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Diversity of Insect Fauna in Horticultural Crops of Assam Agricultural University, Campus, Jorhat, Assam

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ABSTRACT
A study was conducted to know the status of abundance of various insect species under different orders in banana, citrus, brinjal, tomato, cabbage and okra crops present in experimental garden, Department of Horticulture, Assam Agricultural University, Jorhat, Assam. Insects were collected by sweeping nets and hand picking from January 2016 to November 2016 . Altogether 85 species of insects belonging to 8 orders and 34 families have been recorded. Per cent relative species abundance for different orders were 31.76% (Lepidoptera), 38.82%, (Coleoptera),10.58%, (Hymenoptera), 14.11%,(Hemiptera),7.05%(Orthoptera), 5.8% (Odonata), 3.5% (Diptera), 1.1% (Neuroptera).Among the orders, Coleoptera was the dominant one followed by Lepidoptera, hemiptera and the lowest abundant one was Neuroptera. Among the families, Coccinellidae was the dominant one with six species and the lowest one was Chrysopidae with one species i.e. Chrysoperla carnea .Among the crops, highest number of insect species were found in Brinjal (12 species) followed by cabbage and okra (11species) and lowest was found in Banana (3 species).In this experiment, diversity indices i.e. species richness, species evenness and species diversity were also calculated. The seasonal abundance of different species were also studied. In case of banana and citrus, insect abundance was highest in the month of July-August. In case of cabbage, tomato and brinjal abundance was highest in March and in okra it was May-June.
Key words: Relative species abundance, `seasonal abundance, diversity indices

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INTRODUCTION

Insects are the world's most diverse group of animals on earth , in terms of both taxonomic diversity and ecological function. Insects represent the vast majority of species in terrestrial and freshwater ecosystem. They have adopted for almost every conceivable type of environment from the equator to the arctic and from sea level to the snowfield of highest mountains, on land, in air and water and almost everywhere. The insects are considerably estimated to comprise more than 75 percent of the known species of the animals. The insect fauna of India is vast. In an old estimate, Lefroy and Howlett [14] in the monumental book 'Indian Insect Life' reported 25,700 Indian species. Varshney [18] has reported 589 families and 51,450 species of insects from India. In a recent estimate, Alfred *et al.* [1] estimated 59,353 species of insects from India belonging to 619 families. Indian insects belong to 27 orders of which Coleoptera is most dominant with about 15,500 species. Butterflies and Moths with about 15,000 species is another important group. These are followed by Hymenoptera (10,000 spp.), Diptera (6093 spp.) and Hemiptera (6500 spp.) [18]. Insects are closely associated with our lives and affect the welfare of humanity in diverse ways. At the same time, large numbers of insect species, including those not known to science, continue to become extinct or extirpated from local habitats worldwide.

Insects play critical roles in ecosystem function. They cycle nutrients, pollinate plants, disperse seeds, maintain soil structure and fertility, control populations of other organisms, provide a major food source for other taxa [15] and are parasites or disease vectors for many other organisms, including humans. Many insects have considerable capacity for long distance dispersal, enabling them to find and colonize isolated resources as these appear. Other insects are flightless, and hence vulnerable to environmental change or habitat fragmentation. Because of their small size, short life spans, and high reproductive rates, the abundances of many species can change by several orders of magnitude on a seasonal or annual time

scale, minimizing time lags between environmental changes and population adjustment to new conditions. Such changes are easily detectable and make insects more useful as indicators of environmental changes than are larger or longer-lived organisms that respond more slowly. In turn, insect responses to environmental change can affect ecosystem structure and function dramatically.
Insects are highly responsive to environmental changes, including those resulting from anthropogenic activity to agriculture fields. The diversity of insect species represents an equivalent variety of adaptations to variable environmental conditions. The present study was carried out to know the status of abundance of various insect species and also to determine the diversity, species richness under different orders in banana, citrus, brinjal ,tomato, cabbage and okra crops present in experimental garden, Department of Horticulture, Assam Agricultural University, Jorhat.

MATERIAL AND METHODS

Study Area

The study area is located at situated at 26°47/ latitude and 94°12/E longitude at an altitude of 86.6 m above mean sea level. Climatologically, the climate of this region is characterized by subtropical humid having dry and cool winter. Monsoon season normally starts from June and extends upto September and the intensity of rainfall decreases from October. Mean annual rainfall is more than 2000 mm per annum and average humidity is around 85 per cent. The temperature gradually increases from March and reaches maximum during August. The soil of Jorhat is mostly alluvial and sandy loam with pH ranging from 4.8 to 5.5.

Methodology

The present study was carried out from January2016 to November 2016 in Horticultural Orchard of Assam Agricultural University by following methods:

Sweep net:

Sweep sampling was done from the herb and shrub layers of the vegetation using a sweep net. This method is specially suited for sampling insects from ground layer vegetation. The sweeps were done during the morning hours. The insects collected in the sweeping were temporarily transferred in polythene bags and plastic bottles. Later they are taken to the laboratory and killed using chloroform. These insects were stretched, pinned and preserved.

Hand collection:

Insects were directly collected by hand and transferred in killing bottles. The insects were processed for pinning and preserved in wooden insect box in dry condition.

RESULTS

Altogether 85 species of insects belonging to 34 families under 8 orders have been recorded. Per cent relative species abundance for different orders were 31.76% (Lepidoptera), 38.82%,(Coleoptera), 10.58%, (Hymenoptera), 14.11%, (Hemiptera), 7.05% (Orthoptera),5.8% (Odonata), 3.5% (Diptera), 1.1% (Neuroptera). Among the orders, Coleoptera was the dominant one followed by Lepidoptera, Hemiptera and the lowest abundant one was Neuroptera. Among the families, Coccinellidae was the dominant one with six species and the lowest one was observed in Chrysopidae with one species i.e. *Chrysoperla carnea*. Among the crops, highest number of insect species were found in Brinjal (12 species) followed by cabbage and okra (11species) and the lowest was found in Banana (3 species).

Table 1: Major insect pests of Brinjal

Sl. No.	Scientific Name	Family	Order	No. of Insects	%Relative abundance
1	*Leucinodes orbonalis*	Pyralidae	Lepidoptera	44	1.03
2	*Myzus persicae*	Aphididae	Hemiptera	88	2.07
3	*Aphis gossypii*	Aphididae	Hemiptera	250	5.9
4	*Bemisia tabaci*	Aleyrodidae	Hemiptera	130	3.06
5	*Coccinella transversalis*	Coccinellidae	Coleoptera	10	.236
6	*Harmonia dimidiata*	Coccinellidae	Coleoptera	7	0.165
7	*Brumoides suturalis*	Coccinellidae	Coleoptera	3	0.071
8	*Micraspis discolor*	Coccinellidae	Coleoptera	6	0.141
9	*Coccinella septempunctata*	Coccinellidae	Coleoptera	13	0.307
10	*Menochilus sexmaculata*	Coccinellidae	Coleoptera	8	0.189
11	*Amrasca bigutulla bigutulla*	Cicadellidae	Hemiptera	200	4.71
12	*Epilachna vigintioctopunctata*	Coccinellidae	Coleoptera	69	1.63

Species richness indices was found to be highest in okra (628) followed by brinjal (332),tomato (320),cabbage (296) and lowest was observed in banana (159).Species diversity was highest in case of okra (948358) followed by brinjal(275233),tomato (235895),cabbage (210226) and lowest was found in banana (27826).Among all the crops, okra registered highest species richness and species diversity.

Table 2: Major insect pests of Cabbage

Sl. No.	Scientific Name	Family	Order	No. of Insects	%Relative abundance
1	*Plutella xylostella*	Plutellidae	Lepidoptera	30	0.708
2	*Brevicoryne brassicae*	Aphididae	Hemiptera	360	8.49
3	*Pieris canidia*	Pieridae	Lepidoptera	34	0.80
4	*Pieris brassicae*	Pieridae	Lepidoptera	28	0.66
5	*Coccinella transversalis*	Coccinellidae	Coleoptera	12	0.28
6	*Tachinid fly*	tachinidae	Diptera	7	0.165
7	*Agrotis ipsilon*	Noctuidae	Lepidoptera	67	1.58
8	*Micraspis discolor*	Coccinellidae	Coleoptera	10	0.235
9	*Coccinella septempunctata*	Coccinellidae	Coleoptera	7	0.165
10	*Menochilus sexmaculata*	Pieridae	Lepidoptera	6	0.141
11	*Trichoplusia ni*	Noctuidae	Lepidoptera	42	0.99

Table 3: Major insect pests of Okra

Sl. No.	Scientific Name	Family	Order	No. of Insects	%Relative abundance
1	*Earius vitella*	Noctuidae	Lepidoptera	50	1.18
2	*Mylabris pustulata*	Meloidae	Coleoptera	25	0.59
3	*Sylepta derogata*	Crambidae	Lepidoptera	47	1.11
4	*Dysdercus singulatus*	Pyrocoriidae	Hemiptera	38	0.90
5	*Aphis gossypii*	Aphididae	Hemiptera	300	7.07
6	*Amrasca bigutulla bigutulla*	Cicadellidae	Hemiptera	460	10.85
7	*Bemisia tabaci*	Aleyrodidae	Hemiptera	500	11.80
8	*Monolepta signata*	Chrysomelidae	Coleoptera	67	1.58
9	*Coccinella septempunctata*	Coccinellidae	Coleoptera	5	0.12
10	*Coccinella transversalis*	Coccinellidae	Coleoptera	10	0.23
11	*Menochilus sexmaculata*	Coccinellidae	Coleeoptera	7	0.16

Table 4: Major insect pests of Banana

Sl. No.	Scientific name	Family	Order	No. of Insects	%Relative abundance
1	*Nodostoma subcostratum*	Chrysomelidae	Coleoptera	58	1.37
2	*Pentalonia nigronervosa*	Aphididae	Hemiptera	112	2.64
3	*Parasa lepida*	Limacodidae	Lepidoptera	6	0.14

Table 5: Major insect pests of Tomato

Sl. No.	Scientific Name	Family	Order	No. of Insects	%Relative abundance
1	*Helicoverpa armigera*	Noctuidae	Lepidoptera	44	1.04
2	*Agrotis ipsilon*	Noctuidae	Lepidoptera	50	1.18
3	*Spodoptera litura*	Noctuidae	Lepidoptera	10	0.23
4	*Chrysoperla carnea*	Chrysopidae	Neuroptera	5	0.12
5	*Aphis gossypii*	Aphididae	Hemiptera	350	8.26
6	*Bemisia tabaci*	Aleyrodidae	Hemiptera	210	4.95
7	*Liriomyza trifoli*	Agromyzidae	Diptera	50	1.18
8	*Episyrphus belteotus*	Syrphidae	Diptera	4	0.09
9	*Brumoides sutaralis*	Coccinellidae	Coleoptera	10	0.23
10	*Micraspis discolor*	Coccinellidae	Coleoptera	5	0.12

Table 6: Major insect pests of citrus

Sl. No.	Scientific Name	Family	Order	No. of Insects	%Relative abundance
1	*Papilio demoleus*	Papilionidae	Lepidoptera	31	0.73
2	*Anoplophora versteegi*	Cerambycidae	Coleoptera	3	0.07
3	*Toxoptera citricida*	Aphididae	Hemiptera	210	4.95
4	*Toxoptera aurantifolia*	Aphididae	Hemiptera	70	1.65

Table 7: Lepidoptera , coleoptera, hymenoptera, orthoptera, hemiptera and odonata collected from surrounding area of Horticultural crops(Banana, citrus, brinjal, cabbage, tomato and okra)

S.I No.	Scientific Name	Family	Order	No of insects	% Relative abundance
1.	*Danaus genetia*	Nymphalidae	Lepidoptera	**2**	**0.05**
2.	*Danaus chrysippus*	Nymphalidae	Lepidoptera	**1**	**0.02**
3.	*Junonia atites*	Nymphalidae	Lepidoptera	**3**	**0.07**
4.	*Eurema hecaba*	Pieridae	Lepidoptera	**4**	**0.09**
5.	*Parantica agleoides*	Nymphalidae	Lepidoptera	**2**	**0.05**
6.	*Papilio polytes*	Papilionidae	Lepidoptera	**5**	**0.12**
7.	*Junonia lemonias*	Nymphalidae	Lepidoptera	**3**	**0.07**
8.	*Caligo idomeneus*	Nymphalidae	Lepidoptera	**2**	**0.05**
9.	*Pieris marginalis*	Pieridae	Lepidoptera	**1**	**0.02**
10.	*Pararge aegeria*	Nymphalidae	Lepidoptera	**3**	**0.07**
11.	*Theretra silhetensis*	Sphingidae	Lepidoptera	**5**	**0.12**
12.	*Asota ficus*	Erebidae	Lepidoptera	**4**	**0.09**
13.	*Asota caricae*	Erebidae	Lepidoptera	**1**	**0.02**
14.	*Sphinx ateus*	Sphingidae	Lepidoptera	**5**	**0.12**
15.	*Asota egens*	Erebidae	Lepidoptera	**1**	**0.12**
16.	*Oxio velox*	Acrididae	Orthoptera	**1**	**0.12**
17.	*Oxia sp.*	Acrididae	Orthoptera	**1**	**0.12**
18.	*Gryllotalpa africana*	Gryllotalpidae	Orthoptera	**1**	**0.12**
19.	*Acheta domestica*	Gryllidae	Orthoptera	**1**	**0.12**
20.	*Unidentified*	Tettigoniidae	Orthoptera	**1**	**0.12**
21.	Mountain hawk	Cordulegasteridae	Odonata	**1**	**0.12**
22.	Torrent hawk	Cordulidae	Odonata	**1**	**0.12**
23.	Skimmer	Libellulidae	Odonata	**1**	**0.12**
24.	Glories	Calopterigidae	Odonata	**1**	**0.12**
25.	Unidentified		Odonata	**1**	**0.12**
26.	*Drypta lineola*	Carabidae	Coleoptera	**1**	**0.12**
27.	*Clivina assamensis*	Carabidae	Coleoptera	**1**	**0.12**
28.	*Chlaeniu sericeus*	Carabidae	Coleoptera	**1**	**0.12**
29.	*Chlaeniu tricolor*	Carabidae	Coleoptera	**1**	**0.12**
30.	*Chlaeniu bimaculatus*	Carabidae	Coleoptera	**1**	**0.12**
31.	*Cicindela sexpunctata*	Carabidae	Coleoptera	**1**	**0.12**
32	*Pherosophus indus*	Carabidae	Coleoptera	**1**	**0.12**
33.	*Sparostes striatulus*	Carabidae	Coleoptera	**1**	**0.12**

Table 8: Species richness, species richness indices, diversity of different crops

Crop	Species richness	Species richness indices	Diversity
Brinjal	828	332	275233
Cabbage	711	296	210226
Okra	1509	628	948358
Banana	176	159	27876
Citrus	314	225	70669
Tomato	738	320	235895

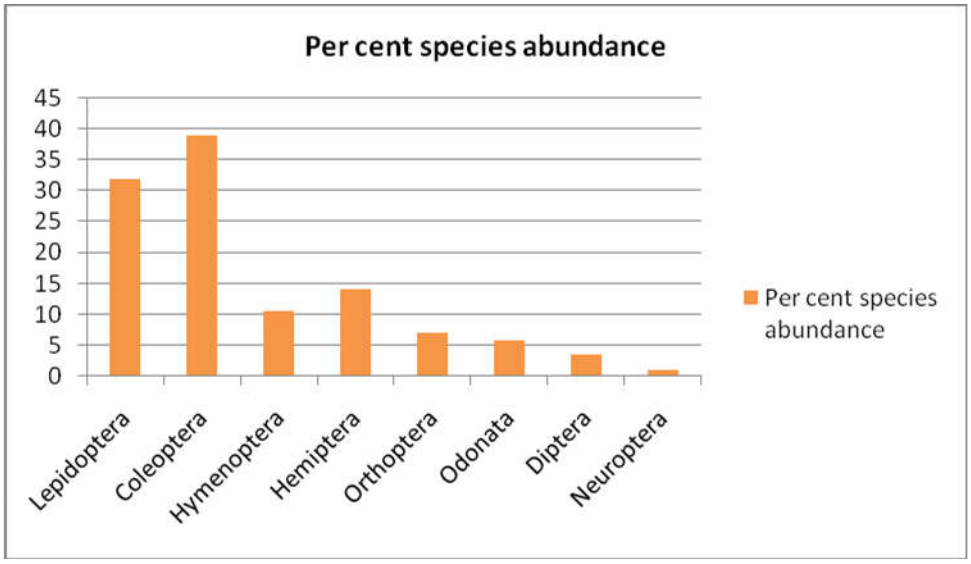

Fig 1: Per cent species abundance of different orders

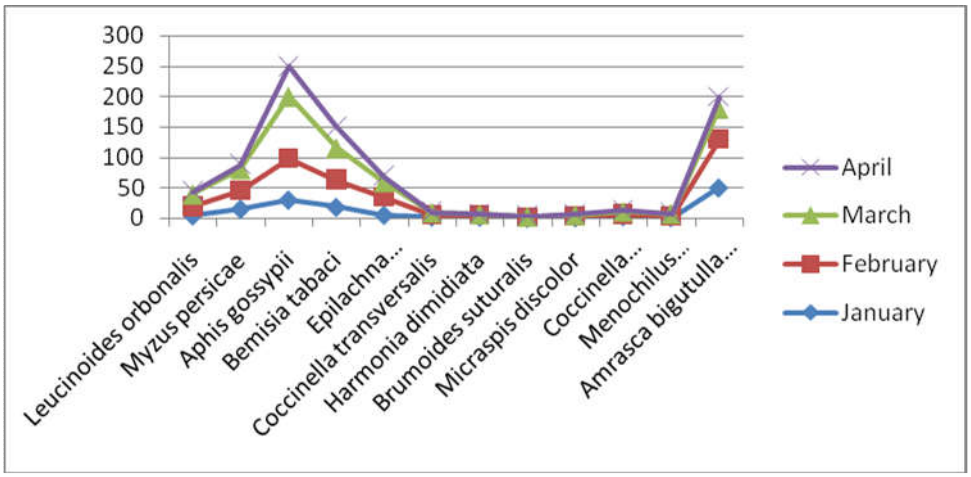

Fig 2: Seasonal abundance of insect pests on brinjal

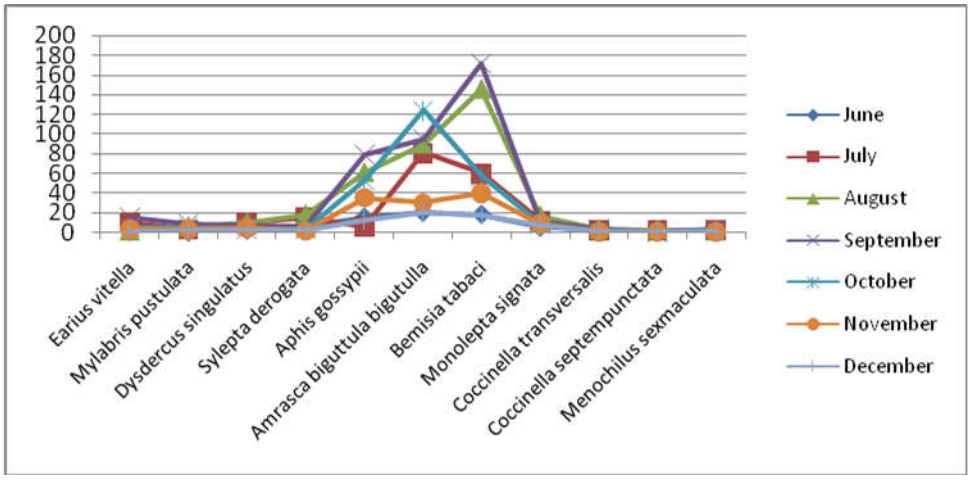

Fig 3: Seasonal abundance of insect pests on okra

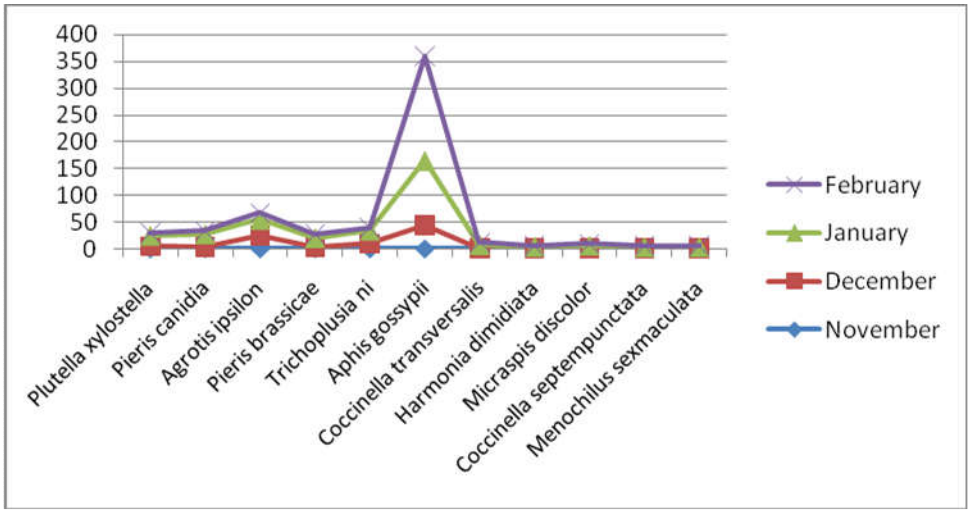

Fig 4: Seasonal abundance of insect pests on cabbage

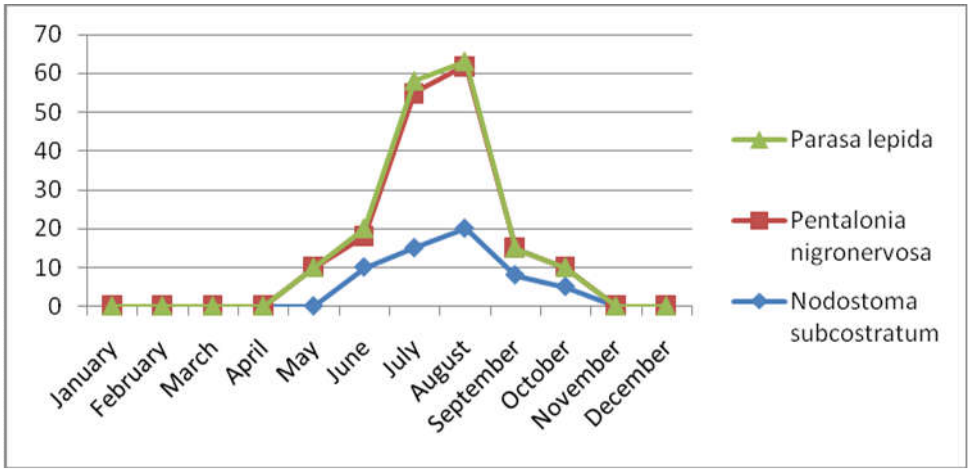

Fig 5: Seasonal abundance of insect pests on banana

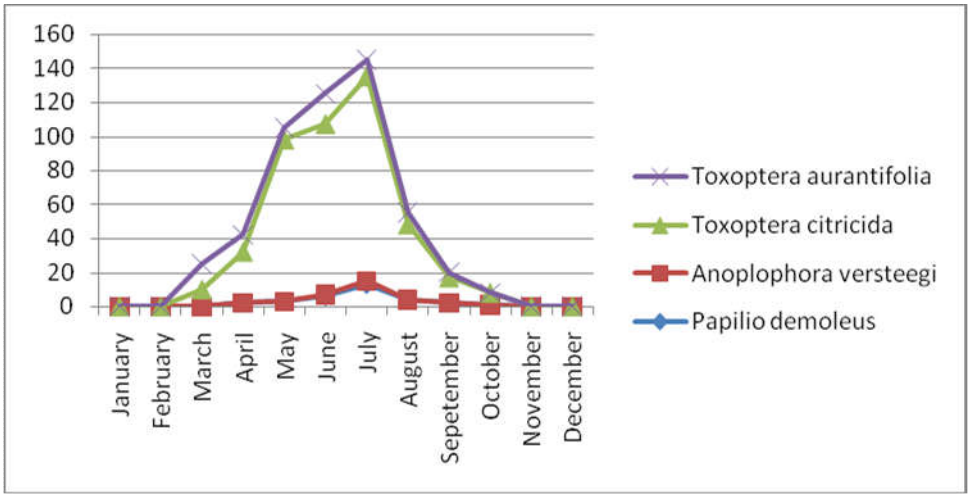

Fig 6: Seasonal abundance of insect pests on citrus

DISCUSSION

This study highlights the richness of the insect fauna comprising 85 insect species. The result of this study showed that the Horticulture Orchard are dominated by insect diversity. It is obvious that agroecosystem, though it was a man made modified farmland, reported to have a rich variety of entomofauna. The rich

number of species available in the agroecosystem was mainly because of the availability of varieties of crop plants and microhabitats.

Lepidoptera are commonly known as 'butterflies' and 'moths'. Two pairs of well-developed wings with colored scales on them. Wings are brilliantly coloured in many species. The various publications on Butterflies of India have been published by Marshall and De Niceville [16] , De Niceville [10, 11], Betham [3-6], Evans [12], Talbot and Wynter-Blyth [17]. During the course of study order Lepidoptera is second dominated order which belong to 9 families and 27 species.

Hemiptera insects that are usually called as 'true bugs' are of great economic importance as most of them are pests of various commercial crops. According to recent estimate about 80,000 Hemipteran species are present worldwide. In India 77 families having 6,500 species are found. Out of these, 2,421 species are endemic to India [1]. In the present study Hemiptera is third dominated order with species i.e. *Toxoptera citricidae, Toxoptera aurantifolia, Brevicoryne brassicae Pentalonia nigronervosa,Myzus persicae,Bemisia tabaci, Amrasca bigutella bigutella,Dysdercus singulatus*.

Coleopterans commonly known as beetles constitutes the largest order of all animals. The major ecological impact of beetles results from their effects on green plants, their contribution to breakdown of plant and animal debris and their predatory activities. India is well known for richness of coleopterans fauna and against an estimated total of 179 families of Coleopterans, about 103 families are known from India, of the 3,50,000 described species from all over the world, 15,000 species under 2,000 genera are known from India [7]. The present study revealed the presence of species belonging to families from the study area. According to total number of individuals it is the first dominated order with a total of 30 species viz., *Cosmopolites sordidus, Brumoides suturalis, Coccinella transversalis,C. septempunctata Micraspis discolour, Harmonia dimidiata,Epilachna vigintioctopunctata and* so on.

The order Orthoptera includes common insects like grasshoppers, locusts, crickets, mole crickets and grouse locusts. Kirby [13] and Chopard [13] wrote the Fauna on Acrididae and Grylloidea of India, and several species were included from Sikkim. Uvarov [19] published the distributional record of family Acrididae of India. Most of the grasshoppers found in Horticulture Orchard belongs to family Acrididae. These grasshoppers feed on plant foliage, with a particular fondness for grasses and spurges. When grasshoppers population increase to the point of crowding, swarms of locusts can compeletely defoliate grassland and agricultural crops over large areas. In the present study, family Acrididae included 2 species,whereas, Gryllotelpidae, Gryllidae and tettigonidae each having 1 species.

Only 6% world dipteran (flies) diversity has been reported from India which is about 6,093 species under 1,075 genera and 87 families [9]. Present study revealed the presence of 53species of dipterans. These included *tachinid fly,Episyrphus species and Liriomyza trifoli.*

Hymenoptera is the most beneficial order in the entire insect class. Mostly predators and pollinators belong to this order. India holds about 8.3% of total world's hymenoptera with about 10,000 species (Jonathan,1998). During the course of present study,a total of 8.species of Hymenoptera were recorded. These are of high value of economic importance which includes yellow jacket, *Trichogramma chilonis Apantales flavipes,Apis cerana, A. dorsata, A.florea, A. mellifera* and ants.

During the course of present investigation, almost about 5 species of order Odonata was recorded. These were Mountain hawk, Torrent Hawk, Skimmers, Glories and unidentified one.

Species richness indices was found to be highest in okra (628).This might be due to the fact that growing season of okra starts from June to December and peak activity period starts from July to September where abundance of insects was more. Lowest species richness indices was observed in banana (159).Similarly, highest species diversity was found in okra (948358) and lowest was found in banana (27876).

CONCLUSION

This work concludes that Horticulture Orchard are dominated by insects. From these records it is obvious that the agro-ecosystem, even though it is a man-made one, it had diverse entomofauna with high level of distribution of the insects. It is an obvious fact that insects contribute much to the ecological welfare and insect conservation has been recognized as vital for sustainable world in view of their critical role in conservation of ecosystem. From this study, the agro-ecosystem is still considered to have a diverse and numerous insect fauna in Horticulture orchard, Assam Agriculture University, Jorhat, Assam. Hopefully, there will be a further research study on the insect biodiversity and taxonomy in this area, in order to get better and comprehensive information on those aspects to be documented for future reference.

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