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Preliminary Study on Differential Abundance and Diversity of Ichneumonids and Braconids in Star Fruit Orchard and Oil Palm Plantations

A. B. Idris
School of Environmental & Natural Resource Sciences, Faculty of Science and Technology, University Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia

Abstract: The preliminary study on differential abundance and diversity of ichneumonids and braconids of star fruit and oil palms was conducted between July and November 1999. The braconids species seemed to be more abundant and diverse than the ichneumonids irrespective of the two agricultural habitats. This indicates a differential habitat preference between these two parasitic wasps. The highly disturbed agricultural habitat had significantly more diverse ichneumonid species than the moderately disturbed one. We have suggested ways to use and materialize these two parasitoid groups for controlling insect pests oil palm and fruit orchard.

Key words: Ichneumonid, braconid, diversity, disturbance, abundance

Introduction

The Ichneumonidae and Braconidae are the largest groups of parasitic Hymenoptera with at least 60, 000 and 40,000 species worldwide, respectively (Wahl & Sharkey, 1993). They are well distributed and highly diverse in almost all terrestrial habitats (La Salle & Gauld, 1993), and play important role as the regulatory agents for phytophagous insect populations dynamic, particularly the economically important insect pests (La Salle, 1993). Without them there may be an ecological catastrophe as the herbivore insects (host of the ichneumonids and braconids) will defoliate the forest and damage the crops.

Several species of these parasitoids (group of insects that use other insects to complete their life cycle or for their survival) have been successfully used as biological control agents (Jervis & Kidd, 1996). For instances, *Diadegma insulare* (ichneumonid) and *Cotesia plutellae* (braconid) are now being used as biological control agents for *Plutella xylostella* (the most important pest of cabbages worldwide) (Biever *et al.*, 1994; Talekar & Shelton, 1993).

The objectives of present study were to investigate the ichneumonid and braconid abundance and their diversity in two disturbed (agriculture) habitats and to provide the base line data for future study of Ichneumonidae and Braconidae from Malaysia.

Materials and Methods

Palm Oil plantation (POP) of Malaysian Palm Oil Board (MPOB), and the New Labu Estate, Nilai, Negeri Sembilan, and Star Fruit Orchard (MSF) of Malaysian Agriculture Research and Development Institute (MARDI), Selangor, Malaysia, were selected as the areas or habitats of study. Four Malaise traps were set randomly per habitat and placed there per week per month for a period between July and November 1999. The insects collected were brought to laboratory for sorting and identification of morphospecies per subfamily. Data were pooled before analysis. The total number of braconid individuals, number of braconid subfamily and species per habitat were analyzed using 1-way analysis of variance (ANOVA), while t-test was used to analyze the total number of braconid and ichneumonid individuals, number of braconid subfamily and species within similar habitat (Abacus Concept, 1991). The species diversity was analyzed following Robinson (1991).

Results and Discussion

A total of 17 braconid and 13 ichneumonid subfamilies were collected from oil palm plantation (OPP) and star fruit orchard. Fourteen and nine braconid subfamilies, were collected from oil palm and star fruit orchard respectively (Table 1). The 14 subfamilies collected from OPP were Agathidinae, Apozyginae, Braconinae, Cardiochilinae, Doryctinae, Euphorinae, Gnamptodontinae, Helconinae, Ichneutinae, Microgastrinae, Opiinae, Rogadinae, Trachypetinae and Khoikhoiinae. Whilst the nine subfamilies from star fruit orchard collected were Agathidinae, Alysiinae, Cheloninae, Euphorinae, Gnamptodontinae, Ichneutinae, Microgastrinae, Opiinae, and Rogadinae. In terms of number of braconid species, the OPP had 39 species (morphospecies) while star fruit had 32 species comprising 265 and 440 individuals respectively. On the other hand, out of 13 ichneumonid subfamilies collected from both habitats the OPP had eight (Cryptinae, Pimpkinae, Anomalolinae, Campopleginae, Diplazontinae, Oxytorinae, Tryponinae and Tatogastrinae) while star fruit had 11 (Cryptinae, Pimpkinae, Anomalolinae, Campopleginae, Ichneumoninae, Crematinae, Lycorininae, Mesochorinae, Tryponinae, Tatogastrinae and Ophinonae) comprising of 11 (24 individuals) and 22 (129 individuals) species respectively.

This data indicates that certain subfamilies were not recorded or present in certain habitats. In addition, the number of subfamilies and species per subfamily could be higher than what we had, if the sampling time was prolonged and types of habitats was increased or more replicates were employed. The number of braconids subfamily, species and total individuals collected were significantly different among habitats (t-test, $P < 0.05$). The number of braconids subfamily, species and total individuals collected were higher in OPP (MPOB) than that of ichneumonid subfamilies (Labu Estate) (Table 1). Similarly, the number of braconid species or total individuals collected from star fruit orchard were different significantly than that of ichneumonids. This suggests that oil palm and star fruit orchard housed more braconids than ichneumonids, and that star fruit orchard habitat seemed to favour braconids. Probably many of the insect pests of star fruits such as the fruit borer and leaf minors are the hosts for braconids (Wahl & Sharkey, 1993). High number of individuals collected from star fruit orchard is probably related to the abundance of food source in orchard that was flowering at the time of study. Similar explanation may be applied to the significant differences in number of ichneumonid species and total individuals collected from oil palm and star fruit orchard (Table 1).

Table 1: Total number of individuals, number of species and subfamilies of ichneumonids and braconids[1].

Habitat	Sub-family	Species	Individual
Oil palm (Labu Estate)[3]	8 a	11 c	24 c
Oil palm (MPOB)[3]	(14) b	(39) a	(265)b
Star Fruit (MARDI)	11 a (9)a	22 b* (32*) a	129 a* (440*)a

[1] In parenthesis is data for braconids
[2], Certain subfamilies were in more than one habitats, therefore, the total subfamily mentioned in the text may not be similar as shown in the Table.
[3], Ichneumonids or braconids was not collected; means in row with similar letter are not significantly different (t- test, P > 0.05)
'*' Mean for the total species or individuals were significantly different (t-test, P < 0.05).

Table 2: Diversity of ichneumonids and braconids species in oil palm plantation and star fruit orchard [1,2]

Habitats	H'	E'	EQ	R'
Oil palm (Labu Estate)[3]	1.97 b	0.82	0.98	3.15
Oil palm (PORIM)[3]	(3.00)a	(0.82)	(0.79)	(6.81)
Star Fruit (MARDI)[4]	2.01b* (3.06*)a	0.65 (0.88)	0.51(1.01)	4.32 (5.09)

[1] In parenthesis is data for braconids
[2] H' (Shannon Diversity Index), E' (Evenness Index), EQ (Loyld and Ghelarddi's Equitability Index, and R' (Margalef's Richness Index)
[3] Ichneumonids or braconids was not collected
[4] Values with '*' are significantly different (t-test, P < 0.05).

Present results tend to agree with Pielou (1975), who observed that community diversity depends on species richness and evenness with which the individuals are apportioned among them. As can be seen from Table 2 the Shannon diversity index (H') for braconid species of OPP (MPOB) and star fruit was significantly higher than the OPP (Labu Estate) (P < 0.05). In contrast, the H' of ichneumonid species was not significantly different among the habitats. Higher H' value of OPP (MPOB) for braconid species, which was not significantly different from that of star fruit, may be due to high value of R' (species richness) as compared with R' values of other habitats. Again, this result indicated that braconids were more diverse in both OPP (MPOB versus Labu Estate) as well as within star fruit orchard as compared with ichneumonid species. This supports the general claim that in the tropic the braconids are more abundant and diverse than that of ichneumonids (Gauld, 1984; Achterberg & Narendran, 1997; Wahl & Sharkey, 1993).

The braconids abundance and high diversity in all habitats should be maintained or manipulated for controlling pests of oil palm and star fruits. However, their effectiveness as natural enemies cannot be materialized if certain beneficial plants in the field or orchard are eliminated (Jervis, Cardiff University, UK – personal communication) and the use of pesticides is a must in controlling insect pests of the two crops. Idris and Grafius (1996) and Hawkin and Sheehan (1994) suggested that certain flowering weeds should be kept in the field as they could serve as host plants for the insect hosts of the parasitoids and other natural enemies. Jervis *et al.* (1993) and Idris and Grafius (1996) reported that the presence of certain wild flowers within and around the field can increase the parasitism rate of insect pests by their parasitoids. It was also reported that the diversity of flower-visiting parasitic Hymenoptera are higher in habitats having more flowering plants than those having less (Jervis *et al.*, 1993). Apart from wild flowers, the flowering plants can be interplanted within field of crops or fruit orchard as a companion plant to increase plant diversity and provide food source for parasitoids and their insect hosts.

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