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Study of encyrtid parasitoid (Chalcidoidea: Hymenoptera) diversity in selected ecosystem in Tamil Nadu

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Abstract
The present study is carried out to study the diversity of encyrtid parasitoid in selected crop ecosystem in Cuddalore district, Tamil Nadu during Dec 2018 to Jan 2020. The selected ecosystem includes cotton, rice, sugarcane, brinjal, plantation crops, orchard crops, and weeds. A total of 479 encyrtid parasitoids were collected which represents 23 genera and 2 subfamilies. The population studies revealed that most number of parasitoid are collected in cotton ecosystem. The least is recorded in the Rice ecosystem. Sucking pest are major constraints in achieving higher yields in the above mentioned crop ecosystems, hence the studies of diversity of encyrtid parasitoid is crucial for success in biological control.

Keywords: diversity, parasitoids, encyrtid, ecosystems

Introduction
Hymenopterans are the most successful biological control agents under the super family Chalcidoidea. Among them, Encyrtid plays a vital role in controlling the sucking pests belonging to the family Coccoidea, Psedococcoidea, and Diaspididae of Heteropteran family. Most of the parasitoids attack the egg or nymphal stages of the host that causes major damage to the crops. The family currently includes nearly 4887 described species in 502 genera globally and 733 species in 163 genera from India (Noyes, 2016). Despite the surplus production, insects form the major constraint in achieving high yield in the selected ecosystems. Adding to this, the increasing resistances of pests to pesticides and awareness about the danger of pesticides use have lead to the use of entomophagous insects in pest management. Diversity of encyrtid is necessary for the achievement of biological control. Hence the study was undertaken.

Materials and methods
The survey was carried out during Dec 2018 to Jan 2020 in selected ecosystems in Cuddalore district, Tamilnadu.

1. Study area
This includes crop ecosystems in Cuddalore district selected for the survey. The Selected ecosystems are cotton ecosystem, rice ecosystem, sugarcane ecosystem, plantation crops, orchard ecosystem, Brinjal ecosystem and weed ecosystem.
The parasitoids are collected using three methods of collection these include Yellow pan trap, netsweeping, and host rearing.

2. Yellow pan trap
The traps which are yellow in colour or plates painted in bright yellow colour on inside attracts many insects is the basic principle behind. Placing the traps in a suitable habitat such as grassland forest and crop cultivated field after the traps were filled with saturated salt solution for preservation and few drops of detergent to break the surface tension. For effective sampling atleast 50 traps were to be placed in a locality for two days and then shifted to a new area. The traps were emptied carefully by filtering through fine mesh tea filter. Then the collection were transferred into spirit and started under microscope.

3. Sweep net
Sweeping is an effective method of capturing parasitoids. The net handle (aluminium) was about 1.0m long with circular head. A net bag was made up of strong and durable white terelene with circular head. A net bag was made up of strong and durable white terelene with a very fine that retains even the minute parasitoids inside the net but allowing easy passage of air and was narrowing to the round bottom. After the sweep, the insects were transferred into polythene bags or light box, then separated the encyrtids using an aspirator into 70 per cent ethyl alcohol.

4. Host rearing
Host rearing was the most rewarding method to recover encyrtid parasitoids from respective hosts, since much can be learnt about their biology (Noyes and Hayat, 1994). Mealybugs, scales and other eggs of insects were collected along with their host plants and kept in polythene bags and reared and observed for the emergence of parasitoids. The emerged parasitoids along with the hosts are preserved in 70 per cent of ethyl alcohol for identification.

5. Preservation and identification of specimens
The specimens thus collected were were preserved in 70 % of ethyl alcohol. The dried specimens are mounted on pointed triangular cards and studied under a stereo zoom microscope and also photographed in stereo zoom microscope and identified through the conventional following taxonomic keys. The collected parasitoids were deposited at Parasitoid taxonomy and biocontrol lab in

EDAU, Annamalai university, Annamalai Nagar, Cuddalore.

6. Diversity indices calculation

Diversity indices is a quantitative measure that shows information about the different types of encyrtid genera in a community. Through this metrics, we can relate the data with the richness, divergence and evenness of the species in the selected crop ecosystem. The following formulae are used to calculate the diversity indices,

- Simpson index (D) = $\sum n(n-1)/N(N-1)$

n = Number of individuals of species

Note: If a value decreases, the diversity increases

- Shannon- Wiener (H') = $\sum$ [(Pi X ln (Pi)]

Pi = Proportion of total sample

Pi = ni/n

Where Ni = Number of total individuals belonging to the i th species

n = Total number of individuals in the sample

Note: Higher index value refers higher diversity

- Evenness Index (E) = H'/ ln (S)

H' = Shannon weiner diversity index

S = Total number of species in the sample

Note: Higher the evenness value more is the diversity

Results and discussion

A total 479 encyrtid parasitoids were recovered through the three collection methods in selected ecosystems. In the present study 140 specimens representing 13 genera were collected from cotton ecosystem showing maximum diversity (0.521), followed by plantation crop (0.479), orchard (0.475), brinjal (0.473), sugarcane (0.363) and rice (0.333). The weed ecosystem showed the lowest recorded diversity of 0.233. The Shannon Weiner index (H') shows maximum diversity in brinjal 3.44 followed by orchard 3.17 and cotton 2.45. The least is recorded in rice ecosystem 0.633. The other ecosystem such as plantation crop ecosystem 1.086, sugarcane 1.72 and weed 1.27 shows moderate diversity of parasitoids. The Present study revealed that the cotton ecosystem showing maximum generic evenness of 0.983, followed by Orchard 0.964, Plantation crops 0.922, Brinjal 0.898 and Weeds 0.863. Rice ecosystem recorded the lowest generic evenness representing 2 genera with 3 specimens.

Tables and Figures

Table 1: Diversity Indices for Encyrtid Parasitoids in Selected Ecosystem

S.No	Collected Ecosystem	Diversity Indices		Generic Evenness Index
		Simpson index	Shanon weiner index	
1.	Cotton	0.521	3.44	0.983
2.	Rice	0.233	0.633	0.800
3.	Sugarcane	0.368	1.72	0.922
4.	Orchard	0.475	3.17	0.964
5.	Brinjal	0.473	2.450	0.898
6.	Plantation crop	0.479	1.806	0.945
7.	Weed	0.333	1.274	0.863

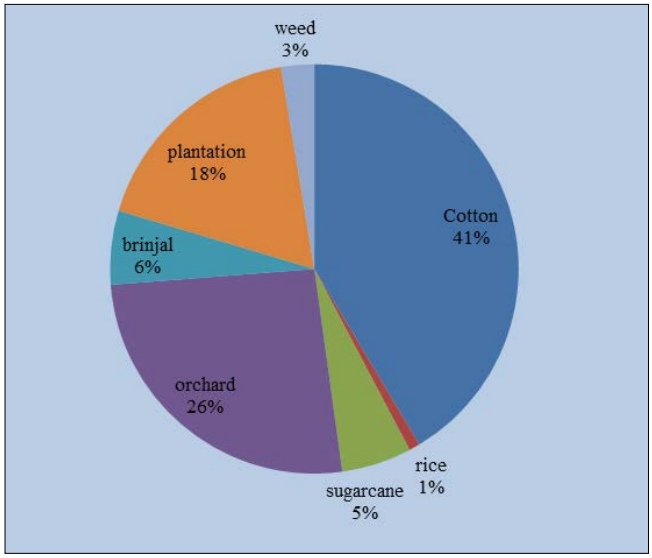

Fig 1: Encyrtids collected in different ecosystem

Conclusion

Thus, from the obtained data, it is clear that diversity index and evenness was maximum Cotton and minimum in Rice ecosystem. Among the surveyed ecosystem, more number of parasitoids are from cotton ecosystem due to the availability of more number of diversity and evenness in hosts, followed by orchard crops where the microclimate is being influenced by the canopy of the fruit as well as tree crops is conducive for the development of hosts as well as the parasitoid population in this ecosystem. On contrary to this, we recorded less number of encyrtids in the rice ecosystem, this may be due to the less availability of hosts insects and their microclimate prevailing in the ecosystem. This is in accordance with Daniel *et al* 2019

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