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ABUNDANCE OF INSECT POLLINATORS IN A MUSTARD FIELD AT DINAJPUR IN BANGLADESH

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ABSTRACT

The study was conducted in the farmer's mustard field near the campus of Hajee Mohammad Danesh Science and Technology University, Dinajpur-5200, Bangladesh from November 2020 to March 2021 to identify the insects involved in pollination of mustard and to know their relative abundance. A total number of 24 pollinator insects belonging to 15 families (Apidae, Andrenidae, Halictidae, Scoliidae, Tenthredinidae, Muscidae, Calliphoridae, Rhiniidae, Syrphidae, Arctiide, Crambidae, Nymphalidae, Pieridae, Plutellidae and Coccinellidae) and 4 orders (Hymenoptera, Diptera, Lepidoptera and Coleoptera) were observed associated with mustard (*Brassica rapa*) crop on BARI Sarisha-17. Among the orders, the Hymenoptera, Diptera, Lepidoptera and Coleoptera were found as 49.8%, 42.0%, 7.4% and 0.6%, respectively. However, Hymenopterans insects were evident the pre-dominant floral visitors. Indian honey bee, *Apis cerana* showed the highest abundance (23.2%) followed by Rock bee, *Apis dorsata* (13.8%), Rhiniid blowfly, *Stomorhina* sp. (10.5%).

Keywords: Diversity, pollinator insects, mustard

Introduction

Pollinators provide an essential ecosystem service by enhancing the reproductive capacity of bionetwork, thereby contributing to food security, improving livelihoods, and conserving bio-diversity (Abrol 2007). Globally 35% of the eaten crops are produced in terms of the volume are depend on animal pollination (Maus 2015). Among them, 75% of the crop species depend on insect pollination to some degree (Klein *et al*. 2007). Once more, the cross-pollinated crops are depended entirely on insect pollinators to set fruit while some are partly dependent; which improves the yield, uniform and early pod setting, enhanced quality and nutritional values (Wietzke *et al*. 2018, Nicholson and Ricketts 2019). Insect-pollinated crops have a higher market value, makes them economically important to intensive cropping systems, where industrial-scale agriculture is crucial for the national economy (Potts *et al*. 2016, Nasrin *et al.* 2021). So, pollinator-dependent crop is rising with increasing gross domestic product (GDP), thereby increasing the global demand for pollinators (Aizen and Harder 2009). But pollination is being endangered by recent declines of pollinators (Garibaldi *et al*. 2011). Destruction and fragmentation of habitats, agricultural intensification, climate change, pathogens, genetically modified organisms, and invasive species adversely affect the diversity and abundance of pollinators (Dicks *et al*. 2016).

Mustard is a self-incompatible crop due to which flowers cannot utilize their own pollen as because the pollen is heavier and sticky, which is unable to be easily wind borne. So on, it needs biological agents of insect groups to transfer the pollen from male to female flowers (Roy *et al*. 2014). Low population of pollinators can lead to insufficient pollination which in turn can significantly minimize the crop yield (Free 1999). If the numbers of pollinators is limited in a landscape, the potential production of insect-pollinated crops will never be achieved by only improving soil conditions or any other factors (Sawe *et al*. 2020). Furthermore, pollinator diversity is also crucial in sustaining pollination and crop productivity (Garibaldi *et al*. 2014). Under these circumstances, the present research was conducted to identify the pollinator insect species of mustard crop and their relative abundance of mustard crop.

Materials and Methods

Experimental site: The experiment was conducted in the village "Kornai" which is located near the campus of Hajee Mohammad Danesh science and Technology University, Dinajpur-5200, Bangladesh during November 2021 to March 2022. The experimental field was located at 88º64' E and 25º70' N. The seeds of BARI Sarisha-17 were sown in the field on November 23. All the intercultural operations and recommended fertilizers were applied except insecticide as and when necessary to produce a healthy crop.

Experimental protocol: To study pollinator insect diversity and the abundance of floral visitors, observation of 100 plants were carried out using scan sampling for 15 minutes (Martin and Bateson 1993, Atmowidi *et al*. 2007) for three times per one hour starting from 8.00 am until 4.00 pm (Singh *et al.* 2000, Westphal *et al*. 2008). Insect observations were conducted from December 25 to January 17 (24 days). Observations of flower-visiting insects were conducted from the start of flowering until approximately 95% of the flower faded. Insects visiting the flowers of the selected plants were surveyed visually by walking slowly and were identified at species level. The unidentified insects were caught by an aerial net for identification in the laboratory using the literature and knowledge available in research expertise. Photos of different insect visitors were captured. The relative abundance of these insect visitors was calculated by using the formula:

Relative abundance (%) = (Population of a particular species visiting flowers/ Total population of all species visiting flowers) × 100 (Das and Jha 2018).

Data analysis: The data were analyzed by using IBM SPSS statistical program version 22.0. Survey data was subjected to one way analysis of variance (ANOVA) and mean separation was performed by using Tukey's HSD test (Silva and Azevedo 2016).

Results

Diverse insect pollinators as many as 24 species associated with mustard crop (*Brassica rapa*) were observed during the study and presented in Table 1. They belonged to 15 families (Apidae, Andrenidae, Halictidae, Scoliidae, Tenthredinidae, Muscidae, Calliphoridae, Rhiniidae, Syrphidae, Arctiide, Crambidae, Nymphalidae, Pieridae, Plutellidae and Coccinellidae) of 4 orders. The individual number of the insects of the 4 orders varied significantly ($P < 0.05$, $df = 3$, $F = 416.8$) and they belonged to Hymenoptera, Diptera, Lepidoptera and Coleoptera as 49.8%, 42.0%, 7.41% and 0.6%, respectively. Among the pollinators, Hymenopterans were found to the pre-dominant floral visitors.

Relative abundance of pollinator insects visiting mustard flowers: A total of 2303 individual pollinators were found during the flowering period which lasted 24 days. Among them, 931.3 insects were found during the first eight days which was 40.0% of the total observed insects. In the next eight days (9th-16th day), 1049.3 insects were found which was 45.0% of the total observed insects. In the last eight days (17^{th}-24^{th} day), 350.3 insects were found which was 15.0% of the total observed insects (Table 2).

The average individual number of 24 species varied significantly ($P < 0.05$, $df = 23$, $F = 612.24$). Relative abundance of nine species from the order Hymenoptera were found as *Apis cerana* (23.2%), *A. dorsata* (13.8%), *A. mellifera* (3.7%), *Xylocopa confusa* (0.3%), *Andrena* sp. (0.5%), *Halictus* sp. (4.9%), *Ropalidia marginata* (3.2%), *Athalia lugens* (0.3%). Eight species from the order Diptera as *Musca domestica* (8.9%), *Chrysomya megacephala* (8.5%), *Stomorhina* sp. (10.5%), *Syrphus* sp. (3.5%), *Eristalinus* sp. (5.2%), *Episyrphus* sp. (5.2%), *Platycherius* sp. (0.2%); seven species from the order Lepidoptera *viz*., *Amata bicincta* (3.5%), *Maruca vitrata* (2.4%), *Danaus* sp (0.2%), *Junonia almana* (0.4%), *Junonia atlites* (0.2%), *Pieris rapae* (0.4%), *Plutella* sp. (0.2%); one species from the order Coleoptera *viz*., *Micraspis crocea* (0.6%) was recorded during observations. Three species of flower-visiting pollinator insects showed high abundance i.e. Indian honey bee, *Apis cerana* (23.2%), rock bee, *Apis dorsata* (13.8%), Rhiniid blowfly, *Stomorhina* sp. (10.5%), other pollinator species as shown in Table 2, had a lower frequent visitors.

Table 1. Taxonomic profile and abundance of pollinator insects in a mustard field at Dinajpur in Bangladesh

Common name	Scientific name	Family and Order	Sum ± SE	Percent
Indian honey bee	*Apis cerana*	Apidae Hymenoptera		
Rock bee	*Apis dorsata*			
European bee	*Apis mellifera*			
Carpentar bee	*Xylocopa confusa*			
Mining bee	*Andrena* sp.	Andrenidae Hymenoptera	1149.0 ± 63.7a	49.8
Sweat bee	*Halictus* sp.	Halictidae Hymenoptera		
Wasp	*Ropalidia marginata*	Scoliidae Hymenoptera		
Mustard sawfly	*Athalia lugens*	Tenthredinidae Hymenoptera		
House fly	*Musca domestica*	Muscidae Diptera		
Blow fly	*Chrysomya megacephala*	Calliphoridae Diptera		
Rhiniid blowfly	*Stomorhina* sp.	Rhiniidae Diptera	968.6 ± 67.9b	42.0
Syrphid fly	*Syrphus* sp.	Syrphidae Diptera		
Hoverfly	*Eristalinus* sp.			
Marmalade hoverfly	*Episyrphus* sp.			
Sedgesitter	*Platycherius* sp.			
Amata moth	*Amata bicincta*	Arctiidae Lepidoptera		
Bean pod borer	*Maruca vitrata*	Crambidae Lepidoptera		
Monarch butterfly	*Danaus chrysippus*	Nymphalidae Lepidoptera	170.6 ± 22.7c	7.4
Peacock pansy	*Junonia almana*			
Grey pansy	*Junonia atlites*			
Cabbage butterfly	*Pieris rapae*	Pieridae Lepidoptera		
Diamond back moth	*Plutella xylostella*	Plutellidae Lepidoptera		
Ladybird beetle	*Micraspis crocea*	Coccinellidae Coleoptera	14.67 ± 4.6c	0.6
Cumulative±SE			2303.0 ± 148.0	
CV (%)			8.3	

Within column values followed by different letter(s) are significantly different at 5% level of probability by Tukey HSD test

DISCUSSION

Insect pollinators are a key component of global food security. By far the most important contribution insect pollinators make to modern agriculture is the pollination services that they provide. Assessing pollination dependence with proper controls is needed to correctly estimate the contribution that insect pollinators can provide to crop yields. However, we have surprisingly little information on the actual degree of pollinator dependence for major crops like mustard. Quality is also important in crop production, especially from an economic standpoint. In this study, we examined the pollinators' diversity on mustard crop using a meta-analysis approach.

Table 2. Relative abundance of insect pollinators as observed on mustard flowers

Observed pollinators	Relative abundance (%)			
	Week 1	Week 2	Week 3	Cumulative
Indian honey bee	9.8	9.8	3.5	23.2
Rock bee	5.3	5.8	2.6	13.8
European honey bee	1.4	2.0	0.4	3.7
Carpenter bee	0.1	0.2	0.0	0.3
Mining bee	0.0	0.4	0.1	0.5
Sweat bee	2.3	2.1	0.4	4.9
Wasp	1.3	1.7	0.2	3.2
Mustard sawfly	0.2	0.1	0.1	0.3
House fly	3.4	3.4	2.0	8.9
Blow fly	3.2	4.0	1.3	8.5
Rhiniid blowfly	4.3	4.2	1.9	10.5
Syrphid fly	1.5	1.6	0.4	3.5
Hoverfly	2.0	2.8	0.5	5.2
Marmalade hoverfly	2.7	2.0	0.6	5.2
Sedgesitter	0.0	0.2	0.0	0.2
Amata moth	1.3	1.9	0.3	3.5
Bean pod borer	0.4	1.8	0.3	2.4
Monarch butterfly	0.0	0.2	0.0	0.2
Peacock pansy	0.0	0.4	0.1	0.4
Grey pansy	0.1	0.1	0.0	0.2
Pierid/Cabbage butterfly	0.2	0.2	0.0	0.4
Diamondback moth	0.1	0.1	0.1	0.2
Ladybird beetle	0.1	0.2	0.3	0.6
Total (%)	40.0	45.0	15.0	100

Within column values followed by different letter(s) are significantly different at 5% level of probability by Tukey HSD test

Diverse insect pollinators associated with mustard crop (*Brassica rapa*) were observed and they belonged to 15 families of 4 orders. Among the pollinators, Hymenopterans were found to the pre-dominant floral visitors comprising of nine species from five families. The present investigation is in parallel to Duara and Borah (2020) who reported that total 21 species belonging to 4 orders (Hymenoptera, Lepidoptera, Diptera and Coleoptera) in mustard flowers. Similar findings were also reported by Das and Jha (2018) who had found 13 species of insect pollinators visiting *Brassica juncea* of which 11 species were observed during this study. They also found those species belonging to five families under three orders *viz*., Hymenoptera, Diptera and Lepidoptera and the highest abundance of pollinator species belonged to Hymenoptera followed by Diptera and Lepidoptera; which is coincided with the findings of the present investigation. Mondal *et al.* (2018) found eight species of insects belonging to eight families in three orders namly Lepidoptera, Diptera and Hymenoptera as the polynators of mastard field at Gazipur in Bangladesh. Rojeet *et al.* (2016) found that eleven species of insect pollinators belonging to five families under three orders as Hymenoptera, Diptera and Lepidoptera were visited rapeseed flowers under natural condition; which is also similar to this present study. Kamel *et al.* (2015) observed similar 21 species of insect pollinators belonging to 14 families under four orders (Hymenoptera, Lepidoptera, Diptera and Coleoptera) visiting on canola, *B. napus* flowers. Kunjwal *et al*. (2014) also found 30 similar

pollinator insect species visiting *B. juncea* belonging to four orders *viz*., Hymenoptera, Diptera, Lepidoptera and Coleoptera. Again, Shakeel *et al.* (2019) found the highest abundance of pollinator species belonged to Hymenoptera which is also agreed with the findings of the present investigation. Giri *et al.* (2018) also reported that seven insect pollinators were found visiting *B. juncea* flowers belonging to the orders Diptera, Hymenoptera and Lepidoptera. Among those, the order Hymenoptera was considered as the major group of pollinators.

A total of 2303 individual pollinators were found during the flowering period of mustard. However, 45.0% insect pollinators were found during the mid flowering time of plants. Results of the present study are parallel with those of Giri *et al*. (2018). They reported that *Apis mllifera and A. dorsata* were the dominant visitor on mustard, *Brassica juncea*. Singh *et al*. (2000) also found that *A. cerana* was the main pollinator of sunflower, closely followed by *A. dorsata*. The present investigation is coincided with the findings of Atmowidi *et al*. (2007) who observed a high abundance of *A. cerana* (43.1%), making it the dominant flower visitor of mustard.

Based on the outcome of these investigations, it can be concluded that blossoms of mustard attract rich fauna of different insect visitors in which, the honeybees constitute the major group of insect pollinators. However, more critical information is needed on this aspect at different locations of the country to establish the effects as observed in this study, since the data refer to a single cropping season and site. Though it was a preliminary attempt to make a report of insect pollinators of mustard (*B. rapa*), it will undoubtedly help the future researchers as a baseline information of pollinators in the area.

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