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A short-term surveillance of coleopteran fauna in an agro-ecosystem near Bikaner (Western Rajasthan), India

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ABSTRACT : Biodiversity of species at ecosystem level plays an important role in sustaining agro-ecosystem. The insect fauna is one of the most diversified biological components of any habitat. A cropland field represents an agro-ecosystem, which is the most assured food source for insects. The agro-ecosystem in Thar desert is, more specific due to a number of features which are hostile and greatly mar heterotroph population. The present study was carried out in an agro-ecosystem near Bikaner (Western Rajasthan). The coleopteran fauna was collected using indigenously fabricated cage and light trap from October 2006 to March 2007. Beetles belonging to five major families viz., Scarabaeidae, Coccinelidae, Curculionidae, Meloidae and Elateridae were documented from the study area. In all, eighteen species were collected thirteen using cage/net, while ten were found in light trap collections. Diversity-wise as well as density-wise members belonging to family Scarabaeidae were the major forms represented by eight species viz. *Scarabeus andrewesi, Schizonycha ruficollis, Pentadon bipiniforns, Onthophagus oculatus, O. bonasus, Anomala bengalensis, Onthogonius sp.*, and *Apogonia ferruginea.*; family Curculionidae was represented by five member viz. *Chlonius duvauceli, Myllocerus undecimpustulatus*, *Hypolixus truncatulus, Paramecops farinosa, Cleonus sannio.*; family Meloidae was represented by two species namely *Mylabris rajasthanicus,* and *Cylindrothorax pictus*; family Elateridae also comprised of two species namely *Melanstus sp.,* and *Silesis inficetus;* family Coccinelidae was represented by only one species namely *Coccinella septempunctata.* The diversity and density of coleopteran fauna in general, was found to depend upon the climatic conditions and various crops in the agro-ecosystem.

INTRODUCTION

Insect fauna is one of the most diversified biological components of any habitat. The agro-ecosystems in Thar desert are specific in a number of features *viz*., extremes of daily annual temperature, long sunshine hours, fewer cloudy days, shallow soil, low moisture content, dry violent wind, high evapo-transpiration rate, poor fertility of soil and in general nature of soil and water-logging. Rain is scanty and droughts occur quite often. Insect being exception as having great degree of adaptability to occupy different habitat and ecological niche play many significant role as pest, predator, pollinator and nutrient transformer in such a system. The biodiversity plays an important role in the functioning of an agro-ecosystem.

More than 75% of the known species of animals and approximately 0.9 million species of insects have been identified throughout the world. The order Coleoptera is the largest order in animal kingdom which includes 40% of all insects and nearly 30% of all animal species. It comprises of 166 families and more than 30,000 species. The members commonly known as 'beetles' include about 3,50,000 species among which about 1,50,88 species are known from Indian region (Kazmi and Ramamurthy, 2004). Looking into the significance of this major order of class Insecta the present study was undertaken to explore the coleopteran fauna of an agro-ecosystem near Bikaner in relation to its : (*i*) Diversity and (*ii*) Density.

The study area

Rajasthan is the largest state in India occupying an area of 3,42,239 sq km. with vivid topographical features. The area under study falls in the Indian desert near Bikaner situated in western Rajasthan along the international border attached to Pakistan. The agro-ecosystem in the form of crop field is situated 8 km from Bikaner (23°3′ and 30°12′ N latitude) and covers an area of 6 ha. Seasonal crops are grown in field. During the period of study the field comprised of wheat, mustard and vegetable crops such as brinjal, cauliflower, cabbage, coriander, raddish and ornamental flowers like marigold etc. In its vicinity are also present *Prosopis cineraria, P. juliflora, P. senegal, Calotropis procera* etc.

METHODOLOGY

(*i*) Periodicity. The collection of coleopteran fauna was carried out from October, 2006 to March, 2007 comprising mainly the winter season and partly also the summer season. Weekly sampling was carried out for the collection of beetles.

(*ii*) Sampling. Sampling was done using cage/net and using light trap.

(*a*) A cage of 1m × 1m of Nylon mesh was used as fabricated for the purpose and insects were mechanically picked up during day hours.

(*b*) Light trap with 260 Watt mercury bulb was used in the field and over-night collection of insect was taken.

(*iii*) Preservation of fauna collected. The beetles collected were transferred to killing bottle and then preserved. Smaller insects were preserved in 70% alcohol and large insect were put to dry preservation by pinning.

(*iv*) Examination and identification of fauna. The coleopteran fauna were sorted and identifications were made by following Arrow (1931), Fowler (1912), Andrews (1929), Saha (1979), Pajni (1990).The count of beetles collected through cage technique was averaged for each month and expressed as No./m^3. The collection made through light trap was expressed as No./light trap/night.

OBSERVATIONS AND RESULTS

Coleopteran fauna in relation to diversity

In all, 18 species belonging to 5 major families were reckoned from the agro-ecosystem during the period of study and have been presented in Table 1. Thirteen species were collected using cage/net Table 2 while ten species were documented in light trap collection Table 3. The coleopteran fauna documented belonged to the following families :

Table 1 : Coleopteran fauna (No./cage + light trap) collected from the agro-ecosystem during the period of study.

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Scarabaeidae						
Scarabeus andrewesi	2	1	1	–	–	–
Schizonycha ruficollis	7	2	2	–	–	3
Pentadon bipiniforns	90	1	–	2	1	–
Onthophagus oculatus	69	20	–	–	–	–
Onthophagus bonasus	78	2	4	4	3	2
Anomala bengalensis	30	–	3	–	–	–
Onthogonius sp.	14	7	2	2	1	–
Apogonia ferrugina	–	–	–	–	5	–
Curculionidae						
Chlonius duvauceli	2	–	1	1	–	–
Myllocerus undecimpustulatus	1	1	3	1	–	–
Hypolixus truncatulus	3	1	1	–	–	–
Paramecops farinosa	2	1	1	–	–	2
Cleonus sannio	1	–	–	–	–	–
Coccinellidae						
Coccinella septempunctata	4	1	1	5	10	1
Meloidae						
Mylabris rajasthanicus	1	–	–	–	–	–
Cyclindrothorax pictus	4	4	3	1	2	1
Elateridae						
Melanotus sp.	1	–	–	–	–	–
Silesis inficetus	57	13	1	–	–	–

Table 2 : Coleopteran fauna (No./m^3) collected using cage from the agro-ecosystem during the period of study.

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Scarbaeidae						
Scarabaeus andrewesi	2	1	1	–	–	–
Schizonycha ruficollis	4	2	1	–	–	3
Pentadon bispinforns	1	1	–	–	–	–
Onthophagus bonasus	3	2	4	3	3	2
Elateridae						
Melanstus sp.	1	–	–	–	–	–

(Contd...)

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Meloidae						
Mylabris rajasthanicus.	–	–	–	–	–	–
Cylindrothorax pictus	1	2	1	–	–	–
Curculionidae						
Chlonius duvauceli	2	–	1	1	–	–
Myllocerus undecimpustulatus.	1	–	–	–	–	–
Hypolixus truncatulus	3	1	1	–	–	–
Paramecops farinose	2	1	1	–	–	2
Cleonus sannio	1	–	–	–	–	–
Coccinelidae						
Coccinella septempunctata	4	1	1	5	10	1

Table 3 : Coleopteran fauna (No./light trap/night) collected using light trap from the agro-ecosystem during period of study.

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Scarabaeidae						
Anomala bengalensis	30	–	3	–	–	–
Onthophagus oculatus	69	20	–	–	–	–
Onthophagus bonasus	75	–	–	1	–	–
Pentadon bispiniforns	89	–	–	2	1	-
Schizonycha ruficollis	3	–	1	–	–	–
Onthogonius sp.	14	7	2	2	1	–
Apogonia ferruginea	–	–	–	–	5	–
Elateridae						
Silesis inficetus	57	13	1	–	–	–
Meloidae						
Cylindrothorax pictus	3	2	2	1	2	1
Curculionidae						
Myllocerus undecimpustulatus	–	1	3	1	–	–

Family : Scarabaeidae

This family was represented by most number of forms, eight in total. The species included *Scarabeus andrewesi*, *Schizonycha ruficollis, Pentadon bispinifrons, Onthophagus oculatus, O. bonasus, Anomala bengalensis, Apogonia ferruginea* and *Onthogonus* sp. Of these, except for *S. audrewsi*, all the other seven forms were observed in light trap collections.This form along with three others *viz.*, *S. ruficollis, P. bispiniforns, O. bonasus* were collected using cage/net. *O. oculatus, A. bengalensis, S. andrewsi* were found only during October-December while, *P. bispinifrons, S. ruficollis, O. bonasus* and *Onthogonius* sp. were observed nearly throughout the study period. *A. ferruginea* was reckoned only once in the month of February. Most number of species was eight, which belonged to family Scarabaeidae and were collected in the month October from agro-ecosystem. The number of species showed a decline from October to March, being only two in the latter months. Except for *A. ferruginea* all the species were collected in the month of October, this species was only reckoned once in the month of February.

Family : Curculionidae

Five species belonging to this family were collected from the agroecosystem during the present study. These were *Chlonius duvanceli, Myllocerus undecimpustulatus, Hypoloxus truncatulus, Parameops farinosa, Cleonus sannio.* Among these except for *M. undecimpustulatus* all species were observed in cage collection. *P. farinosa* was found frequently from October-March, others were observed from October-January. All the five species were present in the month of October while none were found in the month of Feburary. *P. farinosa* was the only species documented in the month of March.

Family : Coccinellidae

Only one species *Coccinella septumpunctata* that was frequent in cage collection was reckoned from the crop field. This was found throughout the study period.

Family : Meloidae

This family was represented by two species viz. *Mylabris rajasthanicus* and *Cylindrothorax pictus* and observed in cage as well as in light trap collections. *M .rajasthanicus* was documented only in the month of October while *C. pictus* was reckoned throughout the study period.

Family : Elateridae

Two species belonging to this family were observed from the agroe-cosystem. These were viz. *Melanotus* sp. and *Silesis inficetus*. Both species were found only during October-December. *Melanotus* sp. was observed in light trap, while *S. inficetus* in cage collection.

Coleopteran fauna in relation to density (Fig.1).

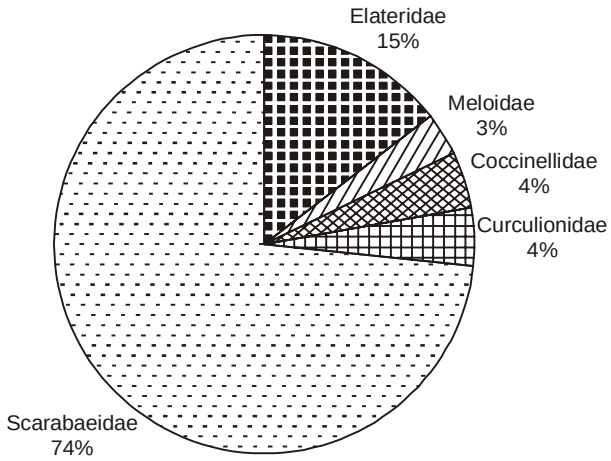

Fig.1. Percent composition (family-wise) of coleopteran fauna.

Family : Scarabaeidae

Maximum number of insects collected during the present study belonged to this family contributing to 74% of the total coleopteran fauna. Among them the major contributing forms were *P. bispinifrons, O. bonasus* and *O. oculatus* representing 26%, 26% and 25% respectively. The species which were frequently observed in the agro-ecosystem belonging to family Scarabaeidae were *A. bengalensis* which represented 9%, *Onthogonius* sp. representing 7% and *S. ruficollis* contributing to 4% of the total forms. On the basis of number species, the rarely documented ones included *S. andrewsi* and *A. ferruginea*, both contributing only 1% each to the total scarabaeid population. Density-wise maximum scarbaeids were collected during October and November thereafter their number showed a decline being minimum in the month of March.

Family : Curculionidae

This family contributed to 4% of the total coleopteran. Within this family, four major forms were reckoned from the agro-ecosystem which were *M. undecimpustulatus, P. farinosa, H. truncatulus* and *C. duvauceli* representing 27%, 27%, 23% and 18% respectively of the total curculionid species while, *C. sannio* was a rare species contributing only 5%.

Family : Coccinellidae

4 percent of the total coleopteran fauna was represented by this family. *C. septumpunctata* was the only form belonging to this family that was observed throughout the period of study. It was found to be maximum in the month of February.

Family : Meloidae

A minimum of only 3% of total coleopterans were represented by members of this family. Two species belonging to this family were observed during the study period, *C. pictus* being the major species and contributing to 94% and *M. rajasthanicus* representing only 6%. While, *C. pictus* was noted throughout the study period being more during October-December, *M. rajasthanicus* was reckoned only once that too only a single member was trapped in the month of October.

Family : Elateridae

Elateridae was the second largest family contributing to 15% of the total coleopteran fauna. This family was also represented by two forms viz. *S. inficetus* which was a major form, contributing to 99% and *Melanotus* sp. a rare form, contributing to only 1% of total elateridae species. *S. inficetus* was found in maximum number in the month of October thereafter the population showed a decline and a complete absence from the field during January to March. *Melanotus* sp. like *Mylabris* was also collected only once in the month of October.

DISCUSSION

Scarabaeidae

During the present study the members belonging to this family were the major contributors diversity-wise as well as density-wise. Their number was maximum in the month of October when the crop in field comprised of brinjal, marigold etc. Commonly called as dung beetles, scarabs can be recognized by their lamellate antennae. Also known as Chafers the plant eating members are highly destructive. Their larvae known as “white grubs” feed on plant roots of various crops, grasses, fruits or forest trees. Both the grubs and adult have an enormous appetite and therefore are a major problem in agriculture and forestry (Atwal & Dhaliwal, 1999). The scarabs were the dominant forms in light trap collection. The results of present study are in conformation with those of Borror *et al.* (1992) who also reported these insect to be common around light in spring and early summer and found that adult feed at night on foliage and flowers. Pal (1977) reported *S. ruficollis* emerging on light from first fortnight of June coinciding with the onset of rainfall. Vyas

(1996) found *S. ruficollis* to cause appreciable damage to ground nut crop in IGNP area of Rajasthan. Both adult and grubs of *A. bengalensis* have been reported to be destructive and the former feeding on foliage flower and fruit and latter feeding on root and a serious pest of groundnut, sorghum etc. by Nayar *et. al.,* (1998). *O. bonasus*, *A. ferruginea*, *S. ruficollis* have also been reckoned by Kazmi & Ramamurthy (2004) from the Indian Thar desert of Rajasthan.

During the present study the scarabs were the predominant forms reckoned in the month of October. The present findings are in agreement with the earlier observations of Saigal (2002) and Dhas (2007) who also recorded maximum scarabid population densitywise and as well as diversitywise during the same month. Earlier *S. ruficollis*, *A. bengalensis* and *A. ferruginea* have also been reported by Bhoond (2004) from the region. She also found their maximum number in light trap collections but that was in the month of March. Dhas (2007) reported the scarabids to be dominant form during kharif crop season and attained pest status in the month of October which could be true for the present study also. Further, the scarabids commonly known as the dung beetle roll the dung of cattle sheep and other herbivores into suitable ball and transport them over long distances and bury them in underground root chamber as food for the future larvae (Mani, 1968). The presence of dung beetles in the agro-ecosystem during the present study might also possible be due to the use of manure in the fields.

Coccinelidae

Lady-bird beetles are some of the best recognized and most beneficial of all beetles. The adults and larvae of most species prey upon common agricultural pests, including scale insects, aphids, other insect eggs and larvae, and these beetles can be used as biological control agent against such insect pests to control crop damage (Atwal & Dhaliwal, 1999). Only one species *Coccinella septempunctata* was collected from the field. Its number was maximum in the month of February when the agricultural field comprised of wheat, marigold, mustard etc., although Roonwal (1982) observed three species from Rajasthan. Earlier Kapur & Bhowmik (1966) also reported ladybird beetles from Rajasthan. A negative correlation between the predator coccinelid and temperature has been reported by Bijur & Verma (1995). Bhattacharya & Mandal (2004) recorded four coccinelid species from West Bengal. Gupta & Yadava (1989) also reported coccinelid as insect predator which feeds on serious pests such as aphids and recorded five species viz. *Coccinella septempunctata, Coccinella* sp., *Brumoides suturolis, Menochilus sexmaculatus and Adonia variegata.* This insect has also been found to very common predator on cabbage by Atwal and Dhaliwal (1999). This species was also reckoned by Bhoond (2004) from January to May, their population being maximum in the month of March. Verma (2003) observed *C. septempunctata* from February to April and its highest population in the month of March. This species has also earlier been reported from the region by Saigal (2002) and Dhas (2007). During the present study the maximum number of this ladybird beetle was reckoned during the month of February which could be due to the aphid population on the crops which are preferred food of these beetles.

Curculionidae

During the present study these were represented by five species. They too were major forms reckoned in the month of October. All weevils are plant eaters and many are serious agricultural pests. Weevil larvae feed on all parts of plant and adults feed on leaves, flowers and developing fruits (Nayar *et al.*, 1998). Earlier some of these species have also been reported by Saigal (2002) from the region. According to Nayar *et al.* 1998, *H. truncatulus* is potential pest of crop in the field such as wheat and during the present study wheat was one of the major crops grown in the field. David & Kumaraswami (1998) suggested that no serious damage is inflicted by the insect. Another member *P. ferinosa* of this family was also reckoned from the agro-ecosystem. This insect has been noted on the plant of *Calotropis gigantea* where the grub has been found to burrow into the stem and shoots by Ayyar (1984). *M. undecimpustulatus* has been considered as a serious polyphagous pest damaging cotton, sorghum, maize, soyabean and other crops and has been found to be active from mid July to mid November by Singh & Singh (1977b). Although during the present study it was a rare form with maximum population in the month of December. Swaminathan & Verma (1991) have also reported it as pest damaging pearl millet and jujube in Rajasthan. The pest was recorded during July to October in and around Jodhpur district of Rajasthan causing damage to neem (Kumar *et al.*, 1996). A high incidence of this weevil was recorded on pearl millet during Kharif season by Singh & Singh (1997a). Falerio *et al.*, 1986 observed this weevil as a stray insect during kharif while studying pest complex in cowpea. *H. trancatulus* and *M. undecimpustulatus* have also been reported by Kazmi & Ramamurthy (2004) from the desert region.

Elateridae

This family was represented by only two members viz. *Silesis inficetus* and *Melanotus* sp. of which *S. inficetus* was the dominant form its number being maximum in the month of October. Commonly known as chick beetles, the adults feed on foliage of trees and bushes and some time under bark in rotten wood. The larvae live in clay and sandy soil where they eat roots, under ground stems and bulbs. The larvae commonly known as wire-worms are a significant agricultural pest and cause extensive damage to tobacco and cotton, potato, corn and beans. Earlier, Saigal (2002) also reckoned these species from the region. *S. inficetus* was noted during rabi season as a rare species and a dominant one during kharif season by Dhas (2007). During the present study also, its maximum number was

noted in the month of October. According to Pruthi (1969) although many elaterids or click beetles are serious pests in cold countries but no species has been found to cause appreciable damage to any crop in India. Kazmi & Ramamurthy (2004) also reported *S. inficetus* from the Indian Thar desert.

Meloidae

During the present study, only two species belonging to this family were observed viz. *Mylabris rajasthanicus* and *Cylindrothorax pictus*. Earlier Saha (1979) while revising the Indian blister beetle recorded seven species from Rajasthan. Commonly these are referred to as blister beetles, are known to be occasional pests at the flowering and milk stages of millet and sorghum. They feed on the flowers and tender panicles of these crops and thus inhibit grain formation. Blister beetle *Mylabris* also attack flower of a wide variety of weeds, ornamental plants and crops belonging to family Leguminosae and Cucurbitaceae. *Cylindrothorax* sp. has been reported to be very common in Namibia and has been designated to be notorious for causing severe blister due to the presence of a chemical-cantharidin in their body fluids (Larsen, 1998). The beetles are also beneficial as they pollinate flower during feeding and these larvae feed on egg masses of other insect in the soil or on the ground. The adult blister beetle *M. pustulata* has been reported to be one of the major insect pest damaging pigeon pea by Singh & Singh (1978). Sardana (1986) also found that cowpea is attacked by a several insect pests at different stages of crop growth including flower beetle *M. testulatis* and suggested it to be a major pest.

Earlier *M. rajasthanicus* has been reported by Saigal (2002) only in the month of July in this region. Singh & Singh (1978) revealed that adult blister beetle were first seen in the first week of October reaching its peak in the third week of October and then declining and no insect was seen after first week of November. This is in conformation with the present findings during which this insect was also noted only in the month of October and not observed in later months. The other related species *M. phalerata , M . pustulata* and *M. balatata* have been reported in India by Nayar *et al.* (1998). Jayanthi *et al.* (1993) found *M. pustulata* to infest groundnut crop during kharif. This insect has been considered to be a regular pest occurring during kharif season on cowpea by Falerio (1986) and Sardana (1986) in India. *C. ruficollis* and its related species *C. tennicallis* have been found to occur on earheads of paddy and other millets (Nayar *et. al.*, 1998). David and Kumaraswami (1998) reported this species to feed on pollen of rice and ears of sorghum.

Overall, during the present survey which was carried out to survey the Coleopteran fauna of an agro-ecosystem near Bikaner it was in general observed that the beetle population, diversity-wise as well as density-wise was maximum during the month of October, may be due to the congenial agro-climatic conditions and preferred host plants.

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