Effects of Aldrin on Young Pheasants Under Semi-Natural Conditions[1]

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Many studies involving direct or indirect effects of chlorinated hydrocarbon insecticides upon ring-necked pheasants (Phasianus colchicus) have involved laboratory experiments in which chemicals were administered to adult or young via food or gelatin capsules. Effects on reproductive capacity, acute and chronic toxicity, and survival and development of young have been studied under these conditions (1).

An additional approach to assessing possible adverse effects of insecticides would be to create conditions under which young pheasants were raised in habitat closely associated with insecticide treated fields. This paper discusses such a study using aldrin in 1-acre enclosures.

Aldrin is used extensively as a soil insecticide for control of numerous insect species including corn rootworms, cutworms, and wireworms.

This study was initiated to evaluate effects of a recommended level of aldrin upon pheasant chicks, and to determine residue levels occurring in pheasant tissues under such conditions.

Methods and Materials

Enclosures, Spraying, Planting

The rectangular study area, 1 mile north of Brookings, South Dakota, was subdivided into four 1-acre adjacent enclosures with treated plots at opposite corners. Each plot was enclosed with 8-foot high chicken wire. The center two-thirds of each plot was planted to corn on May 21; remaining

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peripheral areas were maintained in smooth brome (*Bromus inermis*) and alfalfa (*Medicago sativa*). Center portions of treated plots, 1 and 3, were sprayed on May 20, 1968 with an emulsifiable concentrate of aldrin at a locally recommended rate of 2 pounds per acre. This treatment was immediately disced into the soil to prevent loss of insecticide. The remaining two plots, 2 and 4, served as controls. Spraying and planting dates approximated those suggested for east-central South Dakota. Prior to this study no insecticide applications had been made on this area for at least 10 years.

The corn was cultivated on June 7. A second cultivation on July 8, using a small garden rototiller, was unsuccessful and by late summer the corn was densely vegetated with weeds and alfalfa.

Brood Establishment

Four broody hens (two pheasant and two bantam) were confined on June 12 in each plot with 15, 3-day-old game farm pheasant chicks in small shelters with attached 2 x 3 foot nursery pens. These shelters were placed in the peripheral cover. At 7 days of age chicks were allowed to run in an additional 2 x 15 foot chicken wire runway attached to the nursery pen and extended 7 feet into plowed portions of each plot. Birds in treated plots were therefore capable of being exposed to treated soil at 7 days of age, but may have eaten insects carrying residues prior to this time. Hens and 10-day-old broods were given free run of enclosures June 20, at which time commercial feed was removed.

Insecticide Residue Analysis

Two or three birds were collected from each plot for residue analysis at weekly intervals beginning with birds 19 days of age. Several birds found dead were also analyzed. Samples were analyzed for both aldrin and dieldrin, since aldrin is converted to dieldrin. Bodies of 47 treated birds (21 from plot 1, 26 from plot 3) and 12 control birds (six from each control plot) were analyzed for residues after feathers, crops and gizzards were removed. Samples were analyzed using Florisil column cleanup and electron capture gas chromatography procedures as described by Greichus *et al.* (2) for pheasant tissues. Thin-layer chromatography was employed on six samples to verify identification of residues.

Results and Discussion

Weights and Mortality

Weights of birds, as indicators of general condition, may have direct implications on potential effects of insecticides. Stickel *et al.* (3) reported that most underweight woodcocks (*Philohela minor*) died at levels of heptachlor well below those at which nearly all birds in a normal-weight group lived. Mean weights of pheasants in this study averaged 48 percent below weights of wild birds collected from Pelee Island, Ontario (4). No large differences were noted when weights were compared between plots, between males and females, and between treated and control groups.

Total number of birds found dead in plots 1, 2, 3, and 4 was 19, 25, 26, and 29, respectively. At least 30 chicks were killed by a hailstorm on June 22. Remaining mortality and abnormally low weights found in this study were attributed to the following factors: (1) abrupt cessation of feeding following release, (2) cool wet weather, and (3) insufficient quantities of protein rich insect foods due partly to high concentrations of birds and to weather conditions.

TABLE 1

Mean concentrations of aldrin, dieldrin, aldrin plus dieldrin and ranges of aldrin plus dieldrin for treated and control birds on a whole body, wet weight basis.

Group	Plot	No. Birds Analyzed	Range in Age (days)	Aldrin Mean ppm	Dieldrin Mean ppm	Aldrin + Dieldrin Range ppm	Aldrin + Dieldrin Mean ppm
Control	2	6	19-68	0.02	0.05	0.06-0.10	0.07
	4	6	19-55	0.02	0.06	0.06-0.09	0.08
Treated	1	21	18-92	0.02	0.37	0.12-1.00	0.39
	3	26	16-82	0.03	0.37	0.11-1.26	0.37

Tissue Residue

Mean concentrations (ppm wet weight) of aldrin, dieldrin, aldrin plus dieldrin and ranges of aldrin plus dieldrin are presented in Table 1.

Eighty-one percent of birds in both treated plots had aldrin plus dieldrin concentrations between 0.11 and 0.50 ppm. When concentrations for all ages were averaged, aldrin plus dieldrin concentrations were significantly different ($P<0.05$) between control and treated groups. Concentrations were not significantly different ($P<0.05$) within control or within treated groups. Concentrations of aldrin and dieldrin combined ranged from 0.06 - 0.10 and averaged 0.07 ppm for control birds, and 0.11 - 1.26 and 0.38 ppm for treated birds.

Concentrations of aldrin remained fairly constant for both control and treated birds throughout the study. No relationship was found between length of exposure to treated soil and tissue concentrations of aldrin plus dieldrin. However, single highest values of aldrin plus dieldrin for each of the two sprayed plots occurred in birds 61 days of age. Average aldrin plus dieldrin concentrations for treated birds were 5.4 times higher than average values for control birds.

Range and mean concentrations of aldrin plus dieldrin from tissues of 11 birds found dead in treated plots were 0.14 - 0.45 and 0.26 ppm, respectively. These values were not high when compared to the average concentrations for all birds analyzed from treated plots.

Part of the aldrin and dieldrin residues presumably came from supplemental feed found to contain 0.002 ppm aldrin and 0.004 ppm dieldrin. Residues in control birds may also have come from residue-carrying insects from adjacent treated plots or from outside the study area.

Scot et al. (5), Labisky and Lutz (6), and Clawson and Baker (7) reported heavy losses of game birds following solid-block applications of aldrin, and aldrin plus dieldrin.

In all of these studies extensive areas of land were treated and most of the insecticide remained unincorporated on top of the soil and on vegetation (where sprays were used) thereby creating high surface residues throughout virtually all of the available habitat.

In the present study only a portion of the habitat was treated, and this treatment was immediately incorporated into soil. Birds in treated plots were able to feed in both treated areas and untreated peripheral cover. In addition, to synchronize brood establishment with peak hatching dates of wild birds, broods were not exposed to treated soil until nearly a month after spraying.

Delayed use of cultivated sprayed areas in early spring when soil residues are highest would decrease potential hazards from dermal or respiratory exposure. Broods made little use of cultivated areas early in this study, presumably due to a lack of insects and other foods. As weedy growth developed, birds spent more time in corn, and by late summer it was used extensively for feeding, dusting and loafing.

Greichus et al. (8) found average and highest values of dieldrin from fat samples of 48 adult wild birds to be 0.08 and 1.07 ppm, respectively. Total concentrations of several insecticides and their metabolites in the brain tissue of 15 juvenile pheasants collected from the highest insecticide use area of the state ranged from 0.01 - 2.35 ppm and averaged 0.13 ppm (9). However, concentration of insecticides in fat samples would be higher than those in the whole body. Hall (10) found that levels of residues in the whole body were either greater or about the same as levels in the brain when aldrin was fed to young pheasants. Death occurred when levels exceeded 2 ppm of aldrin plus dieldrin in the brain. As the highest concentration of aldrin plus dieldrin in this study was 1.26 ppm in a whole body sample, it is probable that none of the birds died from insecticide toxicosis. Also, mortality of birds was essentially the same in both treated and control plots.

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