Rec. zool. Surv. India : **107**(Part–4) : 61-69, 2007

EFFECTS OF AGRICULTURAL PRACTICES ON SOIL ARTHROPOD POPULATION IN WEST BENGAL

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INTRODUCTION

Agriculture is the practice of cultivating the soil to produce crops. Though at first this practice was simple, but more recently, synthesized fertilizers and pesticides are being added to this, as a result, with high production of crops, natural soil condition and natural microorganism populations are being affected. Among all the soil micro-arthropods, mites are predominant and playing important role in increasing soil fertility through organic decomposition. But in agricultural fields, due to application of different fertilizers and also by crop rotation, tillage, irrigation, etc. the natural mite population as well as the other soil microarthropods and their ecology are affected. Bhattacharyya, Joy and Joy (1981), Majumder and Deb (1991a, 1991b), Sanyal (1991), Sanyal and Sarkar (1993), Sengupta and Sanyal (1991) studied the effect of agricultural practices on mite population in laterite and alluvial soils in West Bengal.

MATERIAL AND METHODS

The soil and litter samples were taken at fifteen days interval over a period of eight months (January-August, 2006) except the fields-C and D where samples were collected during March-August, '06 and May-August, '06 respectively, by means of stainless steel corers, each measuring 5 cm in diameter. A total number of 170 samples were drawn (at the rate of five samples from each field in one collection). The collected soil samples were extracted in a Tullgren funnel extractor as modified by Macfadyen (1953). The adult insects and spiders were also collected by hand picking method. Soil temperature and moisture content were measured by soil thermometer and infra-red moisture meter respectively.

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SITE DESCRIPTION

Five fields were selected for the study, of these four fields were agricultural and one non-agricultural (control). All the fields were located at Gobardanga, North 24-Parganas, West Bengal.

1. Agricultural fields :

Four selected agricultural fields were denoted as Field-A, Field-B, Field-C and Field-D, each having the area of approximately one acre.

Field-A : This field was a paddy field when the study began and after harvesting the crop, the same field was again prepared for paddy cultivation.

Field-B : When the study started, this field was with chrysanthemum flower and after that, marigold cultivation was started.

Field-C : This field was with sunflower when the study began and after that jute cultivation started in the same field.

Field-D : This field was prepared for Banana cultivation.

All these fields were parts of a large agricultural field and as a result no natural vegetation could grow in the study fields. The other agricultural fields in the surroundings were china-rose (*Hibiscus rosa-sinensis*) field, garden balsam (*Impatiens balsamina*) field, common arum (*Colocasia antiquorum)* field, *etc.* and some grasses as *Cynodon dactylon*, *Brachiaris* sp. were also found during the sampling period. All of these agricultural fields were treated with different fertilizers like N-P-K, Urea, Suphala, Agromin, oil-cake, *etc.* in different concentrations, depending upon the type of crops cultivated in the fields. Tillage and irrigation were also done at a regular interval. Some pesticides as Endosulfan, Cypermethrin, Phosphamidon, etc. were also applied to the fields during cultivation.

2. Non-agricultural field :

This field was very near to the agricultural field-A. It was a fallow land having no crop through out the study. The soil was loamy in texture and the field was covered with grasses like *Cynodon dactylon* and *Brachiaria* sp. Some other seasonal plants like *Eclipta prostrata*, *Amaranthus spinosus*, *Cardiospermum halicacabum, etc.* were also found to grow in the field.

RESULTS

FAUNAL COMPOSITION

Altogether 7,412 arthropods belonging to seven different groups *viz.*, Acarina, Collembola, Hymenoptera, Coleoptera, Hemiptera, Diptera and Spider were collected. As the population of Isoptera, Pseudoscorpion, Diplopoda and Chilopoda were very low and irregularly distributed,

these groups are not considered for calculation. A comparison between arthropods of non-agricultural and agricultural fields showed that non-agricultural field was rich in faunal groups while in agricultural fields, the population fluctuation of arthropod depended on nature of cultivation. In all the fields, Acarina was most dominant group. It formed 73.01%, 67.54%, 61.43%, 66.15% and 67.97% of the total population obtained from non-agricultural field, field-A, field-B, field-C and field-D respectively. In non-agricultural field, the second, third and fourth dominant groups were Collembola (1496.3/m^2), Coleoptera (282.75/m^2) and Hymenoptera (1496.3/m^2) respectively.

Table 1 : Arthropod population and mean values of soil factors in non-agricultural field (January-August, 2006).

Arthropods/m^2 & soil factors	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.
Acarina	6158.3	4021.7	4901.5	5781.2	5027.2	10054.4	7352.2	11185.5
Collembola	2262.2	879.7	911.1	1822.3	848.3	1728.1	2010.8	1508.1
Hymenoptera	125.6	–	314.2	345.6	565.5	31.4	157.1	408.4
Coleoptera	377	502.7	62.8	125.6	157.1	31.4	502.7	502.7
Hemiptera	–	188.5	–	125.6	314.2	–	219.9	–
Diptera	–	–	31.4	125.6	92.2	188.5	125.5	31.4
Spider	–	–	125.6	62.8	188.5	94.2	31.4	125.6
Temperature (°C)	25.9	26.1	29.2	31.3	31.8	29	28.3	27.7
Moisture (%)	25.1	26.3	26	23.8	23.2	27.6	32.5	31.7

Table 2 : Arthropod population and mean values of soil factors in Field-A (January-August, 2006).

Arthropods/m^2 & soil factors	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.
Acarina	3644.7	6032.6	5341.4	4084.6	8609	6472.5	4021.7	7855
Collembola	2513.6	4210.2	3393.3	1633.8	2073.7	1351	1728	1319.6
Hymenoptera	754	251.3	62.8	62.8	439.8	565.5	596.9	816.9
Coleoptera	–	188.5	31.4	31.4	251.3	62.8	157.1	314.2
Hemiptera	–	31.4	–	–	–	–	157.1	314.2
Diptera	188.5	–	–	–	–	–	–	157.1
Spider	–	215.3	94.2	31.4	62.8	–	94.2	219.9
Temperature (°C)	26.2	26.4	28.5	30.1	32.2	28.3	28.1	27.2
Moisture (%)	26.5	27.1	26.4	25.1	24.8	28.3	33.2	33.1

Table 3 : Arthropod population and mean values of soil factors in Field-B (January-August, 2006).

Arthropods/m² & soil factors	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.
Acarina	4713	1256.8	4398.8	5687	3267.6	4618.7	48.7.2	3770.4
Collembola	10054.4	3142	619.2	2010.8	754	2199.4	1633.8	1256.8
Hymenoptera	251.3		125.6	439.8	188.5	125.6	94.2	282.7
Coleoptera	314.2	125.6	282.7	628.4	219.9	596.9	345.6	125.6
Hemiptera	–	–	–	157.1	–	–	94.2	62.8
Diptera	–	–	62.8	157.1	157.1	–	62.8	x
Spider	–	188.5	219.9	62.8	125.6	–	62.8	31.4
Temperature (°C)	25.5	25.2	28.4	30.2	30.9	29.1	28.2	27.3
Moisture (%)	25.8	27.2	27.1	23.5	23.2	28.1	32.2	31.2

Table 4 : Arthropod population and mean values of soil factors in Field-C (March-August, 2006).

Arthropods/m² & soil factors	Mar.	Apr.	May	Jun.	Jul.	Aug.
Acarina	12693.6	4430.2	2513.6	4084.6	4587.3	1728
Collembola	2513.6	1351	1445.3	2450.7	2387.9	1068.2
Hymenoptera	–	62.8	251.3	157	377	345.6
Coleoptera	125.6	–	62.8	188.5	314.2	596.9
Hemiptera	–	–	–	31.4	251.3	157.1
Diptera	–	157.1	188.5	–	62.8	–
Spider	157.1	125.6	–	31.4	251.3	157.1
Temperature (°C)	27.9	30.2	30.2	28.1	26.3	25.2
Moisture (%)	26.2	24.5	24.5	26.8	31.2	32.8

Table 5 : Arthropod population and mean values of soil factors in Field-D (May-August, 2006).

Anthropods/m² & soil factors	May	Jun.	Jul.	Aug.
Acarina	3016.3	3361.9	3079.1	4587.3
Collembola	691.2	1445.3	1382.4	502.7
Hymenoptera	62.8	219.9	125.6	314.2
Coleoptera	–	157	188.5	282.7
Hemiptera	–	–	157	125.6
Diptera	–	–	314.2	–
Spider	–	62.8	31.4	219.9
Temperature (°C)	31.2	28.4	27.2	26.2
Moisture (%)	23.1	28.5	33.1	32.8

Similarly in field-A, Collembola (2277.9/m^2), Hymenoptera (443.75/m^2) and Coleoptera (129.58/m^2); in field-B, Collembola (2717.8/m^2), Coleoptera (329.86/m^2) and Hymenoptera (188.46/m^2); in field-C, Collembola (1869.45 m^2), Coleoptera (214.6/m^2) and Hymenoptera (198.95 m^2) and in field-D, Collembola (1005.4/m^2), Hymenoptera (180.62/m^2) and Coleoptera (157.05/m2) occupied first, second and third position in order of dominance (Tables 1-5).

EDAPHIC FACTORS

The physical factors of the soil considered in this study showed fluctuations in all the fields. In the non-agricultural field, the maximum (31.8°C) and minimum (25.9°C) temperature were recorded in May and January respectively. Maximum moisture (31.7%) was recorded in August where as minimum (23.2%) in May.

In field-A, the temperature showed a range of 26.2°C to 32.2°C (January and May) and the moisture varied between 24.8% to 33.2% (May and August). In field-B, the temperature fluctuated from 25.2°C to 30.2°C (April to May and August). In field-C, temperature varied between 25.2°C (August) to 30.2°C (April and May) and moisture showed range of 24.5% (April to May) to 32.8% (August). In field-D, temperature fluctuated in between 26.2°C (August) to 31.2°C (May) and moisture varied from 23.1% (May) to 33.1% (July) (Tables 1-5).

POPULATION FLUCTUATION

The total number of arthropods collected showed population maxima in March and monsoon months, *i.e.*, July-August in all fields. The arthropods were minimum in number in February in non-agricultural field where as in agricultural fields it varied in different fields depending upon agriculture practices in the respective field.

The population of different groups showed an irregular trend of fluctuation during the sampling period but there was a tendency to increase their number in January-July in all the cultivated fields.

The collembola population was recorded maximum in March in both non-agricultural and agricultural fields (Figs. 1-7).

DISCUSSION

The non-agricultural field as well as most of the agricultural fields showed a higher population during monsoon months when soil moisture was high. The record of low population of mite in agricultural fields, might be due to influence of tillage, irrigation, application of different fertilizers and pesticides. These observations are supported by the earlier works of Sanyal (1991), Sanyal and Sarkar (1993) and Sengupta and Sanyal (1991). The study recorded that when there was standing crop in the field, the number of mites and other soil microarthropods were increased. The acarina population decreased each time after tillage. When there were no crops in the agricultural

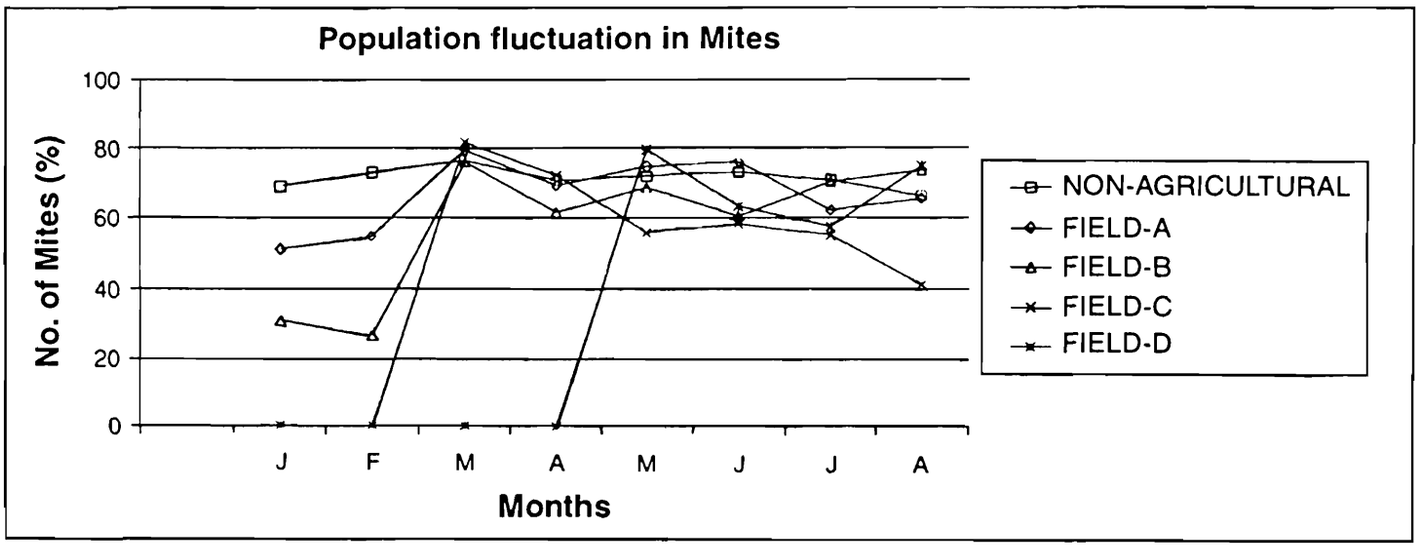

Fig. 1

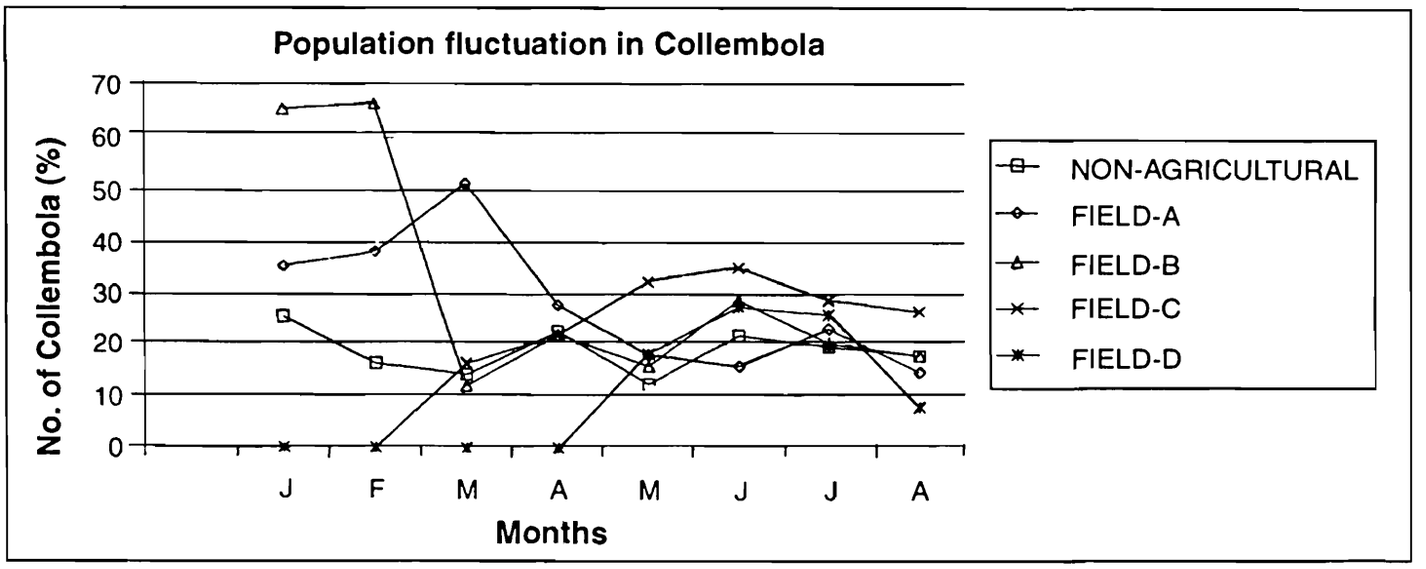

Fig. 2

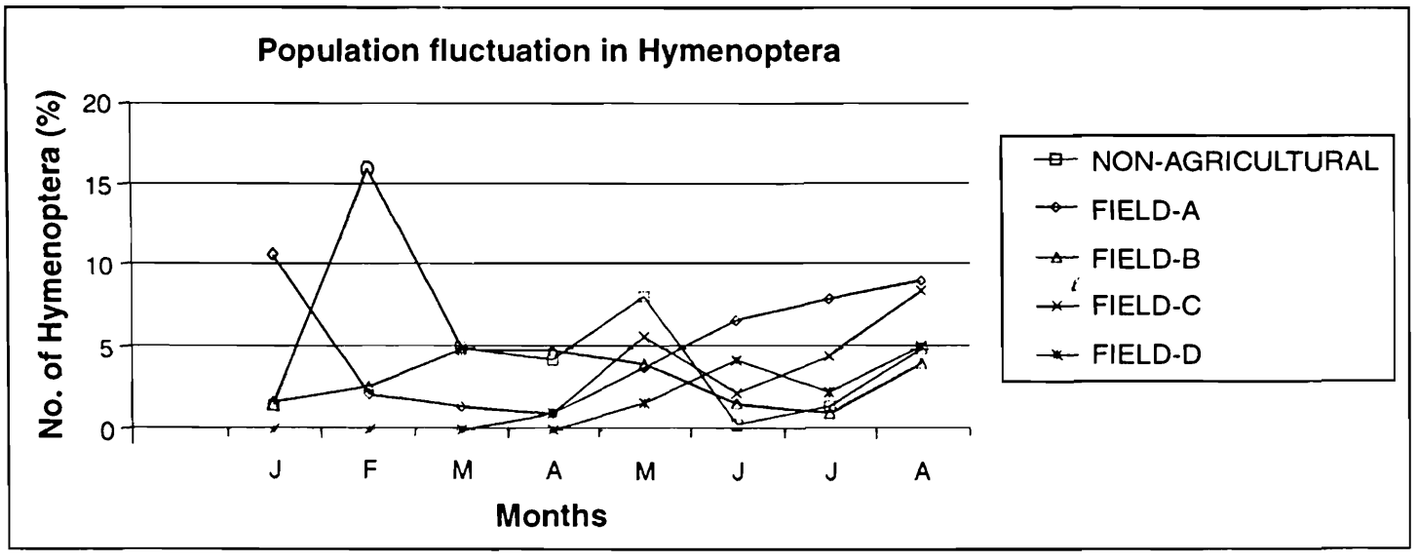

Fig. 3

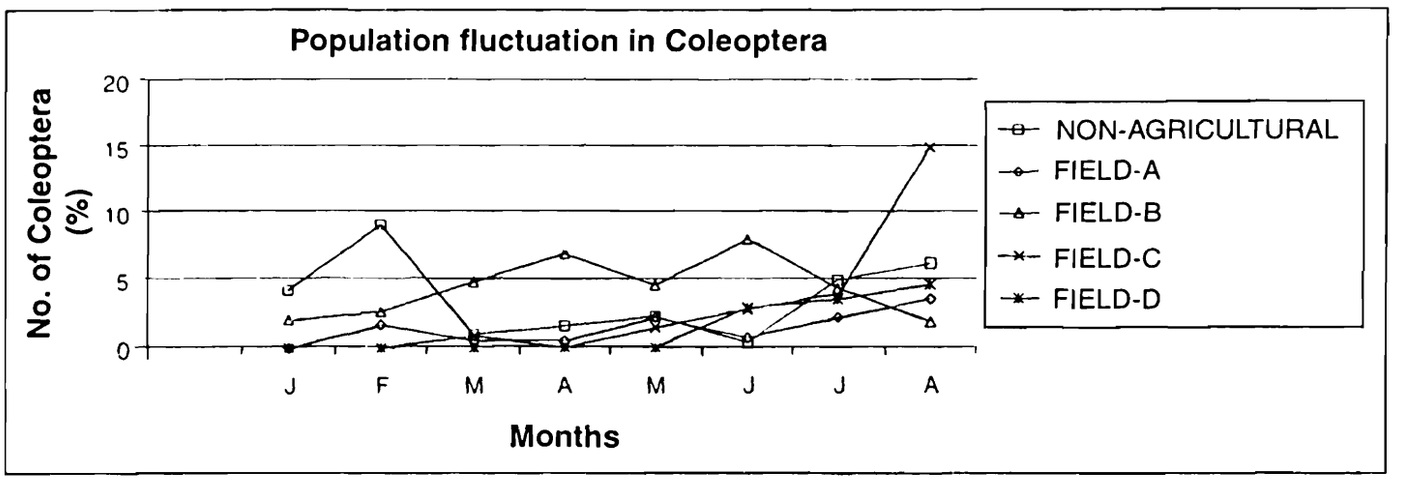

Fig. 4

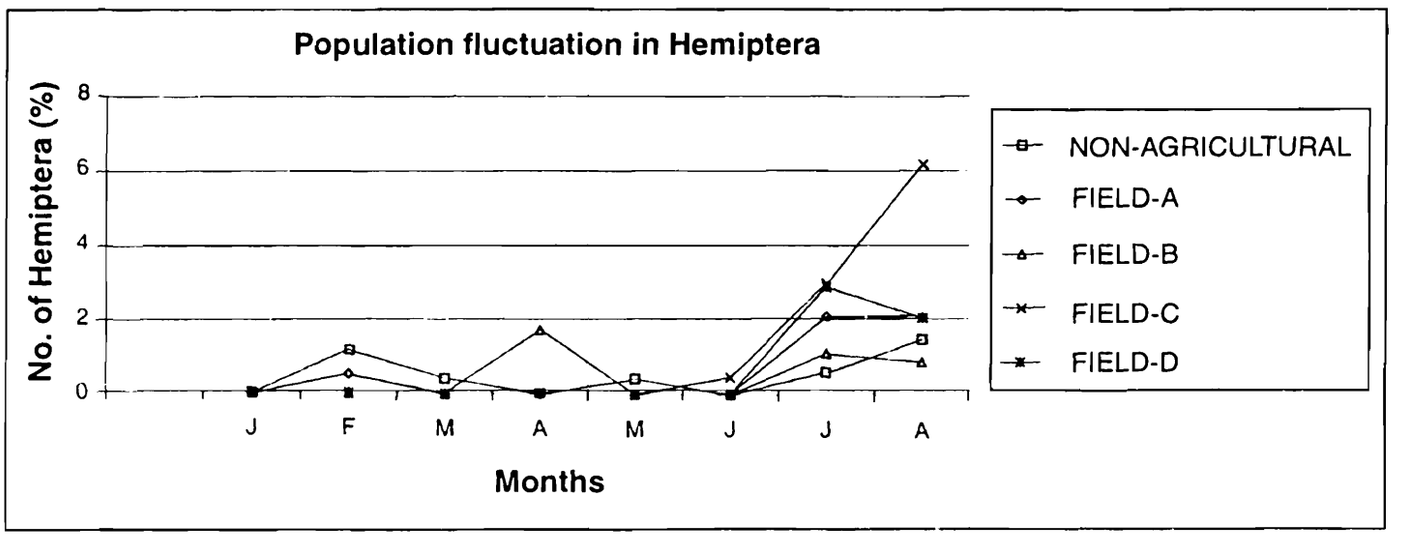

Fig. 5

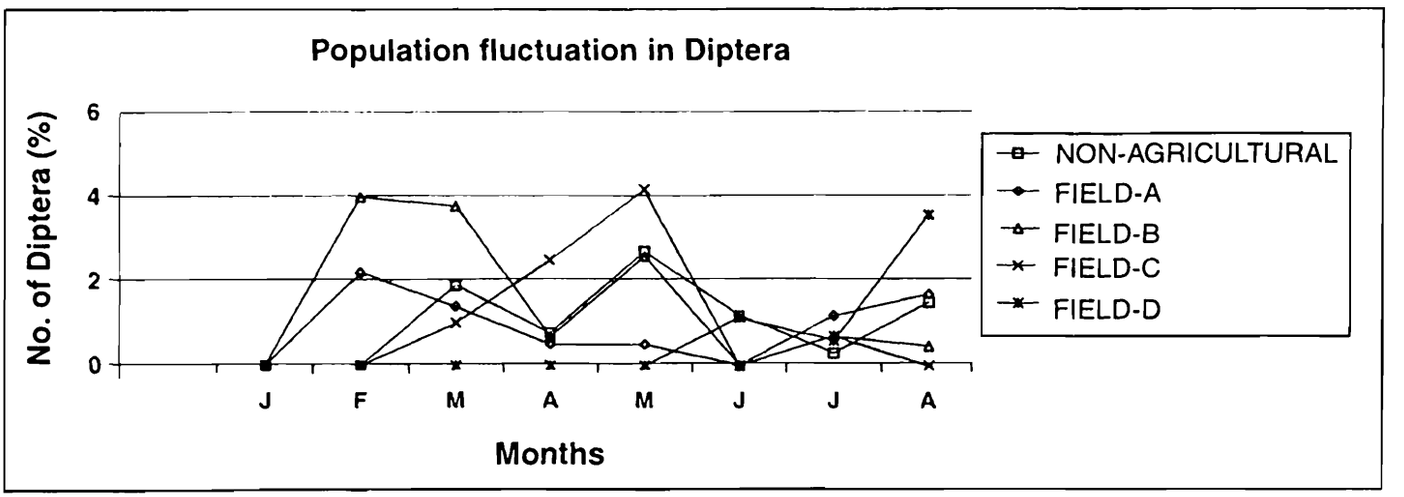

Fig. 6

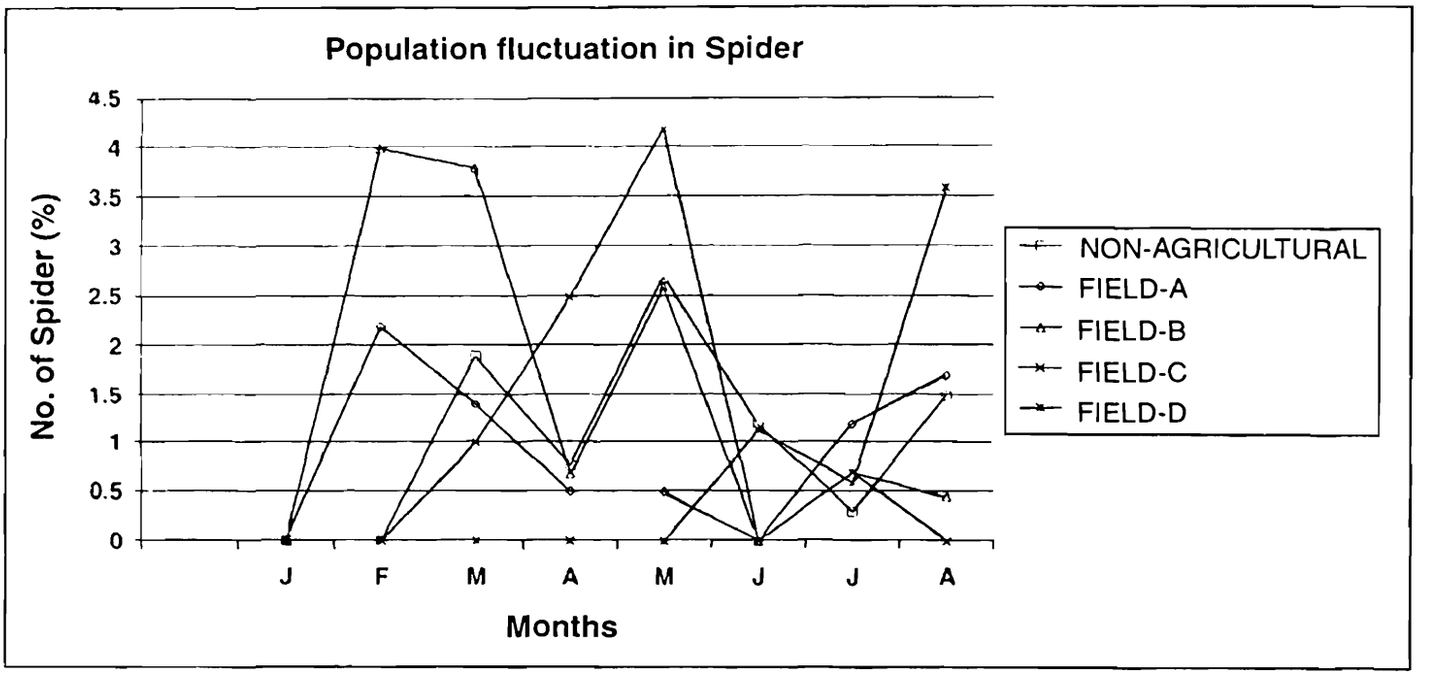

Fig. 7

fields for a long time, the number of soil microarthropods also increased. Majumder and Deb (1991a, 1991b) also reported that microarthropod population was poor in cultivated fields and suggested a crop-dependent association.

SUMMARY

The seasonal abundance of soil inhabiting arthropod fauna and their interrelationship with the edaphic factors like temperature and moisture in agricultural and non-agricultural fields in West Bengal were studied. The soil arthropods were extracted with the help of modified Tullgren funnel apparatus. Altogether 7,412 arthropods belonging to 7 groups were extracted from 170 soil samples collected at fifteen days interval during the period from January, 2006 to August, 2006 except the fields-C and D where samples were collected during March – August, '06 and May – August, '06 respectively. Acarina was the most dominant (67.25% of the total population) group which was followed by Collembola and Hymenoptera. The fauna of non-agricultural site was quantitatively rich as compared to the agricultural fields because of application of different fertilizers, pesticides and also crop rotations. The arthropod population showed seasonal variation with peak in June-July in all the sites.

ACKNOWLEDGEMENTS

The authors are thankful to the Director, Zoological Survey of India, Kolkata for providing laboratory facilities. They also express thanks to the Head of the Department of Zoology, University of Kalyani for extending necessary help for work in the laboratory.

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