The Bioscan 10(4): 1521-1524, 2015
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
www.thebioscan.in

DIVERSITY STUDY OF PREDACEOUS INSECT FAUNA IN MAJOR *KHARIF* CROP AGRO-ECOSYTEM IN AKOLA MAHARASHTRA (INDIA)

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KEYWORDS
Diversity
Predators
Fauna
Kharif
Agro-ecosystem

Received on :
16.07.2015

Accepted on :
25.10.2015

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ABSTRACT
The present paper deals with the diversity of predatory fauna for comparing the species richness and evenness in *kharif* crop agro-ecosystem of Akola district, Maharashtra.During course of investigations,abundant predatory insect fauna was recorded near Akola vicinity (42.28%) might be due to cultivation of diversified agro ecosystem. In terms of highest predatory fauna it was noticed that order Coleoptera contributing (-0.36628), followed by Hemiptera (-0.31415) these two order species showed abundance predatory fauna in this locality. However, moderate to rich species biodiversity of predatory fauna was noticed as per Shannon Biodiversity Index (H' = 1.744) in Akola vicinity during *kharif* 2010-11. Simpson index value was 0.78. The Evenness index had a value of 0.80. Predatory species exhibited variation in their occurrence. Along with the sepredaceous insect fauna some non insect predatory fauna from Arachnida (-0.255), *viz*; spiders *Neoscona* spp, *Oxyopes* spp, *Thomisus* spp., *Pseusetia* spp. was found on various *kharif* crops.Out of the 4 species of spiders recorded *Neoscona* species was found to be predominant species which predating on all types of pests.The results of present study revealed the occurrence of 9 predatory orders and 14 families.In cotton agro-ecosystem highest (34.89%) predatory fauna was recorded followed by soybean (30.87%).

INTRODUCTION

India is one of the mega - biodiversity countries of the world.The word "*diversity*" are diversity of species. Predatory fauna is one of the most diversified biological components of any habitat.Predatory fauna attacks various stages of the pests.An outbreak of pest occurs due to conversion of natural ecosystem to agro-ecosystem by destabilization of an arthropod population. To manage these pests two alternative routes are: The first one is use of sophisticated chemical pesticide and second route to establish a bio-control in agro-ecosystem by the conservation, augmentation and importation of natural enemies and increasing diversity of natural enemies. Due to diversity of predatory fauna biotic balance is maintained by reducing pest population below economic injury level. The species richness indicates the number of species present in a given area whereas evenness indicates the relative quantity of each predatory species (Van clay, 1992). Bardgett (2002) revealed that speciesrichness is vital and of fundamental importance to the management and preservation of biological diversity.

Inrecent past Khan *et al*. (2007) recorded predatory lady bird beetles from 12 crop ecosystems of Kashmir over period of 6 months (April - September). Poorani (2004) has listed 400 species of beetle from Indian region, which includes the 9 species of coccinelids from Bihar including Jharkhand region. Coccinelids have received considerable attention by the insect pest management specialists because of their role as predator of agriculturally important insect pests.Ramanand and Roy (2008) revealed that prey consumption capacity of coccinelids is directly dependentupon their density in the natural habitat.Results of Rekha *et al*. (2007) showed that predatory coccinelids and their diversity in ecosystems depend on presence of the associated prey insect in that particular locality. Rate of predation and species diversity of coccinelids community is influenced by plant community structure and microclimateTooker and Hanks (2000).

The diversity plays an important role in the functioning of an agro-ecosystem. At present, scanty information is available on the presence of the predaceous insect fauna in *kharif* crop agro-ecosystem in Akola district of Maharashtra. Looking into the significance of major predatory fauna the present study was undertaken to explore the predatory fauna of an agro-ecosystem near Akola in relation to its diversity. This work aimed to emphasize the need for conservation of diversity of predatory insect fauna found in major *kharif* crop agro ecosystem for estimating the species diversity and easy identifying the predatory fauna at the farmer's level.

MATERIALS AND METHODS

Study Areas

The present study was carried out at Department of Entomology, Post Graduate Institute Dr. Panjabrao Deshmukh Krishi Vidyapeeth Akola, located at 22º42'N latitude and 77º 02' E longitudes with altitude of the place is 307.42 m above

mean sea level during 2010 - 2011. The predators were collected from *Kharif* crops ecosystem in study areas.

Collection of predatory fauna

Predatory fauna were collected periodically from kharif cropof all the talukas of Akola, Maharashtra between July and December 2011. The beetles were collected as per procedure adopted by Sharma (1987), Joshi and Sharma (2008) and Sharma and Joshi (2010) which included the use of sweep nets, insect collection tubes and jars depending upon the habitat. Adults of coccinelids beetles were collected randomly by "Sweep Sampling Method" as per Gadakar *et al*. (1990), aspirator and hand picking depending upon height of *Kharif* crop. Collection of predators such as dragonfly, damselfly was done by sweep net method and tiger beetle, and stinkbug done by using hand picking. Some coccinelids were collected by placing empty vials (5 cm length and 3 cm diameter) beneath the leaf blade and tapped loose with cap (Khan *et al*., 2007).

Identification of specimens

Field collected predatory fauna were examined carefully for all morphological details under stereo zoom microscope (Nikon SMZ 800) with attached Nikon camera was used. Identification of predatory fauna were made on the bases of available keys in the textbook of Imms, (1912) and literature available in ICAR -Network Project on Insect Biosystematics laboratory, Department of Entomology, Dr. PDKV, Akola. Based on morphological characters Predatory spiders were identified by Dr. G. N. Wankhede, Head of Department of Zoology, Sant Gadge Baba University, Amravati.The diversity of predaceous insect were analyzed by widely used indices viz., the Shannon-Wiener index, which is sensitive to changes in the abundance of rare species in a community, and the Simpson index, which is sensitive to changes in the most abundant species in a community (Solow, 1993). The simplest species richness index is based on the total number of species (S) and the total number of individuals of all species (N) in a habitat.Shannon diversity index and Simpson's index were calculated to support the study. It can be calculated by the following formula -

$$\bar{H}_2 = \sum_{i=1}^{S} pi \ln pi$$

Pi = ni/N

ni = number of individuals of species "i"

N = total number of individuals of all species

pi = relative abundance of species "i"

S = total number of species

H' = Shannon Diversity Index

Simpson index is defined as

D = Σn (n-1)/N (N-1)

D = the Simpson index, n = the number of species of order,

N = total no. of species

Simpson's Index of Diversity (1 - D).

Evenness index: $E = \bar{H}/H_{max}$

Where: H_{max} = maximum diversity possible

RESULTS AND DISCUSSION

Diversity of predaceous fauna

During this study, 149 specimens of predatory fauna were collected from 9 orders and 14 families.It was observed that abundant predatory fauna was found in cotton ecosystem (34.89%) as compared to other agro-ecosystem. In cotton ecosystem mostly Lady Bird beetles (LBB), earwigs, chrysopa, stink bug, predatory wasp, syrphid fly, preying mantid, and various spiders species were recorded (Table1).These observations are in agreement with the reports of Choudhary and Garg (2003). Thakare (2005) observed various predacious

Table 1: Agro ecosystem wise activity of predatory fauna in Akola district

Sr. No	*Kharif* Agro ecosystem	Total no of specimens	Percentage (%)	Predators found
1	Cotton	52	34.89	LBB, Earwigs, Chrysopa, Stink bug, Predatory wasp, Syrphid fly, Reduvid bug, Preying mantid etc.
2	Soybean	46	30.87	LBB, Chrysopa, Stink bug, Syrphid fly, Assassin bug, Dragonfly, Damselfly, *Lynx* spider etc.
3	Pigeon pea	14	09.39	LBB, Dragonfly, Damselfly, Assassin bug, Stink bug, P. mantid, *Thomisus spp*. Big eyed fly etc.
4	Jowar	13	08.72	LBB, Syrphid fly, Robber fly, Predatory wasp, Earwig, Assassins bug, *Neoscona sp*.
5	Sunflower	10	06.71	LBB, Stink bug, Preying mantid, Earwigs, Assassin bug, *Neosconaspe*. etc.
6	Mung	05	03.35	LBB, Stink bug, Chrysopa, Syrphid fly, P. mantid, Predatory waspetc.
7	cowpea	09	06.04	LBB, Stink bug, Chrysopa, Syrphid fly, P. mantid, Robber fly, *Neosconaspe*.etc.
	Total	149	100	

Table 2: *Taluka wise* predatory fauna in Akola districts

Sr.No.	Name of *Taluka*	Total no of specimen collected	Percentage (%)
1	Telhara	16	10.73
2	Barshitakli	20	13.42
3	Murtijapur	15	10.06
4	Akot	20	13.42
5	Akola	63	42.28
6	Patur	15	10.06
	Total	149	100

Table 3: Order wise distribution of predaceous insect in *kharif* crop agro-ecosystem

Sr.No	Order	Specimens	n/N	In(n/N)	pi Ln pi
1	Coleoptera	60	0.403	-0.90960	-0.36628
2	Hemiptera	28	0.188	-1.67174	-0.31415
3	Hymenoptera	7	0.047	-3.05804	-0.14367
4	Mantodea	3	0.020	-3.90533	-0.07863
5	Diptera	19	0.128	-2.05951	-0.26262
6	Odonata	6	0.040	-3.21219	-0.12935
7	Dermaptera	4	0.027	-3.61765	-0.09712
8	Arachnida	18	0.121	-2.11357	-0.25533
9	Neuroptera	4	0.027	-3.61765	-0.09712
	S = 9	Sum = 149			Sum = - 1.744
	Shannon-Wiener index ($\bar{H}$) = 1.744				
	Simpson index (1-D) = 0.78				
	Evenness index (E) = 0.80				

Table 4: family wise activity of predatory fauna

Sr.No.	Name of Family	Order	Total specimen	Percentage (%)
1	Coccinellidae	Coleoptera	57	38.25
2	Chrysopidae	Neuroptera	04	02.68
3	Syrphidae	Diptera	12	08.05
4	pentatomidae	Hemiptera	19	13.42
5	Oxyopidae	Arachnids	14	09.39
6	Mantidae	Mantodea	03	02.01
7	Reduvidae	Hemiptera	09	05.36
8	Vespidae	Hymenoptera	07	04.69
9	Aranaidae	Arachnids	04	02.68
10	Asilidae	Diptera	07	04.69
11	Cicindelidae	Coleoptera	03	02.01
12	Agriidae	Odonata	03	02.01
13	Gomphidae	Odonata	03	02.01
14	Forticulidae	Dermaptera	04	02.68
	Total		149	100

insects like chrysopa, LBB, and Geocorid bug and pentatomid bug, robber fly in cotton ecosystem in Akola region.In the perspective of biological control, our results confirm that seasonal abundance of coccinellids in kharif crop sucking pests may represent an important cause of mortality of aphids, coccids, hoppers, mealy bugs and thrips (Iperti and Paoletti, 1999; Prabhakar and Roy, 2010). These coccinellids beetles are density dependent predators, their numbers rise as the prey numbers increase. Thus, our results are discussed in light of current thinking with most abundant and diverse coccinellids along with other predatory fauna as an important part of integrated pest management in kharif crop agro ecosystem of Akola district of Maharashtra.

Soybean and pigeon pea agro-ecosystems, contributed (30.87%) and (9.39%) predatory fauna, respectively.Common predatory fauna were lady bird beetle, earwigs, chrysopa, stinkbug, syrphid fly, assassin bug, dragonfly, damselfly, preying mantid and some spider's species etc. Choudhary and Garg (2003) recorded dragonfly in cotton, soybean, and pigeon pea ecosystem in M.P. Jowar and sunflower agro ecosystem contributed (8.72%) and (6.71%) predatory fauna,respectively. The observations were in agreement with the reports of Thangavellu (1979) who recorded mantid in cotton, pigeon pea, and sunflower ecosystem. Records of Syrphid fly in Coimbatore, A.P., Haryana, in cotton, cowpea, and jowar ecosystem by Rao *et al*. (1995) and Kavita *et al*. (2003), which is in close proximity with the present findings. Record of *Illeis cincta* Fabricious (Coleoptera: Coccinellidae) as mycophagous on powdery mildew of sunflower was also made by Menon (2002). Green gram and cowpea contributed (3.35%) and (6.04%) predatory fauna, respectively. In green gram and cowpea agro ecosystem common predatory fauna were LBB, stinkbug, chrysopa, preying mantid, robber fly, *Neoscona* spp. of spider and predatory wasp etc.

The observation revealed that, near Akola vicinity recorded abundant predatory fauna (42.28%) might be due to presence of diversified agro ecosystems. This was followed by Barshitakli (13.42%) and Akot (13.42%). Patur and Murtijapur *talukas* showed lowest diversity (10.06%) of predatory fauna as compared to other *talukas* (Table 2).

Order wise activity of predatory fauna

Predatory fauna in different taxonomic orders in Akola district showed that order coleopteran contributed highest predatory fauna followed by Hemiptera, Diptera, Arachnida, Hymenoptera, Dermaptera and Neuropteran (Table 3). These findings on the prevalence of these predators were supported with the reports of Thakare (2005) who observed predators in cotton, soybean and green gram ecosystem of Akola region. Zahoor *et al*. (2003) studied the biodiversity of predaceous coccinelids and their role as bio-indicators in agro ecosystem. Khan *et al*. (2009) studied the biodiversity of predacious lady bird beetle (Coleoptera: Coccinellidae), in Kashmir region.The

diversity and evenness indices were calculated for the collected predatory insect. In similar studies, have been carried by Das *et al*. (2014) to know the biodiversity and seasonality of predaceous coccinellids (Coleoptera: Coccinellidae) in mango agro ecosystem of Jharkhand.

Shannon Biodiversity Index (order level)

Shannon-Wiener diversity index is also an expression of community structure and complexity of a habitat. A high index value suggests more diverse and stable community (Didham et al., 1998). In diverse situation one or two species is rarely dominant than others (Zahoor *et al.,* 2003; Hemchandra *et al.,* 2010). The data (Table 3) showed that order Coleoptera contributing to (-0.36628), followed by Hemiptera (-0.31415) these two order species showed abundance in this locality. Whereas, order Diptera (-0.26262) and Hymenoptera, (-0.14367), contributing predatory fauna respectively. Order Dermaptera (-0.09712) and Mantodea (-0.07863) had poor population and showed less dominance. Along with predators some spider's species shows rich diversity in kharif crop agro ecosystem contributing (-0.25533).However, moderate to rich species biodiversity of predatory fauna was noticed as per Shannon Index (H'= 1.744) in Akola vicinity during *kharif* 2010-11.Simpson index value was 0.78. The Evenness index had a value of 0.80 (Table 3). Predatory species exhibited variation in their occurrence.

Family wise Per cent of predatory fauna

Coccinellidae contributed largest number of predatory fauna (38.25%) followed by pentatomidae (13.42%).Spiders from families Oxyopidae and syrphidae contributed (9.39%)and (8.05%) predatory fauna, respectively (Table 4).

Thus, it is necessary to conserve the predatory fauna in *Kharif* agroecosystems of Akola district of Maharashtra for natural regulation of *kharif* crop pests by minimizing the use of pesticides so that these important predatory fauna can be sustain in future.

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