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Mesofaunal biodiversity and its importance in Thar desert

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Abstract: *Soil animals are considered as important contributors to soil fertility. However, there is paucity of such information for harsh climatic conditions. Therefore, the below ground faunal density and frequency have been studied in relation to physicochemical properties of soil in Thar desert. The selected soil systems were Vigna radiata - Cuminum cyminum, grassland, flower garden and Zizyphus mauritiana. Acari and other soil arthropods exhibited seasonal variation in their populations. There were two population peaks, one in February/March and other in August/September. The highest population was in flower garden, whereas lowest was in Z. mauritiana field. It clearly indicates that the soil fauna population develops in different degrees. The relative density showed that the acarines were more prevalent in comparison to other soil arthropods. The prostigmatids exhibited maximum relative density in comparison to cryptostigmatids and mesostigmatids in all fields. Pauropus showed higher relative density among all other soil arthropods. Acari had higher frequency of occurrence, while the other soil arthropods indicated lower frequency of occurrence in all systems. The highest frequency of occurrence was recorded in July/August and the lowest in May/June. The soil temperature, moisture, organic carbon, total nitrogen and carbon/nitrogen ratio varied significantly throughout the year. The fluctuations in physicochemical characteristics of soil greatly influenced below ground faunal density in different fields. A highly significant and positive correlation was obtained among different soil fauna groups. Faunal population showed a significant positive correlation with soil moisture, organic carbon and total nitrogen. The abiotic factors such as temperature, pH and C/N ratio showed negative correlation with moisture, organic carbon and total nitrogen. However, moisture, organic carbon and total nitrogen had positive correlation among themselves. The present study suggests that the plantation may be done for improvement of physicochemical and biological health of soil on a sustainable basis in desert.*

Key words : *Mesofauna, Organic carbon, Total nitrogen, Physicochemical factors*

Introduction

Soil is considered as a living tissue and the seat of biological activity due to the presence of teeming organisms. Wood (1991) considered the biological quality of the soil in terms of the soil organismic populations or of the processes accomplished by the organisms. When plants die, the above ground plant parts are distributed within the soil by gravity, water movement and by soil organisms. Below ground root growth distributes carbon as does movement of dead plant parts by animals or water movement. In agroecosystems soil fauna play an important role in distribution and flow of carbon within the soil system by creating galleries, chambers, burrows, mounds and nests and producing faecal matters. Research is needed to link soil biological health, biodiversity and the physical and chemical properties of the soil.

Soil biota constitutes the driving force of terrestrial ecosystems because they control the rate of turnover and mineralization of organic substrates. In addition to plant and microbes, the microscopic animals such as protozoans are present in pore spaces where they ingest and process fine organic particles. Some protozoan species are found in gut of bigger soil dwelling fauna where they enhance the decomposition of cellulosic debris (Swift *et al*., 1979). Among other invertebrates, soil arthropods are either saprophagous or carnivorous forms and include millipedes, mites, springtails *etc.* The saprophagous forms are of direct relevance to decomposition process. The significant effects of soil fauna on the nutrient dynamics of ecosystem have been documented (Moore *et al*., 1988; Verhoeff and Brussaard, 1990; Tripathi *et al*., 2003). Soil fauna favour microbial activity, increase enzymatic activity and stimulate root development and maintain a control over plant damaging species. Therefore, the importance of soil fauna at this juncture can not be ignored. Soil animals act as buffer energy source for both soil and plant. They act as indicator of soil conditions and can be used for soil diagnosis (Ghilarov, 1965; Choudhary and Roy, 1967). Some fundamental contributions on fauna of Indian soil have been done by various workers including Choudhuri and Roy (1967, 1970); Mukherji and Singh (1970); Singh and Pillai (1975, 1976); Singh *et al*. (1978); Tripathi *et al*. (2003); Tripathi and Prasad (2005).

Balogh (1970) reported that the biomass of soil fauna of earth is nearly twenty times more than the biomass of human beings living on earth, that is to say, the animal life attains its greatest abundance in soil. This illustrates the need for a greater attention towards the ecology of soil animals. Relationship between biodiversity and sustainability has been studied by various scientists (Tilman and Downing, 1994; Tilman, 1996; Tilman *et al*., 1996; Smith *et al*., 1998; Nombela *et al*., 1999). The aspects of ecology such as the influence of abiotic factors on the composition of fauna, population dynamics, species

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association, dominance and frequency of occurrence *etc.* need to be explored in Rajasthan. In western Rajasthan, the climate is extreme with severe summer and scanty rains, the ecological aspects will have a considerable impact on the distribution and abundance of soil fauna. Most organisms live in a seasonal environment. In the course of a life cycle, some species face hot summer and receive little rain. Many have breeding and non breeding seasons. The number of individuals in a species at the beginning of any one of these seasons is dependant on the survivors from the preceeding season. As species population varies in either distribution or abundance with the seasons, the interaction of a population with a regularly varying environment has become a complex problem which merits detailed analysis. Therefore, it was aimed to investigate the soil faunal biodiversity and its importance in pedoecosystem of Barmer district of Rajasthan for sustainability of pedoecosystem.

Materials and Methods

Description of habitats: The areas under the present investigation are located in Barmer district of Rajasthan. They are situated at the latitude of 26°492 north and a longitude of 72° 12 east with an altitude of 128.96 meters from sea levels in the western part of India. The area is arid and the soil is sandy, which is an important characteristic of hot desert. The climate of the study area is dry tropical type characterized by extremes of temperature, fitful and uncertain rainfall, high potential evapotranspiration and strong winds. The climate of the region is divisible into summer, monsoon and winter. Summer season (March to middle of July) is the most dominant season with very hot and dry condition. The mean maximum temperature ranges from 23°C to 48°C and the mean minimum from 19°C to 36°C. The southwest monsoon (mid July to September) is not the periodic feature in this region. Sometimes there is a little rainfall so the relative humidity is meagerly affected. During post monsoon season that extend from Ist October to Ist November remains comparatively less warm and less humid. The mean maximum temperature reached up to 19°C. Rainfall was scanty in October and almost nil in November. Winter season (November to February) remains very dry and cold with maximum temperature from 19°C to 8°C and the mean minimum temperature from 14°C to 4°C. The mean annual rainfall in this region varies from 34 mm to 204 mm. The southwest monsoon, which begins in the middle of July lasts till 30 September. Sometimes there is a scanty rainfall in the winter season also. Average wind speed is 16 to 20 kmh^{-1}. It reaches as high as 65 to 75 kmh^{-1} in summer. The winds are strongest during June and July. The wind direction is east to north westerly in winter and west to south westerly in summer.

Sample collection and faunal extraction: Fields were randomly surveyed to know the mesofaunal biodiversity in Barmer district of western Rajasthan. Soil samples were collected from fields of Pachpadra, Shivana, Sheo, Chohtan, Dhorimanna and Barmer Tehsils of Barmer district of Rajasthan. Samples were packed in polythene bags, tagged with sampling sites, dates, vegetation *etc.* and brought to the laboratory for further processing. These samples were processed for extraction of soil fauna by Tullgren funnel. Fauna were allowed to move down into the funnel for 24 hours. They were collected in vials containing 70% alcohol. Different groups of soil arthropods were sorted out by naked eye and under stereoscopic microscope. The sorted specimens were preserved in 70% alcohol for identification.

Physicochemical measurement: Soil thermometer was used to measure the soil temperature at 10cm depth (WMO, 1983). Soil temperature of each site was recorded at the time of sampling. Soil moisture content was determined gravimetrically by oven drying at 105°C until the weight stabilized. The procedure for measurement of soil moisture content was adopted from Page *et al.* (1982). Soil samples were air dried and passed to a 2 mm mesh sieve and subjected to various chemical analyses. Soil pH was determined in 1:2 soil water ratio with the help of a pH meter (Anderson and Ingram, 1993). Organic carbon was determined by the partial oxidation method (Walkley and Black, 1934). The principles adopted for estimation of soil nitrogen were mainly based on the methods described by Anderson and Ingram (1993). Nitrogen analyzer was used for estimation of total nitrogen. The C/N ratio was calculated by dividing organic carbon with soil nitrogen.

Population dynamics: Soil samples were collected twice in every month throughout the year from the selected fields. Four samples were taken from each field during forenoon. The soil fauna were extracted and the mean of monthly population was calculated by averaging the monthly data. Monthly record of soil arthropod fauna was made throughout the investigation period. The edaphic factors responsible for changes in population density and distribution *viz.*, soil temperature, soil moisture, pH, organic carbon, soil nitrogen and C/N ratio were correlated with the dependent variables. The group relative density and the group frequency of occurrence were calculated as per description of Tripathi *et al.* (2005).

Statistical analyses: A one way analysis of variance (ANOVA) followed by a post-hoc test were performed. Pearson correlation coefficients were calculated to correlate the changes in different parameters. These statistical analyses were done with the help of SPSS package. The level of significance was set at 0.05.

Results and Discussion

Seasonal fluctuation in population: Anova clearly demonstrated significant ($p<0.001$ to $p<0.05$) variation in the population of Acari in each month (Fig. 1, 2). However, the variation in the population of other soil arthropods such as *Koenenia* in *V. radiata-C. cyminum* and *Japyx, Koenenia* and *Chelifer* in *Z. mauritiana* based soil systems were not significant ($p>0.05$). The tests of within subject effects and between subject effects for season and its interaction with population indicated highly significant ($p<0.001$) variation in an overall data of faunal

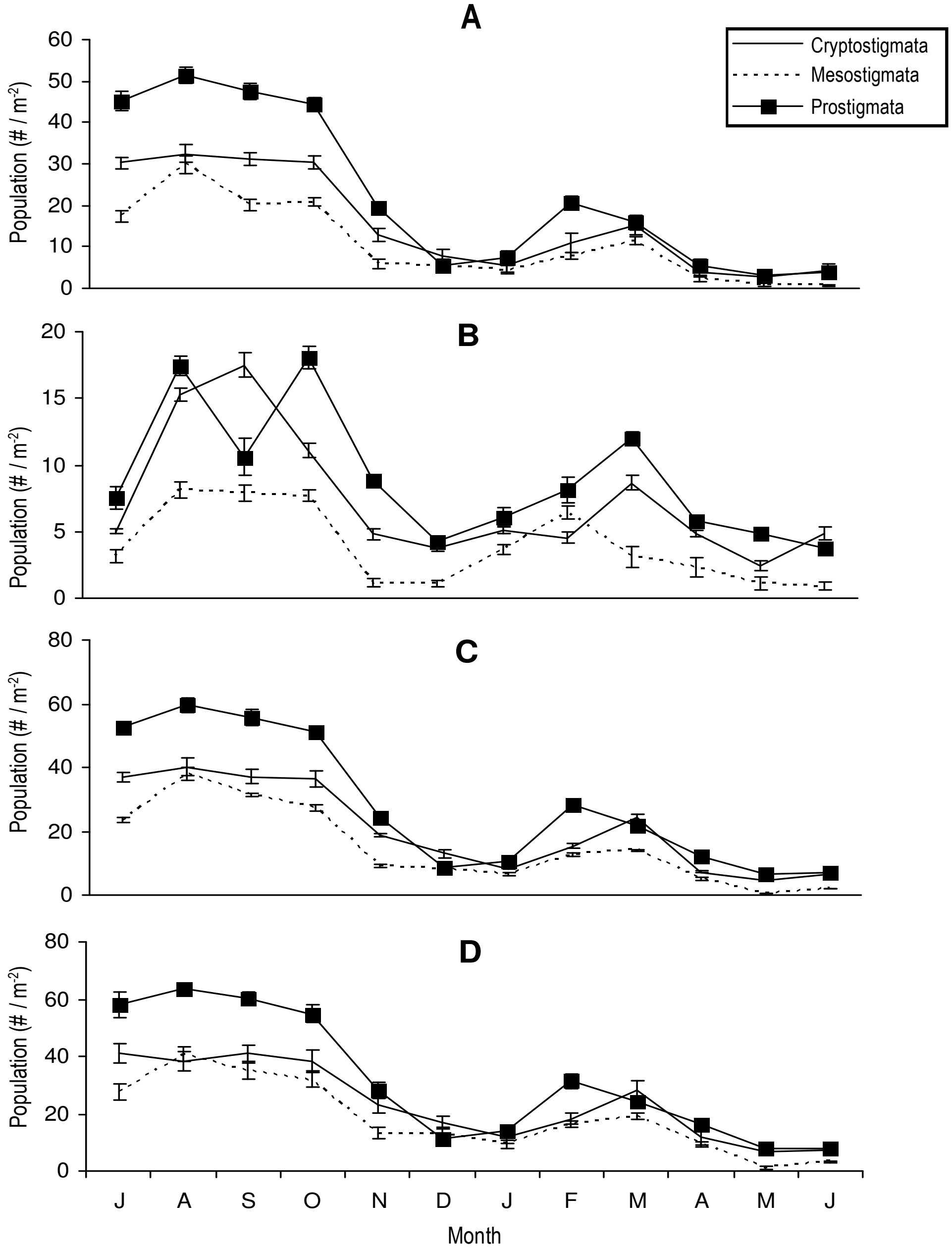

Fig. 1: Monthly variation in populations of different groups of Acari (Cryptostigmata, Mesostigmata, Prostigmata) in *Vigna radiata-Cuminum cyminum* (A), *Zizyphus mauritiana* (B), grassland (C) and flower garden (D) pedoecosystems
Each datum represents mean ±SE of six replications

population of different fields in Barmer district. The soil arthropod populations in some systems were about 2 to 10 fold higher than the faunal population in *Z. mauritiana* field. A drastic increase in population is obvious in the flower garden as compared to population in *Z. mauritiana* based soil system. The much higher faunal population in flower garden based pedoecosystem compared to *Z. mauritiana* field may be due to higher moisture and lower soil temperature as compared to other systems. The difference between soil faunal population of different sites and *Z. mauritiana* field were maximum in case of Acari and minimum in other soil arthropods. These differences in population of various major groups of soil arthropods may be assigned to the differences in nature and ecological adaptation of faunal population in arid environment.

The seasonal fluctuation in populations of different groups of Acari exhibited more or less similar pattern of changes in all studied fields throughout the year. The soil Acari population slightly declined in January and then increased in February and March and showed a subsequent reduction in April and May. The population of May and June was almost similar but it increased sharply through July and August. Thereafter, the soil

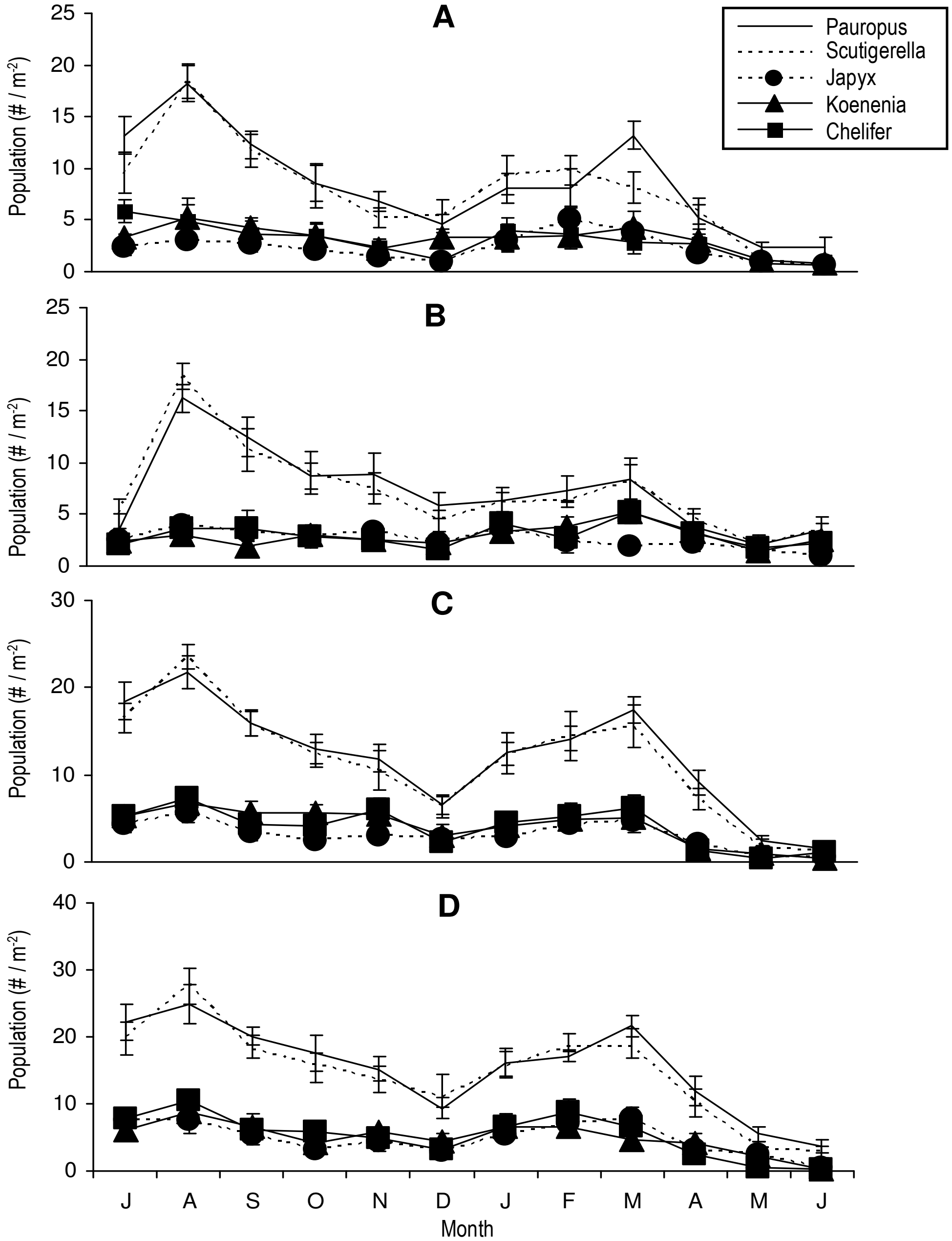

Fig. 2: Monthly variation in populations of other soil arthropods (*Pauropus* sp., *Scutigerella* sp., *Japyx* sp., *Koenenia* sp., *Chelifer* sp.) in *Vigna radiata-Cuminum cyminum* (A), *Zizyphus mauritiana* (B), grassland (C) and flower garden (D) pedoecosystems
Each datum represents mean ±SE six replications

faunal population decreased gradually up to November and December. In this way, all major groups of soil Acari exhibited two population peaks within a year, one in February/March and another in August/September. The faunal population peak of February/March was smaller, whereas the population peak of August/September was higher. This shows that the climate conditions of spring (February and March) and mid rainy season (August and September) were conducive for breeding and growth of soil Acari in arid environment. It may be related to an increase in litter fall and moderate temperature in spring and high moisture and somewhat moderate temperature in August and September.

The present observation of higher population density of mites in rainy season (July to October) does not agree with the earlier report of Hammer (1972) who described maximum mite population from December to April. He also documented that older mite swamp has maximum population in October and minimum

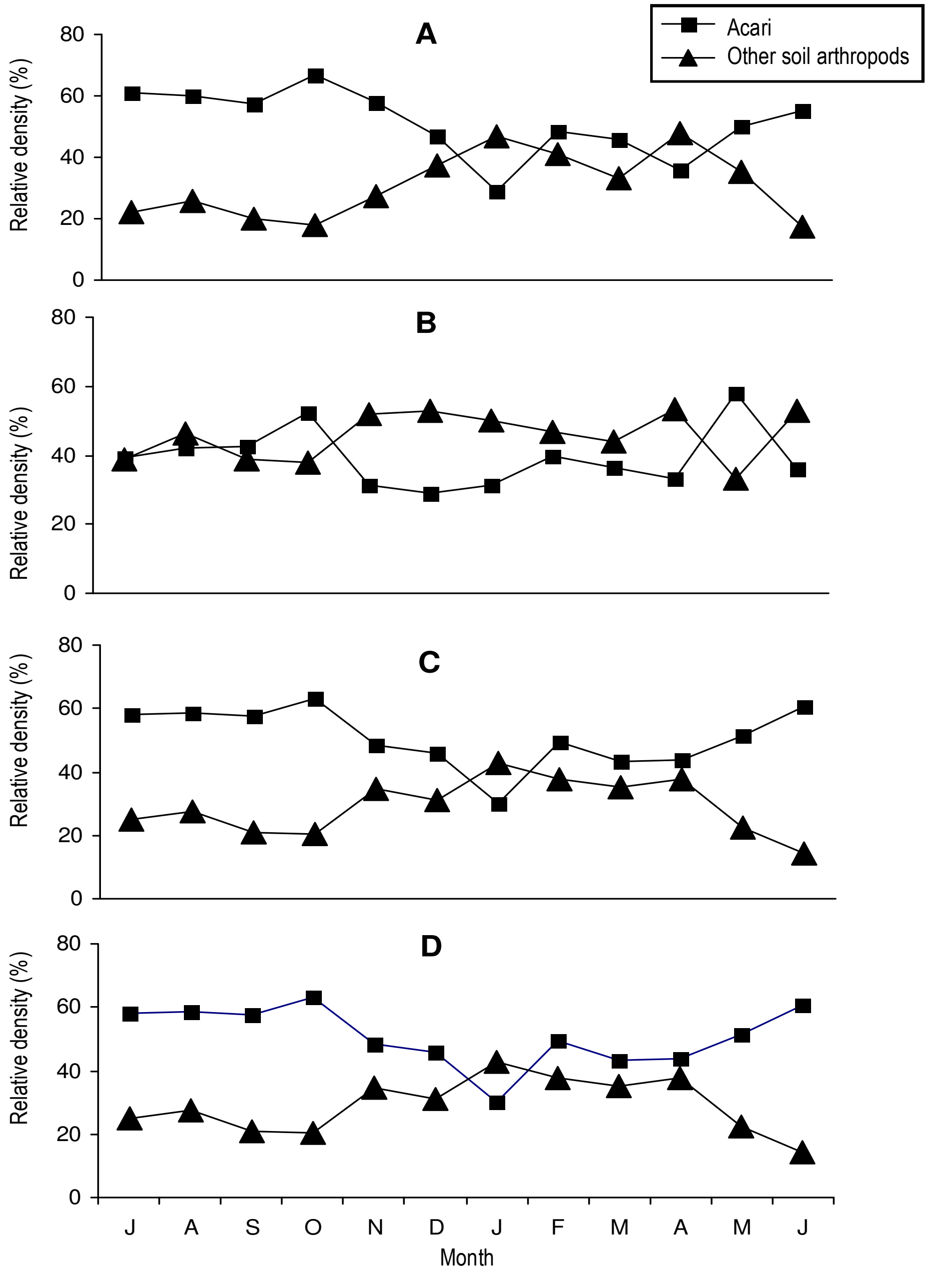

Fig. 3: Relative density (%) of different soil mesofaunal groups (Acari and other soil arthropods) in *Vigna radiata-Cuminum cyminum* (A), *Zizyphus mauritiana* (B), grassland (C) and flower garden (D) pedoecosystems

in spring. In contrast to these, Shweta and Gupta (1997) reported maximum population of Diplura from September to October and Protura from June to July in tube well and sewage irrigated fields. This agrees to some extent with the higher population of soil fauna (other soil arthropods) during July to October as compared to the population during winter season (November to February) in arid condition. However, some scientists (Vannier, 1970; Nef, 1971) are of the view that the animals variable behaviuor due to their age or seasonally varying physiological condition obstruct a quantitative explanation of seasonal changes in age structure of field population. The soil Acari population in *Z. mauritiana* system was significantly lower compared to other systems in most of the months. The soil acarines population of flower garden based system was significantly higher compared to the other systems in most of the months. The decreasing order of acarines population at different sites indicated maximum value in flower garden followed by grassland, *V. radiata-C. cyminum* and *Z. mauritiana*. It indicates that among four soil systems the flower garden is best for development of soil fauna in arid condition. The seasonal fluctuations in populations of different genera of other soil arthropods also exhibited more or less similar pattern of changes as shown by acarines in all studied fields throughout the year.

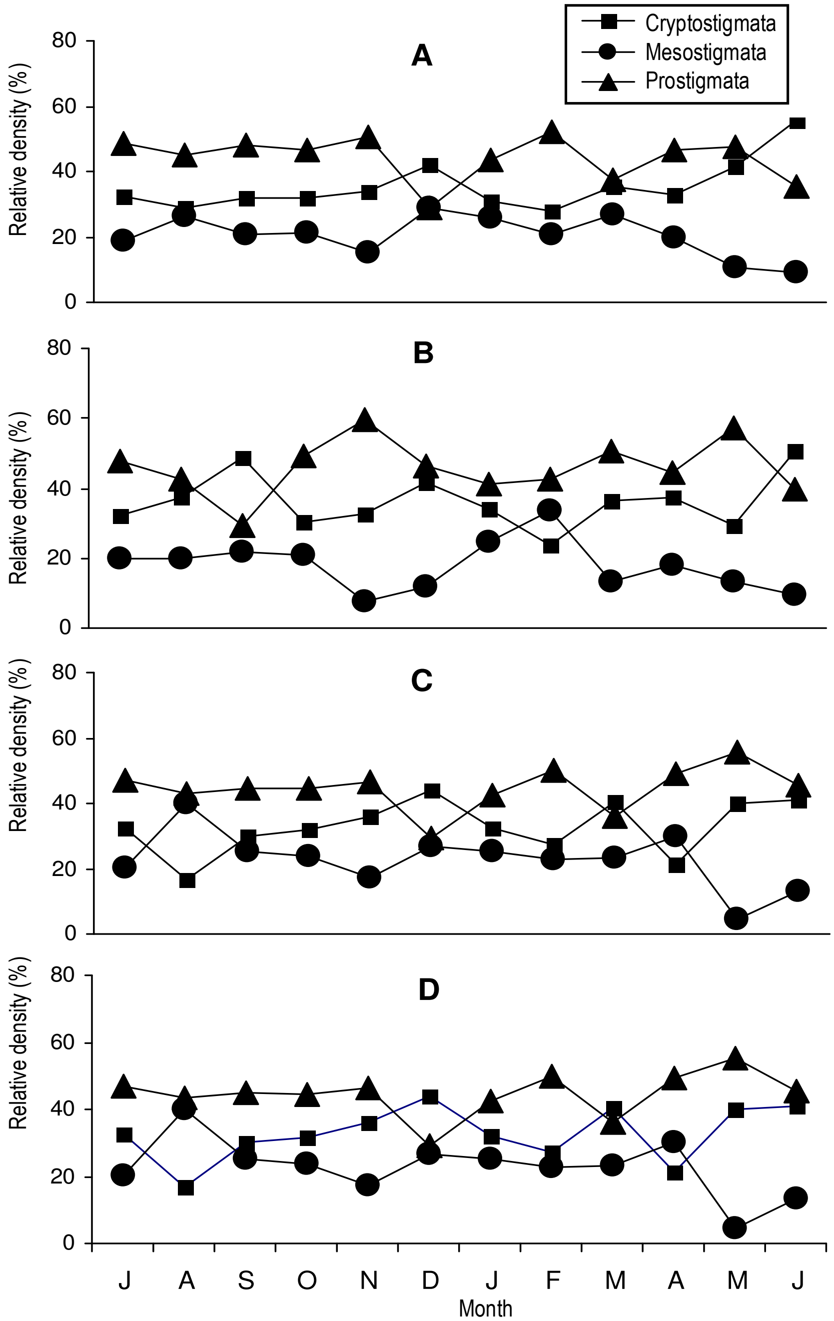

Fig. 4: Relative density (%) of different groups of Acari (Cryptostigmata, Mesostigmata, Prostigmata) in *Vigna radiata-Cuminum cyminum* (A), *Zizyphus mauritiana* (B), grassland (C) and flower garden (D) pedoecosystems

Most of the soil fauna (Acari and other soil arthropods) showed their highest population in flower garden. However, lowest population of these groups of soil fauna was in *Z. mauritiana* based soil system. There may be several reasons for the differences in soil faunal populations in different pedoecosystems. The main reasons which account for these differences may be litter fall, soil condition and disturbances by grazing animals, water availability, shadows *etc.* Sanyal (1996) found that the soil fauna of banana sites was rich compared to guava sites in Nadia district in West Bengal. The arthropod population peaked in August at both the sites. The gradation of faunal abundance at these sites showed maximum population of Acari followed by other soil arthropods. However, these observations may be compared with the acarines population in the leaf litter and topsoil of a *Dalbergia sissoo* plantation in Haryana (Jain *et al.*, 1998). The present seasonal data do not agree with the report of Samiuddin and Haider (1990) who described maximum population of Acari in April. An increase in population density of microfauna leads to an increase in humus contents of soil thereby enhances soil fertility (Kumar *et al.*, 1999). It is because soil microinvertebrates

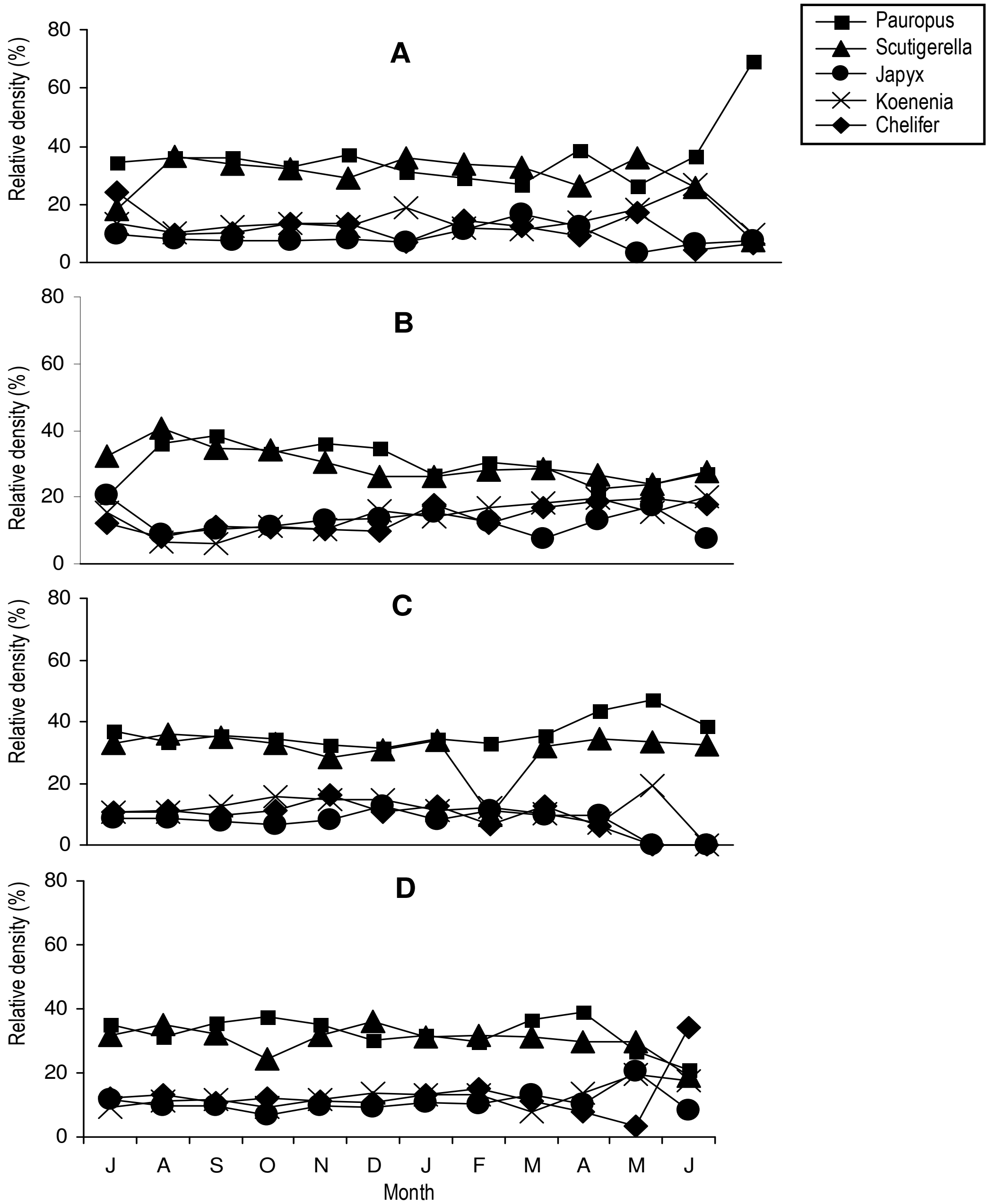

Fig. 5: Relative density (%) of other soil arthropods (*Pauropus* sp., *Scutigera* sp., *Japyx* sp., *Koenenia* sp., *Chelifer* sp.) in *Vigna radiata-Cuminum cyminum* (A) *Zizyphus mauritiana*, (B) grassland (C) and flower garden (D) pedoecosystems

play a valuable role in the breakdown and decomposition of litter which made pedoecosystem self sustainable. A soil system harbouring sufficient biodiversity does not require any extra organic or chemical inputs. Thus plantation substantially contributes to the development of soil fauna which, in turn, help in sustainability of pedoecosystem in arid environment.

Relative density and frequency of soil fauna: The higher relative density of Acari as compared to other group showed its prevalence among soil fauna (Fig. 3-5). The relative density of Acari was highest (55%) in the month of June in *V. radiata-C. cyminum* system, whereas its density was found lowest (17%) in the month of August in grassland. The relative density of other soil arthropods was higher (69%) in the month of June and lower (3%) in April in *V. radiata-C. cyminum* field. The relative density of acarines were higher in all fields (*V. radiata- C. cyminum,* Z. mauritiana, grassland and flower gar511den). The prostigmatids were prevalent among all acarines in all fields. Pauropus exhibited maximum relative density among other soil arthropods. The present observations may be compared to some extent with

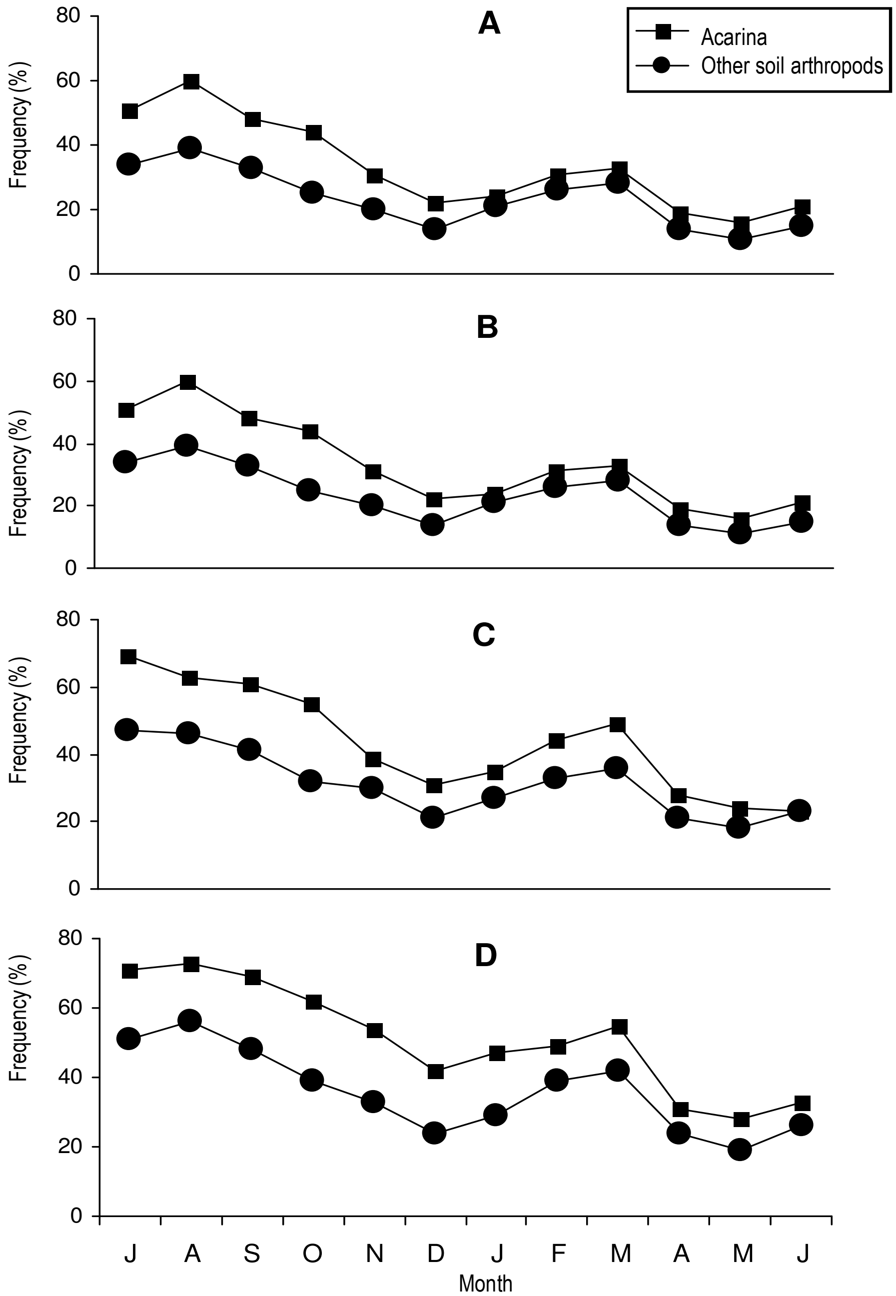

Fig. 6: Frequency (%) of occurrence of different soil mesofaunal groups (Acari and other soil arthropods) in *Vigna radiata-Cuminum cyminum* (A) *Zizyphus mauritiana*, (B) grassland, (C) flower garden, (D) pedoecosystems

acarines relative density in the leaf litter and topsoil of a *Dalbergia sissoo* plantation in Haryana (Jain *et al.*, 1998). Sanyal (1996) found a higher population density of soil fauna in different agricultural fields. Both the present as well as other studies clearly suggest system specific variations in mesofaunal biodiversity.

Fig. 6 shows the frequency of occurrence of Acari and other soil arthropods. Among all soil fauna, the acarines were prevalent. The frequency of occurrence of Acari was higher in all ecosystems. The other soil arthropods showed average frequency of occurrence among all soil mesofauna in different pedoecosystems. It may be compared with the frequency of occurrence of different groups of soil arthropods in desert pedoecosystem (Tripathi *et al.*, 2005). The frequency of occurrence of acarines was higher in August in all fields except in grassland. In the grassland, the frequency of occurrence was higher in July. The frequency of occurrence was minimum in May, while it was lowest in June in grassland. The frequency of occurrence of other soil arthropods was higher in July in *V. radiata-C. cyminum* and grassland region, while it was higher in August

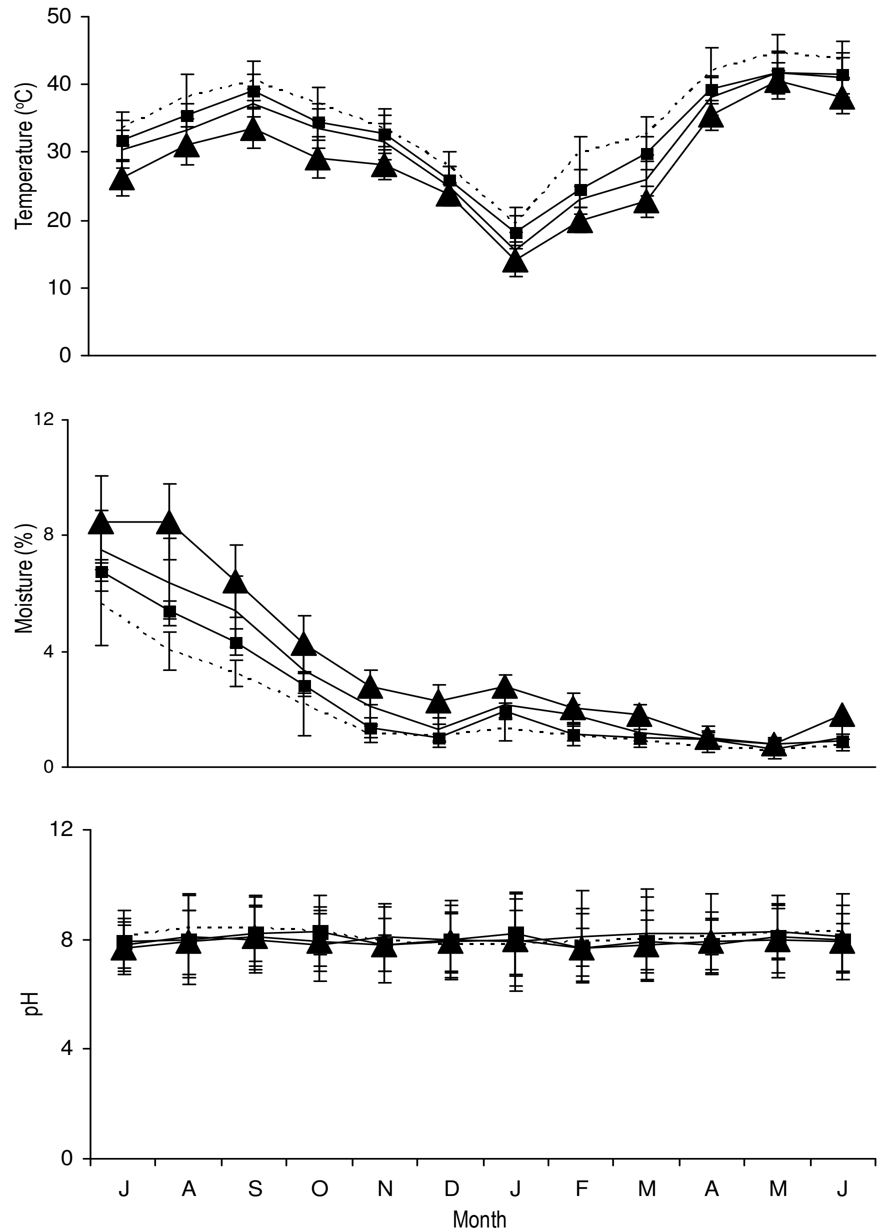

Fig. 7: Seasonal variation in soil temperature (°C), moisture (%) and pH from July 2001 to June 2002 in *Vigna radiata-Cuminum cyminum* (-), *Zizyphus mauritiana* (- - -), grassland (■) and flower garden (▲) pedoecosystems. Each datum represents mean ±SE of six observations

in *Z. maritiana* and flower garden. The frequency of occurrence of these soil arthropods was lower in May.

Relation between soil fauna and physicochemical properties of soil: Abiotic factors affected soil faunal population in different fields of Barmer district of Rajasthan. The population of Acari and other soil arthropods changed with the fluctuation of temperature in different pedoecosystems (Fig. 7). The tests of between subject effects and within subject effects showed statistically significant ($p<0.001$) variations in physical properties (soil temperature and moisture) except pH ($p>0.05$). It clearly indicates that soil temperature and moisture have significant effect on seasonal variation in population of Acari and other soil arthropods. Sanyal (1996), also showed a similar relationship between seasonal abundance of soil inhabiting arthropods and soil temperature of some horticulturalist fields of Nadia district of West Bengal in India. Samiuddin and Haider (1999), demonstrated a relation between population fluctuation of soil microarthropods and soil temperature. They found soil temperature as one of the main factors influencing population fluctuation of microarthropods in Aligarh district of Uttar Pradesh in India.

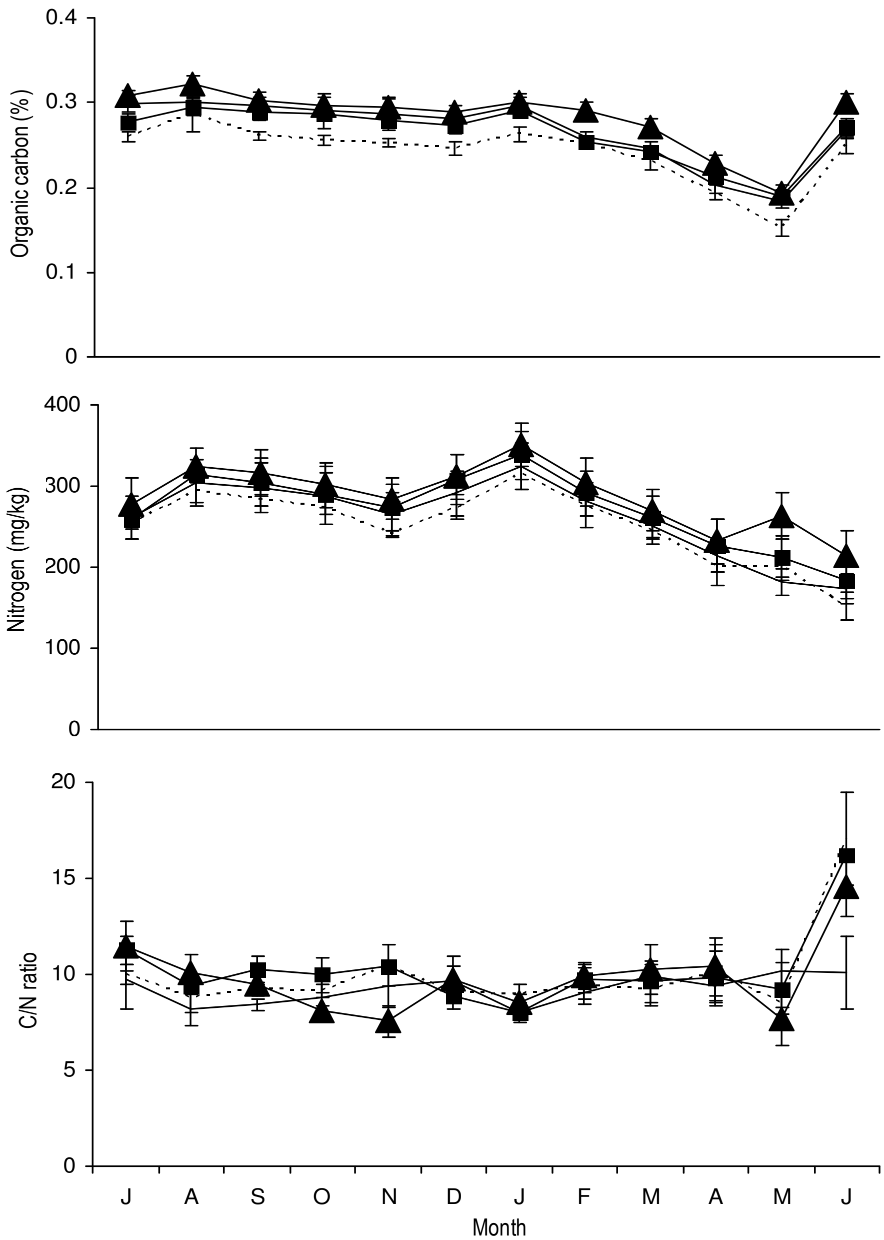

Fig. 8: Seasonal variation in soil organic carbon (%), soil nitrogen (mg/kg) and C/N ratio from July 2001 to June 2002 in *Vigna radiata-Cuminum cyminum* (-), *Zizyphus mauritiana* (- - -), grassland (■) and flower garden (▲) pedoecosystems. Each datum represents mean ±SE of six observations

The population abundance of different faunal groups varied significantly with the seasonal fluctuations in soil moisture content. A similar relationship was found by Sanyal (1996) and Jain *et al.* (1998), between soil arthropod population and moisture content of soil. The quantification of soil mites at sites with high moisture revealed the predominance of cryptostigmatids in the former site and mesostigmatids in the latter (Jain *et al.*, 1998). In the present observations, population of Acari was higher in moist soil. The edaphic factors directly influence faunal abundance. The effects of microclimate (soil temperature, moisture and pH) on population abundance may be due to differences in functional interaction of soil fauna and its association with different pedoecosystems in desert (Fig. 7). The soil organic carbon, total nitrogen and C/N ratio showed the distinct seasonal changes (Fig. 8) in pedoecosystem of arid zone of Barmer. The tests of within-subject and between subject effects revealed significant ($p<0.001$ to $p<0.05$) changes in the above mentioned chemical properties in all the four ecosystems.

The correlations of Acari with other soil arthropods were found positive and highly significant ($p<0.001$) in all fields

Table - 1: Correlation among different soil fauna

Fauna		Acari		Collembola		Other soil arthropods				
		Mesostigmata	Prostigmata	Cyphoderus	*Sminthurus*	*Pauropus*	*Scutigerella*	*Japyx*	*Koenenia*	Chelifer
Cryptostigmata	r	0.921	0.936	0.846	0.837	0.760	0.719	0.430	0.505	0.538
	p	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Mesostigmata	r	–	0.939	0.853	0.819	0.768	0.762	0.457	0.577	0.580
	p	–	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Prostigmata	r	–	–	0.813	0.827	0.745	0.717	0.436	0.532	0.560
	p	–	–	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Sminthurus	*r*	–	–	–	0.896	–	–	–	–	–
	p	–	–	–	< 0.001	–	–	–	–	–
Pauropus	r	–	–	–	–		0.866	0.632	0.616	0.686
	p	–	–	–	–	–	< 0.001	< 0.001	< 0.001	< 0.001
Scutigerella	r	–	–	–	–	–	–	0.626	0.633	0.707
	p	–	–	–	–	–	–	< 0.001	< 0.001	< 0.001
Japyx	r	–	–	–	–	–	–	–	0.446	0.618
	p	–	–	–	–	–	–	–	< 0.001	< 0.001

Table - 2: Correlation between different soil fauna and physio-chemical properties of soil

Fauna		Temperature (°C)	Moisture (%)	pH	Organic carbon (%)	Total nitrogen (mg/kg)	C/N ratio
Cryptostigmata	r	-0.063	0.681	-0.076	0.389	0.351	-0.102
	p	> 0.05	< 0.001	< 0.05	< 0.001	< 0.001	< 0.05
Mesostigmata	r	-0.112	0.693	-0.060	0.408	0.360	-0.099
	p	> 0.05	< 0.001	< 0.05	< 0.001	< 0.001	< 0.05
Prostigmata	r	-0.038	0.731	-0.064	0.355	0.317	-0.105
	p	> 0.05	< 0.001	< 0.05	< 0.001	< 0.001	< 0.05
Sminthurus	r	-0.174	0.623	-0.087	0.428	0.406	-0.132
	p	< 0.05	< 0.001	< 0.05	< 0.001	< 0.001	< 0.05
Cyphoderus	r	-0.222	0.642	-0.081	0.432	0.378	-0.105
	p	< 0.002	< 0.001	< 0.05	< 0.001	< 0.001	< 0.05
Pauropus	r	-0.256	0.626	-0.058	0.407	0.388	-0.146
	p	< 0.001	< 0.001	< 0.05	< 0.001	< 0.001	< 0.05
Scutigerella	r	-0.284	0.615	-0.058	0.386	0.413	-0.181
	p	< 0.001	< 0.001	< 0.05	< 0.001	< 0.001	< 0.05
Japyx	r	-0.324	0.386	-0.026	0.264	0.210	-0.060
	p	< 0.001	< 0.001	< 0.05	< 0.001	< 0.001	< 0.05
Koenenia	r	-0.253	0.421	-0.067	0.276	0.268	-0.121
	p	< 0.001	< 0.001	< 0.05	< 0.001	< 0.001	< 0.05
Chelifer	r	-0.290	0.518	-0.039	0.324	0.362	-0.145
	p	< 0.001	< 0.001	< 0.05	< 0.001	< 0.001	< 0.05

(Table 1). Table 2 shows significant ($p<0.001$) positive correlation among soil arthropods with moisture, organic carbon and total nitrogen. Whereas the negative correlation of different groups of soil fauna with temperature, pH and C/N ratio was significant ($p<0.001$ to $p<0.05$) except in case of Acari ($p>0.05$). Soil temperature, pH and C/N ratio showed significant ($p<0.001$ to $p<0.05$) negative correlation with other physicochemical characteristics (organic carbon and total nitrogen) except moisture and pH ($p>0.05$) (Table 3). Whereas these characteristics showed insignificant ($p> 0.05$) positive correlation with each other except temperature with C/N ratio ($p<0.05$). The correlation between organic carbon and total nitrogen was found significant ($p<0.001$) and positive except in case of organic carbon with C/N ratio ($p>0.05$). However, total nitrogen showed significant negative correlation with C/N ratio.

The increase in soil nutrients are in support to the findings of other workers who documented that carbon (C) mineralization is convenient surrogate for N dynamics because C mineralization is coupled to N mineralization via C/N ratios of detrital resources and their consumers (Smith, 1994; Mary *et al.*, 1996; Myrold, 1998). In fact, mineralized carbon is released as CO_2 while plants and microbes may immobilize mineralized nitrogen. Negative correlation of soil temperature and pH with the population of acarines and other soil arthropods appeared to be due to a positive correlation of these faunal groups with moisture (Table 2).

Table - 3: Correlation among different physio-chemical properties of soil

Physicochemical properties		Moisture (%)	pH	Organic carbon (%)	Total nitrogen (mg/kg)	C/N ratio
Temperature	r	-0.005	0.140	-0.370	-0.400	0.162
	p	> 0.05	> 0.05	< 0.001	< 0.001	< 0.05
Moisture	r	–	-0.031	0.335	0.268	-0.049
	p	–	> 0.05	< 0.001	< 0.001	> 0.05
pH	r	–	–	-0.232	-0.134	-0.001
	p	–	–	< 0.001	> 0.05	> 0.05
Organic carbon	r	–	–	–	0.414	0.276
	p	–	–	–	< 0.001	> 0.05
Total nitrogen	r	–	–	–	–	-0.649
	p	–	–	–	–	< 0.001

Decrease in temperature increased soil moisture content which, in turn, promoted faunal population growth during the observed fields. It supports the observation of Walia and Mathur (1997), who found high acarine population from July to September due to favourable soil temperature and moisture. They also showed that soil pH and organic carbon does not influence mite population which does not support the present findings.

The soil nitrogen concentration showed significant positive correlation with all soil faunal groups (Table 2). The impacts of seasonal abundance of below ground fauna on organic carbon and nitrogen were, to some extent, field or fauna specific. The possible reason for this may be due to the differences in interactions of pedoecosystems and faunal groups. The significant correlations between soil faunal groups and chemical properties of soil reflects that soil arthropod (mites and other soil arthropods) populations influence soil chemical characteristics. The availability of these groups of fauna in pedoecosystem of arid region might be helping enhancement of organic carbon and nitrogen in soil. The soil arthropods largely regulate the soil nutrient status in arid zone because there is no scope of extra organic inputs in desert areas. Therefore, the fertility building characteristics of soil fauna are of some importance in arid region of Barmer.

The present findings of soil fertility regulation by soil arthropods may be supported by the report of Maity and Joy (1999), who described that the colonization of microarthropods has a significant role in trapping energy and nutrients from decomposing litter and in enhancing biological activity in soil. Kumar *et al.* (1999) also found high diversity and density of soil fauna with very high organic content in soil. They remarked that high fertility and organic carbon content of the soil might be due to the presence of the different types of soil fauna which assist in fertility building. Similarly Jain *et al.* (1999) correlated abundance of oribatid mite with the physiochemical characteristics of soil in pedoecosystem of forest plantation in Hissar (Haryana). They found soil predominantly rich in mites during winter month. Fauna associated modification in soil health is a consequence of the burrowing activity and mixing of salivary and faecal organic compounds in soil (Lee and Wood, 1971; Lavelle *et al.*, 1994; Arshad *et al.*, 1988).

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