THE POPULATION DYNAMICS OF INSECTS IN SUGARCANE FIELD AT AUNDIPATTI, THENI DISTRICT, TAMIL NADU.

Dr. Mrs. L. Merlin Dayana., Assistant Professor in Zoology, J.A. College for Women, (Autonomous), Periyakulam.

ABSTRACT

Sugarcane (*Saccharum offecinarum* L) is one of the most important commercial crops of the tropical countries and is the main source of sugar in the world. Sugarcane crop is affected by more than 60 insects of which about 10 insects are rather more important as far as the yield loss is concerned. Among the major insects damaging sugarcane, borers, sucking pests, soil dwelling insects are more prevalent in Tamil Nadu and adjoining states which account for 20% loss in cane yield and 15% loss in sugar yield. About 200 species of insects have been reported as damaging sugarcane crop in India. Light trap serves as an important survey tool to sample population of nocturnal insects effectively. Trapping methods are principal tools in insect pest management programs. The goal of this study was to assess population dynamics of insects in a sugarcane field at Aundipatti, Tamil Nadu. A 6 month study was conducted to sample insects using light trap at the farmer's field from July 2011 to December 2011. Collected specimens were identified to species level and predominant species were identified. Predominant herbivore species were *Diatraea saccharalis, Melanotus communis* and *Agrostis capillaries L.* The result of this study provides important information related to the status of insects in sugarcane field.

Key words:

Population dynamics of insects, sugarcane, Predominant pest.

INTRODUCTION

Saccharum officinarum is the original sugarcane species. It is supposed to have originated in the Indonesian Archipelago. The species does not occur wild in nature but was grown and maintained for a long time by the natives of these islands. Later on it came to be cultivated in south India. Sugarcane plant during their different growth stages are attacked by a number of insect which are major constraints in getting higher yield (Aonnymous, 2006; Iqbal *et al.* 2012). Due to heavy infestation of the pests, serious decline (86.00% reduction in cane yield;

1.4-1.8% reduction in sugar recovery) in production has been reported by (Anonymous, 2006). Sugarcane is known to be attacked by about 200 species of insect and non-insect pests in India (David and Ananthanarayana, 1988). However, none of these pests warranted except at few locations, but now a day's sugarcane woolly aphid, *Ceratovacuna lanigera* (Zehntner) has appeared in pestiferous form with alarming speed of spread and severity has created panic among the farmers and threatened the sugar industry.

Climate

Sugarcane is grown in the world from a latitude 36.7° N to 31.0° S, from sea level to 1000m of altitude or a little more. It is considered as essentially a tropical plant. It is a long duration crop and thus it encounters all the seasons' viz., rainy, winter and summer during its life cycle.

Rainfall

A total rainfall between 1100 and 1500 mm is adequate provided the distribution is right, abundant in the months of vegetative growth followed by a dry period for ripening. During the active growth period rainfall encourages rapid cane growth, cane elongation and internode formation.

Temperature

Growth is closely related to temperature. Optimum temperature for sprouting (germination) of stem cuttings is 32° to 38°c. It slows down below 25°, reaches plateau between 30°-34°, is reduced above 35° and practically stops when the temperature is above 38°. Temperatures above 38° reduce the rate of photosynthesis and increase respiration.

Relative humidity

High humidity (80-85%) favors rapid cane elongation during grand growth period. A moderate value of 45-65% coupled with limited water supply is favorable during the ripening phase.

Insects of sugarcane

Sugarcane crop is affected by more than 60 insects of which about 10 insects are rather more important as far as the yield loss is concerned. Among the major insects damaging sugarcane, borers, sucking pests, soil dwelling insects are more prevalent in Tamil Nadu and adjoining states which account for 20% loss in cane yield and 15% loss in sugar yield. The population dynamics and biomass production of above ground insects in tropical grassland was recorded by Kaushal and Vats, 1983. Studies of insect population dynamics based on field observation and evaluation were carried out to understand the insect species interaction in any ecosystem. Ambrose and Livingstone (1989) studied the population dynamics of assassin bugs from peninsular India. Nader Sallam (2011) reported the review of current knowledge on the population dynamics of *Dermolepida albohirtum* (Waterhouse) (Coleoptera: Scarabaeidae).

Studies on light trap collections

Light trap serves as an important survey tool to sample population of nocturnal insects effectively. Trapping methods are principal tools in insect pest management programs. The different colour sticky traps are used to monitor leafhopper species on many crops (Kersting *etal*., 1997; Chu *et al*., 2000; Lessio and Alma, 2004; Raja and Arivudainambi, 2004). Ramamurthy *et al*. (2010) studied the different numbers of insects species caught by light traps with different light sources. Light trap catch is influenced not only by the actual population of adult insects present in the environment but also by weather factors and moonlight. Verma *et al*., (1982) thoroughly analysed the effect of temperature, relative humidity and rainfall on light trap catches for three years and indicated that rains only have a short lived but significant effect on trap catches.

MATERIALS AND METHODS

Location of the study area

Aundipatti, was selected for the study of population dynamics of insects associated with sugarcane field. The collection was done in the farmer's field

Soil and crop

Sugarcane is cultivated once in a Year. Soil is a medium for plant growth. It provides nutrients, water and anchorage to the growing plants. Maintenance of proper physical, chemical and biological conditions of the soil is necessary for realizing higher growth, yield and quality of sugarcane.

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.

Light trap

The light trap consisted of a metal funnel with a central light source of 100W mercury lamp. At a bottom of a funnel a jar containing killing agent of formalin could be placed. The light trap is 50cm or 0.5m in diameter and 1m height. The light trap was set on near the sugarcane field. The light trap was run once in fifteen days for a period of 3months (July 2011 to December 2011). The light trap was regularly switched on at 18:00hrs (evening) and switched off at 6:00hrs (in the next morning). The light attracted insects passed through the funnel and 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 from the two sites pooled together, identified and population status were carried out.

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 day were treated separately and were put into vials for biodiversity count.

Statistical analysis

Correlation coefficient:

Correlation coefficient was calculated using standard formula. The statistical treatment was given between different abiotic characters (temperature and rainfall). The correlation between monthly individuals of different orders and abiotic factors in total collection and light trap collection for 6 months in sugarcane field at Aundipatti.

Karl Pearson's coefficient of correlation:

Karl Pearson's, a great biometrician and statistician, suggested a mathematical method for measuring the magnitude of linear relationship between two variables. Karl Pearson's method is the most widely used method in practice and is known as Pearson coefficient of correlation. It is denoted by the symbol '$\boldsymbol{\gamma}$'**.** The simplest formula is

$$\boldsymbol{\gamma} = \frac{\sum \mathbf{dxdy}}{\sqrt{\sum \mathbf{dx^2 X dy^2}}} = \frac{\sum (\mathbf{dx}) \mathbf{X} (\mathbf{dy})}{\sqrt{\sum (\mathbf{dx^2}) \mathbf{X} (\mathbf{dy^2})}}$$

Meteorological parameters of the study area

Month	Max. Tem (ºC)	Min. Tem (ºC)	Total rainfall (mm)
July	30.6	28.9	3.6
August	30.1	28.5	34.0

September	32.7	29.2	9.6
October	37.9	25.6	241.1
November	30.3	23.7	189.2
December	27.8	25.8	32.2

Month wise insect population of sugarcane field at Aundipatti

Orders	July	August	September	October	November	December	Total	Percentage (%)
Coleoptera	98	38	12	18	73	108	347	11.05
Diptera	440	155	128	150	178	320	1371	43.69
Hemiptera	52	48	55	0	14	0	169	5.38
Hymenoptera	23	92	29	25	16	14	199	6.34
Lepidoptera	4	20	42	73	142	153	434	13.83
Odonata	21	13	65	41	71	67	278	8.85
Orthoptera	58	47	42	29	29	135	340	10.83
Total							**3138**	

Total number of species and percentage recorded in the sugarcane field at Aundipatti

Orders	**Total no. of species**	**Percentage (%)**
Coleoptera	7	23.3

Diptera	3	17.6
Hemiptera	5	29.4
Hymenoptera	4	23.5
Lepidoptera	5	29.4
Odonata	2	11.7
Orthoptera	4	23.5
Total	**30**	

Correlation between monthly population and abiotic factors in sugarcane field at Aundipatti

Orders	**Abiotic factors**	**Correlation coefficient γ**

Coleoptera	Max. Temperature	**-0.73**
	Min. Temperature	**-0.05**
	Total Rainfall	**-0.26**
Diptera	Max. Temperature	**-0.26**
	Min. Temperature	**0.17**
	Total Rainfall	**-0.44**
Hemiptera	Max. Temperature	**-0.01**
	Min. Temperature	**0.79**
	Total Rainfall	**0.91**
Hymenoptera	Max. Temperature	**-0.07**
	Min. Temperature	**0.46**
	Total Rainfall	**-0.25**
Lepidoptera	Max. Temperature	**-0.25**
	Min. Temperature	**0.87**
	Total Rainfall	**0.42**
Odonata	Max. Temperature	**-0.11**
	Min. Temperature	**-0.56**
	Total Rainfall	**0.54**
Orthoptera	Max. Temperature	**-0.63**
	Min. Temperature	**-0.01**
	Total Rainfall	**-0.47**

Monthly population of coleopterans in sugarcane field at Aundipatti

Coleopterans	**July**	**August**	**September**	**October**	**November**	**December**	**Total**	**%**
Melanotus communis	11			5	20	45	81	23.3

G.bimarginata		7			11		18	5.1
Dermolepida albohirtusn	40		8	9			57	16.4
Holotrichia seerata		18			12	20	50	14.4
Holotrichia consanguinea	20	6		2		40	68	19.5
Anomala bengalensis		6	4		30		40	11.5
Maladera Sp.	27	1		2		3	33	9.5
Total	98	38	12	18	73	108	347	

Monthly population of Dipterans in sugarcane field at Aundipatti

Dipterans	**July**	**August**	**September**	**October**	**November**	**December**	**Total**	**%**
Mayetiola destructor (Say)		123	57		160	190	530	38.6
Calliphora sp.	345		56	134	18	27	580	42.3
Musca domestica (Linnaeus)	95	32	15	16		103	261	19.0
Total	440	155	128	150	178	320	1371	

Monthly population of Hemipterans in sugarcane field at Aundipatti

Hemipterans	**July**	**August**	**September**	**October**	**November**	**December**	**Total**	**%**

Ceratovacuna lanigera (Zehntner)	16		38		2		56	33.1
Aleurolobus barodensis		25					25	2.9
Saccharicoccus sacchari	27	9			4		40	23.6
Melanaspis glomerata		6	17		3		26	15.3
Metamasias hemipterous	9	8			5		22	13.0
Total	52	48	55		14		169	

Monthly population of Hymenopterans in sugarcane field at Aundipatti

Hymenopterans	**July**	**August**	**September**	**October**	**November**	**December**	**Total**	**%**
Corynepherus canescens L.	20	7	17		3		47	23.6
Agrostis capillaries L.		73		20		7	100	50.2
Tetramorium Sp.	3		8		10	2	23	11.5
O. fragilis		12	4	5	3	5	29	14.5
Total	23	92	29	25	16	14	199	

Monthly population of Lepidopterans in sugarcane field at Aundipatti

Lepidopterans	**July**	**August**	**September**	**October**	**November**	**December**	**Total**	**%**
Diatraea saccharalis	4	5		48	53	45	155	35.7
Eldana sacharina			13		26	21	60	13.8
Chilo infuscatellus		12		8	28	7	55	12.6
Chilo sacchariphagus indicus			10		15	50	75	17.2
Scirphophaga excerptalis		3	19	17	20	30	89	20.5
Total	4	20	42	73	142	153	434	

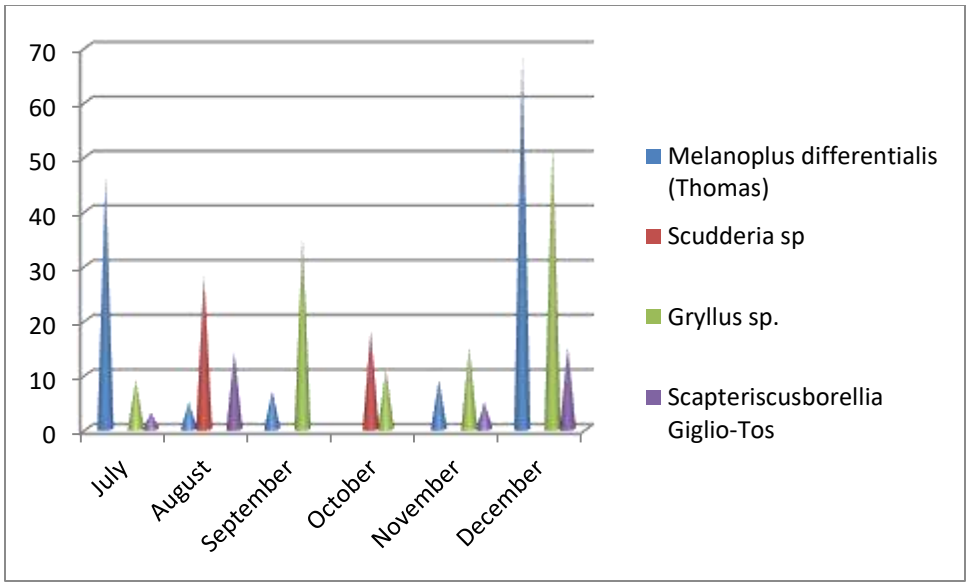
Monthly population of Odonata in sugarcane field at Aundipatti

Odonata	**July**	**August**	**September**	**October**	**November**	**December**	**Total**	**%**
Libellula luctosa Burmeister	**21**	**8**	**43**	**41**	**45**	**50**	**208**	**74.8**
Varies		**5**	**22**		**26**	**17**	**70**	**25.1**
Total	**21**	**13**	**65**	**41**	**71**	**67**	**278**	

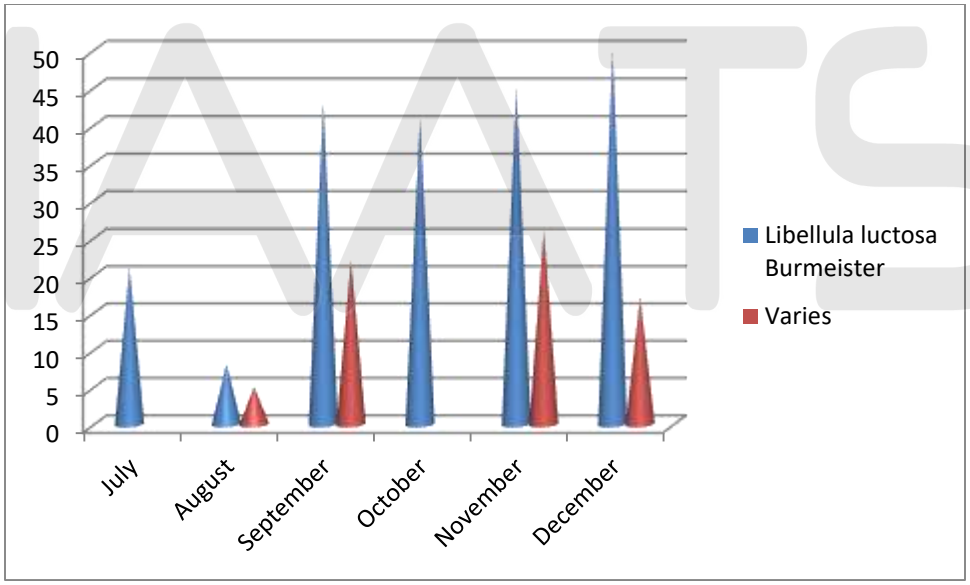
Monthly population of Orthopterans in sugarcane field at Aundipatti

Orthopterans	July	August	September	October	November	December	Total	%
Melanoplus differentialis (Thomas)	46	5	7		9	68	135	39.7
Scudderia sp		28		18			46	13.5
Gryllus sp.	9		35	11	15	52	122	35.8
Scapteriscusborellia Giglio-Tos	3	14			5	15	37	10.8
Total	58	47	42	29	29	135	340	

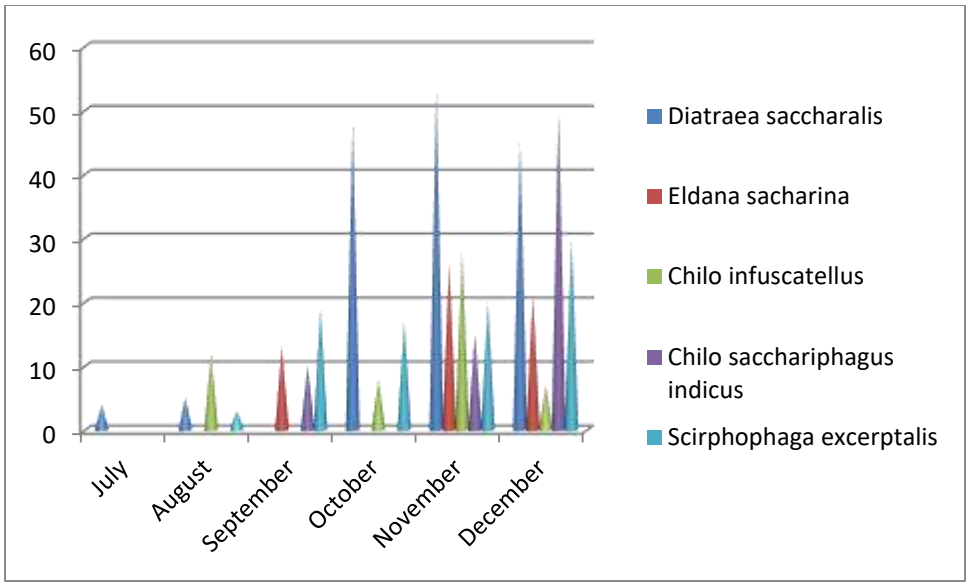
Monthwise insect population of Orthoptera in sugarcane field



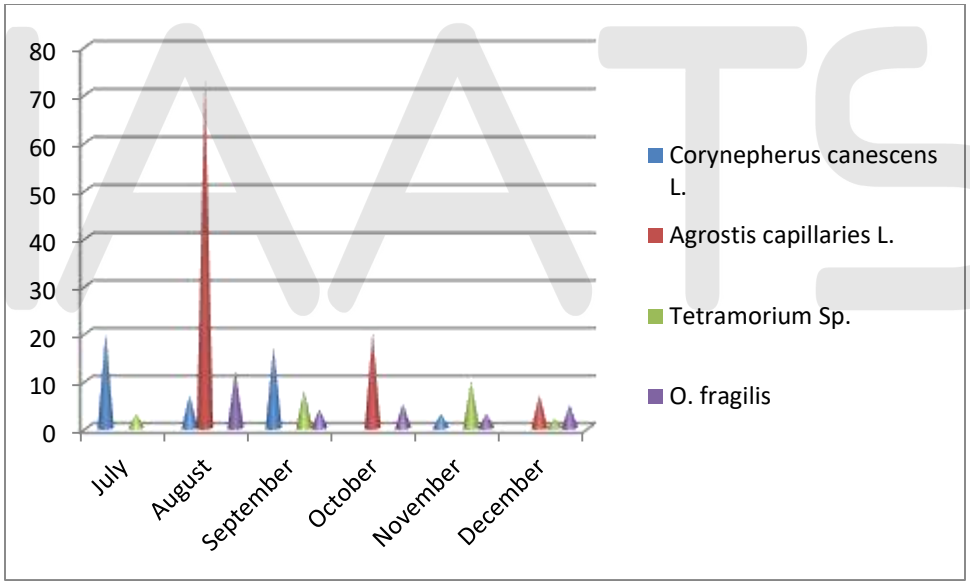
Monthwise insect population of Odonata in sugarcane field



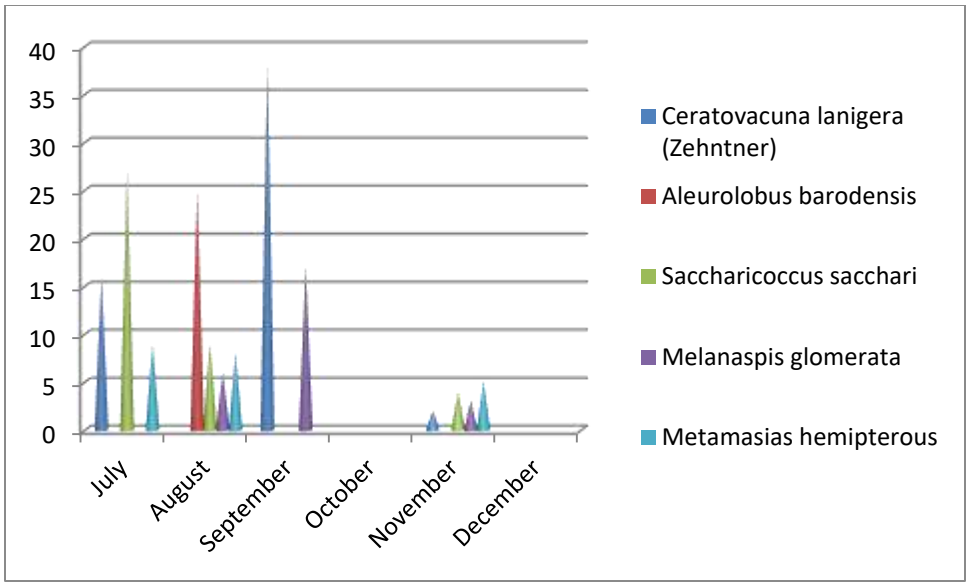
Monthwise insect population of Lepidoptera in sugarcane field



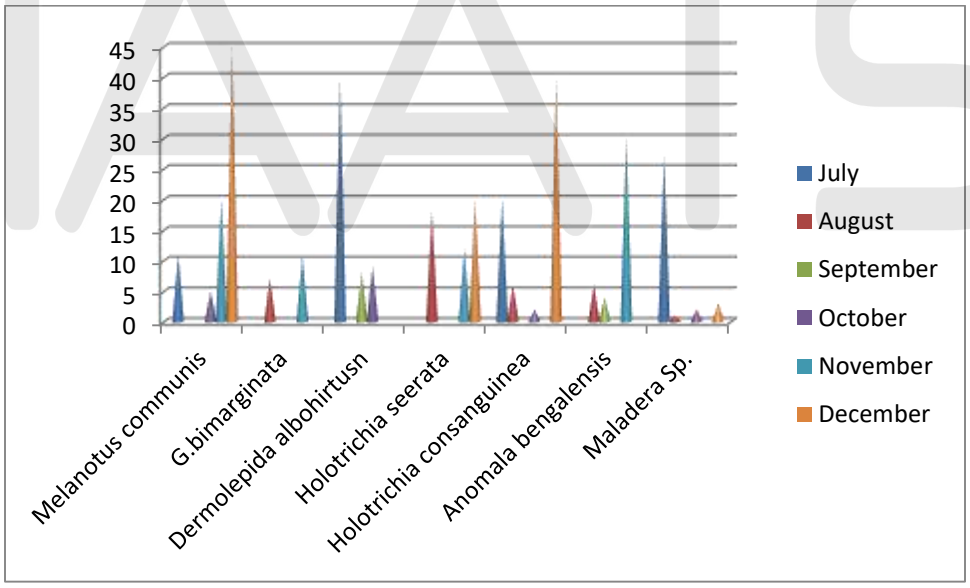
Monthwise insect population of Hymenoptera in sugarcane field



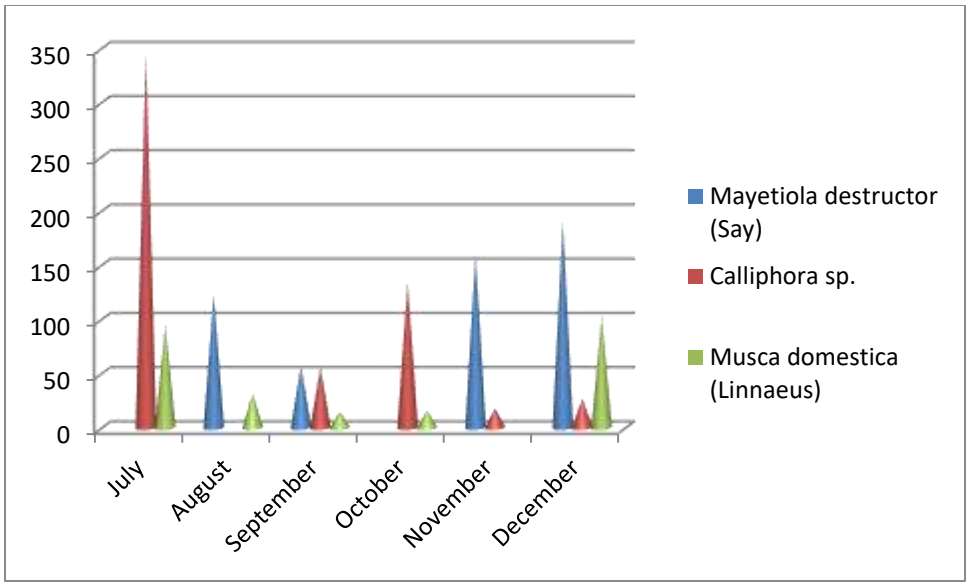
Monthwise insect population of Hemiptera in sugarcane field



Monthwise insect population of Coleoptera in sugarcane field



Monthwise insect population of Diptera in sugarcane field



RESULT

Coleoptera

A total of 347 coleopterans belonging to 7 species were recorded in sugarcane field. *Melanotus communis* population was highly dominant (81). The peak population occurred (108) in December 2011and dipped to the lowest ebb (12) in September 2011.

Diptera

In this sugarcane field a total number of 1371 dipterans belonging to 3 species were recorded, *Calliphora* sp. was the most abundant species (580). The lowest level (128) observed during September 2011.

Hemiptera

Five species of Hemipterans observed in this sugarcane field. *Ceratovacuna lanigera (Zehntner)* were the most abundant (56) Hemipterans. Hemipterans were found only for 4 months with consistent distribution. The population first appeared in July 2011(52), August 2011 (48) and September 2011 (55) then disappear and reappeared in November 2011 (14), thereafter disappeared.

Hymenoptera

At this sugarcane field, a total of 199 Hymenopterans belonging to 4 species were recorded**.** *Agrostis capillaries L.* was the most dominant (100) whereas the *Tetramorium Sp.* was the least (23).

Lepidoptera

A total number of (434) Lepidopterans belonging to 5 species were observed in the collection made in this field. *Diatraea saccharalis* were the most dominant (155) Lepidopterans.Initially Lepidopterans appeared with a minimal population (4) in July 2011 and reached a peak (153) in December 2011.

Odonata

In this sugarcane field a total of 278 Odonata belonging to two species were recorded, *Libellula luctosa* (Burmeister) was the most abundant (208) and Varies was the least represented (70).

Orothoptera

Four speacies of Orthopterans were recorded in the sugarcane field. *Melanoplus differentialis* (Thomas) were the most abundant (135) whereas *Scapteriscusborellia* Giglio-Tos were the least represented (37). *Scudderia* sp. occurred only August and October 2011.

DISCUSSION

The analysis of data in order wise population dynamics of insects revealed the predominance of coleopterans followed by Lepidoptera and Orthoptera. Hemiptera and Hymenoptera species were moderately abundant. Odonata were at the lowest. Peak population of coleopteran, in the sugarcane field were December 2011, Diptera in July 2011, Hemipterans in September 2011 and Odonata in November 2011. Coleopterans with countless adaptations and wide distribution have occupied a dominant position as the largest group in animal kingdom. (Nayar *et al.* 1990). The study area was dominated by coleopterans in terms of species diversity than all the other orders. The population consistently available in good number during the study period with a peak in December. Higher coleopterans population was found to be existing with rainfall. Most beetles prefer thick vegetation which was available during monsoon season would probably the reason for maximum number for beetles collected most of the wet months. From available literature it was evident that t the coleopteran s were found to be maximal only during wet months and not during dry months.

The peak Lepidopteron population was noted during November and December 2011. Observations throughout the years have led sugarcane industry consultants, growers and Researchers to suggest that frequent rainfall is an important factor in increasing sugarcane borer infestations. Hensley (1971) documented that weather conditions favorable to rapid growth of the sugarcane plant (warm temperature and abundant rainfall) invariable result in rapid increase in populations of the sugarcane borers. The minimal population was found in July 2011. The maximum Hemipterons population occurred during September 2011 was due to the dominance of *Ceratovacuna lanigera (Zehntner).* Vats and Handa (1983) reported that the Hemipterons were found to be dominant in summer. It was also true in the case present study that the Hemipterons were found at low level during rainy season.

The peak Hymenopteran population was noted during August 2011 and minimum during December 2011. The peak was mainly due to the dominance of *Agrostis capillaries L.* Vats and Handa (1983) who reported that the Hymenopterons were found to be dominant during summer season. During summer the ant nest could be heated by the sun, which could be required for the development of ant broods (Nielson 1978) and it was natural that the population was at its peak in summer. The Othopteron population peak in December 2011, comprised of 4 species. Vats and Mittal (1981) observed peak density of Orthopterons in early rainy season in India.

Muralirangan *et al* (1993) reported that higher temperature with less soil moisture hindered the density of Orhtopteron population.

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 maximum Odonata population occurred during November 2011. Truman and Rowe (2008) reported the Odonates can be collected from places near water bodies, meadows, wood ands and the hill slides above aquatic habitats. From available literature it was evident that the Odonates were found to be maximal only during wet months and not during dry months. The present study throws on the population dynamics of entomofauna in sugarcane fields. It will help to evolve measures to conserve and proper management of the sugarcane agro ecosystem through future programmes.

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