
Impact of some pesticides on the population of soil microorganisms

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The effect of five commonly used pesticide (Endosulfan, Paraquat, Fipronil, 2,4-D and Imidacloprid) on the soil microbial population in tea agroecosystem was studied. The experiment was set up in earthen pots containing 3 kgs of soil each. The soil was taken from the tea plantation areas (i.e. tea agroecosystem) of Rosekandy Tea Estate. The soil sample in each pot was treated with different concentrations of the above mentioned pesticides (i.e. 1000, 2000 and 10,000 ppm). Control consisted of soil only without any treatment. The samples were analysed at 10 days interval up to 50 days. The total number of microorganisms was determined using the dilution plate method. Results obtained revealed that population of bacteria, fungi and actinomycetes declined following the pesticide treatment but gradually recovered with time. This shows that microbial population can recover with time from the deleterious effect of pesticides (insecticide/weedicide) applied to soil.

Key words: Microorganisms, pesticides, soil

INTRODUCTION

The modern day agriculture depends on a wide variety of synthetically produced chemicals including insecticides, fungicides, herbicides and other pesticides (Martinez-Toledo *et al.*, 1998). India, considers agriculture to be the most important source of economy. And in the course of development pesticides have become an important tool for plant protection for boosting food production (Abhilash and Singh, 2009).

Ideally, a pesticide must be lethal to the targeted pests, but not to the non target species. However, this is not always the case and the rampant use of these chemicals has played havoc

with human and other life forms (Bhatnagar, 2001). When pesticides are applied to crops and soil, it exerts certain effects on non target organisms including soil microorganisms. Soil microorganisms represent a unique position in the biological cycles and are essential for plant growth and soil fertility. The retention of pesticides in the soil and their presence in the soil can influence the chemical and microbiological properties of the soil. It negatively affects the soil environment and microbial activity of the soil which may alter the soil fertility and influence the growth and development of plants (Ferrero and David, 2000). Many pesticides affect soil microbes, some negatively, some positively, but all usually have a transient effect. The transient effect is due to the ability of the soil microbes to metabolize most pesticides (Broadbent, 1980).

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The purpose of the present study is to examine the impact of some pesticides i.e Endosulfan, Fipronil, Imidacloprid which are insecticides, and Paraquat and 2,4-D which are herbicides on the population of soil microorganisms in the tea agroecosystem of Barak Valley, Assam.

MATERIALS AND METHOD

The experiment was set up in earthen pots containing 3 kg of soil each. The soil was taken from the agricultural field (i.e tea agroecosystem) of Rosekandy Tea Estate. The plant debris were removed and the soil samples sieved (<2mm) before putting in the pots. The soil sample in each pot was treated with three concentrations (i.e 1000, 2000 and 10,000 ppm) of the pesticides namely Endosulfan, Paraquat, Fipronil, 2-4-D and Imidacloprid. Sample was examined in triplicate for every treatment. The soil samples were taken from the three pots and mixed thoroughly to prepare one composite sample for each pesticide treatment. Control consisting of soil only without any treatment was taken for the experiment. Samples for soil analysis were taken at an interval of 10 days up to 50 days. The total number of microorganisms was determined using the dilution plate method (Timonin, 1940). Nutrient Agar medium was used for determining bacterial population while Rose Bengal Agar and Starch Casein Agar were used for fungal and actinomycetes population respectively.

The data generated from this study was subjected to analysis of variance (ANOVA).

RESULTS AND DISCUSSION

Effect of pesticides on the soil bacterial population

It can be seen, that in case of Endosulfan, Fipronil and Imidacloprid, the bacterial population showed a gradual increase from the first sampling with the highest in the third sampling. It then declined with time. The Imidacloprid treated soil recorded the highest bacterial population in the observations on the 30th day following the treatment.

The control sample and the herbicides Paraquat

and 2,4-D also showed the similar trend of gradual increase and then decline of the population. These results suggested that the pesticide treatment had very little effect on the soil bacterial population. The data in Table 1 showed the effect of pesticides on bacterial count. The pesticide treatment had significant effect on the bacterial count on the 20th (<0.005), 30th (<0.005), 40th (<0.005) and 50th (<0.005) day whereas the effect was less significant on the first sampling, i.e 10th day

Effect of pesticides on the soil actinomycetes population

In the control sample the actinomycetes population declined from the first sampling i.e 10th day to the last sampling i.e 50th day. In the soil samples treated with Fipronil, the actinomycetes population actually decreased during the second sampling but eventually it recovered and showed higher population count by the time of the last sampling i.e on the 50th day.

The Paraquat, Endosulfan, Imidacloprid and 2,4-D treated soils showed an almost similar trend where the population declined with time compared to the first sampling.

The effect of the pesticide treatment on the actinomycetes population was presented in the Table 2. It can be seen that during the course of the treatment, there was very little effect on the actinomycetes population following the days of treatment.

Effect of pesticides on the soil fungal populations

In the soil treated with Paraquat, Endosulfan and 2,4-D, the fungal population was found to overcome the effect of the pesticides and their population increased by the last sampling time i.e the 50th day as compared to the treated soils. In the Fipronil and Imidacloprid treated soil, the population was observed to have decreased from the first sampling.

The values presented in Table 3 showed that the fungal population on the 10th day after treatment had higher significant effect as compared to the rest of the sampling time. The

Table 1 : Effect of pesticides on soil bacterial population.

Treatment	Total Population (Mean±S.E) Days after treatment				
	10	20	30	40	50
Control	270±5.29	204±23.4	265±5.8	230±15.7	220±23.0
Fipronil	38.6±16.7	96±8.3	197.3±6.1	172±16.1	124±15.1
Paraquat	64±15.1	108±14.4	209.3±14.4	79.3±7.0	73.3±6.6
2,4-D	38.6±7.4	134.6±11.3	160±10.0	146.6±7.4	125.3±23.1
Imidacloprid	32±15.6	121.3±4.3	256 ±7.9	224±21.1	150.6±23.2
Endosulfan	53.3±9.6	89.3±10.9	181.3±38.4	185.5±7.4	162.6±15.3
P values	.026	.000	.002	.000	.003

*p value <0.005 is significant

Table 2 : Effect of pesticides on the soil actinomycetes population

Treatment	Total population (Mean±S.E) Days after treatment				
	10	20	30	40	50
Control	284 ±22.0	208 ±17.4	265 ±13.8	265 ±17.9	180± 27.2
Fipronil	166.6 ±40.8	145.3 ±22.1	197.3 ±9.6	234.6 ±9.6	201.3 ±5.8
Paraquat	196 ±36.2	216 ±66.6	209.3± 24.9	148 ±26.2	117.3 ±24.2
2,4-D	238± 28.6	174.6 ±51.9	160 ±17.4	230.6 ±48.6	162.6± 15.7
Imidacloprid	224 ±22.0	166.6 ±49.3	256 ±27.2	216 ±12.8	152 ±12.8
Endosulfan	261± 5.2	192± 64.1	181.3± 17.9	246 ±13.1	198.±6 7.4
P values	.235	.907	.015	.082	.044

*p value <0.005 is significant

Table 3 : Effect of pesticides on the soil fungal populations

Treatment	Total Populations (Mean±S.E) Days after treatment				
	10	20	30	40	50
Control	12 ±1.15	14.3 ±2.18	7 ±1.52	15.3 ±1.45	13 ±2.0
Fipronil	6.3 ±1.20	10.3 ±1.45	4 ±1.15	8.6 ±2.18	3.3± 0.8
Paraquat	3.6 ±1.76	7 ±2.08	2.6± 0.66	8.6 ±0.66	5.3 ±0.8
2,4-D	6 ±0.57	8.6± 0.88	5 ±1.0	15 ±1.52	7.3± 1.20
Imidacloprid	8.3± 0.88	11.6 ±1.20	5.6 ±2.02	11.3 ±4.23	7± 1.52
Endosulfan	6 ±1.15	9 ±1.15	2.3± 0.66	14.6± 1.45	6.6±1.7
P values	.006	.073	.150	.629	.036

*p value <0.005 is significant

rest of the treatment days showed less significant effect on the total fungal population.

The above results indicated that the soil microorganisms were able to recover with time from the deleterious effects of the pesticides. Similar results were reported when Descis (insecticide) treated soil was found to show higher total viable bacteria than the control soil (Aurelia 2009). Bavistin (fungicide) and SDMA (herbicide) also did not have any inhibitory effect on the total microbial population. Domsch and Paul (1974) and Johnen and Drew (1977) also reported that generally, normal application rates of herbicides did not exert any significant changes on the microbial population of the soil. Niewiadomska and Sawicka (2002) also observed that applied pesticides reduced the total bacterial count in soil 7 days after the application compared to control, while 14 days after sowing, the applied herbicide was found to have significantly stimulated bacterial multiplication. They also observed that the fungicide alone or when applied in combination with the herbicide exerted a significant stimulatory effect on the growth of the actinomycetes.

The fungal groups were found to be the least inhibited apart from the bacteria in a study regarding the response of microbial populations in soil after incorporation of some insecticides and fungicides. Actinomycetes isolates were also reported to grow on all pesticide amended soil samples (Digrak and Ozcelik 1998). In laboratory and field studies conducted to determine the effects of some pesticides on the total number of soil bacteria results obtained showed that Chlorpyrifos caused significant reduction in number of soil bacteria, however its effect disappeared within 21 days after application (Ahmed and Muhammad, 2006). Similarly, it was observed that the total viable bacteria was to be higher than that of the control groups (Digrak and Kazanici, 1999) and that this treatment had no inhibitory effects on the development of the

other soil microorganism groups present in the soil (i.e actinomycetes, fungi and bacteria).

Thus, the present study indicated that the selected pesticides i.e Endosulfan, 2,4-D, Imidacloprid, Fipronil and Paraquat did not have a significant effect on the growth and population of the soil microbes and that they are able to recover with time from the deleterious effect of the pesticides.

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