



E-ISSN: 2320-7078

P-ISSN: 2349-6800

www.entomoljournal.com

JEZS 2020; 8(5): 790-794

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Received: 30-06-2020

Accepted: 28-08-2020

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Study of spatial distribution of important predatory fauna found in Kharif agro-ecosystem from the region, Akola, Maharashtra, India

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Abstract

Information on the spatial distribution of predatory fauna found in kharif crop agro-ecosystem in relatively little is known. Spatial distribution of major predatory fauna found, viz. Lady bird beetle, Stink bug, Green lace wing / Mallada, Earwigs, Syrphid fly, Preying Mantid, Assassin Bug, Robber fly, Hoverfly, Tiger Beetle, Dragonfly/ Damsel fly, Spider species were studied on various kharif crop agro-ecosystems during kharif, 2010 in Akola district of Maharashtra, India. During study period total 154 specimens of predatory fauna associated with various important pests collected from various *Kharif* crops agro-ecosystem. This study shows that the *kharif* crop agro-ecosystem to attract more number of natural enemies. These natural enemies consisted of different 9 orders: Coleoptera, Hemiptera, Diptera, Arachnida, Hymenoptera, Dermaptera, Mantodea and Neuroptera are divided into 14 families. 6 families demonstrated the significance of spatial distribution patterns. Lady bird beetle, stink bug and spiders were recorded on all the kharif crops. Both lady bird beetle and predatory spiders were found in these six talukas of the Akola district. The results of this study indicate that both lady bird beetle and spiders have a wide range of host pests and vertical distribution from low land to high land. Information on spatial distribution of predatory fauna would be helpful in ensuring better management decision.

Keywords: Agro-ecosystem, fauna, *Kharif*, predatory, spatial

Introduction

Kharif crop play a key role in agriculture as well as basic resource for thousand of industrial products manufactured in India and play crucial role in national economy in both rural and urban sector. It provides raw material to industry and contributed one third of total foreign exchange of India (Mayee and Rao, 2002) [12]. *Kharif* crop consist of mainly cotton, pigeon pea, mung bean, soybean, urdbean, jowar, bajara, cowpea, sunflower etc. Production of *kharif* in India is 140.20 million tonnes (Anonymous, 2018) [1].

In kharif crops various biotic and a biotic factors play crucial role in low production in which insect pest attack is a major limiting factors. Worldwide food plants are damaged by more than 10,000 species of insects (Dhaliwal *et al.*, 2007) [5]. Despite using various control methods the control of agriculture pests continues to be critical for farmers. The yield loss by insects reaches as high as 60-70%. Therefore for reducing damage in terms of yield use of biocontrol methods for managing pests in kharif crop agro-ecosystem is necessary.

Earlylier period before 50's many kharif pests under natural control; however, many crop varieties grown were tolerant to insect pests and suitable cultural practices were adopted for preventing the flare up of pest population therefore use of pesticide less to manage insect pests in kharif crops. In the 50's use of synthetic pesticide done prominently and age of environment friendly practices were considered as low priority. Therefore, due to more usage of insecticides in kharif crops agro-ecosystem its accounts for about 50 per cent of total production cost. To avoid these losses there was need to adoption of IPM strategy, because of frequent failure of chemical control therefore biological control seems to have alternative to chemical control. Previous workers (Das and Veda, 2005) [3] stated the importance of biological control in regarding the reduction of cost of cultivation and of different pest control measures including IPM strategy.

In India biological control was successfully conducted in various crop ecosystems to manage pests in effectively manner before this study. Previous study data of (Pokharkar, 2010) [18] stated that papaya mealy bug *Paracoccus marginatus* Williams, was successfully control by using *Acerophagus papayae* Noves in Pune region of Maharashtra state.

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Among insects, several species of chrysopa, lady bird beetle and mantid were good examples of predators of insect pests (Dhaliwal and Arora, 2004)^[4]. In recent years, predaceous ladybird beetles have drawn considerable attention as biological control agents, due to their ability to feed on a large number of preys (Oliveira *et al.*, 2004^[17], Khan and Zaki, 2007^[11]). Previous study of (Gautam, 1994)^[6] on chrysopa (*Chrysoperla carnea* Steph) stated that it is one of the most important predators because of its high predatory potential and effectiveness in control of bollworm of cotton in their initial stages.

For using biocontrol agents in particular locality it is necessary to know the spatial distribution of predatory fauna observed in that locality. Therefore, study of spatial distribution of predatory fauna recorded in various talukas of Akola district of Maharashtra was taken into consideration. The information on the predatory fauna recorded in Akola, vidharbha region of Maharashtra state is an unclear, especially predatory fauna spatial distribution. Most of the predatory fauna in kharif crop agro-ecosystem of vidarbha region is unexplored and undescribed. This study aims are to recognize the spatial distribution of important predatory fauna found in Akola district. The results of this study provide basic information in especially information on predatory fauna in Akola, Maharashtra. This information is valuable for IPM workers in planning IPM strategies involving biocontrol of this important pest of kharif crop agro-ecosystem.

Materials and Methods

The present study "Study of Spatial Distribution of Important Predatory fauna found in Kharif Agro-ecosystem from the region, Akola, Maharashtra, India" was carried out at Department of Entomology, Post Graduate Institute Dr. Panjabrao Deshmukh Krishi Vidyaapeeth Akola during 2010-11. Predatory fauna were collected periodically from kharif crops of Akola, Maharashtra between July and December 2010. The Coleopteran predatory fauna were collected as per procedure adopted by previous workers (Sharma 1987^[21]; Joshi and Sharma 2008^[8]; Sharma and Joshi 2010^[20]) which included the use of sweep nets, insect collection tubes and jars depending upon the habitat. Different predatory fauna such as green lacewing, syrphid fly of these adults were collected by using sweep net and grub and maggot of these predators were transfer into small plastic containers (12x7 cm). Collection of predators such as dragonfly, damselfly was done by sweep net method and tiger beetle, and stinkbug done by using hand picking. Predatory spiders were collected in small plastic containers (12x7 cm) containing 70% ethyl alcohol with the help of sweep net. The specimens were then processed for identification for which they were killed in killing jar and spread and pinned properly. Spiders specimens were preserved by using 70% ethyl alcohol. Collected specimens were preserved, labeled, in insect biosystematics laboratory ICAR-NPIB Project of Entomology Department, Post Graduation Institute, Dr. Panjabrao Deshmukh Krishi Vidyaapeeth, Akola during 2010-11.

Photographs of species were captured with the help of digital camera (Nikon SMZ 800 digital camera). Field collected predatory fauna were examined carefully for all morphological details under stereo zoom microscope (Nikon SMZ 800) with attached Nikon camera were used. The identification, of the predatory fauna was done with the help of available keys in the textbook of (Imms, 1912)^[7] and literature available in ICAR -Network Project on Insect

Biosystematics laboratory, Department of Entomology, Dr. PDKV, Akola. Identification of predatory fauna were made on the bases of Based on morphological characters Predatory spiders were identified from Dr. G. N. Wankhede, Head of Department of Zoology, Sant Gadge Baba University, Amravati.

Results

A. Spatial distribution of predatory fauna found on various kharif crops: During the study period total 154 specimens of important predatory fauna collected from various *Kharif* crops agro-ecosystem from Akola district. The collected data revealed that total twelve species of important predatory fauna were collected from different crop agro-ecosystem from Akola district. Among the collected predatory fauna lady bird beetle, predatory spider and stink bug was recorded to all the *kharif* crops viz. cotton, cowpea, soybean, tur, jowar, sunflower, green gram. The results of this study indicate that both lady bird beetle, spider and stink bug have a wide range of host and vertical distribution from low land to high land. The results of this study revealed that green lace wing/mallada was observed in all the crops except tur and sunflower crops.

An earwig was observed in three crop ecosystem viz. cotton, jowar and sunflower. Syrphid mainly occurs in Cotton, Cowpea, Soybean, and Jowar crop agro-ecosystem during observation period. Preying mantid was recorded in cotton, cowpea, tur and sunflower whereas, assassin bug was observed in soybean, tur, jowar, sunflower crop agro-ecosystem in Akola district. Robber fly is generalist predatory fauna was mainly recorded in cotton, soybean and jowar crop agro-ecosystem. The predatory fauna namely Hoverfly and Tiger Beetle had recorded on single crop agro-ecosystem jowar and cotton, respectively. Results also stated that among the various predatory fauna collected from various kharif crops lady bird beetle collected maximum specimens during study period. Recorded observation stated that maximum predatory fauna specimens collected from cotton (57) crop agro-ecosystem followed by soybean (46) crop agro-ecosystem during observation period (Table 1).

B. Spatial distribution of predatory fauna found on various talukas of Akola districts: Results showed that occurrence of lady bird beetle and predatory spider was found in all the six talukas of Akola districts viz. Telhara, Barshitakali, Murtijapur, Akot, Akola, Patur on different kharif crop agro-ecosystem in low to high level. Stink bug was observed in Telhara, Akot and Akola talukas whereas, green lace wings occurrence was mostly observed in Akot and Akola talukas of Akola district. Earwigs mostly occurred in Akot and patur talukas; however, syrphid fly was recorded in Barshitakli, Murtijapur and Akola talukas. Recorded data revealed that preying mantid and Assassin bug was recorded in Telhara, Akola, Murtijapur and Barshitakli talukas. Occurrence of robber fly was recorded in only Akola and Patur talukas of Akola district.

During observation hoverfly and tiger beetle was observed in Akola and Murtijapur talukas, respectively. The observation revealed that, in Akola taluka recorded abundant predatory fauna (68) might be due to presence of diversified agro ecosystems. This was followed by Barshitakli and Akot (20). Patur and Murtijapur talukas showed lowest specimens (15) of predatory fauna as compared to other talukas (Table 2).

C. Spatial distribution of predatory fauna found on various pests group: Observation revealed that aphids and jassids pests were targeted mainly by lady bird beetle, chrysopa and spider species in various *kharif* crop agro-ecosystems in Akola district. It was observed that stink bug and assassin bug was targeted mainly larvae of lepidopteron pests viz. *H. armigera*, caterpillar and red hairy caterpillar. Earwigs and syrphid fly was mainly targeted lepidopteron larvae and aphids, respectively. However, preying mantid

targeted on flying and soft bodied insect, caterpillar and grasshopper pests. Results stated that robber fly and hoverfly targeted to flying and soft bodied insect and aphids, respectively. Recorded data revealed that flying and soft bodied insect mainly targeted by tiger beetle, dragonfly and damselfly. It was observed that lady bird beetle predatory fauna found to be maximum among the collected predatory fauna which feed mainly on aphids and jassids (Table 3).

Table 1: Spatial Distribution of predatory fauna found on various kharif crops in Akola District in Vidarbha region

Crops	Predatory fauna												Number of specimen collected
	Lady bird beetle	Stink bug	Green lace wing / Mallada	Earwigs	Syrphid fly	Preying Mantid	Assassin Bug	Robber fly	Hoverfly	Tiger Beetle	Dragonfly/ Damsel fly	Spider species	
Cotton	+	+	+/+	+	+	+	-	+	-	+	-/+	+	57
Cowpea	+	+	+	-	+	+	-	-	-	-	-	+	9
Soybean	+	+	+	-	+	-	+	+	-	-	+/+	+	46
Tur	+	+	-	-	-	+	+	-	-	-	+/+	+	14
Jowar	+	-	+	+	+	-	+	+	+	-	-	+	13
Sunflower	+	+	-	+	-	+	+	-	-	-	-	+	10
Green gram	+	+	+	-	-	-	-	-	-	-	-	-	5
Total	60	19	6/5	4	12	4	8	8	1	2	2/6	17	154

+ (Present), - (Absent)

Table 2: Spatial Distribution of predatory fauna found on various kharif crops in different talukas of Akola District in Vidarbha region

Talukas	Predatory fauna												Number of specimen collected
	Lady bird beetle	Stink bug	Green lace wing / Mallada	Earwigs	Syrphid fly	Preying Mantid	Assassin Bug	Robber fly	Hoverfly	Tiger Beetle	Dragonfly/ Damsel fly	Spider species	
Telhara	+	+	-	-	-	+	+	-	-	-	-/+	+	16
Barshitakali	+	-	-	-	+	+	-	-	-	-	-	-	20
Murtijapur	+	-	-	-	+	-	+	-	-	-	+/-	+	15
Akot	+	+	+	+	-	+	-	-	-	+	-	+	20
Akola	+	+	+/+	-	+	-	+	+	+	-	+/+	+	68
Patur	+	-	+	+	-	-	-	+	-	-	-	+	15
Total	60	19	6/5	4	12	4	8	8	1	2	2/6	17	154

Table 3: Spatial Distribution of predatory fauna found on main pests of various kharif crops in Akola District in Vidarbha region

Pests group targeted	Predatory fauna												Number of specimen collected
	Lady bird beetle	Stink bug	Green lace wing / Mallada	Earwigs	Syrphid fly	Preying Mantid	Assassin Bug	Robber fly	Hoverfly	Tiger Beetle	Dragonfly/ Damsel fly	Spider species	
Aphids	+	-	+	-	+	-	-	-	+	-	-	+	58
Jassids	+	-	+	-	-	-	-	-	-	-	-	+	46
Lepidopteron larvae	-	-	-	+	-	-	-	-	-	-	-	-	4
<i>H. armigera</i>	-	+	-	-	-	-	+	-	-	-	-	-	8
Flying and soft bodied insect	-	-	-	-	-	+	-	+	-	+	+/+	-	20
Caterpillar	-	+	-	-	-	+	+	-	-	-	-	-	13
Red hairy caterpillar	-	+	-	-	-	-	-	-	-	-	-	-	4
Grasshopper	-	-	-	-	-	+	-	-	-	-	-	-	2
Total	60	19	6/5	4	12	4	8	8	1	2	2/6	17	154

Discussion

The results from this study build on our knowledge of predatory fauna distributions in various talukas of Akola district by providing information on the spatial distribution of some mostly found predatory fauna active in kharif crop agro-ecosystem. Spatial distribution of insects appears to be a fundamental trait with considerable ecological significance (Tatlor, 1984)^[22]. Spatial distribution demonstrated a clearly defined zone where predatory fauna were concentrated.

Results revealed that lady bird beetle population was more as compared to other predatory fauna. The value of lady bird beetle population showed that the whole of the crop area was evenly distributed with only the dominance of a ladybird beetle grub as well as adults. These findings supported with the observations of earlier workers, (Choudhary and Garg 2003)^[2] and (Kavitha *et al.* 2003)^[10], who recorded ladybird

beetle grub as well as adults in various ecosystem of Madhya Pradesh and Haryana, respectively. Similarly, (Kale *et al.* 2020)^[9] recorded sixteen species of predatory fauna on aphids found on kharif and Rabi crop agro-ecosystem in near Akola vicinity. In predators sixteen species were observed among them predators rich fauna of *C. sexmaculata* was observed with contribution of 53.17 per cent, followed by *Neoscona* sp., *C. transversalis*, *Mallada* sp., *Illeis* sp., *Eriovixia* sp., *Oxyopes pankajii*, *Chrysoperla* sp., *Thomisus* sp., *Tetragnatha* sp.

Our results was in line with the results of (Thakare 2005)^[23] who reported the occurrence of predatory fauna in various kharif crop agro-ecosystem, viz. chrysopa, lady bird beetle, and Geocorid bug, and pentatomid bug, Robber fly, mantid, syrphid fly and Chrysopa species in cotton, pigeon pea, soybean, and Green gram ecosystem of Akola region.

Similarly, (Choudhary and Garg 2003) ^[2] recorded dragonfly in cotton, soybean, and pigeon pea ecosystem in M.P. The observations were supported by the report of (Menon and Thangavelu 1979) ^[13] who recorded mantid in cotton, pigeon pea, and sunflower ecosystem. It was revealed that occurrence of syrphid fly population mainly observed on cotton, cowpea, and jowar ecosystem near Akola vicinity. Similar results were recorded by (Thangavelu 1979) ^[24], (Rao *et al.* 1995) ^[19], (Chaudhary and Garg 2003) ^[2] and (Kavita *et al.* 2003) ^[10], who recorded Syrphid fly in Coimbatore, A.P., M.P., Haryana, respectively in cotton cowpea, and Jowar ecosystem which in close proximity with the present findings. Our observation data revealed that spatial distribution of pentatomid bug seen in cotton ecosystem in Akola district. These observations are in agreement with the reports of (Choudhary and Garg 2003) ^[2] and (Thakare 2005) ^[23] who recorded pentatomid bug in cotton ecosystem in M.P. and Akola region of Maharashtra, respectively.

Our results showed that chrysopa, LBB, spiders mainly targeted sucking pests of various kharif crops. Similar results of (Menon and Thangavelu 1979) ^[13] who recorded chrysopa in various crop ecosystems of Coimbatore and found effectiveness against sucking pests of various crops support these observations. (Mushtaq *et al.* 2010) ^[14] studied functional response of *Chrysoperla carnea* (Stephens) (Neuroptera: Chrysopidae) to different densities of *Aphis craccivora* Koch and *Aphis pomi* De Geer (Homoptera: Aphididae).

Among the predatory fauna found spider species was observed most active during study period in cotton crop which plays key role in management of sucking pests of cotton. Similar, observation was recorded by the earlier worker (Naikwadi *et al.* 2015) ^[16] reported four species of spiders in kharif crop agro-ecosystems viz; spiders *Neoscona* spp, *Oxyopes* spp, *Thomisus* spp., *Pseusetia* spp. was found on various kharif crops of Akola district support the present findings. Out of the 4 species of spiders recorded *Neoscona* species was found to be predominant species which predated on all types of pests. Similarly, our results are in line with the results of (Nagrare *et al.* 2015) ^[15] who reported fifteen species of spiders from rainfed cotton agro ecosystem belonging to six families viz., Araneidae, Oxyopidae, Thomisidae, Salticidae, Tetragnathidae and Theridiidae mainly dominated by Araneidae, Oxyopidae and Thomisidae. Also reported frequent occurrence of *Neoscona theisi* followed by *Oxyopes pankaji* and *Thomisus spectabilis* in cotton agro-ecosystem.

Conclusion

This study shows that the kharif crop agro-ecosystem to attract more number of natural enemies. These natural enemies consisted of different 9 orders: Coleoptera, Hemiptera, Diptera, Arachnida, Hymenoptera, Dermaptera, Mantodea and Neuroptera are divided into 14 families. 6 families demonstrated the significance of spatial distribution patterns. Based on the above investigations, it was observed that lady bird beetle, predatory spider and stink bug was recorded to all the kharif crops viz. cotton, cowpea, soybean, tur, jowar, sunflower, green gram also active in all the talukas of Akola district play vital role in natural pests management in kharif crop agro-ecosystem. Based on the results it was concluded that both lady bird beetle, spider and stink bug have a wide range of host and vertical distribution from low land to high land. During the investigation, it was observed

that aphids and jassids pests were targeted mainly by lady bird beetle, chrysopa, syrphid fly and spider species while stink bug and assassin bug, earwigs and was targeted to larvae of lepidopteron pests viz. *H. armigera*, caterpillar and red hairy caterpillar. The information collected in this study is useful in insect pest management. This investigation may be helpful to the farmers as well as researchers and students for awareness, identification and spatial distribution studies of the different predatory fauna found in kharif crop agro-ecosystem.

Acknowledgements

The authors are grateful to Hon'ble Chairman Dr. S. M. Dadmal, Associate Professor, PGI, Dr. PDKV, Akola, for his constant inspiration, valuable guidance, helpful suggestions, constructive criticism, kind advice right selection of research work. I express my hearty sincere gratitude to Dr. U.P. Barkhade, Head, Department of Agricultural Entomology, Dr. PDKV, Akola for providing necessary facilities for my research work and member of my Advisory Committee, for his valuable guidance, helpful suggestions and taking their keen interest and encouragement to carry out this research work.

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