

Diversity of Visiting Insects and Butterflies on Mustard (*Brassica* sp.) Flower at Ghatal, Midnapore, West Bengal, India

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Abstract: The present study was conducted a qualitative and quantitative assessment of diversity of visiting insects on flower of mustard (*Brassica* sp.) in Ghatal area, West Bengal, India. The insect and butterfly species diversity indices such as total specimens (*N*), Shannon diversity index (*H'*), Index of Dominance (*C*), Berger-Parker Dominance Index, and Margalef's species richness index (*S*) and Gini coefficient (*G*) index were calculated. There were about 18 types of varieties of species recorded. The Hymenoptera recorded majority of species and moderate species under Diptera and minimum species under Odonata and Lepidoptera were obtained. Different diversity indices indicated that total of about 4272 nos. of organisms were recorded. Different indices such as Shannon diversity index, Index of Dominance, and Margalef species richness index, Berger-Parker Dominance Index and Gini coefficient value 2.30, 0.88, 0.21, 2.00 and 0.55, respectively were observed. It is concluded that the mustard flowers attract multiple insect species especially those belonging from Hymenoptera, Diptera and Odonata, and also some species of butterflies and these help pollination to better yield of mustard crop. Future study should be emphasized on the soil condition and the accumulation of metal (loids) and insecticides in this crop specimen due to the application of pest control method.

Keywords: Mustard crop, Insect and butterfly diversity, Pollination and Yield, Biodiversity indices, West Bengal

1. Introduction

Modern agricultural practices depend on highest yield of crops. To produce maximum yield of crops, the pest control is necessary approach in the agricultural fields. ^[1] (Mandal & Mandal, 2010). Among several crops, mustard is the important crops of India, which occupies 23% in total oil seed production. ^[1]

Moreover, the insects and butterflies play an important role for pollination in the mustard crop through foraging, nectaring and touching the flower because pollens need to transfer from male to female flower. ^[2, 3]

Many international and Indian studies have been emphasized regarding the diversity of visiting insects such as Hymenoptera, Lepidoptera, Diptera, Coleoptera,

Thysanoptera, Hemiptera and Neuroptera on mustard flower. ^[2-14] But regarding diversity of visiting insects on the flower of mustard, few studies are reported in West Bengal ^[2, 6-8] and the study is lacking in Ghatal area, West Bengal, India.

In this context, the objective of the study was to conduct a qualitative and quantitative assessment of diversity of visiting insects on flower of mustard (*Brassica* sp.) in Ghatal area, West Bengal, India.

2. Materials and Methods

Study area

The study area was selected near Argora village, Ghatal area, Paschim Midnapore (Latitude = 22°40'N and Longitude = 87°43'E). Fig 1 depicts Google Earth image of the study area.



Figure 1: Google Earth image of study area and the sampling points (SP1, SP2, SP3 and SP4) (Source: Google Earth)

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Diversity assessment

A total 500m line transects was done randomly weekly once (2hrs. duration) in each study site during winter period (2021) as per the method of Santhosh and Basavarajappa. [15] Within 500m, 10m x 10m (100m²) area was used for transects walks and randomly visited five sites during daytime as per the protocol of Devkota et al. [16] Each species of insects and butterflies was identified with the help of research articles. [9, 11, 17]

Qualitative and quantitative assessment of insect and butterfly species

Insect and butterfly diversity indices such as total specimens (N), Shannon diversity index (H'), Index of Dominance (C), Berger-Parker Dominance Index, and Margalef's species richness index (S), Gini coefficient index were calculated. [18-23] The formulae are as follows:

Shannon-Wiener diversity index (H') = $-\sum P_i \ln P_i$... (1)
 where, P_i is proportion of species i relative to the total number of species, and lnP_i is natural logarithm of this proportion.

Index of Dominance (C) = $\sum (n_i/N)^2$ (2)
 where, n_i = importance value for each species (number of individuals), N = total number of importance value

Berger-Parker Dominance Index = N_{max} / N (3)
 where, N_{max} is the number of Individuals of a species, and N is total population of birds.

Margalef's species richness = $S - 1 \div \ln N$ (4)
 where, S = number of species, ln N = natural logarithm of the total number of individuals

Gini coefficient (G) = $2 \sum_i n_i \div n \sum_i n_i - N + 1 \div N$ (5)
 Where, n = number of values observed and i = rank of values in ascending order

Finally, Whitaker plot or rank-abundance curve was studied to know the abundance rank (X axis) and Y-axis relative abundance (Y axis). Further, it is used to visualize species richness and evenness simultaneously. [24] A Lorenz curve was studied to evaluate phenomena such as disproportionate distribution of species abundance in a community and to know the degree of inequality in abundance in a community.

The values of different biodiversity indices were calculated by using online tool namely Biodiversity calculator developed by AL Young Studio (https://www.alyoung.com/labs/biodiversity_calculator.html?rand).

3. Results

In the present findings, qualitative and quantitative assessment indicated that the variety of insect and butterfly species were observed in the study sites (Table 1). There were about 18 types of varieties of species recorded. Under Hymenoptera, majority of species such as *Apis dorsata*, *Apis cerana indica*, *Apis florea*, *Solenopsis geminata*, *Diacamma rugosum*, *Camponotus compressus*, and *Vespa* sp., moderate

species under Diptera and minimum species under Odonata and Lepidoptera were obtained.

Table 1: List of insects and butterfly species in the study sites

Sl. No.	Scientific Name	Common name	Total No.
Hymenoptera			
1.	<i>Apis dorsata</i>	Giant honeybee	506
2.	<i>Apis cerana indica</i>	Indian honeybee	444
3.	<i>Apis florea</i>	Little honeybee	502
4.	<i>Solenopsis geminata</i>	Fire ant	619
5.	<i>Diacamma rugosum</i>	Bornean queenless ant	876
6.	<i>Camponotus compressus</i>	Ant	531
7.	<i>Vespa</i> sp.	Wasp	103
Diptera			
8.	<i>Stomorphina lunata</i>	Hover fly	101
9.	<i>Chrysomya megacephala</i>	Oriental latrine fly	103
10.	<i>Musca domestica</i>	Housefly	118
11.	<i>Hermetia illucens</i>	Black soldier fly	119
Odonata			
12.	<i>Crocothemis servilia</i>	Ruddy marsh skimmer	17
13.	<i>Brachythemis contaminata</i>	Dragonfly	37
Lepidoptera			
14.	<i>Amata cyssea</i>	Handmaiden moth	27
15.	<i>Danaus chrysippus</i>	Plain tiger	33
16.	<i>Pieris brassicae</i>	Cabbage butterfly	37
17.	<i>Catopsilia pomona</i>	Lemon emigrant	43
18.	<i>Papilio plexippus</i>	Monarch butterfly	56

In Table 2, different diversity indices indicated that total of about 4272 nos. of organisms were recorded. Different indices such as Shannon diversity index, Index of Dominance, and Margalef's species richness index, Berger-Parker Dominance Index and Gini coefficient value 2.30, 0.88, 0.21, 2.00 and 0.55, respectively were observed.

Table 2: Different diversity indices of the study sites

Indices	Study sites
Total No. of species	18
Total No. of organisms	4272
Shannon-Wiener diversity index	2.30
Index of Dominance	0.88
Berger-Parker Dominance Index	0.21
Margalef species richness	2.00
Gini coefficient	0.55

In Lorenz curve (Figure 1), equal species abundance in which every species has the same population size. The Gini coefficient is the ratio of the area between the line of equality and Lorenz curve and the ranges observe between 0 and 1 and the value of about 0.55 observed a higher abundance value in Gini index.

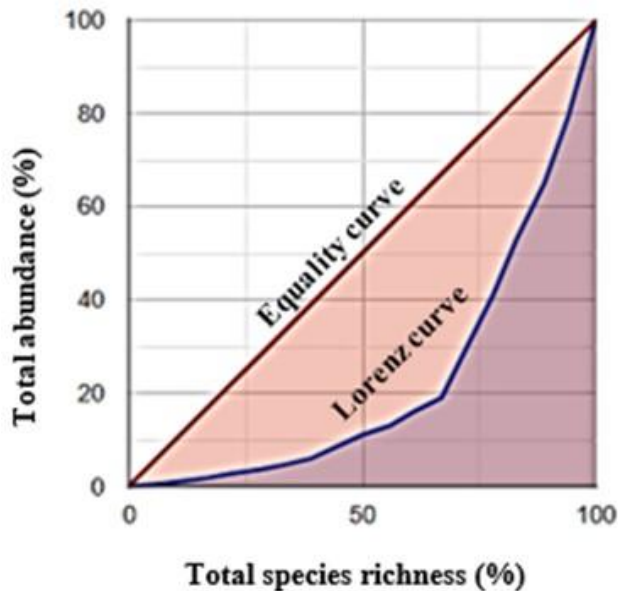


Figure 1: Lorenz graph for inequality in total species richness and abundance

4. Discussion

In the present study, mustard flowers harbour different insects and butterflies but the numbers species of insects (Hymenoptera, Diptera and Odonata) were higher compared to butterfly species (Lepidoptera), which is supported by earlier studies in West Bengal that these insect species are good pollinator.^[3, 6-8] A similar observation was documented by Roy et al.^[3] that Hymenopteran are frequent visitors on mustard flower compared to other species and these species are well-known pollinators. Biswas et al.^[17] observed butterfly abundance was higher during winter and post-monsoon season at West Midnapore District of West Bengal, India but the study was based on overall plant species. On the other hand, Devi et al.^[10] observed maximum varieties and numbers of insects and butterflies at Baghor farm, Department of Entomology, Dr. Y. S. Parmar University of Horticulture and Forestry Nauni, Solan (Himachal Pradesh) compared to the present study because this farm did not use insecticides. Moreover, Gini^[18] established that the higher Gini coefficient led to more unequal population distribution and in the present findings the value was 0.55, which is quite higher than earlier study by Biswas et al.^[17]

5. Conclusion

It is concluded that the mustard flowers attract multiple insect species especially those belonging from Hymenoptera, Diptera and Odonata, and also some species of butterflies. Some of the insects are well-known nectar collector, few are both nectar and pollen collector and few are only visitors, but pollination may take place with the help of all insects and butterflies, which enhance the yield of crops especially mustard. Future study should be emphasized on the soil condition and the accumulation of metal (loids) and insecticides in this crop specimen due to the application of pest control method.

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Conflict of interest

Authors declare no conflict of interest.

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