Dieldrin Residues in the Gallinules *Porphyrula Martinica* L. and *Gallinula Chloropas* L. and its Effect on Clutch Size and Hatchability

by M. K. CAUSEY, F. L. BONNER, and J. B. GRAVES
Louisiana State University, Baton Rouge

Organochlorine insecticides have been used extensively during the past 25 years. Millions of pounds of such chemicals are used annually in the United States (1) and adverse effects on nontarget organisms have been observed by biologists. Much concern has been expressed over the effects of these chemicals on bird populations, but relatively little data are available to justify many of the conclusions (2).

An excellent opportunity to study nesting populations of game birds associated with insecticide use was available in the relationship of the purple gallinule (Porphyrula martinica L.) and the common gallinule (Gallinula chloropus L.) to aldrin-treated rice fields of South Louisiana. In this area seed rice is treated prior to sowing at the rate of 1/4 lb. aldrin/ 100 lb.

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seed. When sown, the treated seed presents an available food source (contaminated with 2,500 ppm aldrin) to the birds during the early part of the nesting season. Since aldrin is known to be readily oxidized to its epoxide, dieldrin, exposure of birds to aldrin-contaminated food would result in the appearance of dieldrin residues in the body tissues and eggs (3).

The purpose of this study was to determine the extent of dieldrin contamination in the eggs of gallinules and to observe the effects of the residues upon clutch size and hatchability.

Method and Materials

Egg Collections and Field Study. Egg samples were taken from 58 purple gallinule nests and from 18 common gallinule nests found in the rice fields near Crowley, Louisiana, during the summers of 1965-66. Eggs were also collected from 14 common gallinule nests at Rockefeller Wildlife Refuge in Cameron Parish, Louisiana, during 1966. These eggs were used as controls since this area is isolated and removed from agricultural insecticide use.

Collected eggs were numbered, placed in game bird flats and transported to the L.S.U. campus in an expanded styrene ice chest containing a layer of crushed ice. The eggs were then placed in plastic bags and frozen until prepared for analysis.

Thirty-eight purple and 18 common gallinule nests were located in the Crowley rice fields and marked by placing 6 ft. bamboo stakes in the ground near them. Seventeen common gallinule nests from Rockefeller Wildlife Refuge were marked in the same manner. All of the nests were observed periodically throughout the nesting season to determine clutch size and percent hatch.

Cleanup and Extraction. Each frozen egg was cracked and the shell discarded. The contents were allowed to thaw in 1 oz. plastic medicine vials and then blended for 3-5 minutes at 5000 rpm in a Sorvall Omni-Mixer cup. A 2 g. sample was weighed quickly into a tared medicine vial and stored in a freezer until analyzed.

Samples were cleaned and extracted using the method described by Cummings et al. (4). The final volume of the eluants was adjusted to 1 g./ml. for injection into the gas chromatograph. A florisil recovery and reagent blank were run with each series of samples. Recovery standards averaged 82.2% with a range of 70-95%. All residue analyses were completed by electron-capture gas chromatography using Varian-Aerograph Model 680 and 682 instruments. The columns were packed with 5% Dow-11 on Gas Chrom Q, operated at 185° C. with nitrogen as the carrier gas. Standard solutions of aldrin, dieldrin, heptachlor epoxide, heod, p,p'-DDT and p,p'-DDE were injected prior to the samples to determine the elution time characteristic

of each pesticide and to check for day to day changes in the behavior of the gas chromatographs. The peak heights resulting from residues detected in each sample were adjusted by dilution until they closely approximated the peak height produced by injection of a known amount of standard. Calculations were made by direct linear comparison of similar sized peaks. The sensitivity levels for all residues except DDT was 0.01 ppm. The level for DDT was 0.05 ppm.

Random samples were selected for qualitative verification of residues by thin layer chromatography using the technique described by Damaska (5).

The combined 15% eluants from all of the egg samples were concentrated and scanned from 2 to 15 microns with a Perkin-Elmer Model 21 Infrared Spectrophotometer using a 0.5 mm. sealed micro-cell with NaCl windows.

Results and Discussion

Residue Analysis. The results of the analyses of the egg samples collected in rice fields during the summer of 1965 are presented in Table 1. Eggs of both species of gallinules contained high levels of dieldrin. Other residues detected were p,p'-DDT, p,p'-DDE and heptachlor epoxide. Table 2 contains the results from the analyses of all egg samples collected from rice fields during the summer of 1966. The average dieldrin contamination of eggs of the purple and common gallinules was 6.51 and

TABLE 1.

Organochlorine insecticide residues in clutches of gallinule eggs collected at Crowley, Louisiana, during May and June, 1965.

		ppm			
Species	No. Eggs in Clutch	Dieldrin	Heptachlor Epoxide	p,p'-DDT	p,p'-DDE
Common	6	10.59	0.08	0.87	0.05
Common	5	12.46	0.04	0.79	2.46
Common	7	13.17	[a]	0.10	0.15
Common	5	2.23	0.09	0.87	0.23
Purple	6	6.47	[a]	2.19	0.15
Purple	10	12.94	[a]	1.92	[a]

[a]Not detected at 0.01 ppm.

TABLE 2.

Organochlorine insecticide residues in gallinule eggs from Crowley, Louisiana, 1966.

		ppm			
	Number	Dieldrin		p,p'-DDE	
Species	Samples	Avg.	Range	Avg.	Range
Purple	56	6.51	0.49-15.35	0.43	0.06-5.81
Common	14	9.37	1.13-22.12	0.31	0.12-1.05

9.37 ppm, respectively. DDE (p,p'-isomer) was present in all egg samples of both species at much lower levels. Heptachlor epoxide was detected in 18 of the 56 purple gallinule samples with an average contamination of 0.08 ppm and a range of 0.05-0.19 ppm. Heptachlor epoxide was also detected in 8 egg samples taken from common gallinule nests. The average amount detected was 0.12 ppm with a range of 0.03-0.48 ppm.

Fourteen egg samples of the common gallinule from Rockefeller Wildlife Refuge were analyzed and only one egg contained a detectable amount of dieldrin (0.28 ppm). Eleven of these egg samples contained p,p'-DDE at an average level of 0.10 ppm with a range of 0.05-0.20 ppm. One egg also contained a detectable amount of p,p'-DDT (0.17 ppm).

Thin layer chromatography confirmed the presence of dieldrin and p,p'-DDE. Dieldrin was also confirmed by infrared spectrophotometry. Heptachlor epoxide was not confirmed by thin layer chromatography because of interfering substances carried over in the 6% eluants.

Clutch Size and Hatchability. The clutch size and percent hatch from all of the gallinule nests observed during the 1966 nesting season are shown in Table 3. Several of the staked nests were abandoned by the female gallinule and were regarded a zero percent hatch in making calculations. The clutch size and percent hatch from the highly contaminated common gallinule

TABLE 3.

Clutch size and hatchability of gallinule eggs observed in 1966.

		Number	Clutch Size		% Hatch	
Species	Location	Nests	Avg.	Range	Avg.	Range
Common	Crowley	18	8.94	6-11	84.2	0-100
Common	Rockefeller	17	8.26	6-16	86.5	0-100
Purple	Crowley	38	6.70	4-10	85.2	0-100

population found in the Crowley rice fields was not significantly different from that of the Rockefeller Wildlife Refuge population when compared using "Student's *t*" test at the 5% level of significance.

The clutch size and hatchability observed in the purple gallinule population around Crowley were compared with other published figures since no control data were obtainable. The purple gallinule lays from 5-10 eggs with 6-8 being the most common number (6,7). An average clutch size of 6.7 compares favorably with these figures and the average hatchability of 85.2% does not seem low. There is apparently a lack of data concerning hatchability of purple gallinule eggs; however, workers using other species of game birds have reported comparable hatchability figures in controlled experiments (8,9). In general an 80-90% hatch is considered very satisfactory when hand rearing most types of game birds (10). It should be

remembered that such data are usually obtained using incubators.

The dieldrin residues in the eggs of the purple and common gallinules associated with rice fields planted with aldrin-treated seed were rather high. The FDA tolerance for dieldrin residues in poultry products is zero. These two game bird species have levels of dieldrin in the eggs which would certainly not be permissible in commercial poultry. This highly undesirable contamination probably has come about as the result of a recommended agricultural practice of pretreating seed rice with aldrin.

These residues appeared to have no effect on the clutch size or hatchability in the common or purple gallinule populations of the rice fields. The effect of these residues upon survival of the newly hatched chicks is not known. The hatchability of eggs injected with as much as 200 ppm dieldrin was unaffected (11). However, the significance of certain insecticide residues upon reproduction in birds seems to be more closely related to chick survival than to egg production, fertility, or hatchability (12).

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