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Taxonomic documentation of total insect fauna of medicinal plants collected through light trap in Jabalpur district

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Abstract
The present research work on "Taxonomic Documentation of Total Insect Fauna of Medicinal Plants Collected Through Light Trap in Jabalpur District" was conducted at the Medicinal garden in collage of agriculture, Jabalpur (MP) during the period between last week of September 2018 to last week of March 2019. A total of 51 insect species belonging to 10 orders and 30 families were recorded throughout the season (*Rabi* 2018-19) based on number of species collected, largest collection was represented by order Lepidoptera 24 species (46%) followed by order Coleoptera 9 species (17%), Hemiptera 6 species (11%) and Orthoptera 3 species (6%) in descending order respectively, orders of minor significance were represented by Hymenoptera, Odonata and Neuroptera having 2 species each while Dermaptera, Diptera and Dictyoptera were represented by one species only. These species were grouped on the basis of their economic importance in two major categories *viz*. Harmful insects-as crop pests 33 species, beneficial insects-as predators and parasites 16 species. The present study also reviles that documented information on these species gives broader scope of using light trap as integrated pest management tool against these insect pests of medicinal, vegetables and other crops.

Keywords: Taxonomic, medicinal plants, light trap, insect pest, documentation

Introduction
Medicinal plants are known to Indian traditional healers since time immemorial. The plants were collected, by and large, from the wild and were used in many preparations of wellness products. India is endowed with diverse group of medicinal plants accounting for more than 8000 species which are being used in more than 10,000 herbal products. Ninety percent of herbal industry's requirement of raw materials is meted out from the natural ecosystem – forests – resulting in ruthless exploitation and destruction of its natural habitats (Mathivanan *et al*. 2016) [5].

Medicinal plants play an important role in achieving the goal of personal and public health care globally as the trend of poor health index across all age groups around the world and the incidents of death due to non communicable diseases are rising at an alarming rate. Since antiquity, these medicinal plants have been conserved and protected for their medicinal properties and hence Indian sub-continent is a rich repository of these plants. Like any other plant, medicinal plants are attacked by a plethora of insect and mite pest species that depreciate the quality and quantity of raw materials and the therapeutic values in these plants. Medicinal plants (MP) significantly contribute to affordable healthcare and livelihood security, making them one of the most valuable non-timber forest products. (Kumari and Shrinivas, 2018) [4]. Light trap is also used for detection of new invasions of insect pest in time and/or space, for delimitation of area of infestation, and for monitoring population levels of established pests. With the introduction of the concepts of "Integrated Pest Management" and "Economic Threshold" around 1975 and revival of non chemical methods of pest control, light trap gained a wide spread importance in Integrated Pest Management strategies in many parts of the world. Urgency was felt to use non chemical approach in pest control which is economically viable and environmentally safe. Use of light trap is one such approach in which pest control is achieved without the use of insecticides (Vaishampayan and Vaishampayan, 2016) [12].

Materials and Methods
The experiment was conducted at the Medicinal garden in collage of agriculture Jabalpur (MP) during the period between last week of September to last week of March, 2018-19.

New Jawahar light trap model developed at JNKVV, Jabalpur with mercury vapor lamp (125 W) as light source was used for the present study.

The insects collected in the chamber of light trap were killed by the exposure of Dichlorvos 76 EC vapours (as fumigating agent) which is directly placed in collection tray for instant killing of trapped insects.

For the taxonomic documentation, the 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 species and their family. Identification of insects was done on the basis of specimens available in insect museum of the Department, Department of Entomology, UAS, Bangalore and Zoological Survey of India, Jabalpur. After counting, dried specimens were prepared by keeping the pinned insects in oven for 24 hours at 30 °C and thereafter well labeled specimens were stored in insect boxes and show cases.

Results and Discussion

A total of (51) insect species belonging to 10 orders and 30 families were recorded throughout the season (*Rabi* 2018-19). Based on number of species collected, largest collection was represented by order Lepidoptera 24 species (46%) followed by order Coleoptera 9 species (17%), Hemiptera 6 species (11%) and Orthoptera 3 species (6%) in descending order respectively. Orders of minor significance were represented by Hymenoptera, Odonata and Neuroptera having 2 species each while Dermaptera, Diptera and Dictyoptera were represented by one species only. To study the relative size of trap catches of various species collected in different taxonomic groups, collection of entire *Rabi* 2018-19 (September-2018 to March-2019) was recorded species wise. These species were grouped on the basis of their economic importance in two major categories *viz*. Harmful insects- as crop pests and beneficial insects- as predators and parasites were given in Table 1 and 2.

In accordance with the present findings, Kakade *et al*. (2018) [3] reported that a total 54 insect species belonging to 10 orders and 33 families were recorded throughout the season (*Rabi* 2016-17) based on number of species collected, largest collection was represented by order Lepidoptera 24 species followed by order Coleoptera 8 species, Hemiptera 8 species, Orthoptera 3 species and Hymenoptera 2 species in descending order respectively. Orders of minor significance are represented by Odonata, Diptera and Neuroptera having 2 species each while Dermaptera and Dictyoptera were represented by one species only (Fig.1).

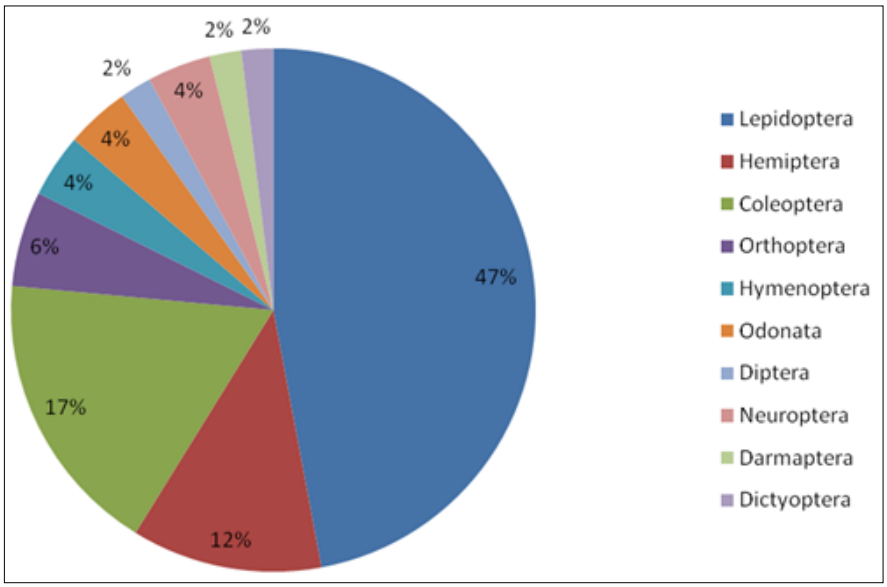

Fig 1: Percent distribution of insect species of different order trapped light trap installed in Medicinal garden at Jabalpur in *Rabi* 2018-19 (September to March).

3.1 Group-I) Harmful insects- as crop pests

Among the harmful crop pest species, order Lepidoptera was represented by the highest number of 7 families including 24 species (46%), in which family Noctuidae has the highest 9 species (Fig.2). This family includes 7 species as important pests of different crops. Among these species, *Helicoverpa armigera* (Hubber) has the highest size of trap catch (779 moths) followed by *Plusia orichalcea* (Fabricius) (741 moths), while the lowest size of trap catch was of *Hyblaea puera (Cramer)* (97 moths) and *Bastilla crameri* (Moore) (87 moths). In accordance to the present findings, Bernardi *et al*. (2011) reported that a total of two thousand and twenty individuals belonging to 14 families, 106 genera and 220 species were collected by using light traps. The families with the highest number of species collected were Noctuidae (59), Geometridae (30), Arctiidae (28) and Saturniidae (14).

Five major polyphagous pest species of Lepidoptera namely, *Plusia orichalcea* (Fabricius) (741 moths), *Spodoptera litura* Fabricius (638 moths), *Spilosoma obliqua* (Walker) (597 moths), *Helicoverpa armigera* (Hubner) (538 moths) and *Agrotis ipsilon* (Hufnagel) (366 moth) were also recorded during the season in trap catches. Similarly, Sharma and Vaishampayan (2009) [8] and Sharma (2004) also reported that *Helicoverpa armigera*, *Agrotis ipsilon* and *Spodoptera litura* were the major polyphagous pests of family Noctuidae through trap catches at Jabalpur. Dangi (2004) [1] also reported that *Spodoptera litura* Fabricius, *Helicoverpa armigera* (Hubner), *Agrotis ipsilon* (Hufnagel) and *Plusia orichalcea* (Febricius) as polyphagous pests of family Noctuidae, in light trap catches at Jabalpur. Other pest species of order Lepidoptera are *Euproctis similis* (Moore) (353 moths) family Erebidea, *Agrius convolvuli* (Linnaeus) (115 moths) and

Acherontia styx (Westwood) (19 moths) Family Sphingidae, *Cretonotos gangis* (Linnaeus) (782 moth) and *Amata* sp.(520 moth) family Arctiidae, *Chilo partellus* (Swinhoe) (48 moths) family Pyralidae, *Palpita vitrealis* (Rossi) (13 moths) family Crambidae, *Melanitis leda ismene* (Cramer) (164 butterflies) family Nymphalidae, *Mythimna separata* (Walker) (516 moths) and *Asota ficus* (Fabricius) (361 moths) family Noctuidae, (Table 1).

Table 1: Taxonomic distribution of Harmful insects-as crop pests collected in light trap during *Rabi* season (2018-19) at Jabalpur.

S. No.	Insect species collected	Total of seasons collection (September to March)	Economic status as crop pest
	Order- Lepidoptera		
	A) Family-Noctuidae		
1	*Helicoverpa armigera* (Hubner) Gram pod borer	779	Major polyphagous pest of pulses, potato, tomato, chilli, okra and cotton. Major pest of Muskdana, Sarpgandha.
2	*Spodoptera litura* (Fabricius) Tobacco caterpillar	724	Major polyphagous pest of soybean, cabbage, cucurbits, potato, chilli and pea etc.Major pest of Brahmi.
3	*Chrysodeixis chalcites* (Esper) Green semi looper	440	Pest of soybean, potato, tomato and bean etc.
4	*Mythimna separata* (Walker) Army worm	516	Major pest of paddy.
5	*Plusia orichalcea* (Fabricius) Cabbage semilooper	741	Major polyphagous pest of vegetable crops, cabbage, cauliflower etc. Major pest of Babchi, Bael.
6	*Asota ficus* (Fabricius)	361	Fodder pest
7	*Agrotis ipsilon* (Hufnagel) Cutworm	663	Major polyphagous pest of pulses, pest of cabbage, cucurbits, potato. Major pest of Muskdana, Ashwagandha, Sarpgandha.
8	*Hyblaea puera* (Cramer) Teak defoliator	97	Major pest of teak.
9	*Bastilla crameri* (Moore)	87	Pest of cereals.
	B) Family- Arctiidae		
10	*Creatonotos gangis* (Linnaeus) Tiger moth	782	Polyphagous pest.
11	*Amata* sp. Seven spotted moth	520	Fodder pest.
12	*Spilarctia obliqua* (Walker) Bihar hairy caterpillar	597	Major polyphagous pest of sesame, linseed and minor pest of cabbage and sweet potato. Major pest of Sarpagandha, Sonapatha, Turmeric, Sadasuhagan.
13	*Amsacta moorei* (Butler)	59	Sarpagandha, Isbagol.
	C) Family-Sphingidae		
14	*Agrius convolvuli* (Linnaeus) Spingid moth	115	Major pest of sweet potato, sunflower and soybean.
15	*Acherontia styx* (Westwood) Til hawk moth	19	Major pest of sesame and minor pest of potato.
16	*Daphinis niri* (Linnaeus) Sphingid caterpillar	177	Major pest of Sarpgandha, Serpentine.
	D) Family- Pyralidae		
17	*Chilo partellus* (Swinhoe) Maize stem borer	48	Major pest of maize and sorghum
	E) Family- Nymphalidae		
18	*Melanitis leda ismene (Cramer) Rice butter fly*	164	Major pest of paddy
	F) Family- Erebidae		
19	*Euproctis similis (Moore)*	353	Minor pest of paddy and ragi
20	*Cyana peregrine (Walker)*	118	Pest of grasses
21	*Digama sp. (Moore)*	73	Pest of Natal plum (Carissa sp.)
22	*Eudocima aurantia (Moore)*	68	Pest of Lemon Grass.
23	*Utetheisa ornatrix (Linnaeus)*	67	Pest of Fodder crop.
24	*Palpita vitrealis (Rossi) Jasmine moth*	13	Pest of ornamental plant (Jasmine)
	Order- Hemiptera		
	A) Family-Pentatomidae		
25	*Nezara viridula (Linnaeus) Green stink bug*	635	Major polyphagous pest of soybean, pigeon pea and vegetable crops. Pest of Sarpagandha, pudina.
	B) Family- Cicadellidae		
26	*Nephotettix virescens (Distant) Green leaf hopper*	1399	Major pest of paddy.Pest of Babchi, Bael.
	C) Family-Pyrrhocoridae		
27	*Dysdercus koenigii (Fabricius) Red cotton bug*	430	Major pest of cotton and okra. Pest of Muskdana, Sarpagandha.
	Order- Coleoptera		
	Family- Chrysomelidae		
28	*Aulacophora foveicolis (Lucas)*	779	Major pest of cucurbitaceous particularly pumpkin. Pest of Muskdana.
29	*Altica oleracea (Linnaeus).*	193	Poliphagous pest.
	Family- Cerambycidae		
30	*Stromatium barbatum (Fabricius) Bamboo borer beetle*	78	Pest of bamboo and Teak
	Order- Orthoptera		
	A) Family- Gryllidae		

31	*Euscyrtus concinnus (de Haan)Field cricket*	992	Pest of fodder grasses
	B) Family- Gryllotalpidae		
32	*Gryllotalpa orientalis (Burmeister) Mole cricket*	513	Pest of paddy. Pest of Safed Mushli.
	Order- Diptera		
	A) Family- Bibionidae		
33	*Plecia amplipennis (Skuse)*	282	Fodder pest

In accordance with the present findings Mishra (2016) [6] also reported pest species of order Lepidoptera were *Euproctis similis* (Moore) (153 moths) family Lymentriidae, *Agrius convolvuli* (Linnaeus) (165 moths) and *Acherontia styx* (Westwood) (77 moths) Family Sphingidae, *Cretonotos gangis* (Linnaeus) (804 moth) and *Amata* sp.(295 moth) family Arctiidae, *Chilo partellus* (Swinhoe) (88 moths) family Pyralidae, *Palpita vitrealis* (Rossi) (42 moths) family Crambidae and *Asota ficus* (Fabricius) (611 moths) family Noctuidae, *Melanitis leda ismene* (Cramer) (565 butterflies) family Nymphalidae, *Mythimna separata* (Walker) (565 moths) family Noctuidae.

After Lepidoptera, Hemiptera was the next highest order of pest species in trap catches with 3 families and 3 species. The family Pentatomidae is represented by *Nezara viridula* (Linnaeus) (635 bugs), followed by *Nephotettix virescens* (Distant) (1399 hoppers) and *Dysdercus koenigii* (Fabricius) (430 bugs). Where as Muchala (2014) observed 5 families and 8 species of lepidoptera. The family Cicadelidae was represented by *Nephotettix virescens* (Distant) with a highest trap catch of 22,753 hopper followed by *Pyrilla perpusilla* Walker (1890 hoppers), *Nezara viridula* Linnaeus (964 bugs), *Dysdercus koenigii* (Fabricius) (401 bugs) *Antestiopsis cruciata* (Fabricius) (187 bugs). Where as Muchala observed the family Cicadelidae was represented by *Nephotettix virescens* (Distant) with a highest trap catch of 22,753 hoppers followed by *Pyrilla perpusilla* Walker (1890 hoppers), *Nezara viridula* Linnaeus (964 bugs), *Dysdercus koenigii* (Fabricius) (401 bugs) *Antestiopsis cruciata* (Fabricius) (187 bugs).

Order Coleoptera was represented by 2 families and 3 species. The family Chrysomelidae, is represented by *Aulacophora foveicollis* (Lucas) with a highest trap catch of (779 beetles) followed by *Altica* sp. (193 beetles), family Cerambycidae, *Stromatium barbatum* (78 beetles). Similarly Sharma *et al*. (2010) also recorded highest trap catch of *Aulacophora foveicollis* (451 beetles) among coleopteran at Jabalpur.

Order Orthoptera was represented by 2 families and 2 species. Among two species of this order highest trap catch was of Field cricket**,** *Euscyrtus concinnus* (de Haan) (992 crickets) followed by Mole cricket, *Gryllotalpa orientalis* (Burmeister) (513 crickets). In contrast with the present findings, Sharma *et al.* (2006) reported that order Orthoptera was represented by 3 families in which highest trap catch was of *Gryllus* sp. (3854) (fam. Gryllidae) followed by Grass hoppers *Trilophidia cristella* S. (311) & *Gastrimargus transversus* T. (387) and *Gryllotalpa gryllotalpa* (Linn.) (213) at Jabalpur.

Order Diptera was represented by one family i.e. Bibionidae with single species *Plecia amplipennis* (Skuse) (282 flies). In conformity with the present findings Muchala (2014) also reported that order Diptera was represented by only one family i.e. Bibionidae with single species *Plecia amplipennis* (Skuse.) The size of catch was 2941 adults.

Group –II) Beneficial insects as predators and parasites

Group of beneficial insects as predators and parasites was represented by 6 orders, 13 families & 14 species as predators and 1 order, 2 families and 2 species as parasites. Among the predatory species order Coleoptera was represented by the highest number of 3 families including 5 species in which family Carabidae has the highest 3 predatory species namely *Chlaenius pictus* (Choudoir) (58 beetles), *Cicindela flexuosa* (Distant) (24 beetles) and *Prothyma* sp. (6 beetles). Family Hydrophilidae and family Scarabaeidae was represented by one species Water beetle, *Hydrochara caraboides* Latreille (105 beetles) and Dung beetle, *Onitis falcutus* (Wulfen) (106 beetles). Similar to the present findings Mucchala (2014) also reported 7 orders, 15 families & 25 species as predators and 1 order, 3 families & 4 species as parasites. Family Scarabaeidae was reported by one species Dung beetle, *Onitis falcutus* (Wulfen) (106 beetles) among all the species of order Coleoptera.

Order Hemiptera was represented by 3 families and 3 species. Major predatory species were *Diplonychus rusticus* (Fabricius) (187 bugs), *Antilochus conqueberti* (Fabricius) (19 bugs) and *Sirthenea carinata* (Fabricius) (28 bugs). Similarly, Sharma *et al.* (2013) [1] reported that order Hemiptera was represented by 4 families and 6 species in trap catches including major predatory species *viz. Antilochus sp*. (126) and *Sirthenea* sp. (96).

Order Hymenoptera was represented by 2 families and 2 species as parasites. *Enicospilus purgatus* (Say) (139 wasps) has the highest trap catch followed by *Dorylus* sp. (21 wasps). Mishra (2016) [6] also reported that order Hymenoptera was represented by 3 families and 4 species as parasites. In terms of relative size of trap catch *Enicospilus purgatus* (Say) (227 wasps) has the highest trap catch followed by *Dorylus* sp. (69 wasps).

Order Odonata contained two families and two species namely *Pantala flavescens* (Fabricius) (90 flies) and *Coenagrion* sp. (64 flies) which belongs to family Libellulidae and Coenagrionidae respectively. Similarly, Sharma *et al*. (2013) [1] also reported that predatory orders Odonata was represented by *Libellula* sp. (213) and *Coenagrion* sp. (48) belonging to family Libellulidae and Conenagriidae, respectively.

Order Neuroptera was represented by two families and two species namely *Chrysoperla sillemi* (Esben-petersen) (163 green lace wings) and *Ascalaphus* sp. (100 flies) which belongs to family Chrysopidae and Ascalaphidae respectively. Similarly, Honek and Kraus (1981) [2] also reported that *Chrysoperla sillemi* (Esben88-petersen) (Neuroptera: Chrysopid ae) active from though light trap catches.

Order Dermaptera, Dictyoptera and Orthoptera were represented by only one species each i.e. Mantis, *Archimantis latistyla* (Serville) (34 mantis) family Mentidae, Earwigs, *Elaunon bipartitus* (Kirby) (66 earwigs) family Forficulidae and Long horn predatory grass hopper, *Conocephalus* sp. (37 hoppers) family Tettigoniidae respectively. Muchala also reported order Dermaptera, Dictyoptera and Orthoptera were represented by only one species each i.e. Ear wigs, *Elaunon bipartitus* (Kirby) (240 ear wings) family Forficulidae; Mantis, *Archimantis latistyla* (Serville) (8 mantis) family Mentidae and Long horn predatory grass hopper, *Conocephalus* sp. (238 hoppers) family Tettigoniidae respectively, (Table2).

Table 2: Taxonomic distribution of beneficial insects - predators and parasites collected in light trap during *Rabi* season (2018-19) at Jabalpur.

S. No.	Insect species collected	Total of seasons collection (September to March)	Economic status Beneficial- Predatory/parasitic
Order- Coleoptera			
A) Family- Carabidae			
1	*Prothyma* sp. Tiger beetle	6	Predator of Colorado potato beetle and small insects
2	*Cicindela flexuosa* (Distant)	24	General predator of small insects
3	*Chlaenius pictus* (Choudoir)	58	General predator of Lepidopterous larvae
B) Family- Hydrophilidae			
4	*Hydrochara caraboides* (Latreille) Water scavenger	105	General predator of aquatic insects
C)Family- Scarabaeidae			
5	*Onitis falcutus* (Wulfen) Dung beetle	106	General predator of aphid, coccids, white fly and bugs
Order- Hemiptera			
A) Family- Reduviidae			
5	*Sirthenea carinata* (Fabricius)	28	Predator of mole cricket and G*ryllus* sp.
C)Family- Belostomatidae			
6	*Diplonychus rusticus* (Fabricius) Water bug	187	Feed on aquatic insects
D)Family- Pyrrhocoridae			
Order- Hymenoptera			
B) Family- Formicidae			
8	*Dorylus* sp. (Fabricius)	21	General parasite of Lepidopterous and Dipterous insects
C)Family- Ichneumonidae			
9	*Enicospilus purgatus* (Say)	139	Larval parasite of stem borer, leaf folder and Lepidopterous insects
Order- Odonata			
A)Family- Coenagrionidae			
10	*Coenagrion* sp.(Kirby) Damsel fly	64	Predator of monarch butterfly, stem borer, gall midge and leaf eating caterpillar
B) Family- Libellulidae			
11	*Pantala flavescens* (Fabricius) Dragon fly	90	General predator on Lepidopterous, Dipterous and Hymenopterous insects
Order- Neuroptera			
A)Family- Chrysopidae			
12	*Chrysoperla sillemi* (Esben-petersen)	163	General predator on leaf hoppers and aphids
B)Family- Ascalaphidae			
13	*Ascalaphus* sp.(Walker) Owl fly	100	Adult feed on caterpillars and grubs
Order- Dictyoptera			
A) Family- Mentidae			
14	*Archimantis latistyla* (Serville) Preying Mantid	34	Nymph feed on leaf hopper and aphids while adult feed on caterpillars
Order- Orthoptera			
Family- Tettigoniidae			
15	*Conocephalus* sp. Long horn grass hopper	37	Predator of Lepidopteran eggs
Order- Dermaptera			
A) Family- Forficulidae			
16	*Elaunon bipartitus* (Kirby) Earwigs	66	General predator on Lepidopteran larvae

Conclusions

The present investigation has provided valuable information about taxonomic status of insect fauna of medicinal plants. Taxonomic analysis revealed that these 52 insect species belonging to 10 orders and 30 families were recorded throughout the season (*Rabi* 2018-19) based on number of species collected, largest collection was represented by order Lepidoptera 24 species (46%) followed by order Coleoptera 9 species (17%), Hemiptera 6 species (11%) and Orthoptera 3 species (6%) in descending order respectively, orders of minor significance were represented by Hymenoptera, Odonata and Neuroptera having 2 species each while Dermaptera, Diptera and Dictyoptera were represented by one species only.

The investigation also has provided information on presence occurrence, distribution and population dynamics of insect pest of medicinal plants and beneficial insects as well. The data collected serve as base line data, useful at present and future for surveillance and monitoring of insects for forecasting and also in use of light trap as Integrated Pest Management tool against these pest species of medicinal plants and other economically important crop of this region.

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