Relative Toxicity of Aldrin and Dieldrin

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The amounts of aldrin or dieldrin present internally in aldrin and dieldrin resistant or susceptible western corn rootworm, *Diabrotica virgifera* LeConte, were determined by gas–liquid chromatography. Recoveries of aldrin and dieldrin in beetles treated at the LD_{50} dosage demonstrated that the quantity of aldrin present in the insect was not illustrative of a toxic response, whereas the dieldrin content appeared to be vitally related.

When aldrin is applied to a living organism, it is converted to an epoxide, dieldrin (Bann *et al.* 1956; Blinn *et al.*, 1960; Brooks, 1960; Brooks *et al.*, 1963; Cohen and Smith, 1961; Dickason and Terriere, 1961; Earle, 1963; Hamilton, 1961; Korte *et al.*, 1962; Ludwig *et al.*, 1964; Lichtenstein, 1960; Lichtenstein and Schulz, 1960a,b, 1965; Lichtenstein *et al.*, 1963, 1965; Moersdorf *et al.*, 1963; Sun and Johnson, 1960). The possibility that aldrin is not toxic, *per se*, in houseflies has been considered (Brooks, 1960; Brooks *et al.*, 1963; Sun and Johnson, 1960). It is the intent of this paper to provide evidence that aldrin is innocuous in western corn rootworm (WCR), *Diabrotica virgifera* LeConte.

MATERIALS AND METHODS

The WCR adults were collected in corn fields at the locations listed in Table I. These beetles were treated within 24 hr after being returned to the laboratory.

Reference grade aldrin and dieldrin (Shell Chemical Co., Modesto, Calif.) were prepared as standard acetone solutions containing 0.01, 0.05, 1.0, 5.0, 10.0, 15.0, and 20.0 microgram (μg) insecticide/microliter (μl) solvent. Three replicates of 40 insect/replicate from each locality were treated topically with 1 μl of insecticide solution applied ventrally to the thoracic region. A dosage series from 1.0 to 20.0 μg/μl was used to treat the beetles except that those from Scottsbluff were treated with a series from 0.01 to 10.0 μg/μl. Dosage–mortality data were obtained at 4 hr and the LD_{50} values estimated by graphic probit analysis. All beetles in the replicate treated with the dosage nearest the estimated 4 hr LD_{50} were rinsed three times in acetone and then homogenized in acetone with a ball mill (Hamilton, 1967) to extract the aldrin and dieldrin. Beetles in the remaining treatments were not used.

One lot of 100 untreated beetles from each locality was handled as described for the treated beetles. This untreated preparation served as a blank to compare with the analysis of the samples from the treated insects. All extracts were purified by the column chromatographic system of Langlois *et al.* (1963). The quantities of aldrin or dieldrin in the beetle extracts were determined in terms of microgram of insecticide from the peak area of the glc recordings (Nelson and Hamilton, 1970; Lamb *et al.*, 1970).

Recovery of the internal aldrin and dieldrin was demonstrated by using ^{14}C-labeled aldrin and dieldrin to treat beetles. These materials had a specific activity of 19.4 and 19.5 μCi/mg, respectively. Glc analysis of the radioactive materials showed that ^{14}C-aldrin consisted of 97.3% aldrin and 2.7% dieldrin; ^{14}C-dieldrin consisted of 98.6% dieldrin and 1.4% aldrin. Insecticide replication and extraction procedures followed those used in the experiments. After elution of the ^{14}C-labeled insecticides, the insect solids remaining on the chromatographic column and several 1-g samples of the Florisil from the column were assayed for radioactivity in a Packard Tri-Carb automatic scintillation counter (Lamb *et al.*, 1970) having a counting efficiency of 83.9%.

RESULTS

The response of the beetles in this study to aldrin and dieldrin treatments ranged from susceptible to very resistant

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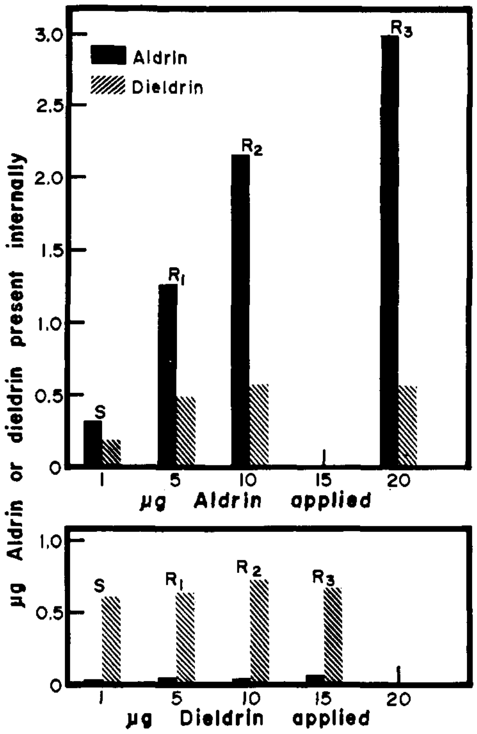

Figure 1. Amounts of aldrin and dieldrin present internally in aldrin or dieldrin resistant (*R*) and susceptible (*S*) adult western corn rootworms at 4 hr treated with an insecticide dosage about equivalent to their 4-hr LD_{50} (see Table I)

Table I. Sources of the Western Corn Rootworms and the Estimated 4-Hr LD_{50} Values in μg Aldrin or Dieldrin/Insect

Source	LD_{50} at 4 hr Aldrin	Dieldrin
Scottsbluff, Neb. (susceptible–S)	1.0	1.0
Rodman, Iowa (resistant–R_1)	4.8	4.0
Grand Island, Neb. (R_2)	8.5	8.0
Brookings, S. Dak. (R_3)	20.0	15.0

(Table I). The amounts of aldrin and dieldrin found internally are shown in Figure 1. Better than 95% efficiency of recovery of the internal insecticide was demonstrated with the ^{14}C-labeled insecticides. It is assumed that a similar efficiency of recovery occurred when using nonradioactive insecticides.

As resistance to aldrin and dieldrin (increasing LD_{50}) rose, the amount of aldrin recovered in aldrin-treated beetles increased, while the quantity of dieldrin recovered rose only slightly (0.3–0.6 μg/insect) and then remained fairly constant (Fig. 1). Conversely, beetles treated with dieldrin contained only the low level of aldrin present initially as a dieldrin impurity, and the quantity of dieldrin recovered (0.6–0.7 μg/insect) increased to a level that was only slightly higher than that in beetles treated with aldrin. Thus, approximately 0.5–0.7 μg dieldrin/beetle, whether applied as dieldrin or obtained as a metabolite of applied aldrin, appears to be lethal at the LD_{50} level. Apparently the amount of internal aldrin had little relationship to the LD_{50} responses.

These results indicate that aldrin is virtually innocuous, *per se*, while dieldrin, either applied directly or obtained through metabolism of aldrin, is highly insecticidal to western corn rootworms. This was true even with great variations of resistance within the species.

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