35°C. This negative temperature coefficient of DDT toxicity is reversible, and an animal may be alternately prostrated, recovered, prostrated, etc., by subjecting it to alternating periods of high and low temperatures. Under these conditions, abnormal trains of impulses in the CNS, characteristic of DDT poisoning, are found only when the insect is exhibiting symptoms of DDT poisoning, and if these symptoms are alleviated by raising the temperature, abnormal trains of impulses within the CNS cease altogether. This phenomenon does not apply to sensory nerves, where abnormal trains persist throughout temperature changes.

Changes in CNS activity as affected by DDT can be varied positively with temperature under certain experimental conditions. When 0.107 ng of DDT in suspension is injected into the 6th abdominal ganglion, no DDT trains are produced. This fact agrees with the results which were obtained when C^{14}-DDT was injected into the cockroach. When 1.07 ng of DDT were injected into the 6th abdominal ganglion, DDT trains were produced in the abdominal CNS. Observation of frequency of appearance of DDT-induced trains at different temperatures revealed a relationship identical to that found in sensory nerves. That is, as temperature increased, the frequency of appearance of DDT-induced trains in the abdominal CNS also increased. Since DDT was not, in this case, in contact with sensory structures, cercal nerve activity was normal. The effect of DDT was limited to a direct action on the CNS, and was obtained only when a dosage far above the amount ever found in vivo was injected into the ganglion. When the effect of DDT in the abdominal CNS is studied in the absence of high levels of sensory input, the relationship between the effect of DDT on nerve and temperature is the direct relationship which was obtained with sensory nerves, and not the inverse relation to temperature found in vivo in the CNS.

In view of these observations and the results presented by Eaton and Sternburg (1967), we suggest that abnormal events at the level of synaptic transmission are largely responsible for the negative temperature coefficient of DDT action. DDT apparently does not act directly to produce the block in synaptic transmission which occurs during DDT-poisoning. A possible explanation is that high afferent activity causes the liberation of excess transmitter substances, which at low temperature accumulate and ultimately produce a block in transmission. Substances causing the block could be the DDT-toxin, acetylcholine, or perhaps a combination of these and unknown chemical transmitters in the cockroach nervous system.

REFERENCES CITED

Calvin, M., C. Heidelberger, J. C. Reid, B. M. Tolbers, and P. F. Yankwich. 1949. Istopic Carbon. John Wiley & Sons, Inc., New York.

Eaton, J. L., and J. Sternburg. 1964. Temperature and the action of DDT on the nervous system of *Periplaneta americana* (L.). J. Insect Physiol. 10: 471–85.

1967. Temperature effects on nerve activity in DDT-treated American cockroaches. J. Econ. Entomol. 60: 1358–64.

Hoyle, G. 1953. Potassium ions and insect nerve muscle. J. Exp. Biol. 30: 121–35.

Matsumura, F., and R. D. O'Brien. 1966. Absorption and binding of DDT by central nervous system of American cockroach. J. Agr. Food Chem. 14: 36–39.

Roeder, K. D., and E. A. Weiant. 1945. The site of action of DDT in the cockroach. Science 103: 304–6.

Smyth, T., and C. Roys. 1955. Chemoreception in insects and the action of DDT. Biol. Bull., Woods Hole 108: 66–76.

Welsh, J. H., and H. T. Gordon. 1947. The mode of action of certain insecticides on the arthropod nerve axon. J. Cell. Comp. Physiol. 30: 147–71.

Yamasaki, T. and T. Ishii. 1954. Studies on the mechanism of action of insecticides. VII. Activity of neurone soma as a factor in development of DDT symptoms in the cockroach. [Trans. from Japanese] Botyu-Kagaku 19: 1–14. English translation, *In* A. W. A. Brown, S. Takei, and S. Nagasawa [ed.]. 1957. Japanese contributions to the study of the insecticide-resistance problem: 130–8. Institute for Insect Control, Kyoto University.

Control of Chicken Body[1], Shaft[1], and Wing[2] Lice on Laying Hens by Self-Treatment with Insecticide Dusts and Granules[3, 4]

R. A. HOFFMAN and B. F. HOGAN

Entomology Research Division, Agr. Res. Serv., USDA, Kerrville, Texas

ABSTRACT

The chicken body louse, *Menacanthus stramineus* (Nitzsch); shaft louse, *Menopon gallinae* (L.); and wing louse, *Lipeurus caponis* (L.), on hens were markedly reduced when granules or dusts of 7 toxicants were applied to litter or when 2 toxicants were placed in dust-bath boxes, except for a dust-bath treatment of 1% Dowco 175 (2,4-dichlorophenyl propyl methylphosphoramidate). Treatment with 4.4% granules of Zytron® (*O*-2,4-dichlorophenyl *O*-methyl isopropylphosphoramidothioate), 2% dust of Imidan® (*O,O*-dimethyl *S*-phthalimidomethyl phosphorodithioate), and 2% dust of carbophenothion gave 100% control in 10 days or less when the toxicants were applied to litter at the rate of 50 g/m^2. A 5% dust of Shell SD-8447 (2-chloro-1-(2,4,5-trichlorophenyl)vinyl dimethyl phosphate), applied at the same rate, was only slightly less effective. However, 5% granules of ronnel, 2% granules of bromophos, and 2% dust of dimetilan, applied at the same rate, never entirely eliminated lice from the birds.

Several investigators have shown that dusts and granules of some insecticides effectively control external parasites of poultry when the toxicants are applied directly to the bird, to the floor litter, or to dust-bath boxes or wallows. Rodriguez and Riehl (1957) controlled the chicken body louse, *Menacan-*

---

[1] Mallophaga: Menoponidae.

[2] Mallophaga: Philopteridae.

[3] Accepted for publication July 7, 1967.

[4] Mention of a proprietary product does not necessarily imply its endorsement by the USDA.

Table 1.—Control of poultry lice with seven toxicants applied to litter. Experiment 1.

Insecticide and formulation	Amount of toxicant in litter (g/m²)	Avg no. lice/bird after indicated no. of days										
		0	1	3	5	7	10	14	21	28	34	37
Ronnel, 5.0% G	50	68	53	2		6	1		4	5		5
	25	101	114	20		33	18		17	27		38
	25[a]	136	30		8		10	6	4	2		2
Bromophos, 2.0% G	50	41	20	18	18	9	8	8	5	4	4	4
Zytron, 4.4% G	50	30	17	5	1	<1	0	0	0	0	0	
Imidan, 8.0% D	50	27	3	<1	0	0	0	0	0	0	0	
2.0% D	50	42	25		<1	0	0	0	0	0		
Dimetilan, 2.0% D	50	18	23		5	4	3	3	8	10		
Carbophenothion, 2.0% D	50	13	10		<1	0	0	0	0	0		
Shell SD-8447, 5.0% D	50	93	93	2		2	<1	0	0	0	0	
	25	47	65	4		4	3	1	1	<1	<1	

[a] Two 25-g treatments 12 days apart.

thus stramineus (Nitzsch), as long as 70 days by a single application to litter of 1 lb/20 ft² of 2% malathion dust or 1 lb/40 ft² of 4% malathion dust. The same workers (1957) used dust-bath boxes containing 1 lb of 4% malathion dust/100 hens to control the chicken body louse in 1957 and 5 species of lice in 1960 (1960), and Hoffman (1961) controlled poultry lice by applying 5% dusts of coumaphos and carbaryl to litter at the rate of 0.5 lb/40 ft². Simco et al. (1962) controlled the chicken body louse with litter treatments of 5% dusts of coumaphos (1 lb/100 ft²), carbaryl (1½ lb/100 ft²), malathion (2 lb/100 ft²), and dichlorvos (1 lb/100 ft²); dichlorvos killed motile forms rapidly, but it had little residual effectiveness. Later Simco et al. (1963) found that granules of dichlorvos were effective at the rate of 1 lb/100 ft², but again residual control was short lived.

Applications to litter and dust boxes are particularly interesting to poultrymen because handling of the birds is greatly reduced. This paper reports the results of recent studies made at the Livestock Insects Investigations Laboratory, Kerrville, Texas, for control of poultry lice with dust and granular treatments of litter and dust-bath boxes.

Methods and Materials.—Of the 20 Government-owned White Leghorn hens used in each of the 2 tests, 10 selected randomly were examined for lice before treatment. After the treatment was prepared, all 20 hens were put into a 3.05×3.05-m poultry house.

In Experiment 1, the old litter was removed, and about 7.5 cm of fresh wood shavings were placed in each house. Then the insecticidal dusts and granules (25 or 50 g/m²) were distributed as evenly as possible from shaker cans and raked lightly into the litter with a garden rake.

In Experiment 2, the poultry houses were prepared with fresh litter as before, but the litter was not treated. A 60×75×15-cm dust-bath box was filled to a depth of 10 cm with dry washed sand and placed amid untreated litter. Then a measured quantity of dust or granular toxicant (227 or 454 g/box, the equivalent of 25 or 50 g/m², respectively) was distributed over the surface of the sand and thoroughly blended with a small garden rake.

The effectiveness of the treatments was checked at frequent intervals by capturing 10 birds randomly and examining them for lice. The count assigned an individual bird was the total number of lice observed in 10 openings of the feathers; 2 openings each at vent, breast, back, neck, and wings.

Toxicants tested and the chemical identification of proprietary materials were: bromophos, carbophenothion, dimetilan, Dowco 175 (2,4-dichlorophenyl propyl methylphosphoramidate), Imidan® (*O,O*-dimethyl *S*-phthalimidomethyl phosphorodithioate), ronnel, Shell SD-8447 (2-chloro-1-(2,4,5-trichlorophenyl)-vinyl dimethyl phosphate), and Zytron® (*O*-2,4-dichlorophenyl *O*-methyl isopropylphosphoramidothioate).

Results and Discussion.—Generally, the population of lice was greatest near the vent of the chickens, but in severe infestations lice were found on all parts of the body. The chicken body louse was the most abundant species, though smaller numbers of the wing louse, *Lipeurus caponis* (L.), and the shaft louse, *Menopon gallinae* (L.), were often present.

Experiment 1.—Litter treated with granules of ronnel, bromophos, or Zytron markedly reduced the numbers of lice, but complete elimination occurred only when 4.4% Zytron was applied at a rate of 50 g/m². A single 25-g treatment of ronnel was the least effective of the granular applications. All dust formulations except 2% dimetilan gave excellent control, and dusts of Imidan provided particularly rapid kill of motile forms and long residual effects (Table 1).

Experiment 2.—Although Zytron granules gave complete control of lice on birds exposed to treated litter

Table 2.—Control of poultry lice after treatment of dust-bath boxes with Zytron or Dowco 175. Experiment 2.

Insecticide and formulation	Amount of toxicant (g/box)	Avg no. lice/bird after indicated no. of days								
		0	1	10	14	17	21	28	35	42
Zytron, 4.4% G	227	81	37	10	6	2	1	1	6	5
	454	72	56	5	2	<1	<1	<1	1	1
Dowco 175, 1.0% D	454	57	38	48	47	51	42	47	52	42
Control (sand)		53	52	65	50	73	60	56	62	58

(Experiment 1), it was less effective in the dust-bath boxes (Table 2). Probably the free-choice factor in the dust-box tests is partially responsible for the difference. Some hens spent little or no time in the boxes, either because of nonacceptance or because other hens monopolized the boxes. No appreciable reduction of lice occurred when 1% Dowco 175 dust or untreated sand was used.

REFERENCES CITED

Hoffman, R. A. 1961. Experiments on the control of poultry lice. J. Econ. Entomol. 54(6): 1114–7.

Rodriguez, J. L., and L. A. Riehl. 1957. Control of the chicken body louse on hens by self-treatment with malathion dust. J. Econ. Entomol. 50(1): 64–7.

1960. The malathion dust-bath for control of five species of lice on chickens. J. Econ. Entomol. 53(2): 328.

Simco, J. S., B. McPherson, and J. L. Lancaster. 1962. Controlling the chicken body louse. Arkansas Farm Res. 11(2): 7–8.

1963. A promising insecticide for controlling chicken body louse. Arkansas Farm Res. 12(2): 7.

Control of the Pickleworm on Cucurbits[1]

T. DON CANERDAY

Department of Zoology-Entomology, Agricultural Experiment Station, Auburn University, Auburn, Alabama

ABSTRACT

Results from a series of field experiments confirmed the effectiveness of carbaryl and lindane for control of the pickleworm, *Diaphania nitidalis* (Stoll), on squash, cantaloupes, and cucumbers. Other materials found to be highly effective against this insect were endosulfan, GC 6506 (dimethyl *p*-(methylthio) phenyl phosphate), GS 13005 (*O,O*-dimethyl phosphorodithioate *S*-ester with 4-(mercaptomethyl)-2-methoxy-Δ^2-1,3,4-thiadiazolin-5-one), and NIA 10242 (2,3-dihydro-2,2-dimethyl-7-benzofuranyl methylcarbamate), applied weekly as foliar sprays. Fungicides significantly reduced pickleworm injury to cantaloupes and cucumbers. Seed treatments with systemic insecticides failed to control the pickleworm on squash.

Repeated applications of insecticides at recommended and accelerated rates had no adverse effect on squash or cantaloupe yield.

The pickleworm, *Diaphania nitidalis* (Stoll), regularly causes serious damage to summer squash, cucumber, and cantaloupe in the South Atlantic and Gulf States, and occasionally as far west as Oklahoma and Nebraska and as far North as Iowa and Connecticut (Reid and Cuthbert 1961). This caterpillar reduces plant vigor and reduces or destroys market value of the crop by feeding in buds, flowers, vines, stalks, and fruits. Plants may be killed when infestations become heavy. Canerday and Dilbeck (unpublished data) observed that squash developing prior to June 1 escaped serious pickleworm injury. Without effective control measures, profitable production of squash, cucumbers, and cantaloupes in the summer or fall is deterred by this insect.

Certain cultural practices have been suggested and several insecticides have been used in experiments to control the pickleworm (Quaintance 1901, Britton 1935, Arant 1942, Fulton 1947, Dupree et al. 1955, Roberts and Anderson 1960, Reid and Cuthbert 1961). Brett et al. (1961) reported distinct differences in varietal response of squashes to the pickleworm and tests with insecticides showed that better control could be obtained on resistant than on susceptible varieties.

Canerday (1967) detected significant differences in response of cantaloupe varieties to pickleworm injury, but none possessed an adequate degree of resistance under heavy pickleworm pressure to eliminate the use of insecticides.

Reid and Cuthbert (1961) listed some restrictions associated with the use of the commonly recommended carbaryl and lindane on certain cucurbits. Therefore, a series of small-plot experiments was conducted from 1964 through 1966 on the Horticultural Substations of the Auburn University Agricultural Experiment Station System at Cullman and Clanton, Alabama. Several conventional and systemic insecticides were evaluated for control of the pickleworm on squash, cantaloupes, or cucumbers; also plant response to repeated insecticidal applications was measured.

MATERIALS AND METHODS.—For insecticide evaluations, all crops were field-seeded in June or July. These planting dates were used to encourage a pickleworm infestation during development of the crop. Early Summer Crookneck squash, Hales Best Jumbo cantaloupe, and Boston Pickling cucumber varieties were used. Plot size varied among the experiments from 1 row 25 ft long, to 3 rows 25 ft long. Generally the latter was used. A randomized complete block design was employed, and plots were replicated 4 times in all experiments. Each crop was planted for a stand and thinned to 2 plants/hill. Approximately 40 gal of finished spray material was applied per acre with a knapsack sprayer. Treatments on squash were initiated at bloom in most experiments, and the 1st applications to cantaloupes and cucumbers were made at early fruit-set. Three to 5 applications were made at weekly intervals. A fungicide, maneb, was added to most insecticides tested on cantaloupes and cucumbers. Additionally, dinocap and Morestan® (6-methyl-2,3-quinoxalinedithiol cyclic *S,S*-dithiocarbonate) were used for mildew control in 1965 and 1966, respectively. Two other fungicides, Difolatan and Dyrene were tested for effectiveness against the pickleworm on cantaloupes in 1966.

Fruits were harvested at 3- to 7-day intervals and examined for pickleworm injury as a measure of insecticidal effectiveness. The center row in each plot was used as the data row when 3-row plots were used. Squash were harvested at bloom-drop, cantaloupes at

---

[1] Accepted for publication July 25, 1967.