



E-ISSN: 2320-7078

P-ISSN: 2349-6800

JEZS 2019; 7(2): 641-646

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Received: 01-01-2019

Accepted: 05-02-2019

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Study on biodiversity of phototactic hexapod fauna by light trap in soybean (*Glycine max* L.) ecosystem

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Abstract

The present research work was conducted record the variability of phototactic arthropod fauna through the light trap in the soybean ecosystem at JNKVV research farm Jabalpur (M.P.). Insect pest fauna of the soybean crop collected through the light trap in JNKVV research farm during the year 2014 was documented and classified on taxonomic basis, economic aspect (crop pest) and bio control importance (parasites and predators). A total of 48 species were recorded. These phototactic insects belong to 9 orders and 31 families. Lepidoptera was the biggest order with 20 species. Other orders were Hemiptera (10 species), Coleoptera (9 species) and Orthoptera (3 species). Hymenoptera, Odonata, Isoptera, Neuroptera and Dictyoptera were the other order of minor significance. Based on economic significance this collection was represented by 34 species of harmful insects (as crop pests) 14 species of predatory and parasitic insects (useful as bio-control agents). Category of harmful insect pests includes 7 species belongs to soybean crop and remaining 27 pest species of different agricultural crops and forest trees. The present study reveals the valuable base line data on biodiversity of phototactic arthropods (insect pests) fauna of soybean ecosystem and provides broader scope of using a light trap as an Integrated Pest Management tool in soybean and other crops.

Keywords: light trap, insect pest fauna, soybean and ecosystem

Introduction

One of the most innate behaviors of insects is flying towards a light source at night known as phototaxis or phototactic. Light traps are effective and eco friendly tool used for entomological experiments and in IPM systems all over the world for survey, detection and control of insect pest population. Collections of a light trap provide a significant clue to the diversity of insects active at night [19]. Although much work has been done on use of light trap against pests of pulses and paddy but very little information is available on pests of soybean particularly in JNKVV research farm. Soybean is a 21st century crop introduced and commercially exploited in India [3]. Madhya Pradesh is a soybean state of India with highest area 62.20 lakh ha. and production 59.457 lakh tones. Insect pest damage is one of the main causes for low productivity. About 65 insect species have been reported to attack the soybean crop from emergence of crop to harvesting stage. In an effort to expand our knowledge on the arthropod (insect) fauna in the soybean ecosystem of JNKVV research farm, present study is put forth with the principal objective to collect valuable information on the diversity of insect pest fauna collected in light trap classified on taxonomic basis, economic aspect (crop pests) and bio-control significance for future reference.

Materials and Methods

Study site: The experiment was conducted at JNKVV research farm Jabalpur from July 2014 to Nov. 2014. It is situated at 24.26°N latitude, 79.21° E longitude and at an altitude of 349.170 m above the mean sea level.

Light trap design: The experiment was conducted by using the standard design of Jawahar light trap. The trap design was having attracting device and collection device which is made up of 24 gauge iron sheets. Mercury vapor lamp of 80 W. was used as light source. The insects collected in the collection chamber of light trap are killed by the exposure of Dichlorvos 76 EC vapor (as fumigant) which is directly placed in the collection chamber.

Sampling and sorting for specimen: Light trap was operated every night but collection of a single day per week was recorded from July 2014 to November 2014.

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Division of weeks was based on calendar days (i.e. Ist Week (1-7th day), IInd Week (8th to 15th day) IIIrd Week (16th to 23rd day), IVth Week (24th to 30th/31st day). Insects collected through light trap were first divided and recorded in to different taxonomical categories. Thereafter, the insect-pests are categorized on the basis of their economic importance viz., harmful (crop pests) and beneficial (predatory and parasitic species).

Identification of insects: Identification of insects was done on the basis of specimens available in insect museum of the Department of Entomology, JNKVV and with the help of Zoological Survey of India, Jabalpur. After counting the, specimen of concerned species were preserved as per the standard procedure. Dried specimens were kept in insect boxes and showcase for identification.

Results and Discussion

Analysis on composition of arthropod fauna on taxonomic basis

Documentation of taxonomic analysis (table1&2) revealed that 48 species of insect pest and beneficial once were recorded in soybean ecosystem. These insect species belongs to 9 insect orders and 31 families (Fig.1 Lepidoptera was the largest order with 20 species. Other major orders were Hemiptera (10 species), Coleoptera (09 species) and Orthoptera (03 species). Hymenoptera (2 species), Odonata, Isoptera, Neuroptera and Dictyoptera were the other orders of minor significance.

(15) Who also reported a record of 62 species through light trap catches at Jabalpur (2002-03). These species belonging to 11 orders and 36 families. Lepidoptera was the largest order with 31 species (5 & 6) also reported 35 species of Endoptera and Exoptera were collected in light trap catches.

Analysis on composition of arthropod fauna (insects) on economic basis

The total 48 species were grouped on the basis of their economic role in two categories namely (i) Harmful insect pests of crop (34 species) (ii) Beneficial bio control agents (12 predatory & 2 parasitic species). In crop pest category order Lepidoptera was the largest group including 8 families and 20 species (Fig.2). Under this order family Noctuidae included the largest number of 9 species^[2]. Observed a total of 438 species of Lepidoptera including Noctuids (222 species), Geometrids (127 species), Notodontids (27 species), Arctiids (26 species), Sphingids (10 species) and Saturniids (9 species). Similarly (8) reported collection of 44 species of families Sphingidae and Noctuidae of order Lepidoptera.

The major soybean and polyphagous pest species of this family includes *Helicoverpa armigera* (Hub.) (144), *Agrotis ipsiton* Huf. (121) *Spodoptera litura* Fab. (511). *Chrysodeixis chalcites* (Esper) (317) and *Thysanoplusia orichalcea* (Fabricius) (198). Comparing the relative size of trap catches of order Lepidoptera the highest catch was observed of Rice leaf folder, *Cnaphalocrocis medinalis* G. (951 moths) belonging to family Pyralidae (table 1)^[13]. Also reported the highest trap catch of *Cnaphalocrocis medinalis* G. at Jabalpur. Other major pest species are *Amsacta moorei* (359) and *Spilarctia obliqua* (479) of family Arctiidae and *Acherontia styx* (333) of family Sphingidae. The soybean defoliators [*Spodoptera litura* (Fab.), *Thysanoplusia orichalcea* (Fab.) *Spilarctia obliqua* (Wlk.)] and *Helicoverpa armigera* (Hubner) are feeding on foliage, flower and pods causing

significant yield loss^[20].

After Lepidoptera, Hemiptera was the next highest order of pest species in trap catch with 6 families and 6 species. The family Delphacidae was represented by *Sogatella furcifera* Harvath with highest trap catch of 8,391 hoppers. *Nephotettix* sp. (2,254), *Pyrilla perpusilla* (576) are the other major pest species of this order. Among the soybean pest green stink bug, *Nezara viridula* Linnaeus (733 bugs) family Pentatomidae was recorded throughout the period in trap catch^[14, 12]. also confirmed that *Nezara viridula* was one of the most abundant species recorded in light trap collection.

Order Coleoptera was represented by 4 families and 4 species. *Aulocophora faveicollis* was highest in trap catch size (435 beetles). The other major species of this order included, *Mylabris pustulata* (121), *Anomala viridis* (59) and *Holotrichia consanguinea* (39). In conformity with the present findings^[17] also reported highest trap catch of *A. faveicollis* among the other coleopterous including *Mylabris pustulata*, *Anomala viridis* and *Holotrichia consanguinea*. Similarly^[11] and^[10] also observed the collection of white grubs, *Holotrichia consanguinea* and blister beetle *Epicacuta* sp. in light trap.

Order Orthoptera was represented by 2 families in which highest trap catch was of *Gryllus* sp. (4,821) (fam. Gryllidae) followed by Grass hoppers, *Trilophidia cristata* (333) & *Gastrimaris transversus* (221). Vaishampayan (2002) also reported light trap catches of grass hoppers, *Trilophidia cristata* and *Gastrimaris transversus*, at Jabalpur (M.P.). While^[18] reported that the nocturnal Orthopterous were represented by six families viz. Gryllidae, Gryllotalpidae, Tettigoniidae (belonging to Suborder Ensifera) and Acrididae, Tridactylidae, and Tetrigidae (belonging to Suborder Caelifera) in light trap catches.

Order Isoptera was the smallest one with single family (Termitidae) and single species *Odontotermes obesus* (Rambur) (479)^[16, 9]. Also recorded the termite swarming through light trap.

Group-II) Beneficial insects- as bio-control agents (predators and parasites):

Group of beneficial predatory species as natural Bio-control agent was represented by 6 orders, 10 families and 14 species (Table 2). Among these orders Coleoptera was the highest order with 3 families and 5 species (Fig.3). Family Carabidae has the maximum number of 3 species namely *Deserida lineola* (197), *Crospedophorus* sp. (136) and *Chlaenius* sp. (71). The highest size of trap catch of 5,512 beetles was recorded in *Coccinella* sp. of the family Coccinellidae. Order Hemiptera was represented by 3 families and 4 species. Major predatory species were *Eocanthecona furcellata* (189), *Sirthena* sp. (120) and *Antilochus* sp. (83).

(7) Observed 21 predaceous and 8 parasitic species of insect collected in light trap at Jabalpur including Carabids and Cicindelids and Reduviids as most responsive to light. Similarly (22) reported that a total of 17 predatory species belongs to 9 families and 4 parasitic species belonging to 2 families^[4]. Also reported 17 families of Coleoptera trapped at light including 89 species of Carabidae and 13 species of Coccinellidae in North India.

Among the other predatory orders Odonata was represented by *Libellula* sp. (299) belonging to family Libellulidae. Similarly (15) also reported that predatory order Odonata was represented by *Libellula* sp. (213) & *Coenagrion* sp. (48). Dictyoptera and Neuroptera were represented by only one species *Statilia maculate* (fam. Mentidae) and *Chrysoperla*

sillemi (Esben-petersen) (Family- Chrysopidae). Similar observations were made by [21].

Parasitic species were represented by order Hymenoptera, having two species namely *Enicospilus purgatus* (Say) (51) and *Vespa orientalis* Linnaeus (67) family Ichneumonidae.

The present investigation has provided voluble information on presence, occurrence, distribution and population dynamics of 48 phototactic insect species in soybean ecosystem at JNKVV research farm. Among these 34 crop pest species 7 species belongs to soybean and remaining 27 pest species of different agricultural crops and forest trees. This will serve as base line

data, useful at present and in future for surveillance and monitoring of insect pests, for forecasting and also in use of light trap as Integrated Pest Management tool against these pest species of soybean and other economically important crops of this region. The present study also gives the status of phototactic beneficial fauna as bio control agents (predatory & parasitic species) their occurrence, activity and distribution in soybean ecosystem of this region which is very important in planning the IPM programme for different crops of this region with a view to conserve the bio control agents.

Table 1: Taxonomic distribution of insect pest species collected in light trap in soybean ecosystem during July 2014 to Nov. 2014
Group-I: Harmful insect pest species as crop pest

S. No.	Insect species collected		Season's total collection* (July 2014 to Nov. 2014.)	Economic status as crop pest
Order-Lepidoptera				
i) Fam.-Noctuidae				
1.	1.	<i>Helicoverpa arimgera</i> (Hubner) (Gram pod borer)	144	Major polyphagous pest of pulses, cotton & vegetable. Major Pest of Soybean
2.	2.	<i>Agrotis ipsilon</i> (Hufnagel) (Black cut worm)	121	Major pest of pulses
3.	3.	<i>Spodoptera litura</i> Fabricius (Tobacco caterpillar)	511	Major polyphagous, pest of vegetables, peas. Major Pest of Soybean
4.	4.	<i>Thysanoplusia orichalcea</i> (Fabricius) (Green semilooper)	198	Pest of cabbage and cauliflower Major Pest of Soybean
5.	5.	<i>Chrysodeixis chalcites</i> (Esper) (Cabbage semilooper)	317	Pest of cabbage and cauliflower
6.	6.	<i>Mythimna separata</i> (Walker) (Army worm)	146	Major pest of Paddy
7.	7.	<i>Hyblaea puera</i> Cramer (Teak defoliator)	105	Major pest of Teak
8.	8.	<i>Earias vittella</i> Fab. (Shoot and fruit borer)	114	Major pest of Okras, cotton
9.	9.	<i>Sesamia inferens</i> (Jowar stem borer)	288	Major pest of Sorghum
ii) Fam.- Arctiidae				
10.	10	<i>Spilarctica obliqua</i> Walker (Bihar hairy caterpillar)	479	Major polyphogous pest Sesamam, mung, linseed, mustard and vegetables Major Pest of Soybean
11.	11.	<i>Amsacta moorie</i> Butler (Red hairy caterpillar)	359	Major pest of sunnhemp, maize and jowar Minor Pest of Soybean
12.	12.	<i>Utetheisa pulchella</i> (Sunnhemp hairy caterpillar)	186	Major pest of sunnhemp
iii) Fam.-Pyralidae				
13.	13.	<i>Cnaphalocrocis medinalis</i> (G.) (Rice Leaf folder)	951	Major pest of paddy
14.	14.	<i>Scirpophaga nivella</i> (Sugarcane top shoot borer)	245	Major pest of sugarcane
iv) Fam.- Hyspidae				
15.	15.	<i>Argna cribraria</i> (Sunnhemp caterpillar)	101	Pest of sunnhemp
v) Fam.-Sphingidae				
16.	16	<i>Acherontia styx</i> (Westwood) (Til howk moth)	333	Major pest of sesamum and minor pest of potato, bringal etc. Minor Pest of Soybean
17.	17	<i>Daphinis nerii</i>	390	Forest and fodder crop pest
vi) Fam.-Nymphalidae				
18.	18	<i>Melanitis ismene</i> Cramer (Rice butterfly)	76	Pest of paddy
vii) Fam.-Hesperiidae				
19.	19	<i>Pelopidas mathias</i> (Rice skipper)	66	Pest of paddy
viii) Fam.-Syntomidae				
20.	20	<i>Creyx godarti</i>	654	Forest and fodder crop pest
Order-Hemiptera				
i) Fam.-Delphacidae				
21.	1	<i>Sogatella furcifera</i> (Harvath) (White baked plant hopper)	8391	Major pest of paddy
ii) Fam.- Cecadelidae				
22.	2	<i>Nephotettix</i> sp. (Green leaf hopper)	2254	Major pest of paddy
iii) Fam.- Fulgoridae				

23	3	<i>Pyrilla</i> sp. (Sugarcane leaf hopper)	576	Major pest of sugarcane
iv) Fam.-Coreidae				
24	4.	<i>Leptocoris</i> sp. (Rice gandhi bug)	43	Major pest of paddy
v) Fam.-Pyrrhocoridae				
25	5.	<i>Dysdercus cingulatus</i> . Fabricius (Red cotton bug)	54	Major pest of cotton. miner pest of okra, maize & pearl millet
vi) Fam.-Pentatomidae				
26	6.	<i>Nezara viridula</i> Linnaeus (Green stink bug)	733	Pest of potato and Minor Pest of soybean
Order-Coleoptera				
i) Fam.- Chrysomelidae				
27	1	<i>Aulacophora foveicollis</i> (Lucas) (Red pumpkin beetle)	435	Major pest of cucurbitaceous vegetables
ii) Fam.-Rutelinae				
28	2	<i>Anomala viridis</i> (Cockchafer beetle)	59	Pest of paddy
iii) Fam.-Melalonthidae				
29	3	<i>Holotrichia consanguinea</i> (White grub)	39	Major Pest of Soybean Polyphagous pest, particularly of sugarcane, sorghum, maize and vegetables etc.
iv) Fam.-Meloidae				
30	4.	<i>Mylobris pustulata</i> (Blister beetle)	121	Pest of sorghum
Order-Orthoptera				
i) Fam.- Acridiidae				
31.	1.	<i>Trilophidia cristata</i> Grass hopper	333	Major pest of paddy
32.	2.	<i>Gastrimargus transverses</i>	221	Major pest of paddy
ii) Fam.-Gryllidae				
33.	3	<i>Gryllus</i> sp. (Field cricket)	4821	Pest of paddy
Order-Isoptera				
i) Fam.-Termitidae				
34.	1.	<i>Odontotermes obesus</i> (Rambur) (Termite)	479	Major pest of wheat, sugarcane and cereals

*Single day's collection per week and 4 days collection per month

Table 2: Taxonomic distribution of insect species collected in light trap in soybean ecosystem during July 2014 to Nov. 2014 Group-II beneficial – predatory & parasitic species as natural biocontrol agents

S. No.	Insect species collected		Season's total collection* (July 2014 to Nov. 2014.)	Economic status beneficial predator – as biocontrol agents
Order-Coleoptera				
i) Fam.-Carabidae				
1.	1.	<i>Deserida lineola</i>	197	-
2.	2.	<i>Crospedophorus</i> sp.	136	Predator of lepidopterous larvae and soft bodied insects
3.	3.	<i>Chlaenius</i> sp.	71	Predaceous upon <i>Laphgma pyrausta</i> nubilalis, <i>Pinusinsiguos</i> etc.
ii) Fam.-Coccinellidae				
4.	4.	<i>Coccinella</i> sp.	5,512	Predator of aphids, coccids, white fly, bugs, pyrilla etc.
iv) Fam.- Cicindelidae				
5.	5.	<i>Cicindela</i> sp.	132	Predaceous upon lepidoterous larvae and small insects
Order-Hemiptera				
i) Fam.-Reduviidae				
6.	1.	<i>Sirthena</i> sp.	120	General predator, feed upon <i>Oryctes</i> sp., <i>Scapterisus</i> sp. and small insects
7.	2.	<i>Ectomocoris cordiger</i>	107	Predator upon- Caterpillars and small insects
ii) Fam.-Pentatomidae				
8.	3.	<i>Canthecona furcellata</i> (Wolff)	189	Predaceous up on caterpillars and small insects
iii) Fam.- Pyrrhocoridae				
9.	4.	<i>Antilochus</i> sp.	83	Predator of nymphs of red cotton bug
Order-Odonata				
i) Fam.-Libellulidae				
10.	1.	<i>Libellula</i> sp.	299	General predator of Lepidotarous, Dipterous and Hymenopterous insects
Order-Hymenoptera				
i) Fam.- Ichneumonidae				
11.	1.	<i>Enicospilus purgatus</i> (Say)	51	Larval parasite of stem borer, leaf folder and Lepidopterous insects
12.	2.	<i>Vespa orientalis</i> Linnaeus	67	General parasite of Lepidopterous, Coleopterous and Dipterous insects
Order- Neuroptera				
i) Family- Chrysopidae				

13.	1.	<i>Chrysoperla sillemi</i> (Esben-petersen)	10	General predator on leaf hoppers and aphids
Order-Dictyoptera				
i) Fam.-Mantidae				
14.	1.	<i>Statilia maculata</i>	91	Nymphs feed upon- leaf hoppers and aphids while adults feed on caterpillars, grass hopper

*Single day's collection per week and 4 days collection per month

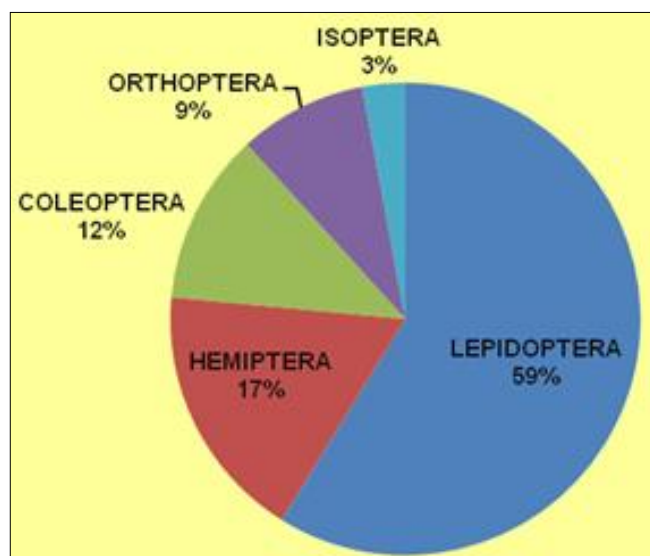


Fig 1: Percentage shared by different insect pests orders in total trap catch (July-Nov. 2014)

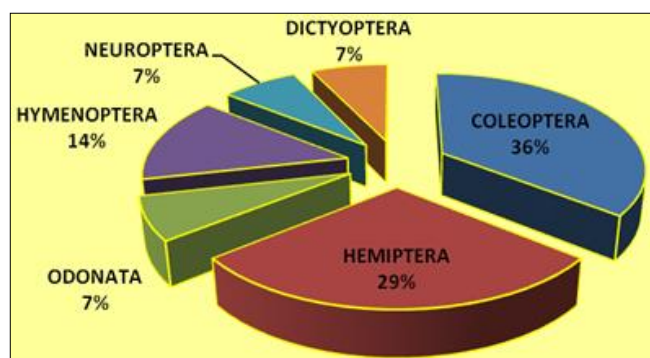


Fig 1: Percentage shared by different predatory & parasitic pest orders in total trap catch (July-Nov. 2014)

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