RICHNESS, DIVERSITY AND POPULATION DYNAMICS OF INSECTS ASSOCIATED WITH SUGARCANE FIELD AT CHINNAMANUR THENI DISTRICT, TAMILNADU.

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ABSTRACT: Sugarcane is an important source of energy and livelihoods worldwide. The production of sugarcane is significantly affected by several insects, weeds and pathogens commonly referred to as pests. Insects are the largest and the most diverse group of organisms. The crops showed varied responses towards insect populations. In addition, climate change or variabliiity will affect sugarcane production and its associated pests. The survey was conducted to study the Richness, diversity and population dynamics of insects. Insect collection was done in the sugarcane field at Chinnamanur, Theni District from October 2016 to February in 2017. The field works were carried with the help of sweep net, hand picking and light trap method. Given the economic importance of sugarcane and the losses incurred by insects infestation, the population dynamics of insect in sugarcane crops and the influence of abiotic parameters, such as temperature, and rainfall for per day on the insects population were studied. The insects collections were carried out in the early hours of the day because insect are usually active at early sun rise, therefore, it was easy to observe and collect them. The light trap collection yielded nine orders namely Hemiptera, Odonata, Orthoptera, Homoptera, Coleoptera, Lepidoptera, Dermoptera, Diptera and Hymenoptera. Hemiptera was the prominent order with 8 species. Coleoptera was the richer in terms of number of individuals (154) and Dermoptera was least recorded with less number of individuals (24). The present study reveals that the most of the light trap collected insects were pest of sugarcane agroecosystem. Even though, many insects are found in the sugarcane agro ecosystem, many insects were found to be the pest of sugarcane crop. The maximum insect population was observed in the months of October and January because there was maximum relative rainfall and temperature. It shows that the overall diversity results of insects recorded in sugarcane agro ecosystem. Typically, the value of the index ranges from 0.178 to 0.973 (R_2), 0.05 to 0.372 (E), 0,480 to 3.22 (R) and 0.502 to 0.874 (D) it indicate moderate species richness and evenness. However, current knowledge of the insect fauna in agricultural landscapes is extremely limited when compared with information available for other ecosystems such as forest and rivers. From these results, the diversity and evenness in this site has highly disturbed. Because, the sugarcane ecosystem contain greater number of species. But, the individuals in the community are distributed more equitably among these species.

KEY WORDS: **Population dynamics of insects, diversity, sugarcane, light trap, predominant insect.**

I. INTRODUCTION

Sugarcane is main source of sugar to majority of human population. It is consumed in a variety of ways, ranging from direct chewing to extracted juice from different forms of processed sugar to alcoholic beverages (Naidu, 2009). Chemically it consists of 70% water, 14% fibre, 13% sacchrose and 2-7% soluble impurities. Sugar! Is the most preferred natural sweetener and energy source worldwide, while the healthy benefits of sugar is a source of constant debate in the developed countries (Ruxton *et al.*, 2010), It is a xource of livelihood to millions of people and is integral to the economic development program of sugar producing countries (Hess *et al.*, 2016). About 80% of the world's sugar is derived from sugarcane (*Saccharum officinarum:*Poaceae) while the remaining 20%is from sugar beet (FAOSTAT, 2018)

The average cane yield in India is about 70.0 tonnes per hectare while the sugarcane recovery is around 10.0 percent (IISR, 2011). Species diversity is used to explain the variety of different species (whether domesticated or wild) within a given area (Anonymous, 2000). Its culture area of 7 million ha makes Brazil its largest producer and the second largest producer of ethanol in the world (CONAB, 2009; Institute of Agro-industrial Development, 1998; UNICA, 2009). Low yield of sugarcane in Pakistan was recorded compared to the other countries of the world. The main causes of low yield are attack of pests and diseases. Most agro ecosystems tend to be highly disturbed. On the other hand a significant reduction in the amount and poor distribution of rainfall because of severe droughts or rising temperature affects availability of water for irrigation resulting in poor crop yields

(Emmet *et al.,* 2013). Common practices like tillage, planting, application of fertilizers and pesticides, irrigation, and harvest can cause temporary or longer-lasting changes in average environmental conditions that change the functioning of the ecosystem (Altieri *et al.,* 2005). More than half of the world's identified animal species are insects.

As climate change leads to altered species distributions (Parmesan, 2006) and less stable environmental conditions, the demographic function of populations can be severely impacted. In the Indian subcontinent, the early shoot borer *Chilo infuscatellus,* the internode borer *Chilo sacchariphagus* and top borer *Scirpophaga excerptalis* cause significant yield losses (Nrip and Gaikwd, 2017). Environmental conditions are also likely to influence light trap catches by altering trap efficiency. It is important that the collected insect must be identified.

Light traps have been used widely in studies of abundance of agricultural pest species, community structure, population variability and incidence of density dependence. However measured population variability is difficult to interpret because time series of animal abundance usually contain both sampling error and variation in population size due to real changes in abundance Gas. Daily changes in insect captures are more representative of changes in flight activity than changes in abundance.

However, largest numbers are desirable. If the pests exist as adults and immature, species, specimens of all life the stages should be collected. Immature insect which cannot be identified accurately have to be reared up to the adult stages for precise identification. To display specimens, it is desirable to collect with their host plants for instance; gall producing insects may be collected with gall. Insects are found in different types of environment and they occupy little more than two thirds of the known species of insect and pests. As many species are strictly seasons and prefer only particularly set of habitats they are god indicates of habitat quality. The number of known species of Orthoptera from the world is about 20,000 out of these 1750 species nearly 10% of the world fauna are known from India.

II. METERIALS AND METHODS

2.1Study Area

Insect collection was done in the farmers sugarcane field at Chinnamanur, Theni district Tamilnadu, India.

2.2 Climate

The climate in general is hot in summer and cool in winter. The bulk of rainfall is mainly due to North-East (October to December) monsoon and South – West (June to August) monsoon.

2.3 Collection Method

Collection was done by sweep net hand picking and light trap method. Large insects were killed using killing jars with potassium cyanide powder. For storage and preservation the killing jars with potassium cyanide were used to killed large insects. The small insects were preserved in glass vials consisting of 70-90% ethyl alcohol. Identification and labelling was done in the laboratory using the standard keys available in taxonomic literature and manuals.

2.4 Light trap

The light trap consisted of a metal funnel with a central light source of 100w mercury lamp. At bottom of a funnel a jar containing killing agent of formalin could be placed plate (2). The light trap is 50cm or 0.5m in diameter and 1m height. The light trap was set on near the paddy field. The light trap was run once in fifteen days for a period of five months (October 2016 to February 2017). The light trap was regularly switched on at 18:00 hrs (evening) and switched off at 6:00 hrs (in the next morning). The light attracted insects passed through the funnel land got into the killer jar. The trap catches were removed soon after the light was switched off and sorted out on the same way. The collected entomofauna was counted individually (less abundant species and more abundant species). The insects thus collected were pooled together, identified and population status were carried out.

2.5 Identification of insect species

The collected specimens were stored in vials containing formalin solution and identified to species level. The specimens were identified with the help of related taxonomic materials. The specimens for each and every collection were treated separately and were put into vials for biodiversity count.

2.6 Net sweeping

Two types of net (aerial and sweeping nets) were used for insect collection. The aerial net was used for collection flying insects especially the butterflies and dragon flies. The aerial net have net bags that are composed of some types of meshed material and often have a light weight handle. Sweeping nets are usually mead of a heavy material such as canvas with heavier handles that can be dragged through dense vegetation. Grass hoppers and moths were collected by this net. During sweeping, the net was examined at regular intervals for any trapped insects, which were immediately transferred to polythene bags.

2.7 Hand picking

Hand picking method was to collect the insect from the leaf blades, flowers, dry leafs and from ground stratum the areas each plant were throughly examined from the top to bottom on leaf blades, flowers are dry leaf for insect pests. The ground area near the plants was also searched. According to the collection the location where the insects were found was also noted. Insect were easily collected by leading them in to glass vials (5.2 cm × 2.0 cm) from the ground stratum and from the terminals of the plants all the collected specimens were preserved in 70% ethyl alcohol with proper labelling of locality, date, crop stage and other notes of importance. Field record was maintained throughout the study period.

For identification, of collected specimens were stored in vials containing formalin solution and identified to species level. The specimens were identified with the help of related taxonomic materials the specimens for each and every collection were treated separately and were put in to vials for biodiversity count.

2.8 Pinning

Normally insects were pinning vertically through the body leaving enough space at the top of the pin to facilitate handling during identified (or) comparison studies. The methods of pinning followed were based on the guidelines drown by Dunstan P. Ambrose (2004) beetles were pinned through light elytron near the base, large bugs through the scutellum to the right of the middle line, grass hoppers through between the thorax, bees and wasps through between the bases of the fore wings and dragonflies through the middle line of the thorax at the thickest point. Temporary labels giving essential information of collections were attached to the specimens during preparation and mounting. Mounted insects were stored in pest-proof storage cabinets. A ball of naphthalene covered in a small net bas was pinned firmly at a corner of the storage pests.

III. DATA ANALYSIS

3.1 Richness indices:

The richness indices were calculated by using following formulae.

R_2(Menhinick index, 1964)

$$R_2 = S/\sqrt{n}$$

Where S = number of specie

n = Total number of individuals of the all the species.

3.2 Margalef index:

$$R_1 = \frac{S-1}{\text{Log } N}$$

S = Total number of species in a community.
N = total number of individuals observed.

3.3 Pielon evenness index

$$\mathbf{E_1 = \frac{In\ (N_1)}{In\ (N_0)}}$$

Where,

In =Number of individual

N_0 = Number of all species

N1 = Number of abundant species

3.4 Simpson's index

$$D = \frac{\Sigma n (n-1)}{N (N-1)}$$

n = The total number of organisms of a particular species

N = The total number of organisms of all species

IV. RESULTS AND DISCUSSION

4.1Taxonomic distribution and diversity

During the research study, a total number of 42 species and nine order viz., Hemiptera, Odonata, Coleoptera, Orthoptera, Lepidoptera, Diptera, Hymenoptera, Dermoptera, and Homoptera were collected from October 2016 to February 2017 in a sugarcane field at Chinnamanur,Theni district. In sugarcane field 42 species were recorded such as Hemiptera 08, Odonata 07, Coleoptera 05, Orthoptera 04, Lepidoptera 06, Diptera 02, Hymenoptera 02, Dermoptera 02 and Homoptera 06. Hemiptera has high species number than other insect orders.

Table - 4. 1 Abiottic factors recorded during fortnight collection in a sugarcane field at chinnamanur, Theni district, Tamilnadu.

Fortnight collection	Temperature			Rain fall(mm)
	Maximum	Minimum	Average	
Oct- Ⅰ	31	24	28	76
Oct- Ⅱ	31	22	27	84
Nov- Ⅰ	38	35	29.6	125
Nov- Ⅱ	39	34	29.3	149
Dec- Ⅰ	35	22.3	28	46
Dec- Ⅱ	31	19	24.5	35
Jan- Ⅰ	38	36	29.5	20
Jan- Ⅱ	30	16	23	14
Feb- Ⅰ	30	23	29	19
Feb- Ⅱ	30	19	26	15

Table -4.2 Taxonomic diversity of the Endomofauna in a sugarcane field at Chinnamanur, Theni district, Tamilnadu.

S.no	Order	Fortnight collection periodicity										Total	(%)
		1	2	3	4	5	6	7	8	9	10		
1	Hemiptera	18	15	13	17	20	18	12	13	12	10	148	15.04
2	Odonata	15s	12	14	10	11	10	15	13	12	10	122	12.39
3	Coleoptera	14	14	16	14	17	15	16	15	16	13	154	15.65
4	Orthoptera	15	16	14	13	15	14	13	10	11	10	131	13.31
5	Lepidoptera	8	10	12	10	15	13	17	14	11	10	120	12.19
6	Diptera	10	12	14	11	12	11	11	12	15	13	121	12.29
7	Hymenoptera	15	12	12	13	10	13	14	12	15	10	126	12.80

8	Dermoptera	2	3	4	2	1	2	3	2	3	2	24	2.43
9	Homoptera	4	3	4	5	3	2	3	3	5	4	38	3.86

Table- 4.3 Total number of species diversity and percentage recorded in sugarcane field at Chinnamanur, Theni district, Tamilnadu.

S.no	Order	Number of species	(%)
1	Hemiptera	8	19.04
2	Odonata	7	16.66
3	Coleoptera	5	11.90
4	Orthoptera	4	9.52
5	Lepidoptera	6	14.28
6	Diptera	2	4.76
7	Hymenoptera	2	4.76
8	Dermoptera	2	4.76
9	Homoptera	6	14.28

Table - 4.4 Monthly observetion of Endomofauna in sugarcane field at Chinnamanur, Theni district, Tamilnadu.

S.no	Order	Oct	Nov	Dec	Jan	Feb	Total
1	Hemiptera	33	30	38	25	22	148
2	Odonata	27	24	21	28	22	122
3	Coleoptera	32	30	32	31	29	154
4	Orthoptera	31	27	29	23	21	131
5	Lepidoptera	18	22	28	31	21	120
6	Diptera	22	25	23	23	28	121
7	Hymenoptera	27	25	23	26	25	126
8	Dermoptera	5	6	3	5	5	24
9	Homoptera	7	9	5	8	9	38

Table- 4.5 Overall presentation of Richness indices for endomofauna recorded in sugarcane field at Chinnamanur, Theni district, Tamilnadu.

S.no	Order	Richness indices
		Menhinick indices(r^2)
1	Hemiptera	0.675
2	Odonata	0.633
3	Coleoptera	0.402
4	Orthoptera	0.349
5	Lepidoptera	0.547
6	Diptera	0.181
7	Hymenoptera	0.178
8	Dermoptera	0.408
9	Homoptera	0.973

Table- 4.6 Overall presentation of Margalef indices for endomofauna recorded in sugarcane field at chinnamanur, Theni district, tamilnadu.

S.no	Order	Margalef index
1	Hemiptera	3.22
2	Odonata	2.87
3	Coleoptera	1.82
4	Orthoptera	1.41
5	Lepidoptera	2.40
6	Diptera	0.48
7	Hymenoptera	0.41

8	Dermoptera	0.72
9	Homoptera	3.16

Table- 4.7 overall presentation of evenness index for endomofauna recorded in sugarcane field at chinnamanur, theni district, tamilnadu .

S.no	Order	Evenness index
1	Hemiptera	0.358
2	Odonata	0.295
3	Coleoptera	0.372
4	Orthoptera	0.316
5	Lepidoptera	0.290
6	Diptera	0.296
7	Hymenoptera	0.304
8	Dermoptera	0.057
9	Homoptera	0.091

Table-4.8 Overall presentation of Simpson' s Index for endomofauna recorded in sugarcane field at chinnamanur, Theni district, Tamilnadu .

S.no	Order	Simpson' s index
1	Hemiptera	0.874
2	Odonata	0.863
3	Coleoptera	0.801
4	Orthoptera	0.750
5	Lepidoptera	0.836
6	Diptera	0.504
7	Hymenoptera	0.502
8	Dermoptera	0.518
9	Homoptera	0.846

Table – 4.9 List of difeerent species of insect observed in sugarcane field at chinnamanur, Theni district.

S.no	Order	Scientific name	Family name
1	Hemiptera	*Pyrillaperpusilla*	Fulgoroidae
		Cercopidae	Aphrophoridae
		Aleurobusbanodenis	Aleyrodidae
		Saccharicoccussacchari	Pseudococcidae
		Metamasias hemiptera	Diaspididae
		Melanaspisglomerala	Diaspididae
		Neomaskelliabergii	Aleyrodidae
		Cerotovacuna lanigera	Phempigidae
2	Odonata	*Libullulavibrans*	Libellulidea
		Pantalaflavesscens	Libellulidea
		Orthetrumglaucaum	Libellulidea
		Anaciaeschnajaspidea	Aeshnidae
		Cratilla lineate	Libellulidea
		Trithemis aurora	Libellulidea
		Agriaapicalis	Coenagrionidae
3	Coleoptera	*Holotrichiaconsanguinea*	Scarabaeidae
		Holotrichaiaseerata	Scarabaeidae

		Dermolepidaalbohirtusn	Scarabaeidae
		Oryctes rhinoceros	Scarabaeidae
		Anomalabengalensis	Scarabaeidae
4	Orthoptera	*Amblycrophaolongifolia*	Tettiganiidae
		Melanoplusdifferentialis	Acrididae
		Chorthippusalomarginatus	Acrididae
		Hieroglyphus banyan	Acrididae
5	Lepidoptera	*Chilo infuscatellus*	Poaceae
		Lymantriadispar	Erebidae
		Delia eucharis	Pieridae
		Eldanasacharina	Sphingidae
		Eumorphovitis	Pyralidae
		Danausplexippus	Nymphalidae
6	Diptera	*Muscadomestica*	Muscidae
		Mayetiola destructor	Araneidae
7	Hymenoptera	*Formica lemani*	Formicidae
		Apismellifera	Apidae
8	Dermoptera	*Proreussimulans*	Chelisochidae
		Labidurariparia	Labiduridae
9	Homoptera	*Brevenniarehi*	Pseudococcidae
		Amrascabiguttulabigguttula	Cicadellidae
		Aphis gossypii glover	Aphididae
		Bemisiatabaci	Aleyrodidae
		Nephotettixbipunctatusfab	Jaasidae
		Siphaflava	Aphididae
		Siphaflava	Aphididae

The Hemiptera was the most species rich order with 8 species collected in sugarcane fields at Chinnamanur, Theni district. It contributed 15.04% of individuals abundance and 19.04% of species richness of the total collection in the entomofauna collected at Chinnamanur, Theni district. Odonata was represented with 7 species and it contributed 12.39% of insect abundance and 16.66% of species richness of entomofauna. It and recorded during all the fortnight collection. It was uniformly observed.

Only species of Coleopterans were collected with 154 individuals. They contributed 15.65% of individual's abundance and 11.90% of species richness of the total collection in the sugarcane field. Four species of Orthoptera were collected with 131 individuals. The contribution of Orthopteran species richness was 9.52%. 6 species of lepidopterans were collected in sugarcane fields at chinnamanur, Theni district. They contributed 12.19% of individual's abundance and 14.28% of species richness of entomofauna.

2 species of dipterans collected in sugarcane field at chinnamanur, Theni district. It contributed 12.29% of individual's abundance and 4.76% of species richness of endomofauna. It was uniformly observed during all the fortnight collection. Hymenoptera was represented with 126 individuals. They contributed 12.80% of individual's abundance and 4.76% of species richness of the total collection in the entomofauna. Six species of Homoptera were collected with 38 individuals. They contributed 3.76% of insect abundance 14.28% of species richness of entomofauna. It was recorded in all the fortnight collection and uniformly observed.

As observed for Dermoptera, Hymenoptera and Diptera was also represented with only two species. It also contributed ten individuals. i.e., 2.43% of the total collection. Moreover it was present only in the forth fortnight collection. It is interesting to report here that it was not the least represented species but also least abundance observed in all the collection.

Adnan Ahmed, Anjumsuhail, Zain-UI-Abdin, Sohaiblftikhar and KshifZahoor (2004) reported that are 2140 individuals Lepidoptera recorded in three localities (Shahbazpur, Agriculture University Faisalabad and Makkuana). Zhao *et al.* (2013) stated the abundance, species richness and diversity increased with increasing plant diversity and landscape complexity. Diversity indices depend not only on species richness but also on the evenness, or equitability, with which individuals are distributed among the different species. Recent studies suggested that the Lepidopptera may have more species than earlier thought (Kristensen*et al.*, 2007), and is among the four most specious order, along with the Hymenoptera, Diptera and the Coleoptera (Powell *et al.*, 2009).

The shoot borer chilo infuscatellus is more active during hot periods of the year both in tropical and subtropical India (Bains and Dev Roy, 1981). According to Kalra and sherma (1963), high day temperature with moderate humidity is conductive for its multiplication and its activity continues till October. The analysis of dominance, diversity and evenness indices provide valuable quantitative information in the different months. Diversity index has two components, species richness and equitability, this index is better understood along with Margalef's evenness component. Species richness depends largely in the structural diversity of the animal and equitability component is dependent on the stability of the physicochemical conditions (Yela, J. L. and C. M. Herrera, 1993).They are mostly diurnal and a few are nocturnal. The species abundance was very less than Lepidoptera, Orthoptera, Hemiptera and Diptera. The Odonata is general predator. Odonata is a relatively small insects order, comprising about 6500 species placed (Truemanand Rowe, 2008). Trueman and Rowe (2008) reported that about 6,500 species placed into just over 600 genera.

Diptera constitute the third most diverse order of insects, with an estimated 120,000 species, and are often the most abundant animals in temperate habitats. They are involved in various ecological functions, including decomposition, pollination and pest control (Kearns, 1992 and Berebaum, 1995). Diptera is one of the largest order comprising of many insects. The maximal Dipteran population in July, at the middle of the summer season in the study area. Many gall midges are important pests. The mosquitoes were also most abundant. The eggs are laid either on the surface of water or near water (Ambrose, 2004).

The light trap yielded more Coleopterans than any other method. Beetles are found in almost any type of habitat on plants on the soil surface, in soil, in water and in ant nests was reported by Larry P. Pedigo, (2002). Coleopterans with countless adaptations and wide distribution have occupied a dominant position as the largest group in animal kingdom. The coleoptera constitute 40% of the endomofauna with richest diversity almost and inhibiting the entire ecosystem irrespective of place and time (Ambrose, 2004). Sugarcane is one of the most important industrial field crops in India. The present investigation entitled "Richness, diversity and population dynamics of insects associated with sugarcane field at chinnamanur, theni district, tamilnadu" was undertaken to investigate the richness, diversity and population dynamics of insects associated with sugarcane, their seasonal incidence as well as influence of abiotic factors on their activity.

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