Relative abundance of different insect pollinators on mustard (*Brassica juncea* Linn) and cauliflower (*Brassica oleracea* Linn)

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Abstract

Pollination is transfer of pollens from anther to stigma either of the same or different flowers. In the present study, the abundance and diversity of insect pollinators associated with mustard and cauliflower, grown on research farm of Lovely Professional University, Jalandhar, India was observed using scan sampling method. Relative abundance of different flower visitors was checked. Hymenoptera was most diverse insect pollinators on mustard and cauliflower both followed by Diptera and Lepidoptera. *A. mellifera* (Relative abundance= 18.54 % / m^2) was the most abundant insect species during onset, full and end of bloom showing significantly higher population compared to second most abundant *M. domestica* (3.07, 3.92 and 3.61 insects/ m^2), respectively on cauliflower. On mustard, *A. mellifera* (4.90 and 6.32 insects/ m^2) was the most abundant insect during onset and full bloom, respectively. However, *Syrphus* spp (4.76 insects/ m^2) was most abundant insect species during end of bloom but its population was at par with the *A. mellifera* (4.62 insects/ m^2) and *M. domestica* (4.60 insects/ m^2).

Introduction

The process of transfer of pollen from anther to stigma either of the same or different flower is pollination. Approximately 75% of crops all over the world rely upon pollination by animals out of which majority is composed of insect pollinators (Choi *et al*., 2015). Insect perform 80% of total pollination activity and bees contribute nearly 80% of the total insect pollination, thus are considered as the better pollinators (Robinson and Morse, 1989). Insects contributing to pollination mainly fall under three orders i.e. Lepidoptera, Hymenoptera and Diptera (Jadhav *et al*., 2018). Among the Hymenopterans, honeybees are the preeminent insect pollinators succeeded by wasps and flies (Bashir *et al.,* 2018). They are responsible for pollination of major crops, especially in the seeded species. The Food and Agriculture Organization (FAO, 2016) of the U.N. has estimates that of the slightly more than 100 crop species that provide 90 percent of food supplies for 146 countries, 71 are bee-pollinated (mainly by wild bees), and several others are pollinated by thrips, wasps, flies, beetles, moths and other insects. Flowering plants and honey bees show mutual relationship, they obtain nectar and pollen from plants and honey bees in turn carry out pollination and communication in the plant

species. Honeybees help farmers by increasing crop yield both qualitatively and quantitatively through pollination (Sharmah *et al*., 2015), enhance agricultural productivity to the tune of 30–80% annually through cross-pollination (Behera *et al.*, 2014). Among insect pollinators on cauliflower, hymenopteran constitute 83.95% of the total insect visitors responsible for increasing number of siliqua per plant, seeds per siliqua (Sharma *et.al.*, 2013).

Diptera are one of most diverse animal groups in the world (Skevington and Dang, 2002) including around 160,000 identified species in about 150 contain different families (Evenhuis et al. 2008). Insects from different families of Diptera visit around 555 flowering plant species (Larson *et al*., 2001) and act as pollinator of more than 100 cultivated plants including mango, cashew, tea, cacao, onions, strawberries (Larson and Kevan ; Heath 1982), cauliflower, mustard, carrots, apples (Mitra and Banerjee 2007), leek (Clement *et al*., 2007) and cassava (Hansen, 1983). Diptera are thus one of the most important groups of pollinating organisms, second only to the Hymenoptera. There are various other important insect pollinators are also present which visit flowers regularly for pollen and nectar collection and in turn help in pollination of crop. Thus the current study has been undertaken to find out the diversity of insect pollinators visiting cauliflower and mustard crop.

Material and Methods

The experiment was conducted in Entomology Farms, Lovely Professional University, Phagwara. Cauliflower (*Brassica oleracea* Linn) and mustard (*Brassica juncea* Linn) were raised as per recommended package practices of Punjab Agriculture University. The experiment include six treatments, each replicated four times with a plot size of 3×3 m sq.

The observations on diversity and abundance of different insect species were recorded on mustard and cauliflower crop during January, February and March months of 2021. The data was collected on three days per week. Diversity of insects was checked by using scan sampling; different insect pollinators were recorded on five different spots from cauliflower and mustard for five minutes in 1 square meter area randomly.

The data thus obtained was analyzed using STPR3 programme, developed by Department of Statistics, College of Basic Science and Humanities, GBPUA&T, Pantnagar. The relative abundance was calculated by using the following formula (Das and Jha, 2019):

Relative abundance (%) = (Population of a particular species visiting flowers / Total population of all species visiting flowers) x 100

RESULT AND DISCUSSION

Relative abundance of insect pollinators on cauliflower

The perusal of data (Table 1) indicated that 13 identified species from 4 orders: Hymenoptera, Diptera, Lepidoptera and Coleoptera including respectively 5, 3, 4 and 1 species has been recorded on cauliflower bloom. *A. mellifera* (Relative abundance= 18.54 % / m^2) was the most abundant insect species during onset, full and end of bloom with the average population of 4.00, 4.56 and 3.60 *A. mellifera*/ m^2, showing significantly higher population compared to second most abundant *M. domestica* (3.07, 3.92 and 3.61 insects/ m^2), respectively. Among three *Apis* spp *viz., A. cerana* (1.22, 1.64 and 0.90 insects/m^2), *A. dorsata* (0.95, 1.14 and 0.25 insects/ m^2) and *A. florae* (1.70, 2.75 and 2.4 insects/ m^2), *A. florae* was relatively more abundant (10.43 %). No *Coccinella* spp. were observed during onset of bloom intermediate population was observed during full bloom (2.88 insects / m^2) and end of bloom (2.84 insects / m^2). *Syrphus* spp was third most prominent insect species during full bloom (3.24 insects/ m^2) and end of bloom (3.10 insects/ m^2).

It is evident from the scan sampling data that *A. mellifera* is most important pollinator owing to its significantly higher population compared to other flower visiting insects followed by *M.domestica*.

Relative abundance of insect pollinators on mustard

The data (table 2) shows that on mustard also 13 identified insect species were observed from 4 different orders: Hymenoptera, Diptera, Lepidoptera and coleopteran including 6, 4, 2 and 1 insect species in each order, respectively. *A. mellifera* (4.90 and 6.32 insects/ m^2) was the most abundant insect in mustard crop during onset and full bloom, respectively. However, *Syrphus* spp (4.76 insects/ m^2) was most abundant insect

species during end of bloom but its population was at par with the *A. mellifera* (4.62 insects/ m^2) and *M. domestica* (4.60 insects/ m^2). *M. domestica* was the second most abundant insect species (4.15 and 4.86 insects/ m^2) during onset and full bloom, respectively. *A. florae* (2.625, 3.62 and 3.62 insects/m^2) was second most abundant honey bee species in mustard followed by *A. cerana* (2.55, 2.76 and 1.77 insects/m^2) and *A. dorsata* (0.00, 1.72 and 0.40 insects/m^2) during onset, full and end of bloom, respectively.

It is apparent from the data that on mustard crop, *A. mellifera* was most abundant throughout the season except for end of bloom where *Syrphus* spp was most prominent, however the difference was not significant. The comparison between two crops (cauliflower and mustard) revealed that the population of different insect pest species visiting the flowers was higher in mustard than cauliflower.

Various studies have been carried out to find out the diversity and abundance of insect species on flowers of different crops. Roy *et al.,* (2014) in a study at Agricultural land of Phaldi, near Duttapukur, West Bengal, India, during 2012-2013 through scan sampling found that the Hymenoptera was most abundant in the field followed by coleopteran and Lepidoptera. In our experiment also, in both the crops, Hymenoptera was most diverse insect pollinator. However, the diversity and activity of Coleoptera was least whereas Diptera and Lepidoptera were second and third most abundant order (Table 1 and 2). In another study, carried out at Instructional Farm Jaguli, Bidhan Chandra Krishi Viswavidyalaya, West Bengal during 2017 – 2018, Das and Jha (2019) revealed that the abundance (percentage of insect fauna/sq.m/2 min.) of Hymenopterans was maximum followed by the Dipterans and Lepidoptera. *A. mellifera* (35.18%) was most dominant followed by the *A. cerana indica* (23.11%), *A. dorsata* (12.00%) and *A. florea* (4.23%). Among Dipteran flies (21.25%), Syrphids were most common. Similarly among honeybees, *A. mellifera* (18.54 and 17.73 % relative abundance) was predominant in our experiment, however *A. florae* (10.43 and %) was second most dominant followed by *A.cerana* (5.74 %) and *A. dorsata* (3.57 %), in cauliflower and mustard crops respectively (table 1 and 2).

Lepidoptera were more active during morning and afternoon. Hoverflies and cabbage butterflies were also more active in afternoon. Coleoptera order was less diverse and showed less activity. The decline in pollinators diversity and availability could result in grievous threats to crop pollination by reducing the crop

yields. Hence, conservation of pollinator species and employment of effective crop management techniques that encourage the foraging activity of the pollinators must be adopted by the people for increasing crop production.

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Table 1: Relative abundance of insect pollination on cauliflower (*Brassica oleracea* Linn)

Name of species	On set bloom	Full bloom	End of bloom	Average	Mean percent population
Apis mellifera	4.00 (2.23)	4.56 (2.36)	3.60 (2.14)	4.053	18.54
Apis cerana	1.22 (1.48)	1.64 (1.62)	0.9 (1.38)	1.255	5.74
Allograpta obliqua	1.32 (1.52)	3.30 (2.07)	2.685 (1.91)	2.436	11.14
Musa domestica	3.07 (2.02)	3.92 (2.22)	3.61 (2.14)	3.535	16.16
Pieris brassicae	0.65 (1.28)	1.30 (1.52)	0.5 (1.45)	0.816	3.74
***Syrphus* spp.**	1.20 (1.48)	3.24 (2.05)	3.10 (1.95)	2.513	11.50
***Xylocopa* spp.**	1.30 (1.51)	1.32 (1.52)	0.625 (1.34)	1.08	4.94
Apis florea	1.70 (1.64)	2.76 (1.94)	2.40 (1.74)	2.28	10.43
Danaus plexippus	0.30 (1.14)	1.04 (1.42)	1.00 (1.34)	0.78	3.57
Apis dorsata	0.95 (1.39)	1.14 (1.46)	0.25 (1.11)	0.78	3.57
***Coccinella* spp.**	0.00 (1.00)	2.88 (1.97)	2.84 (1.95)	1.90	8.69
Plutella xylostella	0.00 (1.00)	0.84 (1.35)	0.31 (1.13)	0.385	1.77
Daphnis nerii	0.00 (1.00)	0.16 (1.07)	0.00 (1.00)	0.053	0.25
CD at 1%	0.14	0.18	0.22		
CV	5.74	6.16	8.32		
SEM	0 .03694	0.04783	0.0589		

* Data in parentheses represents the means of √n+1 transformation

Table 2: Relative abundance of insect pollination on Mustard (*Brassica juncea* Linn)

Name of species	on set bloom	Full bloom	End of bloom	Average	Mean percent population
Apis mellifera	4.9 (2.438473)	6.32 (2.702761)	4.62 (2.370360)	5.28	17.73
Apis cerana	2.55 (1.864196)	2.76 (1.933411)	1.775 (1.664748)	2.361	7.92
Allograpta obliqua	1.8 (1.669694)	3.86 (2.203680)	4.135 (2.263324)	3.265	10.96
Musa domestica	4.15 (2.267643)	4.86 (2.417242)	4.6 (2.360219)	4.536	15.22
Pieris brassicae	1.275 (1.531812)	2.06 (2.239325)	1.3 (2.397178)	1.545	5.18
***Syrphus* spp.**	1.35 (1.505190)	4.02 (1.742034)	4.76 (1.511822)	3.376	11.33
***Xylocopa* spp.**	1.15 (1.457414)	2.28 (1.804407)	1.25 (1.497244)	1.56	5.23
Apis florea	2.625 (1.903018)	3.62 (2.14812)	3.625 (2.149576)	3.29	11.04
Danaus plexippus	0.2 (1.089472)	1.58 (1.604633)	1.225 (1.488896)	1.00	3.35
Apis dorsata	0 (1.000000)	1.72 (1.822337)	0.4 (1.938445)	0.70	2.35
***Coccinella* spp.**	0 (1.000000)	2.36 (1.646931)	2.775 (1.174445)	1.711	5.74
Scaptomyza pall	0 (1.000000)	1.28 (1.507009)	1.25 (1.491145)	0.84	2.82
***Ichneumon* spp**	0 (1.000000)	0.96 (1.393954)	0 (1.000000)	0.32	1.07
CD at 1%	0.2063006	0.2273259	0.1933243		
CV	8.013776	6.922022	6.356064		
SEM	0.0544	0.0599	0.0509		

* Data in parentheses represents the means of √n+1 transformation