

Taxonomic Documentation of Phototactic Insect Fauna Collected in Light Trap during *rabi* Season from Vegetable Ecosystem under the Satpura Plateau Region of Chhindwara, Madhya Pradesh, India

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ABSTRACT

An experiment was conducted under the taxonomic documentation of phototactic insect pests collected in light trap during Rabi season in vegetable ecosystem at Chhindwara (MP). Information on insect fauna of vegetable collected at Chhindwara MP. The data of trap catch during *Rabi* 2019-20 and 2020-21 was classified on taxonomic basis, economic aspect (crop pest) and bio control significance (parasite and predators). Insect belonging to 77 species and 10 insect orders were collected from both the locations of farmer's field, during *rabi* season, 2019-20 and 2020-21. Lepidoptera was the predominant order represented by 32 species (42%) followed by Hemiptera 8 species (23%), Coleoptera 11 species (14%), Odonata 4 species (5%), Orthoptera and Diptera three species each (4%) Hymenoptera and Dictioptera two species each (3%), Neuroptera and Dermaptera were represented

by one species each (1%). Among all the harmful species, *Plutella xylostella* recorded highest number of catches (1133.5 moths) followed by *Plusia orichalcea* (1010 moths), *Leucinodes orbonalis* (927.5 moths), *Spodoptera litura* (673.5 moths) and *Helicoverpa armigera* (558.5 moths). Among the other order species highest number of catches were recorded with by *Nezara viridula* (326.5 bugs) followed by *Nephotettix virescens* (310 hoppers), *Dysdercus koenigii* (265 bugs) order Hemiptera and *Aulacophora foveicollis* (190 beetle) order coleoptera respectively as phytophagous insect species. Among all the harmful species *Pluchia orichalcea*, *Spodoptera litura*, *Helicoverpa armigera*, *Spodoptera frugiperda* and *Chrysodeixis chalcites* was recorded as major polyphagous pests. Among all the beneficial species *Scadra annulipes* has the highest size of trap catch (204 bugs) followed by *Onitis falcatus* (78 beetles), *Dorylus* sp (73 wasps), *Antilochus coquebertii* (67 bugs), *Enicospilus purgatus* (55.5 wasps) and *Diplonychus rusticus* (28 bugs) respectively. The ratio between beneficial insects and harmful crop pests at farmer's field -I is 1: 2.20.

Keywords Trap catches, Vegetable ecosystem, Harmful species, Beneficial species.

INTRODUCTION

In India there exists a diverse climate which ensures availability of all types of vegetables. In the world India ranks second in vegetable production, after China. In India the total area of vegetables is 10353 thousand ha with production 191769 thousand MT and productivity of vegetables 17.97 MT /ha. In

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Madhya Pradesh it was cultivated in 967.23 thousand ha with production 19144.37 thousand MT during 2019-20 second estimate (Anonymous 2020). In district Chhindwara of Madhya Pradesh total cultivated area of vegetable was 65.04 thousand ha with production 1513.11 thousand MT during 2019-20 (Anonymous 2020).

Light trap is an important tool for minimizing the insect pests damage without any toxic hazard. Apart from this light trap has been used to supplement the knowledge of pest fauna of given locality, geographical distribution and their seasonal activity. Insects are the most species-rich taxon with about one million species described worldwide, corresponding to more than half of all known species due to their high ecological diversification and short generation times, insects are useful indicators of environmental change. Lepidoptera (butterflies and moths) is one of the largest insect orders with 160,000 described species, of which 95% are moths. Moths play important roles in many ecosystems as pollinators, herbivores, and prey for a wide range of species such as birds and bats. The distribution and ecology of moths are well known in comparison to many other invertebrates.

Vaishampayan (1981), Sharma and Bisen (2013) have done extensive research on various aspects of light trap designs, light sources, and seasonal activities of major insect pests of chickpea and paddy, but there is very little information on phototactic insect fauna of vegetable crops, particularly in Chhindwara (MP). There are few reports of work done on light trap against insect pests of vegetable crops by different workers together (Sharma and Bisen 2013, Vaishampayan 1981, Sivaprakasam 1996, Wafa *et al.* 1972 and Begemann and Schoeman 1998). So, with this in mind, the current study is a step forward in collecting useful information on insect pest fauna collected in light traps and categorized on taxonomic basis, economic aspect (crop pests), and bio-control relevance.

MATERIALS AND METHODS

The experiment was carried out at farmer's field of district Chhindwara (MP) of vegetable ecosystem during the *rabi* season 2019-20 and 2020-21. The farmer's field was located at village Chandangaon,

district Chhindwara which was 05 km. away from the Krishi Vigyan Kendra, Chhindwara. Experiment conducted by standard design of Jawahar light trap by using 125-watt mercury vapor lamp. Light trap was operated every night and collection was observed on the next day morning. Observations will be recorded every day throughout the *rabi* season. Total insects were observed and sorted out on the basis of orders, species and their family. Specimens were prepared by keeping the pinned insects in oven for 24 hours at 30°C and thereafter well labelled specimens were stored in insect boxes and show cases. Detail photographic presentation of these species was also made.

RESULTS AND DISCUSSION

Insect belonging to 77 species and 10 insect orders were collected from both the locations of farmer's field, during *rabi* season, 2019-20 and 2020-21. Lepidoptera was the predominant order represented by 32 species (42%) followed by Hemiptera 8 species (23%), Coleoptera 11 species (14%), Odonata 4 species (5%), Orthoptera and Diptera three species each (4%) Hymenoptera and Dictyoptera two species each (3%), Neuroptera and Dermaptera were represented by one species each (1%) (Table 1- 2) (Fig.1- 2).

Taxonomic distribution of phototactic insect fauna of vegetable ecosystem (at both location) was further classified into two groups viz. harmful insects as crop pests and beneficial insects (predators/parasites/pollinators) on economic bases (Table 1 and 2).

Group of harmful insects- as crop pests during 2019-20 and 2020-21 at Farmers Field-I (pooled total and mean)

In the year 2019-20 and 2020-21 (pooled total) group of harmful insects as crop pests, was represented by 5 orders, 25 families and 53 species as crop pest. Among the harmful crop pest species Lepidoptera was dominant order, represented by the highest number of 12 families including 31 species (57%). Among all the families, Noctuidae was recorded highest number of species (9 species). This family includes 9 species as important pests of different crops. Among these species, *Plusia orichalcea* has the highest size of trap catch (1010 moths) followed by *Spodoptera litura* (673.5 moths), *Helicoverpa armigera* (558.5 moths), *Spodoptera frugiperda* (391 moths), *Agro-*

Table 1. Taxonomic distributions of phototactic insect species collected in light trap during rabi 2019-20 and 2020-21 in vegetable ecosystem at Chhindwara (M.P.).

(Group-I) Harmful insects- as crop pests

Sl. No.	Insect species collected	Total number of insects collected in light trap			Status
		2019-20	2020-21	Pooled mean	
I-Order- Lepidoptera					
A. Family-Noctuidae (9)					
1	Spodoptera litura (Fabricius 1775)	662	685	673.5	Major polyphagous pest of soybean, cabbage, cucurbits, potato, chilli and pea. (Meena 2015)
2	Helicoverpa armigera (Hubner 1808)	552	565	558.5	Major polyphagous pest of pulses, potato, tomato, chilli, okra and cotton.
3	Chrysodeixis chalcites (Esper 1789)	27	29	28	Polyphagous pest of soybean, potato, tomato and bean.
4	Plusia orichalcea (Fabricius 1775)	960	1060	1010	Major polyphagous pest of vegetable crops, cabbage, cauliflower (Mishra 2016)
5	Mythimna separata (Walker 1865)	281	290	285.5	Pest of paddy, Maize, Wheat, Barley and fodder grasses (Meena 2015)
6	Earias vitella (Fabricius 1794)	70	83	76.5	Pest of cotton and okra
7	Agrotis ipsilon (Hufnagel 1766)	376	372	374	Major polyphagous pest of pulses, pest of cabbage, cucurbits, potato (Bhargava 2019)
8	Asota ficus (Fabricius 1775)	79	78	78.5	Fodder pest
9	Spodoptera frugiperda (J. E. Smith 1797)	385	397	391	Major Pest of Maize (Anonymous 2020)
B. Family- Erebiidae(5)					
10	Cyana peregrina (Walker 1854)	4	2	3	Pest of grasses
11	Amsacta moorei (Butler 1876)	4	2	3	Major pest of sun hemp, maize and Jwar (Polyphagus)
12	Anomis fulvida (Guenée 1852)	0	4	2	Feed on Hibiscus rosa-sinensis, Hibiscus cannabinus and Legnephoramoorei (Kurmi 2019)
13	Digama hearseyanasimilis (Moore 1878)	0	8	4	Feed on grasses
14	Pericyma crugeri Butler. 1886	0	7	3.5	Feed on foliage of Caesalpiniaceae species (Kurmi 2019)
C. Family- Arctiidae (4)					
15	Cretonotos gangis (Linnaeus)	530	553	541.5	Polyphagous pest
16	Amata sp.	659	668	663.5	Fodder pest (Kurmi, 2019)
17	Spilosoma obliqua (Walker 1855)	27	25	26	Major polyphagous pest of sesame, linseed and minor pest of cabbage and sweet potato (Meena 2015)
18	Utheasia pulchella (Linnaeus 1758)	41	42	41.5	Major pest of sunhemp
D. Family-Sphingidae (3)					

Table 1. Continued

Sl. No.	Insect species collected	Total number of insects collected in light trap			Status
		2019-20	2020-21	Pooled mean	
19	<i>Agrius convolvuli</i> (Linnaeus 1758)	39	45	42	Major pest of sweet potato, sunflower and soybean
20	<i>Acherontia styx</i> (Westwood 1847)	4	4	4	Major pest of sesame and minor pest of potato (Mishra 2016)
21	<i>Daphinis nerii</i> (Linnaeus)	6	7	6.5	Feed on nectar of variety of flowers. Like Petunia, Jasmine and Honey suckle
E. Family- Lasiocampidae (2)					
22	<i>Metanastria hyrtaca</i> (Cramer 1782)	2	3	2.5	Pest of Almond, Guava, Sal tree, Babul and Cashew nut
23	<i>Trabala vishnou</i> (Lefebvre 1827)	1	2	1.5	Pest of pomegranate, castor, almond, jamun, guava, Acacia and Eucalyptus
F. Family- Geometridae (1)					
24	<i>Buzura suppressaria</i> (Guenee 1858)	3	3	3	Pest of tea
G. Family- Plutellidae (1)					
25	<i>Plutella xylostella</i> (Linnaeus 1758)	1128	1139	1133.5	Major pest of cabbage and cauliflower (Anonymous 2020)
H. Family- Pyraustidae (1)					
26	<i>Leucinodes orbonalis</i> (Guenée 1854)	903	952	927.5	Major pest of brinjal (Anonymous 2020)
I. Family- Pyralidae (1)					
27	<i>Chilo partellus</i> (Swinhoe 1885)	11	15	13	Major pest of maize and sorghum (Meena 2015)
J. Family- Nymphalidae (1)					
28	<i>Melanitis leda ismene</i> (Cramer)	5	2	3.5	Major pest of paddy (Mishra 2016)
K. Family- Lymantriidae (1)					
29	<i>Euproctis similis</i> (Moore)	63	62	62.5	Minor pest of paddy and ragi (Bhargava 2019)
L. Family- Crambidae (2)					
30	<i>Palpita vitrealis</i> (Rossi)	5	2	3.5	Pest of ornamental plant (Jasmine)
31	<i>Pygospilatyres</i> (Cramer 1780)	2	4	3	Forest pest
II-Order- Hemiptera					
A. Family- Pentatomidae (4)					
32	<i>Nezara viridula</i> (Linnaeus 1758)	315	338	326.5	Major polyphagous pest of soybean, pigeon pea and vegetable crops (Bhargava 2019)

Table 1. Continued.

Sl. No.	Insect species collected	Total number of insects collected in light trap			Status
		2019-20	2020-21	Pooled mean	
33	<i>Antestiopsis cruciata</i> (Fabricius 1775)	82	68	75	Pest of coffee and jasmine
34	<i>Plautia crossota</i> (Stal 1869)	0	11	5.5	Pest of Pigeonpea, field bean, cowpea, cotton, and several other plants (Kurmi 2019)
35	<i>Bagrda</i> sp.	0	135	67.5	Pest of crucifer plants(Kurmi 2019)
B. Family- Pyrrhocoridae(3)					
36	<i>Dysdercus koenigii</i> (Fabricius 1775)	251	279	265	Pest of Okra and cotton
37	<i>Ectatops</i> sp.	5	2	3.5	Phytophagous (Kurmi 2019)
38	<i>Probergrothius</i> sp.	3	12	7.5	Pest of okra and cotton (Kurmi 2019)
C. Family- Cicadellidae (3)					
39	<i>Nephotettix virescens</i> (Distant 1908)	305	315	310	Major pest of paddy
40	<i>Idioscopus niveosparus</i> (Lethierry)	1	4	2.5	Major pest of mango
41	<i>Ledra</i> sp.	6	3	4.5	Phytophagous pest (Kurmi 2019)
D. Family – Coreidae (2)					
42	<i>Anoplocnemis phasiana</i> (Fabricius 1781)	0	8	4	Feed on Pigeonpea, cowpea, field bean, brinjal, etc. (Kurmi 2019)
43	<i>Riptortus pedestris</i> (Fabricius 1775)	0	15	7.5	Feeds on legume plants (Kurmi 2019)
III- Order – Coleoptera					
A. Family-Chrysomelidae(2)					
44	<i>Aulacophora foveicollis</i> (Lucas 1849)	192	188	190	Pest of cucurbit plants
45	<i>Altica oleracea</i> (Linnaeus 1758)	17	12	14.5	Pest of brassica crops (Bhargava 2019)
B. Family- -Scarabaeidae (1)					
46	<i>Holotrichia consanguinea</i> Blanchard 1851	19	27	23	Polyphagous pest of various crops
C. Family- Cerambycidae(2)					
47	<i>Stromatium barbatum</i> (Fabricius)	4	2	3	Pest of bamboo and Teak
48	<i>Xystrocera globosa</i> (Olivier 1795)	0	4	2	Pest of citrus species (Kurmi 2019)
IV-Order – Orthoptera					
A. Family- Gryllidae					

Table 1. Continued.

Sl. No.	Insect species collected	Total number of insects collected in light trap			Status
		2019-20	2020-21	Pooled mean	
49	<i>Euscyrtus concinnus</i> (De Haan 1842)	61	72	66.5	Pest of fodder grasses
B. Family- Gryllotalpidae					
50	<i>Gryllotalpa orientalis</i> (Burmeister 1838)	71	86	78.5	Minor pest of paddy (Sharma 2019)
V-Order – Diptera (3)					
A. Family- Bibionidae (1)					
51	<i>Plecia amplipennis</i> (Skuse)	65	70	67.5	Fodder pest (Mishra 2016)
B. Family- Calliphoridae (1)					
52	<i>Chrysomya</i> sp. (Robineau-Desvoidy)	5	3	4	Feed on flowers of many plants, decaying matter (Kurmi 2019)
C. Family – Tephritidae(1)					
53	<i>Bactrocera cucurbitae</i> (Coquillett 1849)	0	24	12	Pest of cucurbits (Kurmi 2019)

Table 2. Taxonomic distributions of phototactic insect species collected in light trap during rabi 2019-20 and 2020-21 in vegetable ecosystem (farmer's field) at Chhindwara (M.P.)

Group-II) Beneficial insects (Predators/Parasites/Pollinators)

Sl. No.	Insect species collected	Total number of insects collected in light trap			Status of insects
		Farmer's Field -I			
		2019-20	2020-21	Pooled	
I. Order- Hemiptera					
A. Family- Pyrrhocoridae (1)					
1	<i>Antilochus coquebertii</i> (Fabricius 1803)	69	65	67	Predator on other Pyrrhocoridae species (Kurmi 2019)
B. Family Reduviidae(4)					
2	<i>Sirthenecarinata</i> (Fabricius 1798)	5	3	4	Predator on various insects (Kurmi 2019)
3	<i>Scadra annulipes</i> Reuter 1881	210	198	204	Predator on various insects (Kurmi 2019)
4	<i>Ectomocoris ululans</i> (Rossi 1790)	5	3	4	Predator on various insects (Kurmi 2019)
5	<i>Sirthenea</i> sp.	16	12	14	Predator on various insects (Kurmi 2019)
C. Family-Belostomidae (1)					
6	<i>Diplonychus rusticus</i> (Fabricius)	31	25	28	Feed on aquatic insects (Kurmi 2019)
II Order – Coleoptera					

Table 2. Continued.

Sl. No.	Insect species collected	Total number of insects collected in light trap			Status of insects
		Farmer's Field -I			
		2019-20	2020-21	Pooled	
A. Family- Carabidae (4)					
7	<i>Prothyma</i> sp.	39	35	37	Predator of Colorado potato beetle and small insects (Mishra 2016)
8	<i>Cicindela flexuosa</i> (Linnaeus 1758)	9	5	7	General predator of small insects (Mishra 2016)
9	<i>Chlaenius pictus</i> (Choudoir)	12	10	11	General predator of Lepidopterous larvae (Mishra 2016)
10	<i>Brachinus sexmaculeatus</i> (Dejean 1852)	0	12	6	General predator (Mishra 2016)
B. Family- Scarabaeidae					
11	<i>Onitis falcutus</i> (Wulfen 1786)	81	75	78	General predator of aphid, coccids, white fly and bugs (Mishra 2016)
C. Family Hydrophidae(1)					
12	<i>Hydrochara caraboides</i> (Linnaeus 1758)	32	46	39	General predator of aquatic insects (Mishra 2016)
III- Order – Orthoptera					
C. Family- Tettigoniidae					
13	<i>Euconocephalus</i> sp.	5	5	5	Predator of Lepidopteran eggs (Mishra 2016)
IV- Order – Hymenoptera					
A. Family- Ichneumonidae (1)					
14	<i>Enicospilus purgatus</i> (Say 1835)	59	52	55.5	Larval parasite of stem borer, leaf folder and Lepidopterous insects (Mishra 2016)
B. Family- Formicidae (1)					
15	<i>Dorylus</i> sp.(Fabricius)	67	79	73	General parasite of Lepidopterous and Dipterous insects (Mishra 2016)
V Order – Odonata					
A. Family- Libellulidae(3)					
16	<i>Pantala flavescens</i> (Fabricius 1798)	25	20	22.5	General predator on Lepidopterous, Dipterous and Hymenopterous insects (Mishra 2016)
17	<i>Brachythemis contaminata</i> Fabricius 1793	0	8	4	Predator on various insects (Kurmi 2019)
18	<i>Orthetrum Sabina</i> (Drury 1770),	0	6	3	Predator on various insects (Kurmi 2019)
B. Family- Coenagrionidae (1)					
19	<i>Coenagrion</i> sp. Damsel fly (Kirby)	7	2	4.5	Predator of monarch butterfly, stem borer, gall midge and leaf eating caterpillar (Mishra 2016)
20	<i>Ascalaphus sinister</i> (Walker 1853)	43	47	45	Adult feed on caterpillars and grubs (Mishra 2016)
21	<i>Chrysoperla sillemi</i> (Esben-petersen)	58	66	62	General predator on leaf hoppers and aphids (Mishra 2016)
22	<i>Elaunon bipartitus</i> (Kirby 1891)	3	1	2	General predator on Lepidopteran larvae (Mishra 2016)

Table 2. Continued.

Sl. No.	Insect species collected	Total number of insects collected in light trap			Status of insects
		Farmer's Field -I			
		2019-20	2020-21	Pooled	
23	<i>Archimantis latistyla</i> (Serville 1838)	15	18	16.5	Nymph feed on leaf hopper and aphids while adult feed on caterpillars (Mishra 2016)
24	<i>Polyptychus dentatus</i> (Cramer 1777)	0	5	2.5	Efficient pollinator, Feed on <i>Cordia dichotoma</i> , <i>Cordia sebestena</i> and <i>Ehretialaevis</i> (Kurmi 2019)

tis ipsilon (374 moths), *Mythimna separata* (285.5 moths), *Earias vitella* (76.5 moths) and *Asota, ficus* (78.5 moths) while the lowest size of trap catch was of *Chrysodeixis chalcites* (28 moths). Among this species of *Lepidoptera* *Plusia orichalcea* *Helicoverpa armigera*, *Spodoptera litura*, *Agrotis ipsilon*, *Chrysodeixis chalcites* were recorded as major polyphagous pest during the season in trap catches.

Other Families of order *Lepidopetra*, the highest number of species were recorded with the family *Erebidae* (5 species) followed by *Arctiidae* (4 species each), *Sphingidae* (3 species), *Lasiocampidae* and *Crambidae* (2 species each), whereas family *Geometridae*, *Pyrastidae*, *Pyalidae*, *Nymphalidae* and *Lymantriidae* (1 species each respectively) during the season in trap catches. Among the other families of order *Lepidopetra* highest catches with the species *Plutella xylostella* (1133.5 moths) family *Plutellidae* followed by *Leucinodes orbonalis* (927.5 moths) family *Pyrastidae*, *Amata* sp. (663.5 moths) and *Cretonotos gangis* (541.5 moths) family *Erebidae*

were also recorded during the season in trap catches.

After *Lepidoptera*, *Hemiptera* (24%) was the next highest order of pest species in trap catches with 5 families and 11 species. The highest number of species were recorded with the family *Pyrrhocoridae* and *Cicadellidae* (3 species each) followed by *Pentatomidae* and *Coreidae* (2 species each) while *Belostomidae* represented by only one species. Among the species highest number of catches were recorded with *Nezara viridula* (265 bugs) followed by *Nephotettix virescens* (310 hoppers) family *Cicadellidae* and *Dysdercus koenigii* (265 bugs) family *Pyrrhocoridae* while the lowest number of catches were recorded with the species *Idioscopus niveosparsus* (2.5 hoppers) were recorded during the season.

Order *Coleoptera* (9%) was represented by 3 families and 5 species. Among all the pest species of this order highest trap catches was *Aulacophora foveicollis* (190 beetle) family *Chrysomelidae* followed by *Holotrichia consanguinea* (23 beetles) family

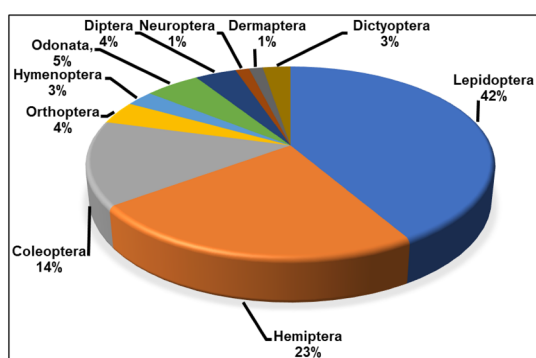


Fig. 1. Distribution of phototactic insect fauna at farmer field-I during rabi 2019-20 and 2020-21 (pooled total).

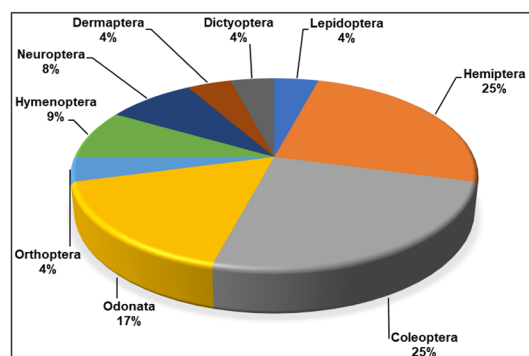


Fig. 2. Distribution of beneficial insects (Predators/Parasites/Pollinators) trapped in light trap during rabi 2019-20 and 2020-21 (pooled total- farmers field-I).

Table 3. Ratio between beneficial insects and Harmful crop pests during *rabi* 2019-20 and 2020-21 (farmer's field-I).

Sl. No.	Particulars	2019-20 and 2020-21 Farmer's Field-I (Pooled Total)
1	Number of harmful species as crop pest	53
2	Number of beneficial species	24
	Ratio (Beneficial: Harmful)	1: 2.20

Scarabaeidae and *Altica oleracea* (14.5 beetles) family Chrysomelidae were recorded during the season.

Order Diptera (6%) was represented by 3 families and 3 species. *Plecia amplipennis* (67.5 Flies), family Bibionidae, *Bactrocera cucurbitae* (12 flies) family Tephritidae and *Chrysomya* sp. (4 flies) family Calliphoridae were recorded during the season.

Order Orthoptera (4%) was represented by 2 families and 2 species. In terms of relative size of trap catch *Gryllotalpa orientalis* has the highest trap catches of (78.5 crickets) followed by *Euscirtus concinnus* (66.5 crickets).

Group of beneficial insects (Predators/Parasites/Pollinators) during 2019-20 and 2020-21 (pooled total and mean) farmer's field-I

During the year 2019-20 and 2020-21 (pooled) revealed that the group of beneficial insects (24 species) as natural biocontrol agents was represented by 9 orders, 16 families and 20 species as predators, 3 species as parasites and 1 species as pollinators. Among the predatory species order Hemiptera and Coleoptera was represented by the highest number including 6 species each, followed by Odonata (4 species) Hymenoptera and Neuroptera with 2 species each while Orthoptera, Dermaptera, Dictyoptera and Lepidoptera represented only one species each (Table 1 and Fig. 1).

Among the predatory species order Hemiptera was represented by the highest number of 3 families including 6 species, in which family Reduviidae has the highest 4 predatory species. Among these species *Scadraannulipes* has the highest size of trap catch (198 bugs) followed by *Antilochus coquebertii* (65 bugs) family Pyrrhocoridae and *Diplonychus rusticus* (28 bugs) Family Belostomidae were recorded during the season (Table 1).

Order Coleoptera was also represented by the highest number of 3 families including 6 species in

which family Carabidae has the highest 4 predatory species. Among these species *Prothyma* sp. has the highest size of trap catch (37 beetles) followed by *Brachinus sexmaculeatus* (12 beetles) and *Chlaenius pictus* (10 beetles) while the Family Scarabaeidae and Hydrophidae were recorded one species each (Table 1).

Order Odonata was represented by 2 families 4 species in which Family Libellulidae has the highest 4 predatory species while the Family Coenagrionidae were recorded only one species. Among these species *Pantala flavescens* has the highest size of trap catch (22.5 dragon flies) (Table 1).

Order Hymenoptera was represented by 2 parasitic species belonging to 2 families, in which species *Dorylus* sp. recorded highest number of catches (73) under the family Formicidae followed by *Enicospilus purgatus* (55.5) family Ichneumonidae (Table 1).

Order Neuroptera was represented by 2 families and 2 predatory species in which species *Chrysoperla sillem* has been recorded highest trap catches (62) under the family Chrysopidae followed by *Ascalaphus sinister* (45) family Ascalaphidae (Table 1).

Order Orthoptera was represented by only one predatory species *Euconocephalus* sp. (5 crickets), family Tettigoniidae (Table 1).

Order Dermaptera was represented by only one predatory species *Elaunonbi partitus* (2), family Forficulidae (Table 1).

Order Dictyoptera was represented by only one predatory species *Archimantis latistyla* (16.5) belonging to family Mentidae (Table 1).

Order- Lepidoptera was represented by only one efficient pollinator species *Polyptychus dentatus* (2.5 moths), family Sphingidae (Table 1).

During the *rabi* 2019-20 and 2020-21 (pooled total) total 53 harmful species as crop pest and 24

beneficial species were collected from farmers field-I (Table 3).

It revealed that farmers field-I with traditional way of cultivation or less disturbance to ecosystem has shown the richness in terms of number of insect species. Whereas the ratio between beneficial insects and harmful crop pests at farmers field is 1: 2.20.

CONCLUSIONS

The present investigation has provided valuable information on taxonomic status of insect fauna of vegetable ecosystem. 77 insect species belonging to 10 orders and 37 families were recorded throughout the season. Lepidoptera was dominant order, recorded 32 species (42%) followed by Hemiptera 18 species (23%), order Coleoptera 11 species (14%), Odonata 4 species (5%), Orthoptera 3 species (4%) and Hymenoptera 3 species (4%) respectively. Orders of minor significance were represented by Diptera and Neuroptera having 2 species each (2%) while Dermaptera and Dictyoptera were represented by one species (1%) only.

Among all the families, noctuidae were recorded highest number of species (9) followed by Erabidae (5) Arctiidae (4) and Sphingidae (4) respectively. Family Pentatomidae Reduviidae and Pyrrhocoridae also represented 4 species each (Order Hemiptera).

Among all the harmful species, *Plutella xylostella* recorded highest number of catches (1133.5 moths) followed by *Plusia orichalcea* (1010 moths), *Leucinodes orbonalis* (927.5 moths), *Spodoptera litura* (673.5 moths) and *Helicoverpa armigera* (558.5 moths). Among the other order species highest number of catches were recorded with by *Nezara viridula* (326.5 bugs) followed by *Nephotettix virescens* (310 hoppers), *Dysdercus koenigii* (265 bugs) order Hemiptera and *Aulacophora foveicollis* (190 beetle) order coleoptera respectively as phytophagous insect species. Among all the harmful species *Pluchia orichalcea*, *Spodoptera litura*, *Helicoverpa armigera*, *Spodoptera frugiperda* and *Chrysodeixis chalcites* was recorded as major polyphagous pests.

Among all the beneficial species *Scadra annulipes* has the highest size of trap catch (204 bugs) followed by *Onitis falcatus* (78 beetles), *Dorylus*

sp (73 wasps), *Antilochus coquebertii* (67 bugs), *Enicospilus purgatus* (55.5 wasps) and *Diplonychus rusticus* (28 bugs) respectively.

Numbers of species were found more at farmer's field-I, the results indicated that farmer's field-I with traditional way of cultivation or less disturbance to ecosystem has shown the richness in terms of number of insect species. It can be concluded that due to less use of pesticides and fertilizers, species richness is observed at farmers field-I. Whereas the ratio between beneficial insects and harmful crop pests at farmer's field -I is 1: 2.20.

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