Tolerance of *Stethorus punctum*[1] Adults and Larvae to Various Pesticides[2]

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ABSTRACT

Thirty-eight miticide, insecticide, and fungicide treatments were tested by a laboratory dip method for toxicity to adults of a ladybird beetle, *Stethorus punctum* (LeConte). Six treatments were tested for toxicity to larvae. Highly toxic to adults were Bay Hox 2709 (*O*-(3-Chloro-7-methylpyrazolo [1,-5-a] pyrimidin-2yl) *O,O*-diethyl phosphorothioate) and CGA 13608 (*o*-(Methyl-2-propinylamino) phenyl methylcarbamate) at 0.5 lb AI/100 gal, carbaryl and Dursban® (*O,O*-diethyl *O*-(3,5,6-trichloro-2-pyridyl) phosphorothioate) at 0.25 lb AI/100 gal, Mesurol® (4-(methylthio)-3,5-xylyl methylcarbamate) at 0.094 lb AI/100 gal, and Ortho 15223 *O,S*-dimethyl(methoxyacetyl)-phosphoramidothioate at 0.3 and 0.6 lb AI/100 gal. Carbaryl at 0.125 lb AI per 100 gallons was highly toxic to larvae, and Ortho 15223 was moderately toxic to larvae at 0.15 and 0.30 lb AI per 100 gal. All other materials exhibited either moderate or low toxicity to adults and larvae, and they appear to have a place in future integrated chemical and biological control of fruit pests.

A ladybird beetle, *Stethorus punctum* (LeConte), is one of the most important native predators of the European red mite, *Panonychus ulmi* (Koch), in south-central Pennsylvania fruit orchards. To aid in development of future programs of integrated control a need exists to establish the toxicity to *S. punctum* adults and larvae of various pesticides used for control of fruit pests.

Ripper (1956) summarized previous research on the effect of various chemicals on *S. punctum*. We (Colburn and Asquith 1971) evaluated 16 pesticides to determine their relative toxicity to all life stages of *S. punctum*. Further results of the toxicity to adults and larvae of *S. punctum* of 15 registered and experimental insecticides and miticides and 11 fungicides are summarized here.

METHODS AND MATERIALS.—*S. punctum* adults were collected from 6 apple orchards in south-central Pennsylvania on 8 dates from June 21 to Oct. 11, 1972. The beetles were collected from the trees by placing a 1-yd^2 cloth tray beneath a limb and tapping it to dislodge the beetles. The beetles were taken from the tray with an aspirator and transferred to styrofoam cups for transport to the laboratory.

The materials to be tested were weighed and measured, and solutions were mixed in the appropriate amount with well water. The miticides, insecticides, and fungicides, their formulations, active ingredients, and sources were:

Insecticides and Miticides

- Azinphosmethyl WP 50%, Chemagro Corp
- Bay-Hox 2709 WP 50%, *O*-(3-Chloro-7-methylpyrazolo [1,5-a] pyrimidin-2yl) *O,O*-diethyl phosphorothioate, Chemagro Corp.
- Carbaryl WP 50%, Union Carbide Corp.
- CGA-13608 WP 50%, *o*-(Methyl-2-propinylamino) phenyl methylcarbamate, Ciba-Geigy Corp.
- Dursban® EC, *O,O*-diethyl *O*-(3,5,6-trichloro-2-pyridyl phosphorothioate, 2 lb/gal, Dow Chemical Co.
- Mesurol® WP 75%, 4-(Methylthio)-3,5-xylyl methylcarbamate, Chemagro Corp.
- Ortho 15223 SP 60%, *O,S*-dimethyl (methoxyacetyl) phosphoramidothioate, Chevron Chemical Co.
- Phosalone WP 25%, Chipman Chemical Div., Rhodia, Inc.
- Phosphamidon 8 EC, Chevron Chemical Co.
- Phosvel® WP 50%, *O*-(2,5-Dichloro-4-bromophenyl) *O*-methyl phenylthiophosphonate, Velsicol Chemical Co.
- R-28627 WP 25%, *S*-Tricyclohexyltin *O,O*-di-isopropyl dithiophosphate, Stauffer Chemical Co.
- S-2957 EC 50%, *o*-[2,5-dichloro-4-(methylthio) phenyl] *O,O*-diethyl phosphorothioate, Cela-EM Laboratories
- SD-14114 WP 50%, hexakis (beta,beta-dimethylphenyl) distannoxane, Shell Chemical Co.
- U-36059 EC 20%, *N,N'*-[(methylimino)dimethylidyne] di-2,4-xylidine, American Cyanamid Co.
- Vydate-L® EC, methyl *N,N*-dimethyl-*N'* [(methylcarbamoyl)oxy]-1-thiooxamimidate, 2 lb/gal, E. I. duPont de Nemours & Co.

Fungicides

- Afugan® EC 33%, 20(*O,O*-Diethyl-thionophosphoryl)-5-methyl-6-carbethoxy-pyrazolo-(1.5.a)pyrimidine, American Hoechst Corp.
- Benomyl WP 50%, E. I. duPont de Nemours & Co.
- Binapacryl WP 50%, Niagara Chemical Div. FMC Corp.
- Captan WP 50%, Stauffer Chemical Co.
- Dikar® WP 80%, 74% a coordination product of zinc ion and manganese ethylene bisdithio-carbamate + 6% dinocap, Rohm & Haas Co.
- Dodine WP 65%, American Cyanamid Co.
- Morestan® WP 25%, 6-Methyl-2,3-quinoxalinedithiol cyclic *S,S*-dithiocarbonate, Chemagro Corp.
- Polyram® WP 80%, mixture of 5.2 parts by wt (83.9%) of ammoniates of [ethylenebis(dithiocarbamato)] zinc with one part by wt (16.1%) ethylenebis [dithiocarbamic acid] bimolecular and trimolecular cyclic anhydrosulfides and disulfides, Niagara Chemical Div. FMC Corp.
- Sulfur WP 95%, Stauffer Chemical Co.
- Thiram WP 65%, E. I. duPont de Nemours & Co.
- Zineb, WP 75%, Rohm & Haas Co.

Capture cups and test cups for the adults were 8-oz styrofoam. Preparation of cups and test methods were the same as those we described (Colburn and Asquith 1971). Adults and larvae were placed in cups which were placed in cages in a screened insectary for the duration of the test period. Each formulation was tested on 10 beetles with a check of 10 wetted (water) and 10 nonwetted beetles maintained on each test date.

[1] Coleoptera: Coccinellidae.

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Table 1.—Influence of various insecticides and miticides on *S. punctum* adults and larvae.

Material	lb AI/100 Gal	Percent Survival[a] Adults	Larvae
Azinphosmethyl WP 50%	0.125	100	—
	.250	100	—
	.500	60	—
Bay-Hox 2709 WP 50%	.500	30	—
Carbaryl WP 50%	.031	100	50
	.062	90	50
	.125	60	30
	.250	0	—
CGA-13608 WP 50%	.500	0	—
Dursban 4 EC	.250	30	—
Mesurol WP 75%	.094	0	—
Ortho 15223 SP 60%	.150	80	70
	.300	30	60
	.600	10	—
Phosalone WP 25%	.250	60	—
Phosphamidon 8 EC	.375	90	—
Phosvel WP 50%	.500	100	—
	1.000	90	—
R-28627 WP 25%	.250	100	—
S-2957 50 EC	.250	80	—
SD-14114 WP 50%	.250	100	100
U-36059 20 EC	.188	90	—
	.375	80	—
Vydate-L2 EC	.250	60	—
Check (water)		100	100
(dry)		100	100

[a] Survival after 48-h exposure

Table 2.—Influence of various fungicides on *S. punctum* adults.

Material	lb AI/100 Gal	Percent Survival[a] Adults
Afugan 33 EC	0.125	90
Benomyl WP 50%	.063	100
	.125	100
	.188	90
	.250	50
Binapacryl WP 50%	.250	90
Captan WP 50%	1.000	100
Dikar WP 80%	1.600	100
Dodine WP 65%	.250	100
Morestan WP 25%	.063	90
Polyram WP 80%	1.600	100
Sulfur WP 95%	.500	100
Thiram WP 65%	1.300	100
Zineb WP 75%	.375	90
Check (water)		100
(dry)		100

[a] Survival after 48-h exposure

S. punctum larvae, 3rd and 4th stadia, were collected and tested as described previously (Colburn and Asquith 1971). Ten larvae were tested in several selected materials; 10 check larvae were dipped in water (well); 10 were kept dry throughout the test period.

Tests were conducted in an outside insectary and conditions ranged from 26 to 100% RH (mean 68) and 50 to 85°F (mean 69). Observations were made at 1, 2, 4, 8, 12, 24, and 48 h after treatment. An average percent survival was computed.

RESULTS AND DISCUSSION.—Tables 1 and 2 present the results in terms of survival for 48 h (Colburn and Asquith 1970). Highly toxic materials to adult *S. punctum* (<30% survival) were carbaryl, Bay Hox 2709, and CGA 13608 at 0.5 lb AI/100 gal, carbaryl and Dursban at 0.25 lb AI/100 gal, Mesurol at 0.094 lb AI/100 gal, and Ortho 15223 at 0.3 and 0.6 lb AI/100 gal. Moderately toxic materials to adults (35–65% survival) were azinphosmethyl at 0.5 lb AI/100 gal, phosalone, Vydate-L, and benomyl at 0.25 lb AI/100 gal, and carbaryl at 0.125 AI/100 gal. All lower dosages of these and other tested materials were tolerated to a high degree by the adults (survival > 70%) and, as far as toxicity to *S. punctum* adults is concerned, they appear to have a place in future integrated-control programs on fruit.

Carbaryl at 0.125 lb AI/100 gal was highly toxic to the larvae, with the lower dosages being moderately toxic. Ortho 15223 was moderately toxic to the larvae at dosages of 0.15 and 0.30 lb AI/100 gal.

Mortalities probably are higher in the laboratory than those likely to occur in the field, because the insects were immersed directly into the materials. Therefore, we view the resultant mortalities as only an indication of the relative toxicity of the various pesticides. Nevertheless, these data are essential in determining if a material will fit into future integrated chemical and biological programs for control of fruit-pest species.

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