

The Diversity and Abundance of Insect Pollinators Visiting Apple Flowers

Vikram Saharan, D. P. Abrol

Received 4 July 2023, Accepted 12 October 2023, Published on 15 December 2023

ABSTRACT

A study was conducted to determine the insect pollinators visiting apple flowers. In studies, Apple flowers attracted insects from five orders, including *Hymenoptera*, *Diptera*, *Lepidoptera*, *Coleoptera* and *Thysanoptera*. Of all the orders, insects belonging to order *Hymenoptera* were most abundant. They included honey bee *Apis mellifera*, *Apis cerana*, bumble bees *Bombus* sp. *Anthophoridae* *Xylocopa fenestrata*, *X. aestuans* *X. pubescens*, *X. valga*, *Halictidae* *Halictus* spp. *Nomia* spp. *Lasioglossum* spp. *Ceratina* spp. *Melissodes* spp., *Colletidae* *Colletes* spp., *Vespa orientalis*, *V. cinctus* *V. mandarinia*, *Polistes hebraeus*, *Megachilidae* *Osmia* spp. *Andrenidae* *Andrena flaviceps*, *Formicidae* *Camponotus compressus*. Honeybees were the most abundant of all flower visitors and made up more than 48% of the total.

Keywords Insect Pollinators, Species diversity, Pollination.

INTRODUCTION

The apple is a very remunerative crop that grows worldwide in temperate regions. It is extensively grown in Jammu and Kashmir, Himachal Pradesh, and Uttarakhand hills, while it is grown in the North-Eastern region in Arunachal Pradesh. In India, apples account for about 10% of total fruit production and are the most common temperate fruit crop. The major apple producing states are Jammu and Kashmir, Himachal Pradesh, and Uttarakhand, which account for 95% of total production. Apple is an important fruit crop and plays an important role in economy of Jammu and Kashmir state. Bees and hoverflies are the most important pollination vectors for apple trees, which means their presence in orchards is essential for apple production (Klein *et al.* 2007) and there is some evidence that levels of pollination affect seed number with associated impacts on size and calcium concentration (Matsumoto *et al.* 2012). In developing countries, honeybees play an essential role in pollinating a wide range of crops. A wide range of agricultural/horticultural and natural ecosystems depend on insect pollinators for sustainability. In Jammu and Kashmir state, due to the spread of Thai sac brood virus disease, *Apis cerana* has almost been wiped out (Abrol and Bhat 1990). The other honey bee species *Apis florea* F. and *Apis dorsata* F. are invaluable pollinators but their numbers fluctuate from year to year. The exotic honey bee *Apis mellifera* L. which has fully acclimatized to the agro-climatic and geographical conditions of Jammu and Kashmir State is managed on commercial scale for honey production and pollination. In view of the above facts, the present

Vikram Saharan¹, Dr D. P. Abrol^{2*}

¹Ph D. Scholar, ²Fellow National Academy of Agricultural Sciences (India) Ex-Dean Faculty of Agriculture

^{1,2}Division of Entomology, Sher-e-Kashmir University of Agricultural Sciences and Technology, Faculty of Agriculture, Chatha Jammu 180009, J and K, India

Email: dharam_abrol@rediffmail

*Corresponding author

study investigated the diversity of species composition and abundance of insect visitors on apples. The results obtained are presented below.

MATERIALS AND METHODS

Study were conducted at Regional Horticultural Research Sub Station RHRSS) at Bhaderwah of Sher-e-Kashmir university of Agricultural Sciences and Technology Jammu, during 2020.

Details of experiment

Experiment site is located 320 53' and 340 21' latitude and 750 01' and 760 47' E longitudes with an altitudinal 1600 m above the sea level. ~ 3520, The climate is characterized as sub humid temperate region, rainfall restricted mostly to winter months. Snowfalls during January and February months are also experienced.

Identifying and determining the species composition

The insect pollinators were collected using hand net/sweep method from Regional Horticultural Research Sub Station RHRSS) at Bhaderwah locations of Jammu division and further preserved as dry and wet collection for identification of species and determination of insect pollinator species composition. It was confirmed by insect taxonomists that the identification was correct. A nylon cloth hand net was used to collect pollinators and ethyl acetate was used to kill them. Some collection was also made by setting up the malaise trap. The majority of the collections were found in open areas rather than closed ones. Random sampling was used for most of the collection. Additionally, they used Nikkon cameras for their live macro photography. A sweeping hand net was found to be more effective than a malaise trap in collecting pollinators at high altitudes due to very high wind velocity accompanied by intermittent rains.

Methods of killing and setting

To identify and analyze the collected insect material, the material was first sorted out in the field, then brought to the laboratory. Special transparent killing jars were designed to preserve the color of

the pubescence of these insects. The color of insect pollinators' pubescence is very important for species identification, so proper care was taken during the collection period. In order to protect the pubescence, insects killed in the killing jar were constantly shifted to another jar of the same size. The specimens were pinned using entomological pins of various sizes after arriving in the laboratory. After stretching the specimens were appended with data label containing the important information regarding its locality, altitude, date of collection and name of the collector. Later on, stretched specimens were transferred to the storage boxes, poisoned with ethyl acetate soaked cotton and naphthalene powder filled in the side grooves of boxes. All the identified specimens have been deposited in the Division of Entomology, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, Chatha, Jammu.

RESULTS

Based on the data presented in Table 1, insect visitors were observed in 2020. The apple flowers were visited by 35 species and 14 families of insects belonging to five orders: hymenoptera, diptera, coleoptera, lepidoptera, and thysanoptera. It was found that

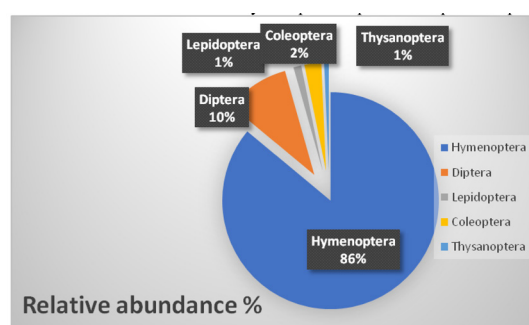
Table 1. Taxonomic status of insect pollinators visiting apple flowers during April 2020.

Species	Order	Family	Relative abundance (%)
<i>A.mellifera</i>	<i>Hymenoptera</i>	Apidae	24.10
<i>A. cerana</i>	<i>Hymenoptera</i>	Apidae	22.3
<i>Bombus spp.</i>	<i>Hymenoptera</i>	Apidae	7.9
<i>Xylocopafenestrata</i>	<i>Hymenoptera</i>	Anthophoridae	1.75
<i>X. aestuans</i>			2.35
<i>X. pubescens</i>			0.15
<i>X. valga</i>			0.75
<i>Halictus spp.</i>	<i>Hymenoptera</i>	Halictidae	4.51
<i>Nomia spp.</i>			1.25
<i>Lasioglossum spp.</i>			2.35
<i>Ceratina spp.</i>			1.10
<i>Melissodes spp.</i>			1.08
<i>Colletesous</i>	<i>Hymenoptera</i>	Colletidae	1.00
<i>Vespa orientalis</i>	<i>Hymenoptera</i>	Vespidae	0.92
<i>V. cincta</i>			0.24
<i>V. mandarina</i>			0.62

Table 1. Continued.

Species	Order	Family	Relative abundance (%)
<i>Polistes hebraeus</i>			1.3
<i>Osmia spp.</i>	Hymenoptera	Megachilidae	6.92
<i>Andrenaflaviceps</i>	Hymenoptera	Andrenidae	2.12
<i>Camponotuscompressus</i>	Hymenoptera	Formicidae	3.34
<i>Musca spp.</i>	Diptera	Muscidae	2.90
<i>Chrysomia spp.</i>	Diptera	Calliphoridae	0.45
<i>Pseudopyrilla spp.</i>	Diptera		0.50
<i>Eristalistenax</i>	Diptera	Syrphidae	1.05
<i>Eristalis spp.</i>			2.03
<i>Sporophoriaindiana</i>			1.08
<i>Metasyrphuscorollae</i>			0.55
<i>Melanostomaunivittatum</i>			0.39
<i>Episyrphusbalteatus</i>			0.25
<i>Scaevapyastris</i>			0.36
<i>Pieris brassicae</i>	Lepidoptera	Pieridae	1.18
<i>Coccinella septempunctata</i>	Coleoptera	Coccinellidae	0.80
<i>C.septempunctata var divaricata</i>			0.87
<i>Menochilus sexmaculata</i>			0.84
<i>Thrips</i>	Thysanoptera	Thripidae	0.70

insects belonging to the order *Hymenoptera* were most abundant out of all the orders. They included honey bee *Apis mellifera*, *Apis cerana*, bumble bees *Bombus* sp. Anthophoride *Xylocopa fenestrata*, *X. aestuans*, *X. pubescens*, *X. valga*, *Halictidae* *Halictus* spp. *Nomia* spp. *Lasioglossum* spp. *Ceratina* spp. *Melissodes* spp., *Colletidae* *Colletes* spp., *Vespa orientalis*, *V. cincta*, *V. mandarinia*, *Polistes hebraeus*, *Megachilidae* *Osmia* spp. *Andrenidae* *Andrena flaviceps*, *Formicidae* *Camponotus compressus*. Of these entire insect visitors honeybee were most abundant and comprised of more than 48% of the

**Fig. 1.** Relative abundance of insect visitors on Apple during April 2020.

total flower visitors.

The insects belonging to order diptera included insects belonging to family Muscidae *Musca* spp. *Calliphoridae* *Chrysomia* spp. *Pseudopyrilla* spp. *Syrphidae* *Eristalis tenax* *Eristalis* spp. *Sporophoria Indiana* *Metasyrphus corollae*, *Melanostoma univittatum* *Episyrphus balteatus* *Scaeva pyrastris*. More than 9% of the insects were dipterans. Among the insects belonging to the order Lepidoptera, 1.18% were Pieridae *Pieris brassicae*. The other insect visitors belonged to order coleoptera family coccinellidae as *Coccinella septempunctata* *C. septempunctata* var *divaricata* *Menochilus sexmaculata* comprising of 2.51%. There were also thrips belonging to the order thysanoptera visiting the apple flowers.

According to the data in Fig. 1 and Table 2, hymenopteran insects constituted more than 86.00 percent of all flower visitors. Among the hymenopteran insects, Among the flower visitors, honeybees accounted for more than 46.00% of the total. It is clear that honeybees are the most reliable and effective pollinators of apple flowers. The other pollinators belonging to order hymenoptera such as *Bombus*

Table 2. Relative abundance of insect visitors on apple flowers during April 2020.

Order	Relative abundance %
Hymenoptera	86.05
Diptera	9.56
Lepidoptera	1.18
Coleoptera	2.51
Thysanoptera	0.70

spp. Xylocopa fenestrata X. aestuans X. pubescens X. valga Halictus spp. Nomia spp. Lasioglossum spp. Ceratina spp. Melissodes spp. Colletes spp. Vespa orientalis V. Cincta V. Mandarinina Polistes hebraeus Osmia spp. Andrena flaviceps Camponotus compressus were represented in lower numbers at interrupted hours. The Hymenoptera was followed by Diptera, Coleoptera, Lepidoptera and Thysanoptera. In general, the abundance was in the order: Hymenoptera > Diptera > Coleoptera > Lepidoptera > Thysanoptera.

DISCUSSION

Insect visitors on apple flower and their species composition during 2020

Similar observations were made by Mishra *et al.* (1976) who reported that apple flowers were visited by Honey bees, *Bombus spp.*, *Eristalis spp.*, *Syrphus spp.* and some lepidopterans (*Plusia and Heliothis*). Observed that honey bees are the most important pollinators of apple and their visits dominated during 12 and 15 hrs. *Eristalis* and *Syrphus sp.* were maximum in number in the forenoon. Verma and Chauhan (1985) reported that the insect pollinators visiting apple bloom comprised 44 species belonging to 14 families and 5 orders. Of these, 16 species belonged to Hymenoptera, 11 to Diptera, 9 to Lepidoptera, 7 to Coleoptera. The data on relative abundance revealed that honey bees (43.03%) were the most abundant visitors, *Bombus tunicatus* (0.33%) was the least abundant in all the apple orchards. The peak activity of *Apis mellifera* and *Apis cerana* was maximum between 1000-1200 hrs, the peak activity hours of *Eristalis tenax* and *E. angustimarginatus* were 800-900 hrs. Kumar (1988) recorded that 16 species of bees visiting apple blooming period in Solan while working on insect pollinators in temperate fruits during blooming period. However, further studies carried out in 1997 on pollinating fauna of apple and cherry flowers reported total of 49 insect species visiting apple flowers. Rai *et al.* (1988) observed that pollination by honey bees and other insect pollinators in 4 cultivars of apple. Revealed that 2.3-9.9 honey bees were recorded visiting per hundred flowers /10 minutes in day light. *Lampides boeticus*, *Heliothis armigera*, *Vespa sp.*, *Pieris brassicae*, *Venessa sp.*, *Colias croceus* were other insect pollinators visiting

the bloom. Honey bees constituted the largest group (64%) of insect visitors.

CONCLUSION

The studies were conducted to determine the insect pollinators visiting apple flowers. Apple flowers attracted insects belonging to five orders which included Hymenoptera, Diptera, Lepidoptera, Coleoptera and Thysanoptera. Of all the orders, insects belonging to order Hymenoptera were most abundant. They included honey bee *Apis mellifera*, *Apis cerana* bumble bees *Bombus sp.*, *Anthophoridae*, *Xylocopa fenestrata*, *X. aestuans*, *X. pubescens*, *X. valga*, *Halictidae Halictus spp.*, *Nomia spp.*, *Lasioglossum spp.*, *Ceratina spp.*, *Melissodes spp.*, *Colletidae Colletes spp.*, *Vespa orientalis*, *V. Cincta V. Mandarinina*, *Polistes hebraeus*, *Megachilidae Osmia spp.*, *Andrenidae Andrena flaviceps*, *Formicidae Camponotus compressus*. Of these entire insect visitors honey bee were most abundant and comprised of more than 48 % of the total flower visitors.

The insects belonging to order Diptera included insects belonging to family Muscidae *Musca spp.*, *Calliphoridae Chrysomya spp.*, *Pseudopyrilla spp.*, *Syrphidae Eristalis tenax Eristalis spp.*, *Sporophoria Indiana Metasyrphus corollae*, *Melanostoma univittatum Episyrrhus balteatus Scaeva pyrastris*. The dipteran insects comprised more than 9.00%. The insects belonging to order Lepidoptera included insects belonging to Pieridae *Pieris brassicae* which comprised of 1.44%. The other insect visitors belonged to order Coleoptera family Coccinellidae as *Coccinella septempunctata C. septempunctata var divaricata Menochilus sexmaculata* comprising of 2.70%. The apple flowers were also visited by thrips belonging to order Thysanoptera. The Hymenoptera was followed by Diptera, Coleoptera, Lepidoptera and Thysanoptera. In general, the abundance was in the order: Hymenoptera > Diptera > Coleoptera > Lepidoptera > Thysanoptera.

REFERENCES

- Abrol DP, Bhat AA (1990) Studies on Thai Sac brood virus affecting indigenous honeybee *Apis cerana indica* Fab. colonies - prospects and future strategies. Jour

- nal of Animal Morphology and Physiology* 37 :101—108.
- Dashad SS, Sharma JK (1993) Relative abundance of insect visitors on blooms of certain cultivars of apple (*Malus domestica* Borkh). *Crop Res Hisar* 6: 491—498.
- Kumar J (1988) Insect pollinators in temperate fruits during bloom. *J Tree Sci* 7 : 38—40.
- Klein AM, Vaissiere BE, Cane JH, Steffan Dewenter I, Cunningham SA, Kremen C (2007) Importance of pollinators in changing landscapes for world crops. *Proceeding of the Royal Society London B Biol Sci* 274: 303—313.
- Mishra RC, Dogra GS, Gupta PR (1976) Some observations on insect pollination of apple. *Ind Bee J* 38: 20—22.
- Matsumoto S, Soejima J, Maejima T (2012) Influence of repeated pollination on seed number and fruit shape of “Fuji” apples. *Sci Hortic* 137 : 131—137.
- Rai KM, Hamid MT, Joshi R, Tewari HC (1988) Honey bee and pollination in apple. *Progressive Hortic* 20 :353—354.
- Verma LR, Chauhan P (1985) Distribution, abundance and diversity of insect pollinators in apple orchards of Shimla hills. *Ind J Ecol* 12: 286—292.