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The Effects of DDT and Sevin on Litter Decomposition and Litter Fauna

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The Effects of DDT and Sevin on Litter Decomposition and Litter Fauna[1]

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Abstract. A comparison of the effects of spraying with DDT, Sevin or water on litter decomposition and litter fauna was made, using a litter bag method. During the thirteen week experimental period no significant differences were found between the rate of decomposition in the litter receiving the three different treatments. Twenty-four hours after spraying the number of Collembola was greatly reduced in the Sevin treated plots. At the end of the experimental period the reduction of fauna other than mites or Collembola was significant at the .01 level as compared to the effects of Sevin or water.

Insecticides are applied to agricultural crops for the reduction of certain "target" organisms. However, insecticides are not specific poisons. In treated areas they are toxic to many "non-target" organisms. These unintended side effects can result in the upset of the delicate balance within the crop ecosystem. The purpose of this study was to look at two potential "non-target" side effects resulting from insecticide stress: 1) changes in the decomposition rate of litter and 2) changes in litter fauna instrumental in litter decomposition and subsequent recycling of nutrients.

DDT, dichloro-diphenyl-trichloroethane, and Sevin, 1-napthyl methyl carbamate, were chosen for comparison because DDT has a half-life of three years in the soil (Edwards, 1966) and Sevin has a half life of eight days in the soil (Mitchell, 1966).

METHODS

Nylon net litter bags (Shanks and Olson, 1961) containing 10 g of dried oat plants cut in 13 cm sections were used to determine the rate of weight loss by litter, and thus decomposition, as it might be affected by DDT or Sevin under standardized conditions. The study area was an abandoned pasture seeded to oats and divided into 30 plots. Seven litter bags were placed in a one m^2 area clipped to ground level in the center of each plot. DDT, Sevin and water were each applied to ten plots.

On collection dates one litter bag was removed from each plot, transported to the laboratory in a plastic bag and placed in a Tullgren funnel (Cox, 1967) to extract the microarthropods. The fauna collected was counted and identified to order to determine the numbers and composition of the litter fauna and how it was

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affected by each treatment. After the extraction procedure was complete the litter samples were again dried and weighed to the nearest .01 gram.

Results

A comparison of the mean weight of litter samples in control and insecticide treated plots for the seven collection dates is presented in Table 1. The insecticides were applied 24 hours before collection of the second group of litter bags. During the 13 week experimental period no significant differences were found between the rate of decomposition in the litter receiving the three different treatments.

The organisms from litter samples of three adjacent plots representing all three experimental treatments were classified and counted for the seven collection periods (Table 2). An apparent correlation was found between the total fauna collected from these plots and the total rainfall for the week preceding the collection date suggesting the fluctuations were caused by migrations in and

Table 1. The mean weight (g) of liter samples ± standard error from control and insecticide treated plots. Litter bags were placed on July 6 and each initially contained 10 g of oat hay.

Collection Date		TREATMENT Control	Sevin	DDT
7/13	(N)	10	10	10
	$\bar{X}\pm S_{\bar{X}}$	9.15±0.12	8.29±0.15	9.13±0.15
7/20	(N)	8	10	10
	$\bar{X}\pm S_{\bar{X}}$	8.17±0.26	8.58±0.28	8.56±0.14
7/27	(N)	8	10	10
	$\bar{X}\pm S_{\bar{X}}$	8.06±0.20	7.56±0.21	7.76±0.27
8/3	(N)	8	9	10
	$\bar{X}\pm S_{\bar{X}}$	7.98±0.27	7.91±0.28	7.77±0.17
8/10	(N)	8	9	10
	$\bar{X}\pm S_{\bar{X}}$	6.56±0.29	6.71±0.12	6.98±0.30
9/7	(N)	8	9	10
	$\bar{X}\pm S_{\bar{X}}$	4.91±0.32	3.64±0.36	4.30±0.34
10/5	(N)	8	9	10
	$\bar{X}\pm S_{\bar{X}}$	3.78±0.36	3.64±0.32	3.20±0.27

Table 2. Fauna collected from three adjacent experimental plots representing the three experimental treatments.

Fauna	COLLECTION DATES 7/13	7/20	7/27	8/3	8/10	9/7	10/5
Control							
Collembola	0	5	6	4	34	27	35
Mites	0	17	35	14	195	96	436
Others	0	4	4	8	4	13	32
Total	0	26	45	26	233	136	503
Sevin							
Collembola	0	6	2	5	17	11	36
Mites	0	41	113	17	201	76	137
Others	0	1	10	2	8	7	11
Total	0	48	125	84	226	94	184
DDT							
Collembola	0	4	35	0	89	63	171
Mites	0	63	73	2	115	141	168
Others	0	1	17	0	1	15	?
Total	0	68	125	2	205	219	341

Table 3. Mean number and standard error of fauna from litter bag samples in control and insecticide treated plots 24 hours and 11 weeks after spraying. Double asterisks indicate significant differences in numbers at the .01 level.

Fauna	TREATMENT Control	Sevin	DDT
July 20			
Total Fauna	38.1±16.7	22.4±13.0	45.8± 6.2
Collembola	19.4±11.5	2.9± 1.9	12.6± 4.8
Mites	10.1± 2.9	12.6± 4.6	27.6±12.8
Other Fauna	9.8± 2.3	6.9± 2.1	5.7± 1.7
October 5			
Total Fauna	163.1±56.7	134.1±23.7	152.0±40.5
Collembola	45.4±42.6	36.7±12.8	60.2±18.7
Mites	108.3±49.8	91.0±16.1	89.4±28.1
Other Fauna	11.3± 3.1	6.4± 0.9	2.4± 0.7**

out of the litter bags in response to moisture conditions. For this reason it was decided that an examination of the organisms collected from all plots 24 hours after spraying and those collected from all plots after 13 weeks in the field would be sufficient to show any cumulative effects and would eliminate the environmental response.

The largest number of litter fauna were Collembola, or spring-

tails, and Oribatid mites (Table 3). All fauna other than mites and Collembola were considered as a taxon referred to as "other fauna". This group consisted of small numbers of Hemiptera, Hymenoptera, Isopoda, Thysanoptera, Isoptera, Chilopoda, Araneida, Thysanura, Diptera, Coleoptera, Annelida and various immature forms. The immature forms were largely Coleoptera and Diptera larva.

The surface application of insecticides did not cause statistically significant changes in the composition of the litter fauna within 24 hours. However, Sevin did appear to have a more immediate effect on the Collembola population than DDT or water. After 13 weeks there were significantly less fauna other than mites and Collembola in the plots sprayed with DDT than those sprayed with Sevin or water.

Discussion

A resurgence of litter organisms after insecticide treatment (Menhinick, 1962) did not occur. However, the great reduction in fauna other than mites and Collembola suggests that such a flare-up could have occurred due to decreased predator pressure. The "other fauna" contains many important mite and Collembola predators.

An increased number of mites and Collembola would probably cause an increased rate of litter decomposition (Malone, 1969) due to their important role in breakdown of dead material. More research is needed to study the long range effects of DDT and Sevin on litter decomposition and litter fauna.

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