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THE RESIDUAL CONTACT TOXICITY OF BAY SIR 8514 TO *SPODOPTERA LITTORALIS* LARVAE

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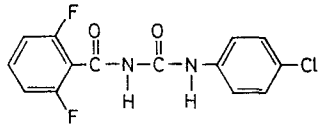
The contact effect of residues on glass of the chitin synthesis inhibitor BAY SIR 8514 against *Spodoptera littoralis* (Boisduval) larvae was investigated and probit-log dosage curves were established. The ED_{50} for cumulative mortality up to the adult stage was 0.0017 g/m² for 100-mg and 0.004 g/m² for 200-mg larvae. The toxicity of BAY SIR 8514 through this route of administration was considerably higher than that of diflubenzuron found in previous work.

KEY WORDS: BAY SIR 8514; diflubenzuron; chitin synthesis inhibitors; *Spodoptera littoralis* larvae; contact with crystalline residues.

INTRODUCTION

In previous work (4) it was demonstrated that the chitin biosynthesis inhibitor diflubenzuron [1-(4-chlorophenyl)-3-(2,6-difluorobenzoyl)urea] exhibited its specific moult-disturbing effect in *Spodoptera littoralis* (Boisduval) larvae *inter alia* through contact with its crystalline residues on glass. Several new compounds related structurally to diflubenzuron have been developed recently by the chemical industry. One of



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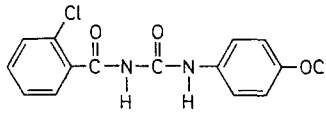
Diflubenzuron



BAY SIR 8514

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these, Bayer compound BAY SIR 8514 (6, 7, 8, 12, 13) [1-(4-trifluoromethoxy-phenyl)-3-(2-chlorobenzoyl)urea] (according to Chemical Abstracts' usage, (2-chloro-N-[(4-trifluoromethoxy-phenylamino)-carbonyl]-benzamide), has been found by us to be somewhat more effective against *S. littoralis* larvae than diflubenzuron, both by feeding treated foliage and by topical application (5). To complete the picture, it was therefore deemed of interest to investigate the contact effect of BAY SIR 8514 residues on glass, on *S. littoralis* larvae.

MATERIALS AND METHODS

Technical BAY SIR 8514, of 91.1% purity, was supplied by Bayer AG, West Germany. An insecticide-susceptible strain of *Spodoptera littoralis* was raised on alfalfa at 27°C and 65% R.H., as described by Ascher *et al.* (2) and Ascher and Moscowitz (3).

S. littoralis larvae of two weight groups, 100 and 200 mg, were exposed in closed 9-cm-diam. petri dishes for 90 min to one-day-old crystalline BAY SIR 8514 residues obtained by swirling to dryness acetone solutions (0.67 ml) of the technical substance in the lower half of the dish (surface area 67 cm^2). By this procedure the value of the concentration (g/100 ml) of the applied solution has the same numerical value as the deposit (g/m^2). Five larvae were put in one petri dish with eight replications per concentration in an experiment which was repeated from five (with the two lowest concentrations employed with 100-mg larvae) to seven times (all the other concentrations). All the experiments were thus based on the treatment of between 200 and 280 larvae of each size for every dosage. Following the exposure, the larvae were placed in groups of ten in cloth-covered glass jars (base diam. 7.5 cm, height 14 cm) containing alfalfa over sawdust, kept at 27°C. Food was renewed and the insects were observed daily for injury and mortality, especially during moulting and the prepupal stage. The final criteria of toxicity were based on the percentage of normal pupae obtained and of normal adults emerging; the criteria are listed in Table 1.

All results were corrected according to Abbott's formula (1) to allow for injury or mortality among larvae exposed in untreated petri dishes and then reared on alfalfa as described above.

RESULTS AND DISCUSSION

The results obtained following 90 min of contact with crystalline BAY SIR 8514 residues on glass of *S. littoralis* larvae subsequently reared on alfalfa, are reported in Table 1. If they are compared with those obtained in earlier work with diflubenzuron (4), the following differences are noted.

100-mg larvae

When considering mortality before the prepupal stage (criterion I), diflubenzuron was more active than BAY SIR 8514: the ED_{50} was 0.13 g/m^2 for BAY SIR 8514

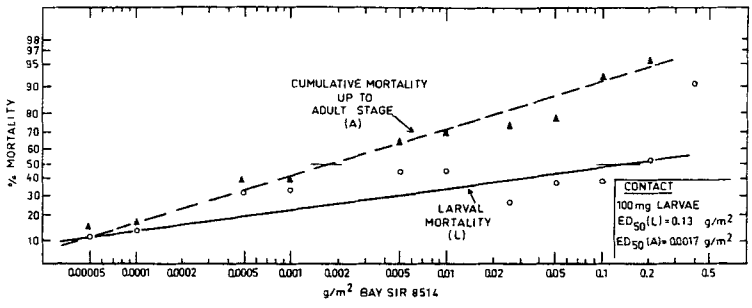
TABLE 1

THE TOXIC EFFECTS FOR LARVAE AND PUPAE WHEN *SPODOPTERA LITTORALIS* LARVAE WERE KEPT IN CONTACT FOR 90 MIN WITH BAY SIR 8514 RESIDUES OBTAINED BY EVAPORATION OF ACETONE SOLUTIONS IN PETRI DISHES

I, Percentage of larvae dying before the prepupal stage; II, cumulative percentage of larvae dying before and during the prepupal stage; III, cumulative percentage mortality up to pupation, plus percentage of abnormal pupae; IV, cumulative percentage mortality up to the adult stage (*in italics*).

Weight of larvae used (mg)	*Criterion*	*Toxicant (g/m²) in the residues*										
		0.00005	0.0001	0.0005	0.001	0.005	0.01	0.025	0.05	0.1	0.2	0.4
		Percentage of insects affected according to criteria I-IV										
100	I	11.2	13.9	30.4	31.2	44.6	44.5	26.0	38.1	39.4	51.4	92.0
	II	13.8	15.4	34.9	35.6	57.1	59.7	48.4	56.8	77.3	85.9	100
	III	13.8	16.9	37.5	37.1	60.9	66.5	62.1	65.9	90.4	89.6	100
	IV	*15.0*	*17.0*	*38.4*	*39.8*	*65.7*	*70.1*	*73.8*	*76.9*	*92.6*	*95.6*	*100*
200	I			6.2	7.1	7.4	19.9	18.2	17.0	18.2	18.0	6.7
	II			10.2	10.1	16.0	44.8	54.2	64.0	62.0	75.0	95.0
	III			19.8	17.7	35.3	64.1	72.7	81.1	87.0	85.5	100
	IV			*22.9*	*15.0**	*37.2*	*71.5*	*79.7*	*91.5*	*94.5*	*96.5*	*100*

*Apparent discrepancy between this and previous number in column is due to Abbott's correction for natural mortality.



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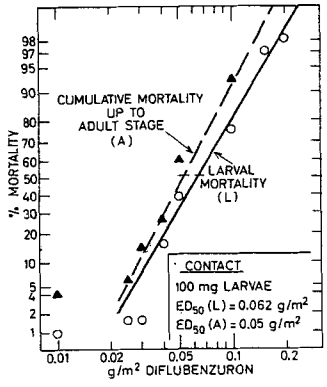

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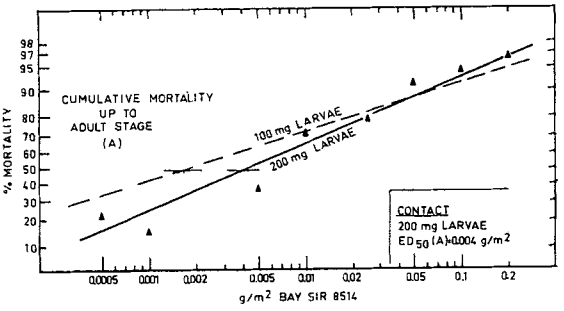

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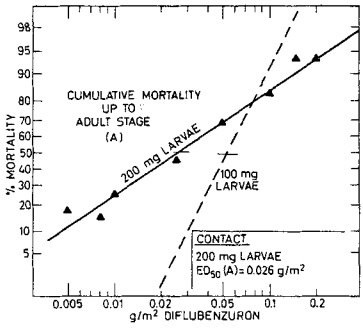

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Fig. 1. The contact effect of crystalline residues of BAY SIR 8514 on glass against 100-mg *Spodoptera littoralis* larvae.

Fig. 2. The contact effect of crystalline residues of diflubenzuron on glass against 100-mg *Spodoptera littoralis* larvae. (Drawn from data in Ascher and Nemny, ref. 4.)

Fig. 3. The contact effect of crystalline residues of BAY SIR 8514 on glass against 200-mg *Spodoptera littoralis* larvae.

Fig. 4. The contact effect of crystalline residues of diflubenzuron on glass against 200-mg *Spodoptera littoralis* larvae. (Drawn from data in Ascher and Nemny, ref. 4.)

(Fig. 1) and 0.062 g/m^2 for diflubenzuron (Fig. 2). In other words, for larval-only mortality, diflubenzuron was about twice as active as BAY SIR 8514 against 100-mg larvae on contact with crystalline residues on glass. However, for diflubenzuron this constituted the major portion of mortality attained, since comparatively little additional mortality set in later. The overall mortality up to the adult stage (criterion IV) due to diflubenzuron can thus be accounted for mostly by mortality during moulting between larval instars before the prepupal stage (criterion I). Curves drawn for criteria I and IV of diflubenzuron (Fig. 2) are very close and nearly parallel; both possess a steep slope (b = 4.38 and 4.75, respectively). On the other hand, the criterion I probit-log dosage curve of BAY SIR 8514 (Fig. 1) had, in contrast with that of diflubenzuron, a very low slope (b = 0.36), but here additional mortality in the prepupal and pupal stages was conspicuous and the curve for criterion IV was somewhat steeper (b = 0.78). The ED_{50} of the cumulative mortality up to the adult stage (criterion IV) for BAY SIR 8514 (0.0017 g/m^2) was much lower ($\sim$29 times less) than that of diflubenzuron (0.05 g/m^2). Thus, in the final count, contact with BAY SIR 8514 residues is much more toxic for 100-mg larvae than is contact with diflubenzuron.

200-mg larvae

Although again the slope of the curve of the cumulative mortality up to the adult stage (criterion IV) was much lower with BAY SIR 8514 (Fig. 3; b = 1.05) than with diflubenzuron (Fig. 4; b = 1.75), BAY SIR 8514 crystalline residues were active by contact at much lower dosages (ED_{50} = 0.004 g/m^2) than those of diflubenzuron (ED_{50} = 0.026 g/m^2), *viz.*, a ratio of 1 : 6.5.

All the results of contact with crystalline residues differ from those of topical application, by which BAY SIR 8514 was only about twice as toxic as diflubenzuron for *S. littoralis* larvae (5).

Particle size is of extreme importance for the *stomach* toxicity of diflubenzuron (9, 10, 11). Thus, diflubenzuron crystals with an average particle size <4 μm were much more active than those with a particle size of 4 – 10 μm, when ingested by larvae of *Pieris brassicae*; this increased activity of fine particles has been ascribed to better absorption in the insect's alimentary canal. It has also been stated that evaporation of acetonic solutions of diflubenzuron may give rise to coarse crystals and that, therefore, acetonic solutions of this compound should not be employed, *e.g.* in impregnating baits (11). These differences, however, do not hold true for the *contact* toxicity of diflubenzuron. Residues of diflubenzuron on glass prepared either from aqueous dilutions of the 5% liquid formulation or the 25% wettable powder (in which the average particle size is <5 μm), or from solutions of the technical substance in acetone, were equitoxic for larvae of *S. littoralis* (4).

REFERENCES

1. Abbott, W.S. (1925) A method of computing the effectiveness of an insecticide. *J. econ. Ent.* 18: 265-267.
2. Ascher, K.R.S., Hirsch, I. and Rones, G. (1964) Screening insecticides against *Prodenia litura*. *Int. Pest Control* 6(5): 6-9.
3. Ascher, K.R.S. and Moscowitz, J. (1970) The ovicidal effect of chlorphenamidine (Fundal) and chlorphenamidine-formetanate (Fundal forte) in the Egyptian cotton leafworm, *Spodoptera littoralis* Boisd. *Z. angew. Ent.* 67: 34-38.
4. Ascher, K.R.S. and Nemny, N.E. (1976) Contact activity of diflubenzuron against *Spodoptera littoralis*. *Pestic. Sci.* 7: 447-452.
5. Ascher, K.R.S., Nemny, N.E., Eliyahu, M. and Ishaaya, I. (1979) The effect of BAY SIR 8514 on *Spodoptera littoralis* (Boisduval) eggs and larvae. *Phytoparasitica* 7: 177-184.
6. Gsell, R. (1980) Zur Wirkung von Dimilin und BAY SIR 8514 auf Eier, Larven und Adulte der Lepidopteren *Pieris brassicae* (L.) und *Plutella xylostella* (L.). Diploma thesis, University of Giessen, W. Germany.
7. Hamman, I. and Sirrenberg, W. (1980) Laboruntersuchungen mit SIR 8514, einem neuen Chitinsynthesehemmer aus der Klasse der benzoylierten Harnstoffe. *PflSchutz-Nachr. Bayer* 33:1-34.
8. Luber, B. (1979) Die Wirkung eines neuen Entwicklungshemmers (SIR 8514) auf einige Forstinsekten. Diploma thesis, University of Munich, W. Germany.
9. Maas, W. (1978) Influence of particle size on pesticidal activity. Abstract Volume, Fourth Int. Congr. Pesticide Chemistry, Zurich, 24-28 July, 1978; lecture no. VII-11.
10. Mulder, R. and Gijswijt, M.J. (1973) The laboratory evaluation of two promising new insecticides which interfere with cuticle deposition. *Pestic. Sci.* 4: 737-745.
11. Philips-Duphar BV (1973) PH 60-40: Experimental Insecticide. Mimeographed technical information brochure. 's-Graveland, The Netherlands. 20 pp.
12. Schmidt, H.-W. and Dörntlein, D. (1980) Freilandversuche zur Bekämpfung von Schadinsekten mit SIR 8514. *PflSchutz-Nachr. Bayer* 33: 35-46.
13. Zoebelein, G., Hamman, I. and Sirrenberg, W. (1980) BAY SIR 8514, a new chitin synthesis inhibitor. *Z. angew. Ent.* 89: 289-297.