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Consequences of pesticide pollution upon the population of Collembola (springtails) in Kashmir apple orchard edaphic ecosystem

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Abstract: *Macrofauna from three harbour along West Coast were analyses to study the impact of various harbour activities on the community. A total of 36 samples were collected onboard CRV Sagar Sukti using a van Veen grab and sub sampled with a quadrant. Macrobenthic communities were represented by 56 species belonging to 6 major groups. The mean macrofaunal density ranged from 2042 - 11482 nos. m^{-2} and was dominated by Polychaete (>90%). Biomass ranged from 6.68 to114.78 $g.m^{-2}$. Based on different biotic indices (Diversity indices, ABC curve, Polychaete: Amphipod ratio) indicate that the macrofaunal community in the study area is under stress condition. Also the fauna of the study area was typically dominated by the deposit feeding opportunistic species, a phenomenon common in harbour area, possibly due to high organic loading from harbour borne activities.*

Key Words: Macrofauna, West coast, Benthic environment.

Introduction

Soil is considered a living entity, a home place for numerous micro and macro organisms.The place where minerals and organic matter undergo degradation and decomposition. Mesofauna of the soil and overlaying layers of organic debris normally comprising of a variety of mites, Collembola, Proturans, Symphylans, micro-insect larvae , Procids, small beetles, Pauropods, Centipedes, Millipedes and various other groups constitute about 88% of soil organisms which vary considerably in different soil types/localities. The complex community of soil fauna which helps in the decomposition process plays an important role in soil dynamics. The agriculture and horticulture being two prominent and most important sectors of farming require numerous agro-chemicals in the form of fertilizers, pesticides, herbicides etc. Due to the high degree of incidence of pests in horticultural sector, the use of pesticides is common to prevent crop losses due to pests and diseases. The use of these chemicals greatly benefit the agriculture on one hand, but at the same time lead to too many problems. One of the most important problem is their ill effect on non-target organisms including soil flora and fauna which are not only killed by chemicals applied to soil but also by those that reach the soil in drift from aerial sprays or washed off foliage. The apple *(Malus domestica Borkh)* is the major component of horticulture in valley of Kashmir, producing 1093275 metric tonnes of fruit annually (Anonymous, 2005). Since a number of agrochemicals including pesticides are used in apple orchards, investigations were undertaken to study their effect on the population of Collembola in apple orchard ecosystem.

Materials and Methods

Studies were carried out during 2005-07 at Zukura Srinagar in two apple orchards (treated and untreated). Treated orchards were sprayed with Ziram (Ziride) at a concentration 0.2%, Diesel oil emulsion @ 1:10(diluted with water) mixed with Ethion (Ethion) of a concentration of 0.05, Hexaconazole (contaf)@ 0.03, Bitertanol

(Baycor), 0.05 combined with Dicofol (Supernomite) of 0.02% concentration, Mancozeb (Zebatene) @ 0.3, Captan (captaf) @ 0.3%,Bitertanol (Baycor) 0.05, Captan 0.3 mixed with chlorpyriphos (Coroban) of 0.01% concentration in the growing season. Soil samples were collected after 10 days interval under apple trees to a depth of about 30 cm at a standard distance of 135 cm from the tree truck. Twelve trees of uniform size and vigour were selected randomly in each orchard. An iron core sampler measuring 7.6 x 7.6 cm across and 32.5 cm tall was used to collect core samples (Singh *et al.*, 1979). After removal, the soil cores were emptied in sealed polythene bags with appropriate labels and taken to laboratory for extraction of Collembola using Berlese funnel (Al-Assiuty *et al.*, 2000). Collembola extracted from each sample from both treated and untreated orchards were counted and analyzed statistically as per the procedure recommended by Singh and Gupta (1993). The Collembola so collected were preserved in 70 % alcohol and mounted in Hoyer's medium for microscopic

Table1. Impact of various pesticides on the abundance of Collembola in apple orchard ecosystem

No	Pesticide	Conc.%	Treatment (Orchard)	Population (individuals per meter square)			
				2 days post treatment		12 days post treatment	
				Mean± S.E. mean	% reduction	Mean ± S.E. Mean	% increase (+)/ decrease (-)
1.	Ziram80 WP	0.2	Untreated Treated	2077 ± 173 1730 ± 180	16.70	1731 ± 150 1212 ± 173	-29.98*
2.	Diesel Oil Ethion 50 EC	1:1+0.05	Untreated Treated	606 ± 87 519 ± 229	14.35	952 ± 264 1212 ± 229	+ 27.31
3.	Hexaconazole 5 EC	0.03	Untreated Treated	1645 ± 218 1125 ± 100	31.61*	866 ± 180 1212 ± 132	+ 28.54
4.	Bitertanol 25 WP+ Dicofol 18.5 EC	0.05 + 0.02	Untreated Treated	1385 ± 180 1125 ± 304	18.77	1904 ± 229 1558 ± 264	- 18.70
5.	Mancozeb 75 WP	0.3	Untreated Treated	1558 ± 100 1212 ± 87	22.20	2077 ± 173 1472 ± 132	-29.12*
6.	Captan 50 WP	0.3	Untreated Treated	866 ± 132 692 ± 132	20.09	778 ± 279 1212 ± 132	+ 35.80
7.	Bitertanol 25 WP	0.05	Untreated Treated	1645 ± 132 1039 ± 229	36.83*	1212 ± 132 779 ± 180	- 35.72*
8.	Captan 50 WP+ Chlorpyriphos 20 EC	0.3 + 0.01	Untreated Treated	1147 ± 132 952 ± 100	17.00	433 ± 132 605.9 ± 50	+ 39.95

*Shows significance at 0.05 level of significance

studies. The mean number of Collembolans per meter square in sprayed and unsprayed orchards was recorded.

Results and Discussion

The effect of spray practices in the apple orchard on the Collembola (Table1) depicted that they respond differently to various pesticides. The combined application of Captan 50 WP (Wettable powder) + Chlorpyriphos 20 EC (Emulsion concentrate) reduced the population after 2 days but then began to come up and within 12 days out numbered the one in untreated orchard. The inverse relation between the pesticides and Collembola was attributed to the killing of their natural enemies by pesticides that would have otherwise preyed upon Collembola and reduced their population. Similar behaviour was recorded after the application of diesel oil + Ethion (50 EC), Hexaconazole (5EC), Captan (50WP). However, the pesticides Bitertanol (25WP) + Dicofol (18.5 EC) treatment combination, Mancozeb (75WP) and Bitertanol (25WP) were highly detrimental to Collembola. All these pesticides reduced the Collembolan population drastically which was statistically significant in case of Bitertanol, Ziram and Mancozeb.

These findings are similar to that of Rajagopal et al., (1990) who found chlorpyriphos 10 G (4.0 kg,a.i /ha) was most toxic and reduced maximum soil fauna. In the present studies chlorpyriphos 20 EC at 0.01% concentration caused the similar effect initially after two days. The effects of captan on both target / non-target soil organisms found that all soil organisms except protozoa were reduced significantly. However in the present studies captan 0.3% reduced the Collembolans initially (after 2 days) but they regrew afterwards and outnumbered the one in untreated orchard in 12 days period. Nevertheless, present findings differ from those of Singh and Gupta (1994) who reported that the application of Phorate in foliar sprays against target pests had no impact on non- target soil arthropod population. Current studies revealed that the soil fauna suffer a heavy mortality by majority of the pesticides that reach the soil in drift from aerial sprays or washed off foliage. These similarities and differences were attributed to the fact that different species of Collembola differ variedly in their susceptibility to pesticides.

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