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Howard Young
*University of Arkansas, Fayetteville*

Andrew H. Hulsey
*University of Arkansas, Fayetteville*

Robert Moe
*University of Arkansas, Fayetteville*

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EFFECTS OF CERTAIN COTTON INSECTICIDES ON THE MOURNING DOVE

HOWARD YOUNG, ANDREW HULSEY, and ROBERT MOE

University of Arkansas

With the recent increase in the use of crop insecticides there has developed a realization of the potentially-harmful side effects of widespread use of these poisons. There have been many attempts to measure the effects of crop poisons on wildlife (3), (4), (8). The first papers were concerned primarily with DDT, the first synthetic organic insecticide to find extensive use. The development of newer poisons has brought need for more research, and the effects of chlordane, aldrin, and toxaphene recently have been studied by Post (6), (7).

The techniques in early studies consisted mainly of field-population counts on two comparable areas. Censuses were taken regularly on an area before and after poison applications and the results were compared with those from censuses taken on a control area to determine the depressing effect on wildlife populations.

In the present paper consideration is given to poisons commonly used on cotton in Arkansas—calcium arsenate, benzene hexachloride containing DDT, toxaphene, dieldrin, and aldrin. According to Barnes and Lincoln (1), the first three have most frequently utilized in Arkansas in recent years. The use of chlordane has almost ceased, and dieldrin and aldrin are used primarily as substitute poisons during shortages of the others.

Some 35 Mourning Doves, Zenaidura macroura, were captured. This species is a common farm-area bird in Arkansas, and a ground-feeding type which might be expected to come in contact with poison residues from crop dustings. Although not extensively hunted in Arkansas, it is an important game bird.

Most of the doves were gathered by Mr. Harold Alexander of the Arkansas Game and Fish Commission, who instituted the problem and maintained administrative supervision. Additional doves were trapped on the University of Arkansas campus. The study was supported in part by funds derived from Arkansas Pittman-Robertson Project 24 - R, Mourning Dove Investigations in Arkansas, and was designated as a special phase of this state-wide study. The University of Arkansas College of Agriculture Extension Service furnished the poisons.

Techniques. The doves were kept in 8' x 8' x 8' outdoor cages made of 1-inch mesh chicken wire. Three cages were used, one for the temporary housing of birds and one each for poison-testing and control. The recommended dosage per acre (for control of cotton pests) for each poison was determined (1), and a prorated amount was computed for the floor area of the poison cage. The commercial poison powders used in dusting programs were mixed thoroughly with the food, which was then scattered evenly about the floor of the poison-testing cage. A three-day food supply, determined by measuring average daily consumption by individually-caged doves, was used. When birds became ill from poison they apparently decreased their consumption, and food was frequently present in excess in the poison cage. It disappeared rapidly in the control cage. Uneaten food was removed at the end of each test. The cages were exposed to the effects of rain, sun, and wind to simulate field conditions, although one side was sheltered by a wall. A small portion of each cage was shaded by boards and perches were provided. The floors were dirt and ample water was furnished. The birds not exposed to poison maintained good health under these conditions.

The small number of doves made it necessary to use some individuals to test more than one poison, and to shift some poison-exposed birds to the control cage for later tests. The possible effects of this procedure are discussed later. The doves were observed daily to determine mortality and weighed about every third day to determine effects of the poison. As much as possible, birds were evenly divided according to sex and weight between the test and control cages. All birds but one (No. 33) were adult. Loss of weight exceeding the average weight loss by the control birds for the same period was considered to be evidence of a deleterious effect of poison. Weights were rounded to the nearest

gram, and because the time of day when the birds were weighed varied, no conclusions were drawn except in cases of extreme change. Control birds and poison-exposed birds were weighed at the same time of day.

Results. Data from each test are presented in a table bearing a like number:

Test 1a. Five doves were exposed to a normal dosage of calcium arsenate (prorated from the amount which is routinely used in the dusting of cotton) on May 16, 1951. On May 19 they were given food without poison, and on May 22 they were given food to which double the usual amount of poison had been added. (Similar techniques were used in the other tests.) None of the birds died, and as a group they had regained their original weight on June 1, when the test was terminated. As rainfall was extremely heavy during the testing period, it was believed that considerable poison had been washed away; the experiment was repeated in July.

Test 1b. On July 9, 8 doves were exposed to the normal dosage of calcium arsenate. It was necessary to use 4 birds which previously had been exposed to benzene hexachloride. The dosage was repeated on July 12 and doubled on July 15. Thus, the birds were given only poisoned food from July 9 to July 18, inclusive. Poison-free food was added on July 18, food with a double dose of calcium arsenate on July 23, and then poison-free food until July 31. One bird, previously exposed to benzene hexachloride, died on July 21. All the others survived for the entire period of the test. There was considerable variation in weight loss; as a group the birds had lost 22 per cent of their original weight at the end of the experiment, contrasted with a 4 per cent average weight loss among the controls.

Test 2. Six doves including 4 previously exposed to calcium arsenate, were exposed to toxaphene on June 1. One bird died on June 7, another on June 11, a third on June 17; the others survived and had an average body weight of 89 per cent of their original weight at the end of the experiment on June 18.

Test 3. On June 18, 9 doves of which 2 previously had been exposed to both calcium arsenate and toxaphene, were exposed to benzene hexachloride. Two birds died; one on July 1, the other on July 2. The survivors showed an average weight loss of only 2 per cent on July 9, when the test was concluded.

Test 4. On July 31, 10 doves, including 7 previously exposed to other poisons, were exposed to dieldrin. Only one bird survived to August 10, and it had lost 32 per cent of its original body weight.

Test 5. On August 10, 9 doves, none of them previously exposed to poison, were given food mixed with aldrin. The last survivor died on August 17.

Test 6. The obvious toxicity of dieldrin and aldrin made additional study advisable. In Test 6 the poison cage was furnished with two dishes of food, one poisoned with aldrin and one unpoisoned. The birds were able to choose freely between the two. Poisoned and unpoisoned water also was offered. Four birds were used in this test, which was initiated on September 16. Two survived to September 28, when the test was terminated.

Test 7. On September 28, dieldrin was offered to 5 doves, the techniques being those used in test 6, except that the location of the dishes was changed daily. All but one bird had died by October 2, but the survivor, which was given only poison-free food after October 1, was released in good condition on October 10.

Discussion. The study was handicapped by the fact that doves were gathered at various periods and were in short supply at all times, which necessitated shifting birds to test more than one poison. However, in any one test, birds with histories of poison exposure suffered no heavier mortality than birds exposed for the first time. In the control cage, doves previously given poison thrived as well as those permanently used for controls. The only exceptions were in the aldrin and dieldrin tests, when it was necessary to use as controls some birds which had been extensively exposed and which were in poor condition. In these cases, however, the differences in loss of weight and survival between the test cage and control cage were so obvious that no difficulty in interpretation arose.

The experiments exposed the doves to more severe poison hazards than they would normally be expected to encounter in the field. The poisoning technique
simulated a situation in which all the poison sprayed over a field settled on the food particles and where all the birds fed permanently only in poisoned areas. Thus, it appears that the routine use of calcium arsenate, toxaphene, or of benzene hexachloride ordinarily would not have deleterious effects on wild mourning dove populations. It should be noted that the field studies of Kozlick (5), Cottam and Higgins (3), Hotchkiss and Pough (4), and Stickel (8) failed to demonstrate heavy mortality among birds or other wildlife following light DDT poisoning of areas. When DDT is used a concentration of about 5 pounds per acre appears to be necessary to cause significant avian mortality. In the present tests, a simulated concentration of 8.5 pounds per acre was used for calcium arsenate, and 12.5 pounds per acre for the other poisons. These figures refer to the routine dosage, and pro-rated amounts were computed for the floor area of the test cage. Post (6) found considerable evidence of avian population depression following the use of chlordane and toxaphene, although the mourning dove was not among the species observed. He failed to find heavy avian mortality following the use of aldrin for grasshopper control (7).

There is, of course, a specific variation in vulnerability to the different poisons. The method of application also has its effect; Coburn and Treichler (2) found that DDT in oil emulsion was much more lethal to the bobwhite, Colinus virginianus, than was the crystalline form. Dusting is the routine method of applying poisons to the cotton areas; furthermore, the small amounts of poison and food used in the present study precluded the use of oil emulsions, so this phase of the problem was not investigated.

In the tests on the mourning dove, evidence for resistance to poison was found in the fact that some birds exposed to the poisons and then removed to the control cage survived for long periods of time and suffered no apparent long range effects (Nos. 26, 31, and 32). The tenacity of some birds under persistent poisoning was notable, one dove (No. 9) dropping to 57 per cent of its original weight before eventually succumbing to the combined effects of benzene hexachloride, calcium arsenate, and dieldrin.

The possible injurious effects on reproductive activity, were not studied. All birds which died were autopsied, and a gross examination of the internal organs was made. The conditions of the gonads were highly variable, but no striking abnormalities were observed in any parts of the viscera.

The known toxicity of aldrin and dieldrin for vertebrates (1) was verified in the case of the mourning dove. From the results of Test 6 and Test 7 it appears that some mortality among birds may be expected when these poisons are used in insect control programs. Although they now serve in Arkansas as substitute insecticides, careful study of their possible side effects should be made before they are distributed widely. These poisons are being extensively advertised.

Summary. Mourning doves were exposed in separate tests to varying dosages of calcium arsenate, benzene hexachloride, toxaphene, dieldrin, and aldrin, under simulated field conditions. Results indicate that routine field applications of calcium arsenate, toxaphene, and benzene hexachloride do not constitute a serious danger to wild mourning dove populations. Aldrin and dieldrin proved to be extremely toxic, and apparently could not be detected by the birds. As they are not heavily employed in Arkansas, they probably do not have a significant effect on wild dove populations.

References
