CONTROL OF THREE SPECIES OF LEAFHOPPERS, ON RUBUS IN BRITISH COLUMBIA[1]

J. RAINE[2] AND N. V. TONKS[3]

Ribautiana tenerrima (H.-S.) and *Edwardsiana rosae* (L.), both of Typhlocybinae, and *Macropsis fuscula* (Zett.), of Macropsinae, frequently damage various species of *Rubus* on Vancouver Island and in the lower Fraser Valley.

Ribautiana tenerrima, and *E. rosae,* have similar life cycles and habits (Raine, 1960; Childs, 1918). There are two generations each year; nymphs emerge during May and again in August, and adults appear during June and September. Both species overwinter as eggs. Feeding by nymphs and adults on the undersides of the leaves causes a characteristic whitish stippling, impairs leaf function, and reduces plant vigour.

Macropsis fuscula, a European species, has only one generation each year. Nymphs emerge from overwintered eggs in late May, and adults appear during July (Tonks, 1960). In the Netherlands this species is reported as a vector of the virus disease known as rubus stunt (de Fluiter, 1953). The nymphs feed mostly on the undersides of the calyces of flower buds and fruit. Damage to the berries is not readily visible, but studies during 1959 showed a 20 per cent reduction in yield from heavily infested plots compared with clean plots. Fruit quality may be reduced by the growth of a sooty-mould fungus in honeydew excreted by the leafhoppers, and nymphs included with the fruit during picking become a contamination problem.

This paper presents results obtained with several materials for control of the three species of leafhoppers. The work was conducted on Vancouver Island, and in the lower Fraser Valley, from 1955 to 1959.

[1] Contribution No. 178 from Entomology Laboratory, Research Branch, Canada Agriculture, Victoria, British Columbia.

[2] Now at Research Station, Research Branch, Canada Agriculture, 6660 N.W. Marine Drive, Vancouver 8, B.C.

[3] Now at Experimental Farm, Canada Agriculture, Saanichton, B.C.

Materials and Methods

The following chemicals were used in the experiments:

DDT, 25 per cent liquid; Chipman Chemical Company, Toronto, Ont.

Derris, 2.5 per cent liquid and 1 per cent dust of rotenone; Chipman Chemical Company, Toronto, Ont.

Diazinon, 25 per cent liquid and 5 per cent dust of *O, O*-diethyl *O*-(2-isopropyl-6-methyl-4-pyrimidinyl) phosphorothioate; Geigy Agricultural Chemicals, Yonkers, N.Y.

Dimethoate, 46 per cent liquid of *S*-methylcarbamoylmethyl *O, O*-dimethyl phosphorodithioate; American Cyanamid Company, Stamford, Conn.

Di-Syston, 5 per cent granules of *O, O*-Diethyl *S*-2-(ethylthio) ethyl phosphorodithioate; Chemagro Corporation, Kansas City, Mo.

Endrin, 18 per cent liquid of endrin; Velsicol Corporation, Chicago, Ill.

Ethion EC 4, liquid containing four pounds of *O, O, O′, O′*-tetraethyl *S* S′-methylene bisphosphorodithioate per U.S. gallon; Niagara Chemical Division, Food Machinery and Chemical Corporation, Middleport, N.Y.

Guthion, 18.4 per cent liquid of *O, O*-dimethyl *S*-4-oxo-1, 2, 3-benzotriazin-3 (4*H*)-ylmethyl phosphorodithioate; Chemagro Corporation, Kansas City, Mo.

Heptachlor, 25 per cent liquid of heptachlor; Velsicol Corporation, Chicago, Ill.

Malathion, 57 per cent liquid and 4 per cent dust of malathion, American Cyanamid Company, Stamford, Conn.

Methoxychlor, 25 per cent liquid of 1, 1, 1-trichloro-2, 2-bis (*p*-methoxyphenyl) ethane; Geigy Agricultural Chemicals, Yonkers, N.Y.

Phorate, 48.5 per cent liquid of *O, O*-diethyl *O* (and *S*)-2-(ethylthio) ethyl phosphorothioates; Chemagro Corporation, Kansas City, Mo.

Phosdrin, 48.5 per cent water-soluble liquid of 2-methoxycarbonyl-1-methyl vinyl dimethyl phosphate; Shell Oil Company of Canada, Toronto, Ont.

Rogor, 40 per cent liquid of S-methylcarbamoylmethyl *O, O*-dimethyl phosphorodithioate; Fisons Pest Control Limited, Cambridge, Eng.

Sevin, 50 per cent wettable powder and 13 per cent emulsion of 1-naphtyl *N*-methylcarbamate; Union Carbide Chemicals Company, New York, N.Y.

Systox, 26 per cent liquid of a mixture of *O, O*-diethyl *S*-(and *O*) (2-ethylthio) ethyl phosphorothioates; Chemagro Corporation, Kansas City, Mo.

Thiodan, 24 per cent liquid of 6, 7, 8, 9, 10, 10-hexachloro-1, 5, 5a, 6, 9, 9a-hexahydro-6, 9-methano-2, 4, 3-benzodioxathiepin 3-oxide; Niagara Chemical Division, Food Machinery and Chemical Corporation, Middleport, N.Y.

Trithion, 43.7 per cent liquid of *O*, *O*-diethyl *S*-*p*-chlorophenylthiomethyl phosphorodithioate; Stauffer Chemical Company, Mountain View, Calif.

The experiments were conducted on loganberry because this crop was most heavily infested with the three species of leafhoppers.

Plots varied in size from year to year, but consisted of not less than four plants per plot, with three replicates. Buffer rows, or portable barriers, were used between plots to prevent spray drift.

Sprays and dusts were applied to the foliage in mid-May to control emerging nymphs. Sprays were applied to the canes in March to kill overwintering eggs. Systemics were applied as drenches to the crowns in April or painted on the canes in May to control emerging nymphs. Di-Syston granules were sprinkled on the soil around the base of the plants in April to control emerging nymphs.

The sprays were applied with a portable "Bean" sprayer operated at 100 lb. pressure. About 200 gal. per acre were required for foliage sprays, and 100 gal. when canes only were sprayed. The dusts were applied with a backpack puff duster at about 50 lb. per acre. The drenches were applied with the same "Bean" portable sprayer fitted with a 3-foot spray wand having a quick shut-off valve and a solid-cone nozzle. (Tee Jet TG3, John Brooks and Co., Ltd., Montreal, Que.). With the machine operating at 100 lb. pressure, one pint of drench was applied to each plant when the nozzle was held for 10 seconds about 15 in. above the crown. The DiSyston granules were used at one pound toxicant per acre.

Counts of Typhlocybinae nymphs were made in May, and late July, on the leaves of 10 to 25 fruiting spurs per plot, collected at random on one side of the row along the top wire. Populations of *M. fuscula* were assessed in late June or early July by counting the nymphs on 200 to 500 berries per plot from both sides of the row. Samples of loganberries treated with Rogor either as a drench, or as a foliage spray were frozen and shipped by air to Fisons Pest Control Ltd., England, for analysis of residues.

Results and Discussion

A summary of the materials used as foliar sprays and the results obtained appears in Table I. Survival is expressed as the mean number of *M. fuscula* nymphs per 100 berries, and the mean number of Typhlocybinae nymphs per 10 fruiting spurs. Where possible, data on the control of both generations of Typhlocybinae were evaluated, since reinfestation may occur from adjacent infested plantings.

Control of Typhlocybinae—One foliage spray of DDT, Thiodan, Trithion or Systox in mid-May controlled first-generation nymphs, and reduced reinfestation by the second generation in August. Diazinon, methoxychlor, Sevin, Guthion, Phosdrin, endrin, phorate, derris, Dimethoate, and Rogor controlled the first generation but did not prevent extensive reinfestation by the second generation. Heptachlor was ineffective.

The mean number of first generation Typhlocybinae nymphs per 10 fruiting spurs, following treatment with foliage dusts in mid-May were as follows:

Malathion	0
Diazinon	2
DDT	5
Derris	28
Check	180

DDT or Trithion spray applied to the canes in mid-March effectively controlled nymphs emerging in May. The action was probably residual rather than ovicidal.

TABLE 1—Mean number of nymphs of **Macropsis fuscula** per 100 berries, and of Typhlocybinae per 10 fruiting spurs, following treatment with foliage sprays in mid-May, 1955-59.

Insecticide	Pints per 100 gal.	Toxicant lb. per 100 gal.	**Macropsis**	Typhlocybinae 1st generation	Typhlocybinae 2nd generation
DDT	3	0.94	25	0	20
Derris (Cube)	4	—	6	6	—
Diazinon	2	0.63	0	0	59
Dimethoate	1	0.62	—	0	63
Endrin	1	0.25	—	0	183
Ethion	¾	0.46	0	—	—
Guthion	1	0.23	0	0	67
Heptachlor	2	0.62	—	203	192
Malathion	2	0.63	0	0	122
Methoxychlor	4	1.25	0	0	126
Phorate	¼	0.16	—	0	77
Phosdrin	½	0.13	—	0	72
Rogor	1	0.50	—	0	60
Sevin WP	2½	1.25	0	—	—
Sevin	8	1.25	—	0	52
Systox	¾	0.23	—	0	18
Thiodan	1	0.31	7	5	20
Trithion	½	0.31	0	0	19
Check	—	—	28	160	102

Results obtained with systemics showed that Dimethoate at one pint per 100 gal. applied as a drench to the crowns in early April controlled first generation nymphs, but did not prevent reinfestation by the second generation. Similar applications of Rogor at one-half pint, and Systox at one pint, per 100 gal., were not effective. Dimethoate at a dilution of 1:10 painted in a one-inch band on the canes of potted plants gave excellent control of nymphs within five days, and at dilutions of 1:100 and 1:800 significantly reduced infestations within 12 days. Granular Di-Syston was ineffective as a soil treatment.

Control of Macropsis fuscula — In the Netherlands, good control of *M. fuscula* is obtained with dormant sprays of tar oil or DNC to kill the eggs in the canes, or by spring applications of Parathion, malathion, Diazinon, or Systox to kill the nymphs (de Fluiter, 1958).

In British Columbia, a dormant spray of tar oil applied to loganberry in mid-March reduced *M. fuscula* infestations in June by 95 per cent; lime sulphur plus dormant oil was about 75 per cent effective. Control with water-soluble dinitrocresol was unsatisfactory. Probably because of better coverage, dormant sprays were more effective when applied after the canes were up on wires than when the canes were trailing on the ground. Dormant sprays have not been generally recommended for leafhopper control in British Columbia, because most growers leave the loganberry canes on the ground throughout the dormant period, and because it is difficult to operate heavy equipment on the land during the winter.

Foliage sprays of malathion, Guthion, Ethion, or Sevin applied once, in mid-May, gave excellent control. Thiodan and derris reduced infestations considerably but were less effective than the other materials. Fall sprays of methoxychlor, malathion, Diazinon, or Trithion applied to assess their potential ovicidal action caused no reduction during the following spring.

Dimethoate at one pint per 100 gal. applied as a drench to the crowns in early April significantly reduced the number of nymphs emerging in late May. Rogor at one-half pint, and Systox at one pint, per 100 gal., were not effective. Granular Di-Syston was ineffective as a soil treatment.

Phytotoxicity—Ferbam, at three lb. per 100 gal. added to emulsible concentrate sprays of malathion, Diazinon, Trithion, methoxychlor, Guthion, and wettable powder sprays of Sevin, caused no deleterious effects on loganberry, nor did Captan, at three lb., added to malathion and Diazinon. Endrin 18 per cent emulsible concentrate at one pint per 100 gal. caused some injury to loganberry foliage. In previous experiments on phytotoxicity of spray materials, DDT and methoxychlor emulsible concentrates at four pints per 100 gal. caused some yellow spotting on raspberry; malathion 50 per cent emulsible concentrate, at two pints, occasionally caused a slight leaf burn on raspberry, particularly on young growth.

Residues — Residues of Rogor in loganberries at harvest were below 0.1 ppm, which is the limit if sensitivity of the clorimetric method for determining phosphorus. Samples for analysis were taken from Rogor treatments applied either as foliage sprays in mid-May at one pint per 100 gal., or as soil drenches in April, at one pint per crown, at a dilution of one-half pint per 100 gal. Dietary toxicity studies conducted by Fisons, including daily oral ingestion trials with humans, have shown that up to 2 ppm of Rogor may be regarded as innocuous in most human foods.

Summary

The bramble leafhopper, *Ribautiana tenerrima* (H.-S.), the rose leafhopper, *Edwardsiana rosae* (L.), (both Typhlocybinae), and *Macropsis fuscula* (Zett.), frequently damage *Rubus* species in British Columbia. One application of Trithion in mid-May controlled all three species, including second-generation nymphs of Typhlocybinae. Malathion, Diazinon, Sevin, methoxychlor, and Guthion applied in mid-May controlled *M. fuscula,* and first - generation nymphs of Typhlocybinae, but did not reduce infestations of the second generation. DDT controlled both generations of Typhlocybinae, but was ineffective on *M. fuscula.* Phorate, endrin, Phosdrin, and Systox, in trials conducted on Typhlocybinae, controlled the first generation; Systox reduced infestations by the first and second generation. Dimethoate applied as a drench to the crowns in April controlled nymphs of both Typhlocybinae and *M. fuscula* and also gave control of Typhlocybinae nymphs when applied as a foliage spray in mid-May. Residues of Rogor at harvest were at a safe level below 0.1 ppm. No deleterious effects were observed from the addition of Ferbam or Captan to foliage sprays on loganberry.

References

Childs, L., 1918. The life-history and control of the rose leafhopper. Oregon Agr. Expt. Sta. Bull. 148.

de Fluiter, H. J., and F. A. van der Meer, 1953. Rubus stunt, a leaf-hopper borne virus disease. Tijdschr. o. Plantenz. 59:195-197.

de Fluiter, H. J., and F. A. van der Meer. 1958. The biology and control of **Macropsis fuscula** Zett., the vector of the rubus stunt virus. Proc. 10th Intern. Congr. Ent. Vol. 3:341-345.

Raine, J., 1960. Life history and behaviour of the bramble leafhopper, **Ribautiana tenerrima** (H.-S.) (Homoptera: Cicadellidae). Canad. Ent. 92:10-20.

Tonks, N. V., 1960. Life history and behaviour of the leafhopper **Macropsis fuscula** (Zett.) (Homoptera: Cicadellidae) in British Columbia. Canad. Ent. 92:707-713.