Toxicity of High Dietary Levels of DDT in Laying Hens

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The correlation of egg shell thinning with residues of DDT (RATCLIFFE, 1967; HICKEY and ANDERSON, 1968) created a new interest in the effects of DDT in the laying hen. Several studies have indicated that the laying hen can tolerate levels of DDT up to 300 ppm without serious adverse effects (SMITH et al., 1970; CECIL et al., 1972; LILLIE et al., 1972; DAVISON AND SELL, 1972; CECIL et al., 1973; LILLIE et al., 1973). RUBIN et al. (1947) showed that DDT was toxic when fed to laying hens at 1250 ppm for 12 weeks and egg production was reduced by feeding 620 ppm.

This study was conducted to determine the toxicity of high levels of dietary DDT as evaluated by mortality, egg production, egg weight, shell thickness, shell beta backscatter and percent shell.

METHODS

A total of 96 Single Comb White Leghorn hens 19 months old were divided into eight equal groups, housed in individual cages, and two groups fed either a commercial ration or that ration supplemented with 300, 600 or 1200 ppm of technical grade DDT (75% p,p'DDT and 23% o,p'DDT). The DDT was dissolved in corn oil to mix into the feed. The diets were fed for three 28-day experimental periods.

Egg production and mortality were determined daily. Egg weight, shell thickness, shell beta backscatter (JAMES and RETZER, 1967) and shell weight were determined for all eggs. A value for percent shell was obtained by dividing shell weight by egg weight.

The data were evaluated by analysis of variance for statistical significance ($P < 0.05$).

RESULTS AND DISCUSSION

Some of the hens fed the diet containing 1200 ppm developed tremors in the ninth week of the experiment and 33% of this group died during the last three weeks of the study. The symptoms of

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the toxicity were similar to those described by RUBIN et al. (1947). There was no mortality or tremors in hens fed the other three diets.

The influence of dietary DDT on egg production, egg weight, shell thickness, shell beta backscatter and percent shell is shown in Table 1. The statistically significant main effects are also shown. The hens fed 600 or 1200 ppm DDT had significantly lower egg production than the 0 ppm group during period 3. A downward trend in egg production was obtained with each increasing level of DDT during the third period.

TABLE 1

Influence of Dietary DDT in the Laying Hen

Measurement	Period[1]	Dietary DDT (ppm) 0	300	600	1200	Significant Main Effects
Egg Production[2] (%)	1	58^{a}	47^{ab}	46^{ab}	50^{ab}	Diet
	2	50^{ab}	53^{ab}	48^{ab}	40^{b}	Diet x Period
	3	59^{a}	49^{ab}	44^{b}	25^{c}	
Egg Weight[2] (g)	1	55.4^{b}	55.8^{b}	56.4^{ab}	55.0^{b}	Diet
	2	55.0^{b}	55.8^{b}	55.0^{b}	52.9^{c}	Diet x Period
	3	58.0^{a}	55.9^{b}	56.4^{ab}	51.1^{c}	
Shell Thickness[2] (mm x 10^{-2})	1	38.0^{ab}	37.8^{ab}	35.2^{de}	36.2^{cd}	Diet
	2	37.2^{bc}	36.8^{bc}	33.8^{f}	34.8^{ef}	Period
	3	38.8^{a}	38.0^{ab}	35.5^{de}	33.5^{f}	Diet x Period
Shell Beta Backscatter[2] (Counts x 10^{3})	1	895^{a}	892^{a}	891^{a}	904^{a}	Period
	2	901^{a}	899^{a}	896^{a}	913^{a}	
	3	800^{b}	806^{b}	808^{b}	832^{b}	
Shell[2] (%)	1	9.4^{ab}	9.3^{bc}	8.7^{d}	8.9^{d}	Diet
	2	9.6^{a}	9.3^{bc}	8.8^{d}	9.0^{cd}	Period
	3	9.7^{a}	9.5^{ab}	9.0^{cd}	8.9^{d}	

[1]28 days/period.

[2]Values within a measurement not followed by the same superscript are significantly different ($P < 0.05$).

Egg weight was decreased significantly during periods 2 and 3 by feeding 1200 ppm DDT. Shell thickness was significantly decreased in the hens fed 600 or 1200 ppm and this decrease was evident during the first period. In the hens fed 1200 ppm the shell thickness declined further each period, but in hens fed 600 ppm shell thickness improved during period 3.

Shell beta backscatter was not influenced by diet. A decrease was seen in all treatments during period 3, but was probably due to changes in machine adjustment. Shell weight as a percent of total egg weight was significantly decreased by feeding the hens 600 or 1200 ppm DDT. This decrease occurred during period 1 and remained about the same during periods 2 and 3.

The results of this study differ somewhat from the toxicity study of DDT conducted by RUBIN et al. (1947). These workers in a 12 weeks study obtained a decrease in egg production in hens fed 310 ppm, a further reduction with 620 ppm and cessation of production with 1250 ppm. The 1250 ppm diet also caused 90% mortality. The different results can probably be explained by the differences in the birds and sources of DDT.

SMITH et al. (1970) reported reduced egg shell thickness and egg production in White Leghorn hens fed 10 ppm technical DDT. However, LILLIE et al. (1972) and CECIL et al. (1972) found that feeding 5 to 300 ppm p,p'-DDT or o,p'-DDT to laying hens had no effects on egg production, egg weight or egg shell thickness. Other experiments with yearling hens and pullets fed technical grade DDT at 10 or 50 ppm showed no effects on egg production or shell thickness (LILLIE et al., 1973; CECIL et al., 1973).

This study supports the hypothesis that laying hens can tolerate high dietary levels of DDT for a considerable period of time. The major problems observed in this study were the reduction in egg production, egg weight and mortality associated with feeding 1200 ppm DDT. Although shell thickness was significantly reduced by dietary DDT, the shells were still within a thickness range that would be acceptable (HUNTON, 1969).

SUMMARY

White Leghorn hens were fed diets containing 0, 300, 600, or 1200 ppm technical grade DDT for three 28-day periods. The 1200 ppm diet caused tremors and 33% mortality in the final period, but no gross toxicity symptoms were seen in birds fed the other diets. Egg production was decreased during the third period by 600 or 1200 ppm. Egg weight was decreased during the third period by 600 or 1200 ppm. Egg weight was decreased during the last two periods by 1200 ppm. Shell thickness was decreased in all three periods by feeding 600 or 1200 ppm DDT. Dietary DDT caused no change that could be detected by shell beta backscatter. Shell weight as a percent of total egg weight was decreased by 600 or 1200 ppm DDT.

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