ผลของยาฆ่าแมลงที่มีต่อ Arthropod Communities ในดิน

Effects of Insecticides on Soil Arthropod Communities

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ABSTRACT

On the study of the effects of insecticides on soil arthropod communities, the results indicated that different insecticides have different effects on these types of communities as well as on their individual population component.

Insecticides are applied to agricultural crops for the reduction of a certain 'target' organisms. However, most of them are not specific poisons. In treated areas they are toxic to many 'non-target' organisms. This side-effects can result in the upset of the balance within the crop ecosystem.

At Rothamsted Experimental Station, Buahin and Edwards (1) studied the side-effect of DDT and aldrin in the soils on arthropods and worms, they reported that Isotomid Collembola, which live near the surface were more numerous in all DDT-treated plots than untreated controls, but they were almost eliminated by aldrin.

They also found that all doses of DDT (6, 20 and 60 lb. a.i./acre) decreased the number of mesostigmatid mites, dipterous larvae, and symphylid.

In regarding to residue of these two insecticides in the plots, they reported that DDT disappeared very slowly; aldrin went more quickly, but its disappearance was accompanied by an increased of dieldrin which is its oxidation product.

In 1965 Raw (3) studied side-effects of soil-applied organophosphorus insecticide (granular menazon). He concluded that, in general the evidence from field experiments and laboratory tests showed that menazon applied to soil at normal rates for aphid control did not significantly affect the soil organisms.

At Drake University, Iowa., Bodtker and Kingsbury (2) studied the effects of DDT and Sevin on litter decomposition and litter fauna, they found that during the thirteen weeks experimental period no significant differences were observed 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 Sevin treated plots.

Materials and Methods

In order to determine its position in the food chain, the identification was tried to the lowest taxon as possible:

- Insecta
  - Family (for the most soil arthropods)
  - Subfamily (for the Collembola group)
- Myriapoda
  - Class
- Arachina
  - Order (most)
  - Acarina (suborder or lower)
- Crustacea
  - Isopoda

The investigation was conducted at Iowa State University's, Experimental Farm South Beach, Ames, Iowa in spring 1972.

The experiment consisted of 4 treatments. Furadan 100 lb/acre, Malathion 100 lb./acre, Heptachlor 100 lb./acre, and control (water). These were replicated four times. The sixteen plots were arranged in Latin-square design. All treatments were applied to the plots by spraying with compressed air sprayers. The sampling technique consisted of taking one sample per plot for every three-days period after treatment up to three weeks. Before the treatments were applied to the plots, one pre-treated sample/plot was initially taken. Sampling was done by taking soilcores, each with 3 in. deep. These were done by using split cores samples. The total of 96 samples were taken during the period of study.

Results and Discussion

Based on 96 soil cores taken during the experimental period, the following groups of arthropods were recorded:

Acarina	Homoptera
Oribatid mites	Aphididae
Others	Cicadellidae
Collembola	Others
Entomobryidae	Coleoptera
Sminthuridae	Staphylinidae
Poduridae	Others
Diplura	Hymenoptera
Hemiptera	
Formicidae	Symphyla
Others	Isopoda
Lepidoptera	Nematoda
Diptera	Annellida
Thysanoptera	Chilopoda

It was found that only Acarina and Collembola were the most abundant. The number of the rest are insufficient for making the meaningful comparison among different treatments. Therefore the further interpretation of the result was based on Acarina and Collembola groups.

The total number of all animals obtained were presented in Table 1. From this table, the following information was obtained.

The total number of animals in all treatments which were recorded on April, 5 can be regarded as the natural population because all of them were in pre-treatment samples. The total number of animals on this date which was taken from plots of control, Furadan, Malathion, and Heptachlor were 75.5, 33.3, 48.0 and 87.5 animals/core respectively. This could be regarded as the fluctuation of the number of animals with space. In addition, under the column 'Check' of Table 1, the total number of animals/core taken for three weeks period with three days interval April, 5, 8, 11, 14, 17 and 20 were, 75.5, 52.5, 103.8, 80.8 and 49.3 respectively. This also could be regarded as the changing in number of animals with time.

Table 1. Number of soil organisms collected at Iowa State University's Experimental Farm. South Beach, Ames. Iowa, 1972.[1]

Date	Treatment			
	Check	Furadan	Malathion	Heptachlor
April, 5[2]	75.5	33.3	48.0	87.5
April, 8	52.5	12.8	23.8	41.1
April, 11	103.8	18.8	36.8	66.3
April, 14	80.8	40.0	49.0	85.0
April, 17	49.3	33.0	36.3	42.8
April, 20	80.0	5.3	25.5	71.5

[1] Each figure represents average of 4 replication.
[2] Data recorded on April, 5 represent pre-treatment sample recording.

This aspect of the result seems to agree well with the recent reports of Bodtker and kingsbury (2) who studied the effect of DDT and Sevin on litter fauna and found that the natural population of litter fauna was greatly varied.

In regarding to the effects of insecticides on arthropod communities, data in Table 1 showed that the insecticides used in this study have different effects among different groups of animals. Of all treatments, the number of animals subjected to Furadan treatment was the lowest,

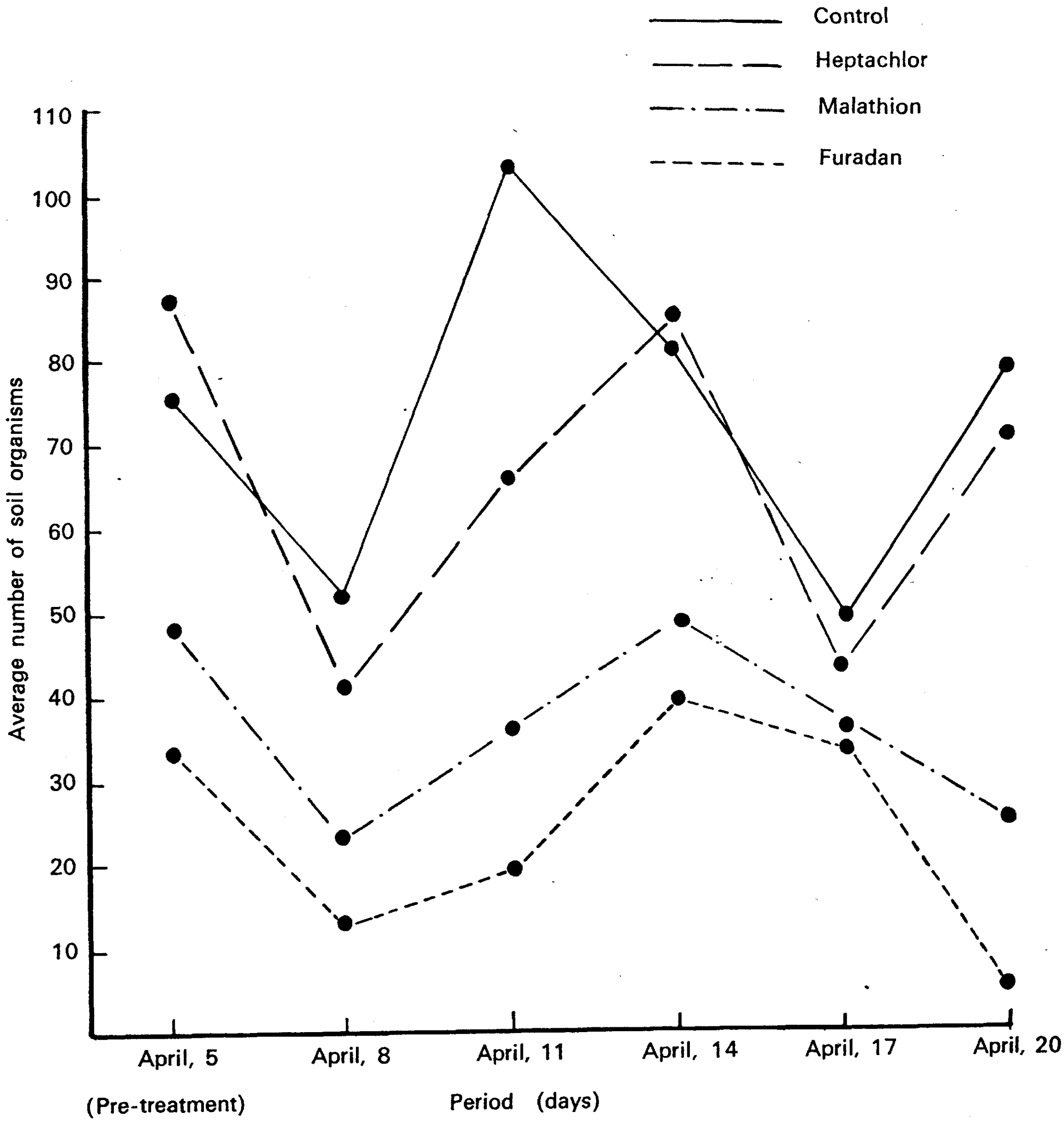

Fig. 1. Pattern of population trend of soil inhabiting organisms subjected to three pesticides for the period of 15 days.

and moderate for the animals subjected to Malathion, while the highest was observed in Heptachlor treatment.

The trend of change in animal numbers subjected to 4 treatments is presented in Figure 1.

In order to observe their response to the effects of different insecticides among different groups of arthropods, the number of Acarina, Collembola, and Thysanoptera were tabulated in Table 2. It was found that the natural number of Acarina, and Collembola were changed with time and space. However, this phenomena did not occur with the Thysanoptera group. This might be due to insufficient number of insects in this group during the time of study, and to the different in behaviors between winged-insect (Thysanoptera) and apterous insect (Collembola).

The result in Table 2 also indicated that Furadan showed strong effect on both of Acarina and Collembola, and this was the same with Malathion, although its effect seems to be milder. However, the differences in effect towards Acarina and Collembola seems to occur with the Heptachlor treatment (Figure 2). It seems likely that this insecticide has a stronger effect on Collembola than on Acarina.

The response of the individual group of Acarina (Oribatid mites, and others) and Collembola (Entomobryidae, Sminthuridae, and Poduridae) when subjected to Furadan, Malathion, and Heptachlor was presented in Table 3. It was indicated that, generally, Furadan has stronger effect on both oribatid mites and others than Heptachlor. However, these data do not allow interpretation of the effect of Malathion on mites.

In regarding to Collembola group, the result in Table 3 indicated that Furadan has the strongest effect to all of its families studied. It is also interesting to notice that Furadan almost completely killed Collembola that belonging to Sminthuridae family.

Malathion also showed strong effect toward this family of Collembola. Based on this study conditions, Heptachlor seems to be less effect on those three families.

Table 2. Number of Acarina, Collembola, and Thysanoptera collected at Iowa State University's Experimental Farm, South Beach. Ames, Iowa. Spring, 1972.[1]

Date	Treatments											
	Check			Furadan			Malathion			Heptachlor		
	Acarina[2]	Collembola[3]	Thysan.	Acarina	Collem.	Thysan.	Acarina	Collem.	Thysan.	Acarina	Collem.	Thysan.
April, 5	37.0	34.3	2.3	17.0	11.5	2.3	23.8	15.3	2.0	54.0	28.8	2.8
April, 8	34.0	14.8	2.5	8.5	2.3	0.3	12.5	8.3	0.3	33.8	4.5	0.3
April, 11	58.5	30.3	1.8	9.3	6.0	0.3	15.8	12.5	0.3	52.5	11.8	0.3
April, 14	25.8	34.5	0.3	19.8	2.3	0.0	33.5	12.8	0.0	48.3	33.5	0.5
April, 17	33.0	11.0	0.3	24.0	6.3	0.5	22.8	8.5	0.5	35.0	5.5	0.0
April, 20	49.3	27.3	0.3	4.0	0.5	0.0	17.0	7.3	0.0	56.0	3.3	0.0

[1] Each figure represents average of 4 replications.
[2] Including Oribatid mites, and other mites.
[3] Including Entomobryidae, Sminthuridae, and Poduridae.

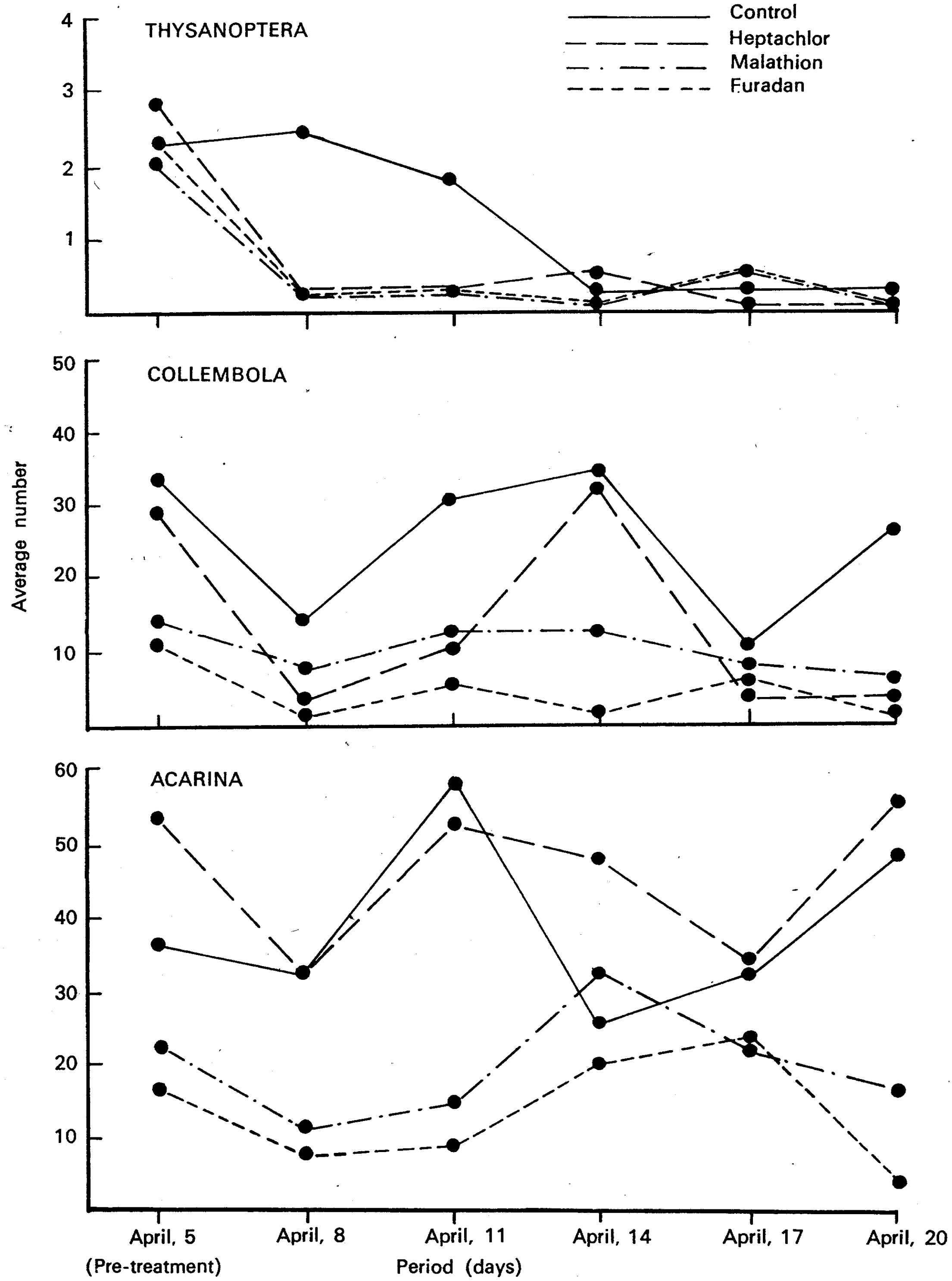

Fig. 2. Pattern of population trend of Thysanoptera, Collembola, and Acarina subjected to three pesticides for the period of 15 days.

Table 3. Number of some members of Acarina and Collembola collected at Iowa State University's Experimental Farm, South Beach. Ames, Iowa. Spring, 1972.[1]

	Treatments																			
	Check					Furadan					Malathion					Heptachlor				
	Acarina[2]		Collembola[3]			Acarina		Collembola			Acarina		Collembola			Acarina		Collembola		
	Orib.	Others	C_1	C_2	C_3	Orib.	Others	C_1	C_2	C_3	Orib.	Others	C_1	C_2	C_3	Orib.	Others	C_1	C_2	C_3
April, 5	10.0	27.0	19.3	11.3	3.8	5.0	11.8	7.8	0.3	3.5	14.3	9.5	9.0	1.0	5.3	10.0	44.0	22.0	2.0	1.3
April, 8	11.3	22.8	8.0	4.3	2.5	2.0	6.5	1.8	0.0	0.5	7.8	4.8	4.5	1.3	2.8	5.8	28.0	1.3	1.0	2.3
April, 11	37.5	21.0	21.8	5.8	2.8	2.5	6.8	4.8	0.0	1.3	5.0	10.8	10.0	0.5	2.0	9.3	43.3	4.5	4.0	1.3
April, 14	6.5	19.3	25.5	4.8	4.3	5.3	14.5	1.0	0.0	1.3	20.0	13.5	11.5	0.0	1.3	19.0	29.3	21.3	11.3	1.0
April, 17	15.3	17.8	9.3	0.3	1.5	18.3	5.8	5.5	0.3	0.5	14.3	8.5	6.3	0.8	1.5	7.3	27.8	3.5	0.5	1.5
April, 20	28.3	21.0	25.0	0.3	2.0	2.3	1.8	0.5	0.0	0.0	11.5	5.5	6.0	0.0	1.3	14.5	41.5	2.3	0.0	1.0

[1] Each figure represent average of 4 replications.
[2] Acarina : Orib. = Oribatid mite
Other = Other mites
[3] Collembola : C_1 = Entomobryidae
C_2 = Sminthuridae
C_3 = Poduridae

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