problem related to the physical environment and handling of the medium.

M. M. Barnes:

A specially designed apparatus and procedure for bioassay of the female sex pheromone in the codling moth have been developed. Responses of males under standard conditions to extracts of female abdominal tips are utilized.

From a series of 25 individual pair matings, two strains of codling moth have been isolated which consist 100% of individuals resistant to DDT. Genetic studies are in progress.

Studies with 4 watt ultraviolet fluorescent lamps in light traps show that lamps with a filter removing much of the visible light are 84% as effective in catching codling moths as unfiltered lamps and result in 22% less "contamination" by other species of insects under the conditions of the 38 night trial. These low wattage light traps are approximately 6 times as effective as bait pails of fermenting molasses. The lamp is placed across and below the lip of a 10 inch funnel, directing light upward over a single 10 inch square baffle. Moths are caught below in alcohol.

M. D. Proverbs:

Sexually sterile male moths were released in a semi-isolated apple orchard for the third consecutive year. Trap records showed that by September 1963 the native population in the 20-tree orchard had been suppressed to the point where the ratio of sterile (released) to fertile (native) male moths was about 90:1; by June 1964 the ratio had increased to about 700:1; and by August 1964 it had reached about 1200:1. Fruit examination indicated that by harvest time 1963, only about 50 mature larvae remained to overwinter in the orchard; by harvest time 1964 the number had declined to 6. It seems likely that the codling moth would have been eliminated from the experimental orchard in 1964, if reinfestation from neighboring commercial orchards could have been prevented.

In a larger and more isolated apple orchard, the procedure of using sterile moths for control was greatly accelerated by sterilizing in the moth stage and by releasing both sterile males and sterile females. Laboratory results and theoretical considerations had indicated that these modifications would result in less codling moth control than would be achieved by the usual procedure of pupal sterilization and release of sterile males only. However, despite this, the release of sterile males plus sterile females in the unsprayed orchard for one year, resulted in only two percent "wormy" fruit at harvest. In previous years, most and sometimes all of the fruit in this orchard was wormy by harvest time.

Orchard Mites

R. W. Zwick and F. W. Peifer:

European red mites were controlled well for over three months with delayed dormant sprays of lighter Humble and Niagara supreme oil-lime sulphur. The lime sulphur included with these oils did not add materially to the control of the combinations as compared with slightly higher rates of the Humble oils used alone. Full bloom sprays applied prior to heavy egg deposition by the first generation adults held a heavy population in check for over two months and included: Morocide, Morestan, B 25141, SD 9129, and UC 21427. Slightly less effective at this time were: UC 19786, Karathane, and UC 20047A.

Cover sprays giving the longest periods of control were: Morestan, Morocide, Niagara supreme oil-ethion, and Naugatuck D014. Kelthane gave good control in some plots and poor control in other applications in grower's plots.

F. P. Dean:

In orchard plot tests of acaracides for control of McDaniel mites, good control for the season was obtained with two applications of several di-nitro and carbamate experimental compounds. Also, binapacryl (Morocide)

gave good control. Morestan 25% WP was applied at 1.0 lb. and 0.5 lb. in the first cover spray (May 26) and on other trees in the second cover spray (July 21). The early spray caused no injury, but fruit spotting resulted from the second cover spray. Also, some Morestan residue remained on the fruit at harvest from the second cover spray applications. Karathane gave fair control for the season with two applications. Kelthane failed to control the mites satisfactorily.

Stan Hoyt:

European Red Mite -- Prepink sprays of Morestan at 1 pound per 100 gallons were effective for control. Lower rates varied in their effectiveness. Union Carbide 20047A gave partial control in prepink applications. In summer sprays this compound provided good control in one orchard and in another it failed to prevent egg hatch and subsequent development. UC 19786, Karathane, Morestan, ethion, Naugatuck C940 and D014, Micasin and Milbex also provided good control.

Stan Hoyt:

Apple Rust Mite -- Karathane, ethion, Morestan, Naugatuck C940 and D014, and HRS 1654B all gave good control. Slightly less effective were Union Carbide 19786 and 20047A.

Stan Hoyt:

McDaniel Spider Mite -- In one test orchard prepink sprays of Morestan controlled the mites through the end of June, when the counts were discontinued. This eliminated the need for a first cover miticide. A three spray program of UC 20047A, UC 19786, HRS 1654B, SD 7438, or Morestan (1/2 lb. per 100) gave excellent control for the season. Ineffective programs included Karathane, or Morestan at 1/4 lb. per 100 gallons. Single applications of UC 21427, UC 20036, C940, and TH 113M provided initial knockdown, but poor residual control. Good control was provided by D014, SD 7438, SD 9129, Micasin and Milbex.

Donald W. Davis:

McDaniel mite populations in Utah were delayed by cold wet weather during June. The development about July 10 was sudden, resulting in many control failures. Two replicated experiments, one in Utah County and one in Davis County, were conducted. No injury was encountered with any of the materials used in the experiments, although injury was encountered by several growers using Morestan and Morocide on a limited commercial basis. Most of the problems originated from the use of these materials following earlier oil treatments in the orchards. One of our graduate students suffered from a skin irritation, resembling sunburn, following the use of Morestan.

Of the named compound, Morestan at 1 pound Wettable per gallon was the best material used. The control achieved from Morestan lasted approximately 5 weeks. Tedion Wettable and Tedion Emulsifiable were compared at equivalent rates. The emulsifiable formulation was clearly superior to the wettable. There were clear indications in the Davis County orchard of mites being resistant to Tedion, but this was not apparent in Utah County. Chlorobenzilate was used in the Utah County experiments with very good results. Systox was used successfully to reduce the mite populations in one of the treatments which failed. Bomyl was used in mid-season to control the mites in the check plots in one orchard. Bomyl worked rather well,

although the control action lasted for only three to four weeks. Karathane plus B 1956 was used in mid-season to treat the check plots in the other orchard. Three applications were needed to bring these populations under control using Karathane. Morocide was used at ½ pound Wettable per 100 gallons. The control at this rate was fair at best, while during 1963, the 1 pound rate gave excellent control. Imidan gave only fair control results.

Several numbered compounds were used. Shell 9129 gave excellent results without any spray injury. Bayer 37344 was used for the third consecutive season with consistently good results. Naugatuck DO 14 looked very promising although the control action seemed to last for only about four weeks. Mobil MC-A-600 failed in McDaniel mite control.

R. S. Downing:

Concentrate applications of Pennsalt Superior oil were more effective in controlling European red mite at the mouse ear bud stage (i.e., two weeks before European red mite winter eggs hatched) than at the dormant stage. Pennsalt Superior oil (vis. 70-75 S.S.U. at 100°F.) was more effective against the red mite than Shell Neutrol oil (vis. 200-215 S.S.U. at 100°F.) when both oils were applied at the dormant stage. Pennsalt Superior, Imperial 862 (vis. 90-105 S.S.U. at 100°F.) or a mixture of Imperial 862 and Ethion were equal in effectiveness when applied at the mouse ear bud stage of apple.

Pink Bud Sprays for Orchard Mite Control

Two new Japanese miticides, Milbex 50% w.p. 1 lb. and Micasin 50% w.p. 1 lb. per 100 gal., applied by handgun sprayer at the pink-bud stage to Spartan and Delicious apple trees gave excellent control of European red mite, Panonychus ulmi (Koch). Pennsalt Superior oil at 1 gal. or Morestan 25% w.p. ½ lb. also gave good control whereas a dinitro compound, U.C. 19786 50% w.p. ½ lb. per 100 gal., gave poor control.

Summer Sprays for Orchard Mite Control

Morestan. As in past years Morestan 25% w.p. ½ lb. per 100 gal. gave excellent initial and residual control of both European red and McDaniel spider mite. It was particularly effective applied when the first summer generation of European red mite eggs had almost finished hatching. If the application was delayed until all stages of mites were present a second application of morestan was required to hold mites under control for the season.

Binapacryl gave excellent control of the McDaniel spider mite but did not control the European red mite even after five applications. Two other dinitro compounds, U.C. 19786 and U.C. 20036, were also unable to control European red mite.

Two Japanese products, Milbex 50% w.p. 1 lb. and Micasin 50% w.p. 1 lb. per 100 gal., were very effective against both the European red and McDaniel spider mite, giving seasonal control with one well timed applications.

Pennsalt Superior oil gave excellent control of European red mite and was also effective against the McDaniel spider mite if two applications, seven days apart, were made.

Three other compounds that were quite effective against both species

of mites but did not give as long lasting control as Morestan or the Japanese compounds were: Chloropropylate 50% w.p. 10 oz., C 940 85% E. 4 oz., and DO 18 85% E. Of the last two, DO 18 seemed to be more effective than C 940 particularly against the McDaniel spider mite.

Animert V-101 gave good control of a heavy infestation of European red mite that was at least partially resistant to tetradifon (Tedion). This is surprising since Animert is a homologue of tetradifon.

Effects of Pesticides on European Red Mite, Typhlodromid Mites and Leafhoppers

The miticides, Kelthane 18.5% w.p. 1 lb., Morestan 25% w.p. 1/2 lb., Milbex 50% w.p. 1 lb., and Micasin 50% w.p. 1 lb. per 100 gal., were highly toxic to the European red mite whereas binapacryl 50% w.p. 1/2 lb., carbaryl 50% w.p. 1 lb., Guthion 25% w.p. 1 lb., and endosulfan 50% w.p. 3/4 lb. were not.

Against predaceous typhlodromid mites, Morestan, binapacryl, carbaryl, and Guthion were highly toxic. Kelthane, endosulfan, Milbex and especially Micasin allowed numbers of these beneficial mites to survive.

Carbaryl and endosulfan were very effective against leafhoppers (mainly the rose leafhopper); Guthion and Kelthane gave good control but Morestan, binapacryl, Milbex and Micasin showed little or no control.

Effect of Early Season Sprays on Predaceous Mites

A mixture of Ethion and Superior oil (vis. 70 S.S.U. at 100°F.) applied at the mouse ear stage was extremely detrimental to predaceous typhlodromid and tydeid mites in an abandoned apple orchard. The oil alone applied at the same time was very harmful to tydeid mites but was only slightly toxic to typhlodromid mites. A dormant application of oil alone reduced both mites although the typhlodromid mites did build up later in the season.

John L. Nickel:

Abstract. Morestan, Naugatuck D-014, Humble 70 oil, and Pennsalt 70 oil gave good control for the entire season with a single petal-fall (may 12) application. Naugatuck C-940 applied at the same time gave good control until mid-August. Petal-fall application of Union Carbide 19786 was ineffective. Karathane, applied in 3 biweekly applications, beginning at petal-fall, gave good control for the entire season. Moricide, applied in the same manner provided control of shorter duration. Ethion, Humble 60 oil, Humble 70 oil and Volck Supreme oil provided good mid-season curative control. Guthion, chloropropylate, and Union Carbide 19786 were ineffective as curative sprays.

San Jose Scale

C.V.G. Morgan:

Phosphate-dormant oil combinations were just as effective as the currently recommended spray mixture of lime sulphur-dormant oil for control of the San Jose scale. A phosphate-superior oil mixture applied at the mouse ear stage of tree development was equally effective but caused bark injury (large lenticels and cracked bark) on the 1963 wood of Red Delicious.

Fate of the San Jose Scale on Apples in Storage

Promising results of an investigation on the fate of the San Jose scale, Aspidiotus perniciosus Comstock, on harvested apples subjected to various storage procedures justify a change in the strict quarantine measures maintained against this insect by many importing countries. At present, one scale in an orchard quarantines the entire crop. Apples could be fumigated to kill the scale but this practice would increase the cost of production and would probably cause storage problems due to gas injury. The practices investigated here for their effects on the San Jose scale were only those currently used in commercial storage of apples in the Okanagan Valley of British Columbia.

All scales died on McIntosh, Delicious, Winesap, Rome Beauty, and Newtown apples placed in cold storage, but the period required for 100 percent mortality varied between 56 and 225 days depending upon (a) variety, (b) harvest date, (c) type of cold storage (standard or controlled atmosphere), and (d) treatment of fruit prior to storage (anti-scald dips or flotation baths for segregating water-cored apples). In standard cold storage (32°F.) the scale died on the above varieties in 56, 84, 84, 85, and 155 days respectively. These varieties were picked at the recommended harvest dates in 1963 of Sept. 6, Sept. 20, Oct. 1, Oct. 7, and Oct. 7 respectively. Extending the harvest date also extended the mortality period. For example, 225 days of standard storage was required to kill the scale on Newtown apples picked and stored on November 12. Controlled atmosphere storage (32°F., 5% CO_2, 3% O_2) reduced the mortality of the scale on Rome Beauty from 85 to 57 days and on Newtown from 155 to 113 days. The mortality period of 140 days of scales on Winesap apples (picked Oct. 11) in standard storage was reduced to 81 days by a pre-storage flotation-segregation bath of methyl alcohol adjusted to a specific gravity of 0.877. An anti-scald dip was equally effective. The effect of combining a number of these factors is presently being investigated. In the orchard where the San Jose scale is subjected to much lower temperatures the mortality of the scale on the fruit left on the tree until the end of December was approximately the same as the natural mortality of the scale on the twigs and limbs. It is speculated that in standard and controlled atmosphere storage the aromatics of the fruit may be a cause of mortality.

Complete mortality of the European fruit scale, Aspidiotus ostreaeformis Curtis, cannot be obtained in any type of cold storage within a reasonable period of time.

European Fruit Scale

C.V.G. Morgan and A.D. McMechan:

The European fruit scale has been known throughout the Province since the turn of the century but it has never been an important orchard pest. However, in 1963, for the first time in the history of the Okanagan Valley, heavy infestations occurred on the fruit of Newtown and McIntosh apple trees. A few growers lost their entire crop. The infestations increased in 1964 and the problem now extends from Penticton north to Vernon. The problem is invariably confined to old, usually large trees, with rough bark on the trunks and scaffold limbs. Varietal susceptibility occurs in the following decreasing order: Newton, McIntosh, Rome Beauty, Winesap, and Delicious apple trees. Prunes are also severly attacked on occasion. Heavy encrustations are common on Newtown and McIntosh trees. The infesta-

tions on McIntosh tend to be most severe in the tops of the trees whereas on Newtown they are more common on the lower scaffold limbs. Fortunately, this scale insect has only one generation a year.

The lime sulphur-dormant oil spray mixture provides excellent control of this insect but further investigations on the value of the oil are warranted. Surprisingly, the European fruit scale, unlike the San Jose scale, is not appreciably affected by phosphate-oil combinations applied either in the dormant or mouse ear stages of bud development.

However, the method of application, not the insecticide, is the most important factor involved in the control of this insect. Again, unlike the San Jose scale, the European fruit scale cannot be controlled by low-volume air-blast spraying even though the trees are sprayed from four sides. Our experiments demonstrated that satisfactory control of the European fruit scale requires a volume of spray liquid sufficient to cause running of the spray under the rough bark.

Apple Aphid

R. W. Zwick and F. W. Peifer:

A single post-harvest application of six materials and/or combinations applied with handgun to heavily infested mature trees indicated BHC-Niagara supreme oil and diazinon WP to be most effective one week after spraying.

PEAR INSECTS AND MITES

Pear Psylla

R. W. Zwick and F. W. Peifer:

A delayed dormant of lime sulphur-oil followed by a pink application of Perthane (WP, EC, and flowable), Dilan (WP, EC), or Morestan WP provided good early season control of psylla. Early season control generally reduces problems with psylla using registered insecticides such as Guthion and Perthane WP to which psylla in Hood River demonstrate a degree of resistance.

Cover sprays of Guthion-ethion, Guthion-Trithion, oil combinations of the foregoing organic phosphates, Perthane (EC and flowable), Morestan, and B 37344 provided good to excellent psylla control for four weeks.

Post-harvest applications of BHC-oil and Perthane-oil were the most effective treatments late in the season. Less effective were: lime sulphur, lime sulphur - oil, lime sulphur - magnetic sulphur 6, and Guthion-oil.

E. C. Burts:

Of several insecticides evaluated for the control of pear psylla only Nabam and American Cyanimid 3,8906 gave sufficient kill to warrant further testing. Because the supply of American Cyanimid 3,8906 was limited it was used in only a single test plot. Nabam was evaluated in greenhouse screening tests, as a summer spray and as a postharvest treatment against pear psylla. To reduce the phytotoxicity of this material it must be reacted with 1/2 its molecular equivalent of zinc sulfate. Since this half reacted mixture may still cause fruit spotting on D'Anjou fruits, this material may best be used as a postharvest spray. Morestan, which had

shown good control of pear psylla in prebloom sprays in previous years failed to be effective in several prebloom tests this year. Growers who applied the material as a delayed-dormant spray obtained better psylla control than was achieved with cluster bud applications.

P. H. Westigard:

Most growers in the Rogue Valley were able to achieve good control of pear psylla with Guthion; however, some signs of resistance to this material were evident. Bayer 37344, Morestan and Guthion applied in pre-pink stage of bud development gave good control of this pest. In summer tests single applications of Perthane were effective against low psylla populations but ineffective against high populations.

H. F. Madsen, K. Williams, R.D. McMullen:

Guthion at two dosages with and without the addition of Superior oil, and Superior oil alone were tested for control of the pear psylla on Bartlett pears. The plots were 1/2 acre in size, and the materials were applied by a concentrate sprayer set to deliver 60 gallons per acre. Evaluations were made by weekly counts of adults, eggs, and nymphs. Adults were counted by means of a beating tray, and the eggs and nymphs by examination of leaves.

Guthion at 6 pounds per acre and at 3 pounds per acre gave good control but the residual action of Guthion was less at the lower dosage. The Guthion-oil treatments were very effective, and a combination of 3 pounds Guthion plus 6 gallons oil per acre was equal to 6 pounds per acre of Guthion alone. Oil alone at 6 gallons per acre was as effective as Guthion at either dosage.

Adult psylla which survived the oil spray laid few eggs on the treated leaves, and most of the eggs were found on new growth. Eggs which were laid prior to the application failed to hatch and appeared desiccated two weeks after treatment.

Predators, principally anthocorids, were present in the orchard prior to the sprays. Guthion and Guthion-oil combinations killed the predators, and none re-established on these plots. Anthocorids were present on the trees sprayed with oil alone, indicating that the Superior oils may not adversely affect this species of predator.

In years past pear psylla in British Columbia has developed resistance to malathion, parathion and dieldrin. Recently increasing difficulty in controlling pear psylla with Guthion has been experienced. In laboratory tests the susceptibility to Guthion of a population of pear psylla collected from a commercial orchard near Kelowna was compared with a population from a nonsprayed experimental orchard. The data indicated that adults and nymphs of the Kelowna population were six and ten times, respectively, more resistant to Guthion.

Dimethoate, a systemic organophosphate insecticide, was tested in the orchard from which the Guthion resistant pear psylla were obtained. The degree of control of pear psylla obtained was unsatisfactory, compared to previous tests when Guthion resistance was unknown, indicating a cross resistance to Guthion and dimethoate. Also the failure of five sprays of carbaryl to control pear psylla earlier in the season might indicate an even more involved complex of resistance between organophosphate and carbamate insecticides.

F. P. Dean:

Pre-bloom sprays - Insecticides tested in the delayed dormant application included Morestan 25% WP at 1.0 lb./100 gal., and superior type oils of 140, 70 and 57 viscosities. The three oils were used alone and in combination with liquid lime-sulfur at 3.0 gal./100 gal. All of the delayed dormant treatments tested resulted in nearly perfect control. In applications at the prepink stage of bud development Nabam 93% WP at 1.0 lb. and Morestan 25% WP at 1.0 lb. resulted in fair control, while perthane 4 lb./gal. LC at 1.0 qt. was nearly as effective as the treatments used in the delayed dormant application.

Summer sprays - Pear psylla has become resistant to Guthion in the test orchards, but because of the relatively light infestation this season, Guthion held the population to less than injurious numbers. Perthane liquid concentrate was superior to Guthion, but the wettable powder formulation of Perthane was much less effective. Three brands of superior type oil with widely different viscosities all were very effective. These oils combined with sevin in the first cover spray caused severe leaf burning.

John L. Nickel:

The pear psylla population remained at a relatively low level throughout the 1964 season in an untreated orchard at San Jose. This was due to effective predation by anthocorids and lacewings. In an unsprayed orchard at Lafayette, however, predators did not become abundant and psylla populations were very high all summer, in spite of a brief period of parasite activity.

Reduced guthion dosages gave fair to excellent codling moth control while permitting more psylla predators than the normal guthion rates.

Orchard Mites

P. H. Westigard:

Post-harvest applications of line-sulfur plus oil or Morestan gave more effective control of European red mite than did delayed dormant applications, however, a pre-pink application of Morestan gave good control.

P. H. Westigard:

Application of pre-bloom acaracides resulted in good control of two-spotted spider mites with Aramite, Morestan; fair control with Bayer 37344 and C940; poor control with Chlorobenzilate and Karathane. Summer application of Shell 9219 gave excellent control of the 2-spot mite. Good control was obtained with Morocide, Trithion, HRS-1654B and C-940. Poor control with Banol. Shell 9219 and C-940 proved phytatonic to D'Anjou variety.

Summer applications of three Morocide dust formulations were applied by both ground and air. The diluted dust proved inferior to both the coated formulations.

P. H. Westigard:

Pear rust mite was kept under control in most commercial orchards which received a pre-bloom spray of lime-sulfur plus oil and summer applications of either Morocide or Kelthane.

Pre-pink applications of Bayer 37344, Morestan, Ethion plus Volck oil, Dithane A-40 and Thiodan gave good control of the rust mite, while Guthion, Perthane and Dilan applications did not give commercial control.

S E C T I O N I I

INSECT AND MITE PESTS OF STONE FRUITS

CHERRY INSECTS AND MITES

Cherry Fruit Fly

S. C. Jones:

Emulsifiable Sevin and MC-A-600 were evaluated this season for cherry fruit fly control. Emulsifiable Sevin at a dosage of 1-400 was unsatisfactory as a control of the cherry fruit fly. On the other hand MC-A-600 50% WP controlled the cherry fruit fly at a dosage of $1\frac{1}{2}$ pounds/100. Foliage injury resulted when three applications were applied at 10 day intervals.

The flies began emerging in ground cages at Corvallis on June 8 and were most abundant in these cages on June 22. Cherry growers following recommended procedures had little difficulty in controlling the cherry fruit fly in the Willamette Valley. These results are based on reports from the canning and brining industry.

Peach Tree Borer

Edward W. Anthon:

Nine insecticides or combinations were tested against the peach tree borer. Thiodan, Sevin, and Thiodan plus parathion combination gave the best results.

Orchard Mites

Edward W. Anthon:

Most of the materials tested gave satisfactory control of plum nursery mite. Morestan, Naugatuck D014 and C940, Union Carbide's 20047, Bayer's 5418 and Shell 9129 all gave good control. Bayer's 5418 caused severe injury to the foliage.

Black Cherry Aphid

S. C. Jones:

Many cherry orchards were severely infested by black cherry aphid in 1964. Considerable complaint was registered by orchardists and pickers at harvest.

Three systemic insecticides, systox, meta-systox and Anthio were evaluated for the control of this pest. The dosages used for the three insecticides was 1-800. They were applied on single tree plots replicated four times. The spray was applied on May 8, at the petal fall stage of fruit development. None of the materials completely controlled the pest this year. In previous years systox, when used at a dosage of 1-800, and applied at either pre-blossom or petal-fall controlled this insect for the season. Late migration of the winged aphids from the surrounding unsprayed orchard probably was responsible for the infestation on the sprayed plots.

San Jose Scale

Edward W. Anthon:

Oils and the combination of oils with parathion and Ethion gave good control of scale as prebloom sprays.

PEACH INSECTS AND MITES

Orchard Mites

Edward W. Anthon:

The materials tested under greenhouse conditions which showed the most promise against resistant two-spotted mites were: Shell 9129, Naugatuck D014, and D048, Morestan, Morocide, Union Carbide's 20047, and Bayer's 57856, 56115, 5417 and 5418.

Green Peach Aphid

Edward W. Anthon:

The following materials gave good control of this aphid both in the greenhouse and field: Mobil's Mc-600, Shell's SD 9129, Union Carbide's 20047. Thiodan was also effective if applied before the aphids had curled the leaves.

PRUNE INSECTS AND MITES

Orchard Mites

Edward W. Anthon:

The compounds which provided the best control of European red mites on prunes and peaches for four weeks were: Morestan, Naugatuck C940 and D014, Union Carbide's 20047, Bayer's 5417, 5418, and 5419, and Shell 9129.

Aphids

S. C. Jones:

There are three species of plum aphids in the Willamette Valley that cause damage to plum foliage. These are: The hop aphid, Phorodon humuli; The thistle Aphid, Anaraphis cardui; and the leaf curl plum aphid, Anuraphis helichrysi. Sometimes all three species are present in the same orchard. The damage is done by curling the foliage. In severe infestations most of the foliage will be curled and remain in that condition for most of the summer. Dormant spraying using insecticides combined with DMSO showed considerable promise in experiments in 1963. This year Thiodan was compared with and without DMSO and used as a dormant spray. The material was applied as follows: Thiodan 50% WP., 2 pounds, plus DMSO one gallon/100, and Thiodan 50% WP., 2 pounds/100. Single tree plots replicated three times were used. Results show that only an occassional limb was infested on the sprayed trees. Except for one unsprayed tree near the sprayed trees all the unsprayed trees were severely infested.

S E C T I O N I I I

INSECT AND MITE PESTS OF NUT CROPS

FILBERT INSECTS AND MITES

Filbert Aphid

S. C. Jones:

The filbert aphid and leafroller appear in filbert orchards during April. One spray application of Sevin, Thiodan, Guthion or Thiodan will control the leafroller and hold the aphids in check for a month.

While the infestation varied between orchards in April and early May the aphid infestation become heavy later in the season in orchards where no controls are applied.

Geigy insecticides GS-13005 and GS-12968 were compared against the filbert aphid and leafroller. Both insecticides reduced the aphid population to low numbers the day following the application. In less than three weeks however, the aphid population was increasing. This infestation was due to aphids flying in and re-infesting the plots. GS-13005 and GS-12968 were both effective in controlling the leafroller.

Big Bud Mite

S. C. Jones:

Three species of Eriophyes mites occur on filberts in Oregon. However, only one species, Phytoptus avellanae, is responsible for "blasting" filbert buds. One species Cecidophyopsis vermiformis, live in the "blasted" buds as inquilines and another species, Coptophylla lamineni feed entirely on the foliage. Both are considered innoculus.

None of the numerous pesticides tested will kill the mites inside the "blasted" buds. Three insecticides including Sevin, Thiodan and Bayer 37344 appear to be effective against the mites feeding on the foliage.

Spraying the foliage in April and May failed to prevent bud "blasting". Three applications of Thiodan and Bayer 37344 applied during June and July also failed to prevent bud "blasting".

Some filbert varieties such as Royal and Daviana are highly susceptible while other varieties such as Barcelona and DuChilly are resistant to the mite. Daviana and DuChilly are used as pollenizers for Barcelona.

WALNUT INSECTS AND MITES

Walnut Husk Fly

M. M. Barnes:

In preparation for studies of possible correlation between husk hardness and susceptibility to oviposition, a study was made of diurnal variation in hardness of husks of Payne walnuts. 160 readings with a pressure tester

were made every 90 minutes over a 13½ hour period. Pressure readings varied from an average of 71 grams to 107 grams. Lowest readings were recorded between 1 and 4 p.m. and highest readings between 7 and 9 a.m. Environmental conditions in relation to time of day must be considered in further development of attempts to correlate husk hardness with onset of oviposition.

John L. Nickel:

Emergence studies demonstrated earliest emergence on the south and west sides and latest emergence on the north side of the trees. The Eureka variety was attacked earliest and most severely. A two to three week minimum period was observed between the appearance of the first flies and oviposition in any field.

Phosphamidon, Bidrin, and Cygon displayed systemic activity in killing larvae feeding in the husk. Phosphamidon appeared to be most effective.

S E C T I O N I V

DISEASES OF POME FRUITS

APPLE DISEASES

Apple Powdery Mildew

Duane L. Coyier:

Single tree plots of Newton apples were sprayed with dodine (Cyprex 65W) and Karathane (WD) for the third and final year. Averages for the 3-year period showed that close interval spraying at reduced concentrations provided better control of powdery mildew than higher dosages applied less frequently. It is recommended that growers adjust the dosage of fungicide in accordance with the number of days between applications, i.e., 7-10 days, $\frac{1}{4}$ lb/100 gallon each of Cyprex and Karathane; 10-14 days, $\frac{1}{2}$ lb/100 gallon and over 14 days, 3/4 lb/100 gallon.

Fungicide screening tests on apple seedlings showed that several materials were comparable with the standard Karathane for powdery mildew control. Morestan 25% w.p., Cyprex 65W plus E.F.A.-2118, Union Carbide 21426 25% w.p., Shell Development 10665 50% w.p., dimethyl sulfoxide plus Geigy 138 iron chelate, Bayer 47531 50% w.p., and Thompson-Hayward 184-F 25% w.p. were satisfactory for mildew control and warrant further testing. Morestan was especially outstanding in these tests, but plants sprayed with this chemical showed a marked inhibition of growth at the 1 lb/100 gallon dosage level. This effect was also present when the chemical was used at the $\frac{1}{2}$ lb/100 gallon rate, but at this level plant growth was nearly the same as plants sprayed with $\frac{1}{2}$ lb/100 gallon of Karathane.

A 3-year study to determine the effectiveness of Karathane dust for apple powdery mildew control was concluded this year. Results showed that dust treatment would give control of the disease comparable with spray treatment. Neither dust nor spray treatment gave good commercial control unless applied on a frequent schedule.

Fifteen surfactants were tested in combination with Karathane on seedling apple trees to determine which were most effective for control of powdery mildew. The addition of surfactants improved mildew control only slightly under the conditions of this test. Some of the surfactants increased mildew on the test plants, which was probably due to a lower Karathane deposit or poorer wetting of the fungus mycelium or both.

S E C T I O N V

SPRAY RESIDUES, COMPATIBILITY, PHYTOTOXICITY, BEE POISONING AND POLLINATION, CONCENTRATE SPRAYING AND OCCUPATIONAL EXPOSURE

SPRAY RESIDUES

L. C. Terriere and Ulo Kiigemagi:

Cyprex in cherries: Last year's study of the effect of various surfactants on the amount of Cyprex deposited on leaves and fruit of sweet cherries was repeated. The treatments included Cyprex only ($\frac{1}{2}$ lb./100 gallon) and Cyprex plus surfactants EFA 2118, Colloidal Spray Modifier, and Triton B 1956. Again the analyses indicated that the highest initial deposits and most persistant residues were achieved without the added surfactants.

DDT and Kelthane in apples: The effect of a spray adjuvant, Paco Adhesive, on the retention of residues of DDT and Kelthane on apples was studied in Hood River. DDT and Kelthane, each at 2 lbs./100 gallon, were applied with and without Paco. The results indicated that Paco did not increase the initial deposits or improve residual life of these pesticides.

K. Williams:

As part of an investigation on the use of summer oils for the control of pear psylla, residue studies on the persistance of oil and of Guthion on pears were carried out. It was found that summer oil (70 vis.) was highly persistent with over 50 percent remaining on the foliage four weeks after spraying. Surprisingly Guthion was more persistent when applied alone than when combined with summer oil. The Guthion residues on fruit and foliage from the Guthion plots were more than double the Guthion residues on fruit and foliage in the Guthion-oil plots.

PHYTOTOXICITY

R. W. Zwick and F. W. Peifer:

Apples - Morestan at 0.5 and 1.0 lb/100 gallon applied as a cover spray produced spotting on undersides of foliage of Newtown, Red and Golden Delicious. SD 9129 caused severe leaf burn and defoliation. Chlorobenzilate WP at 0.75 lb/100 gallon caused brown spots on leaves and fruit of Newtown. Niagara supreme oil at 3.0 qt./100 gallon in early September produced yellow spots on foliage of Golden Delicious. Trithion WP at 0.75 lb/100 gallon burned leaves of Newtown. Morocide at 0.5 lb/100 gallon spotted Golden Delicious, but not Newtown.

Pears - Morestan burned petals slightly in an early April application and produced brown spots on fruit and foliage of Bartlett at 0.5 lb/100 gallon in summer applications. A Karathane - Ziram - Triton B1956 combination produced brown spots on Anjou in a June spray. Bayer 37344 spotted Bartlett leaves brown when handgun sprayed in August at 2.0 lb/100 gallon. BHC, prepared copper, and Niagara supreme oil combination caused premature yellowing and defoliation as a post harvest application to Bartlett pear, with lime sulphur-oil causing a similar, but not so severe condition.

E. C. Burts:

Morocide and Morestan did not injure foliage or fruit when applied as cluster bud or petal fall sprays following delayed-dormant sprays of lime sulfur and oil. Also no damage to pear occurred from petal fall and first cover applications of Morocide or Morestan following cluster bud applications of Volck Supreme oil. When oil was applied to the foliage a week before a Morocide spray, serious leaf and fruit burning occurred. Morocide and Perthane WP applied as a summer spray caused chlorotic spotting and buring on fruits under the deposit spots.

H. F. Madsen and K. Williams:

Combinations of oil and Sevin or oil and Perthane have been reported to cause fruit and foliage injury to Bartlett and Anjou pears. To ascertain how soon an oil spray could be followed by Perthane or Sevin and vice versa, a plot was established in a young Bartlett pear block. Superior oil was applied to one group of trees using a hand gun and these trees were then treated with Perthane or Sevin at intervals of one, two and three weeks following the oil sprays. A second group of trees were treated with Sevin and a third with Perthane. These trees were sprayed with Superior oil at intervals of one, two and three weeks after the insecticide application. All materials were used at the dosages recommended in the 1964 spray calendar.

The trees were examined for phytotoxicity after each spray and continued until leaf fall. No adverse effects were noted on either fruit or foliage. It was concluded that, under the conditions of the test, it was safe to follow Superior oils with either Perthane or Sevin after one week on Bartlett pears. There was also no evidence that Perthane or Sevin followed in one week by a spray of Superior oil would present any phytotoxic hazard.

Duane L. Coyier:

Liquid lime-sulfur plus oil emulsion was applied at two rates (5 gal L.S. + 3 gal oil and 3 gal L.S. + 2 gal oil) and at several stages of bud development to test the effect of these sprays on fruit set in D'Anjou pears. In these experiments the percent fruit set decreased progressively as the spray date approached the bloom period. The difference in fruit set between the earliest and latest spray application was nearly twofold. Similar results were reported a year ago and studies will be continued next season.

Two formulations of Morocide (code 2302 and ME-D-69) $\frac{1}{2}$ lb/100 gallon and Union Carbide 21427, 2 lb/100 gallon caused severe leaf injury when applied to seedling apple plants growing in one-gallon containers under burlap shade. UC 21427 caused death of plants. The Morocide formulations caused leaves to turn brown and eventually drop, but the plants re-foliated when treatment was terminated. Treatment consisted of 4 applications one week apart, commencing on June 1, 1964. Maximum temperature recorded was 87° F. on the day following the last spray application. All other maximum temperatures during the trial were below 80° F.

Morestan caused defoliation of lower leaves at $\frac{1}{2}$ and 1 lb/100 gallon rates when used under conditions described above. Plants treated with the higher dosage showed a marked decrease in growth as compared with the lower dosage and with untreated checks. Growth resumed when treatment ceased, and all plants were comparable in size six weeks following the last spray application.

Stan Hoyt:

Naugatuck C940 caused fruit injury in three different plots. Varieties injured were Winesap, Red and Golden Delicious apples. Morestan ($\frac{1}{2}$ lb rate) caused fruit and foliage injury to Golden Delicious and fruit injury to Red Delicious where repeated sprays were applied. Single applications of UC 21427 and TH 113M caused severe foliage burn on Red Delicious.

CONCENTRATE SPRAYING

E. C. Burts:

Results obtained this season support previous data indicating that concentrate spray applications are effective against many of the insect pests of pear and apple, but with the present acaracides this method of application is not as effective as high volume sprays against spider mites. Concentrate applications caused considerably more russeting of Golden Delicious apples this season than occurred in the high volume plots.

J. E. Dibble and H. F. Madsen:

Concentrate spraying has proved successful in California deciduous orchard tests conducted over a 4-year period. The majority of the insects found on two stone fruits, peaches and prunes; two pome fruits, apples and pears; and two nut crops, walnuts and almonds, in most cases have been controlled as successfully with concentrate spray applications as they have been with high volume dilute sprays. This spraying technique has involved from 60 to 90 gallons of spray per acre instead of the usual 350-1,000 gallons. A combination of approximately 100 pounds pressure at the nozzle, 110 to 130 miles per hour air velocity, the use of hollow cone disc type nozzles and the orchard travel speed of 1 1/2-2 miles per hour have given good pest control results in well over 300 field evaluations. The value of this spraying technique was measured three different ways. Dyes were sprayed into the trees to evaluate spray pattern and coverage. Insect counts were taken to evaluate control in different areas of the tree and spray residue analyses were made of both leaves and fruit. The advantage of this technique to the California tree fruit grower are primarily a savings in water, chemical and time. By using this method the grower can spray each acre with approximately 70 to 90 per cent less water and 25 per cent less insecticide. Since there is no drip or run-off with this technique, a reduction in chemical is possible. There have been no major disadvantages evident or noted in the 3 1/2 seasons of test work.

This is, or course, a more exacting method of application and requires full understanding of the technique as well as a constant checking of the gallons per acre output and the travel speed during application. A mistake in calibration and application rate could mean poor insect control or too high a spray residue. Growers can apply this spray either through the use of machines specifically designed for concentrate spraying or by modifying presently owned or locally available dilute type machines. Work with most of the popular types of air blast sprayers in California shows many of them to be adaptable for modifying to concentrate spraying. The newer types of high volume dilute sprayers are more easily adaptable for this spraying technique due to high air velocity and proper air pressure. Some of the older machines are either not suitable or may in many cases require substantial changes. A number of California growers

have already changed over to this spraying method and, following this past season's series of field demonstrations, many others will no doubt be trying this technique in the near future. Calibration examples and necessary tables are given in University of California Agricultural Extension Service leaflet PUB. AXT-131, "Concentrate Spraying in Deciduous Fruit Orchards".

CONTRIBUTORS TO ABSTRACTS OF THE 39th ANNUAL WESTERN COOPERATIVE SPRAY PROJECT

Anthon, Edward W., Tree Fruit Experiment Station, Washington State University, Wenatchee, Washington

Barnes, M. M., University of California at Riverside, Riverside, California

Burts, Everett C., Tree Fruit Experiment Station, Washington State University, Wenatchee, Washington

Butt, B. A., U.S.D.A., A.R.S., Ent. Research Div., 3706 Nob Hill Blvd, Yakima, Washington

Coyier, Duane I., USDA, ARS, Mid-Columbia Branch Experiment Station, Hood River, Oregon

Davis, Donald W., Utah State University, Logan, Utah

Dean, F. P., USDA, ARS, Entomology Research Division, 3706 Nob Hill Blvd, Yakima, Washington

Downing, R.S., Entomology Laboratory, Canada Dept. of Agri., Summerland, B.C.

Howell, J. Franklin, USDA, ARS, Entomology Research Division, 3706 Nob Hill Blvd, Yakima, Washington

Hoyt, Stanley C., Tree Fruit Experiment Station, Washington State University, Wenatchee, Washington

Jones, S.C., Department of Entomology, Oregon State University, Corvallis, Oregon

Kiigemagi, Ulo, Department of Agricultural Chemistry, Oregon State University, Corvallis, Oregon

Madsen, Harold F., Entomology Laboratory, Canada Department of Agriculture, Summerland, B.C.

McMechan, A.D., Entomology Laboratory, Canada Department of Agriculture, Summerland, B.C.

McMullen, R.D., Entomology Laboratory, Canada Department of Agriculture, Summerland, B.C.

Morgan, C.V.G., Entomology Laboratory, Canada Department of Agriculture, Summerland, B.C.

Nickel, John L., Division of Entomology and Acarology, University of California, Berkeley, California

Peifer, Forrest W., Mid-Columbia Branch Experiment Station, Hood River, Oregon

Proverbs, M.D., Entomology Laboratory, Canada Department of Agriculture, Summerland, B.C.

Terriere, L.C., Department of Entomology, Oregon State University, Corvallis, Oregon

Westigard, P.H., Southern Oregon Branch Experiment Station, 569 Hanley Road, Medford, Oregon

Williams, K., Entomology Laboratory, Canada Department of Agriculture, Summerland, B.C.

Zwick, R. W., Mid-Columbia Branch Experiment Station, Hood River, Oregon

Dibble, J. E., Extension Entomology Technologist, University of California, Berkeley, California

Madsen, H. F., Entomologist in Charge, Entomology Laboratory, Summerland, British Columbia, Canada

S E C T I O N I I

INSECT AND MITE PESTS OF STONE FRUITS

CHERRIES, PEACHES AND APRICOTS

Shot Hole Borer

Ian D. Jack, Beach Avenue, R. R. #1, Peachland, B. C.:

Generations of shot hole borer are characterized by long emergence periods with peaks of flight. Detection of these peaks is important for the timing of sprays. In an experiment to test various traps as indicators of peaks, one glass barrier trap was more satisfactory than either twelve yellow sticky boards or three fermenting pots. Wood piles and brush piles in or near orchards serve as sources of infestation, allowing beetle populations to increase greatly in numbers. Under such conditions healthy trees may be attacked. Control measures should be undertaken not only in the fall but also in the spring. If control of the spring generation is successful control measures may be unnecessary in the fall.

CHERRIES AND PRUNE (ALSO APPLE)

Ambrosia Beetle

Ian D. Jack:

Recently planted young trees seem most susceptible to attack by this beetle. From observations this year there was only one flight period which occurred during the latter part of May. Overwintered as an adult in infested trees. It appears to be associated with a disease but attempts to isolate and identify it using malt extract agar as a culture medium were unsuccessful.

S E C T I O N I V , A

DISEASES OF STONE FRUITS

CHERRY DISEASES

Control of Rots of Cherries in Poly Packs Held for Long Periods in Cold Storage

L. E. Lopatecki, Plant Pathology Section, Canada Agriculture Research Station, Summerland, B. C.:

Cherries held in CA storage at Summerland during the 1963 season developed a high percentage of rot. During 1964, tests were run on the value of fungicidal treatment of fruit packed in poly bags and held for 5 weeks at 32°F. Best control was obtained with a dip treatment of Difolatan at 2 lb. per 100 gallons. Captan at the same concentration was good but less effective, while 2-amino butane and dehydroacetic acid appeared useless.

PEACH DISEASES

The Effect of Water Dumping Upon Development of Brown Rot in Peaches

L. E. Lopatecki:

Peaches dumped in water developed three times as much brown rot as fruit that ramained dry. Addition of soda lime to a Specific gravity 1.01 to float the peaches reduced brown rot slightly, while at a Sp. gr. of 1.02, rot was reduced to the level present in dry fruit.

Addition of brown rot spores to the dipping solution greatly increased subsequent fruit rot. When Captan was added at a 2 lb. rate, infection fell well below the level of untreated controls.

S E C T I O N I V

DISEASES OF POME FRUITS

APPLE DISEASES

The Effect of Scald Suppressing Chemicals Upon Bull's Eye Rot of Apples in Cold Storage

L. E. Lopatecki:

Artificially inoculated apples, after treatment with Stop-Scald and diphenylamine, developed only a small fraction of the rot present in untreated controls. Both Stop-Scald and diphenylamine are powerful inhibitors of mycelial growth of Gloeosporium perennans on agar plates.

S E C T I O N V

SPRAY RESIDUES, COMPATIBILITY, PHYTOTOXICITY, BEE POISONING AND POLLINATION, CONCENTRATE SPRAYING AND OCCUPATIONAL EXPOSURE

BEE POISONING

Carl Johansen, Washington State University, Department of Entomology, Pullman, Washington:

(1) Only UC 20047A, NIA 10,242, and GS 13005 were quite toxic to honey bees in small-scale tests on apple; VC 20047A was reduced to low toxicity with 1-day foliage residues. Pentac, chloropropylate, and GC-9160 presented no hazard to bees.

(2) General results with various insecticides on forage crops were as follows:

Material	lb/acre	Direct Action	Toxicity 1-3 hr residual action
Banol 75% WP	2.0	very high	Very high (7 hr.)
UC 10854 75% WP	1.0	" "	" " "
Malathion tech.	10 oz	" "	" "
Malathion 5 lb E	1.5	" "	" " (7 hr.)
SD 9129 3.2 lb S	0.4-0.8	" "	" "
Sevin 80% WP	1.0	" "	moderate (1 day)
Methoxychlor 50% WP	3.0	-	"
Sevin 4 lb F	1.0	very high	" (1 day)
Soilserv Sevin 2 lb E	1.0	" "	low (1 day)
UC Sevin 2 lb E	1.0	" "	" (1 day)
Sevin 80% WP plus	1.0		
Cellosize QP-4400,	2.1	" "	" (1 day)
Polyox WSR-301,	0.5	" "	" "
or UCAR Latex 680	2.1	" "	" "
Thiocron 50% WP	1.0	" "	" (7 hr.)
Thiocron 2.5 lb E	1.0	" "	" (7 hr.)
GC 9879 4 lb E	0.5	moderate	"
CP 43858 3 lb E	1.0	low	"
DDT 2 lb E	2.0	-	"
Endrin 1.6 lb E	4-8 oz	-	"
AC 47470 10% G	1-3	-	"
AC 47031 10% G	1.3	-	"
Bayer 25141 10% G	2.0	-	"

Several unexpected results obtained this year were undoubtedly caused by cool, rainy weather.

* * *