The Pharma Innovation Journal 2023; 12(6): 2308-2311

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(6): 2308-2311

www.thepharmajournal.com
Received: 19-03-2023
Accepted: 26-04-2023

Manoj Thakur
Division of Entomology, Sher-e-Kashmir University of Agricultural Science and Technology of Jammu, Jammu and Kashmir, India

Devinder Sharma
Division of Entomology, Sher-e-Kashmir University of Agricultural Science and Technology of Jammu, Jammu and Kashmir, India

Bhumika Kapoor
Division of Entomology, Sher-e-Kashmir University of Agricultural Science and Technology of Jammu, Jammu and Kashmir, India

Marvi Khajuria
Division of Entomology, Sher-e-Kashmir University of Agricultural Science and Technology of Jammu, Jammu and Kashmir, India

Virandra Yadav
Division of Entomology, Sher-e-Kashmir University of Agricultural Science and Technology of Jammu, Jammu and Kashmir, India

Corresponding Author:
Manoj Thakur
Division of Entomology, Sher-e-Kashmir University of Agricultural Science and Technology of Jammu, Jammu and Kashmir, India

Diversity of sunflower pollinators and their effect on seed yield

Manoj Thakur, Devinder Sharma, Bhumika Kapoor, Marvi Khajuria and Virandra Yadav

Abstract
Pollination has been considered as a crucial process to ecosystem functioning through the facilitation of both plant and animal diversity. Pollinators (Apis and Non Apis) play an important role in the ecosystem. The field experiment study was conducted to catalogue the diversity of pollinators frequenting sunflower (*Helianthus annuus* L.) and their influence on seed yield in Jammu region of J&K (UT). Insect flower visitors were recorded, seed yield from control and open pollinated plots was evaluated. During the study period, both Apis, non-Apis pollinators were observed visiting sunflower heads. The insect pollinators belonging to 24 insect species were observed visiting sunflower floral heads. These included sixteen Hymenopteran species, two Lepidopteran species, four Dipteran species, and two Coleopteran species. Among Apis species, the majority of abundance was of *A. mellifera* (32%), followed by *Apis dorsita* (23%), *A. cerana* (20%) and *A. florea* (6%). Among all the families recorded (excluding Apidae) on sunflowers, Syrphidae (7%), Halictidae (1%), Megachilidae (1%), Formicidae (1%), Vespidae (1%), Danaidae (1%), Pieridae (1%) and Coccinellidae (1%) account for 14% of insect visitors density. Plots where insect visitors had access produced on average 53% more seed yield compared with plots where insect visitors were excluded.

Keywords: Sunflower, *Apis mellifera*, diversity, abundance, seed yield and pollinators

Introduction
Sunflower (*Helianthus annuus* L.) is an important oil seed crop in India because of its light colour, bland flavour, high smoke point and high level of linoleic acid which is good for heart patient. Sunflower seed contains about 48–53 percent edible oil and sunflower cake has 40-45% protein. This crop is ideal for cultivation in any season because of its wider adaptability, drought tolerance, short duration, photo and thermal insensitivity characteristics**.** In India, Sunflower cultivation occupies about 4.01 Lakh ha area with average yield 0.71 MT/acre. Karnataka with a production of 3.04 lakh tonnes from an area of 7.94 lakh hectares followed by Andhra Pradesh, Maharashtra, Odisha, Bihar and West Bengal are major sunflower producing states of India. Sunflower is a cross pollinated (an allogamic plant) crop, honey bees plays an important role in getting higher yields. Sunflower benefits from insects that visit its flowers for pollen or nectar. Individual sunflower florets are rarely self-pollinated and most need pollen transferred to them from other florets which can be done by pollinators (Free, 1964) [3]. A large number of pollinators (Apis and Non Apis) have been reported to visit sunflower (Arya *et al*., 1994; Hoffmann, 1994; Radford *et al*., 1979; Hoffman and Watkins, 2000) [2, 9, 17, 8]. Honeybee (*Apis mellifera* L.) pollination increases the seed yield by 30% and oil content by more than 6% in hybrid varieties (Furgala *et al*., 1979; Free, 1999; Jyoti and Brewer, 1999) [5, 4, 10]. Information about sunflower pollination and its pollinators in Jammu and Kashmir (UT) is scanty although many farmers rely on this crop as a main source of income. Keeping the above aspects in view, to identify a better pollinating in sunflower the present study was conducted.

Material and Methods
A field experiment was conducted during the February-May 2022 in the experimental farm SKUAST–Jammu, J&K (UT). Sunflower seeds (cv. PSH-2080) were then sown in plots of 10x5m with inter-row and intra-row spacing of 60 × 30 cm respectively, to make a total of 89 plants per plot. The variety is male-fertile and flowers in the same head can inter-pollinate (geitonogamy). Likewise, true cross-pollination occurs when pollen from one sunflower head is deposited to flowers of a different sunflower head.

The planting date was on 08 February 2022. The agronomic practices as recommended in package of practice were followed. No pesticides were sprayed during the study period. For pollinator diversity studies, observations were made during the day from 08:00 -18:00 hr to record and identify flower visitors of sunflower. The visitors were collected and identified accordingly. The foraging behaviour of pollinators (time taken by an individual, number of visits to a flower head by a species) was recorded. For evaluating the effect of pollinators on seed yield, the flower heads of 20 plants were randomly covered from each plot with muslin cloth during the flowering period. Seed yield per treatment was estimated accordingly using established procedures (Morse and Calderone, 2001) [14].

Result and Discussion

Diversity, abundance, and pollination efficiency of flower visitors belonging to 24 insect species (four orders and nine families) were observed visiting sunflowers at the study site. Insect species belonging to the Orders Hymenoptera (16), Diptera (4), Lepidoptera (2) and Coleoptera (2) visited the sunflower crop (Table 1). Hymenopteran visitors belong to five families: Apidae (7), Halictidae (2), Magachilidae (4), Formicidae (1), and Vespidae (2). Lepidopteran (2) visitors belonged to families Danaidae (1) and Pieridae (1). Some Dipteran and Coleopteran visitors belonging to the family Syrphidae (4) and Coccinellidae (2) were observed on sunflowers. Similar findings were reported by Kumar and Srivastava (2021) [11], who reported 17 insect visitors, of which 11 were from Hymenoptera, two from Diptera, and four from Lepidoptera. Another study by Goswami *et al*. (2013) [6] reported 12 insect visitors belonging to Hymenoptera (9), Diptera (1), Lepidoptera (1), and Coleoptera (1). From the family Apidae, honeybees (*A. mellifera*, *A. dorsata*, *A. cerana*, and *A. florea*) were the four species recorded in the field. Carpanter bee (*Pithitis smaragdula*, *Xylocopa latipes* and *Xylocopa fenestrata*) of subfamily Xylocopinae, Alkali bees (*Nomia* sp.) and *Halictus* sp. of Halictidae were recorded. From family Megachilidae (*Megachile bicolor*, *Megachile disjuncta*, *Megachile lanata* and *Coelioxys confuse*), Danaidae (*Danaus plexippus*) and Pieridae (*Pieris brassicae*) six species were recorded. Somewhat similar findings were reported by Hoffman and Watkins, 2000 [8]; Greenleaf and Kremen, 2006 [7]. From family Syrphidae (*Eristalis* sp., *Syrphus* sp., *Metasyrphus* sp., and *Episyrphus balteatus*) and Coccinellidae (*Coccinella septumpunctata* and *Menochilus sexmaculata*) insect visitors on flowers of *H. annuus* were observed.

Abundance of insect pollinators visiting flowers of sunflower

The abundance of insect pollinators visiting flowers of *H. annuus* during day was recorded, and it was found that among Apis species, the majority of abundance was of *A. mellifera* at 32%, followed by *Apis dorsita*, *A. cerana* and *A. florea* at 23, 20 and 6%, respectively (Fig. 1). In contrast, only 19% of other insect visitors were recorded. Similar findings were reported by Goswami *et al*. (2013) [6], who reported an abundance of Hymenoptera (86.09%), followed by dipterans (22.80%), and others (3.87%). Another study by Raghavendra *et al*. (2018) [18] revealed that the Apidae family constitutes 98.67% abundance at the 50% flowering stage. Among the diverse flower visitors to sunflower in the research area, *A. mellifera* was the most frequent visitor, a fact confirmed by its high flower: insect ratio compared to other insect visitors. Their high visitation rate indicates that they are reliable pollinators of sunflowers in the area. Other similar studies conducted by Moreti *et al*. (1993) [12] and Hoffman (1994) [9] found that 80% of sunflower pollinators' were *A. mellifera*. The activity density of both Apis and non-Apis bees on sunflowers peaked between 10:00 and 14:00 h. Similar findings were reported by Kumar and Srivastava (2021) [11], who reported peak visits at 1000–1200 h. On average, honeybees represented 86% of the total number of bee species observed during the study period, while the number of non-bee flower visitors was low, and their activity was irregular. Among all the families recorded (excluding Apidae) on sunflowers, the majority of density was of Syrphidae at 7%. Whereas, 1% density of insect visitors from each family Halictidae, Megachilidae, Formicidae, Vespidae, Danaidae, Pieridae and Coccinellidae was recorded (Fig. 2). Somewhat similar findings were reported by Ahmed *et al*., 1988 [1]; Moreti *et al*., 1996 [13].

Effect of pollinators on sunflower yield

The seeds obtained from plots with sunflower heads that were left unbagged and bagged throughout the blooming period showed significant differences in the yield (Table 2). The number of seeds per capitulum in open pollinated and pollinator exclusion were 1153 and 1058, respectively, implying the enhancement of seed number in open pollinated flowers. The percentage germination in open-pollinated and pollinator exclusions was 93.5 and 89.2%, respectively. The weight of 1000 seeds also varied in both the cases of open pollinated and pollinator exclusion, which were 41.2 and 39.3 g. Similar, results were reported by Nderitu *et al*. (2008) [15]. The seed setting in open pollinated was 75.9%, whereas in pollinator exclusion, it was 66.2%. Similar findings were reported by Hoffman and Watkins, (2000) [8]. However, the percentage of crinkled seeds in pollinator exclusion was higher (34.6%), and in open-pollinated seeds was low (20.8%). The average improvement in seed yield (q/ha) was observed in open pollinated, i.e. 24.84 q/ha, followed by pollinator exclusion which was 21.07 q/ha. The test weight recorded was 49.4 and 41.2 in the open and pollinator exclusion. Perrot *et al*. (2019) [16] reported a yield of 2.08 t/ha.

Table 1: Diversity of insect species visiting flower of sunflower

Order	Family	Insect pollinators/visitors
Hymenoptera	Apidae	*Apis mellifera*, *Apis cerana*, *Apis dorsata*, *Apis florea Pithitis smaragdula*, *Xylocopa latipes*, *Xylocopa fenestrate*
	Halictidae	*Halictus* sp., *Nomia viridissima*
	Megachilidae	*Megachile bicolor*, *Megachile disjuncta*, *Megachile lanata*, *Coelioxys confuse*
	Formicidae	*Camponotos compressus*
	Vespidae	*Vespa sp*., *Polistes* sp.
Lepidoptera	Danaidae	*Danaus plexippus*
	Pieridae	*Pieris brassicae*
Diptera	Syrphidae	*Eristalis* sp., *Syrphus* sp., *Metasyrphus* sp., *Episyrphus balteatus*,
Coleoptera	Coccinellidae	*Coccinella septumpunctata*, *Menochilus sexmaculata*

Table 2: Effect of open pollinated and Pollinator exclusion on various yield parameters of sunflower

Parameter of yield	Open pollinated	Pollinator exclusion
No. of seed/ capitulum	1153	1058
Percent germination	93.5	89.2
1000 seed weight (g)	41.2	39.3
% seed setting	75.9	66.2
Percent crinkled seed	20.8	34.6
Yield (q/ha)	24.84	21.07
Test weight	49.4	41.2

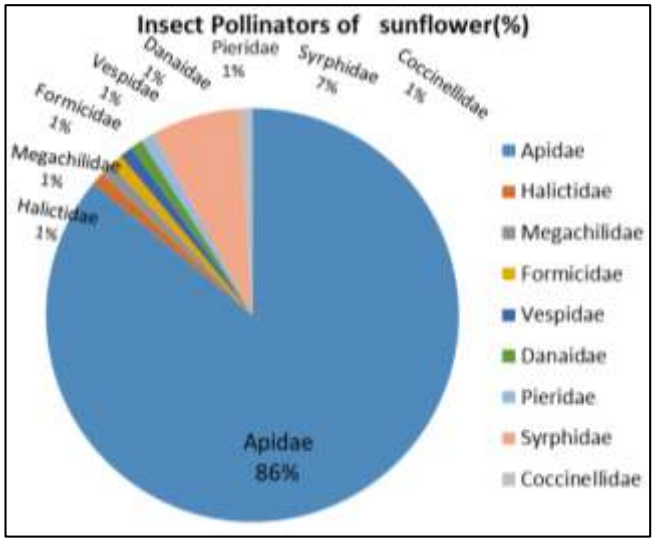

Fig 1: Abundance of insect pollinators/visitors on flower of sunflower

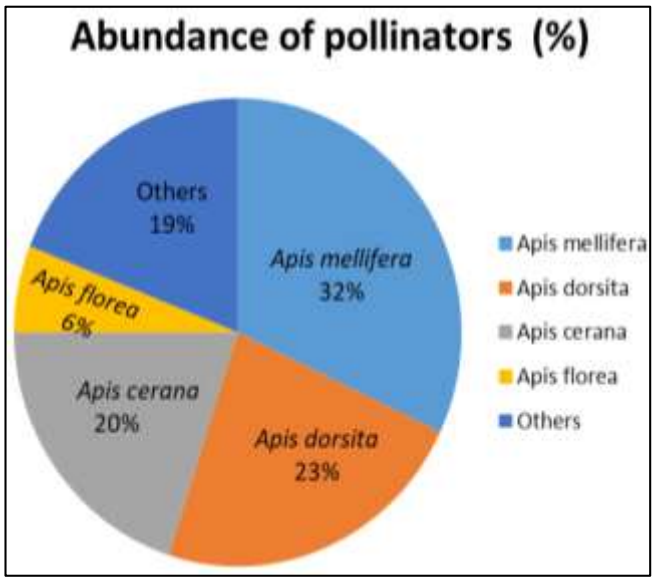

Fig 2: Abundance of Apis and non Apis pollinator on flower of sunflower

Conclusion

The findings of the present investigation revealed that the total 24 insect species belonging to four orders and nine families forage on sunflower inflorescence. It was found that Apis species, accounted for 81% abundance on the sunflower florets. It is clear from the present finding that the sunflower capitulum in bloom is highly attractive to multitude of insect species. The diversity and abundance of pollinator insects, especially bees, plays a significant role in enhancing seed yield of sunflower. Therefore, it would be beneficial that further cultivation of sunflower crops be encouraged along with the other crops, which will enhance biodiversity. Thus, expanding sunflower cultivation can both increase crop output and provide pollen for Apis species.

References

1. Ahmed HMH, Siddig MA, Sarrag MSA. Honeybee pollination of some cultivated crops in Sudan. In: Proceedings of the Fourth International Conference on Apiculture in Tropical Climates, Cairo, Egypt. 1988;6(10):100-108.
2. Arya DR, Sihag RC, Yadav PR. Diversity, abundance and foraging activity of insect pollinators of sunflower (*Helianthus annuus* L.) at Hisar (India). Indian Bee Journal. 1994;56:172-178.
3. Free JB. The behavior of honeybees on sunflower (*Helianthus annuus* L.). Journal of Applied Ecology. 1964;1:19-27.
4. Free JB. Pollination in the tropics. Beekeeping and Development. 1999;51:6-7.
5. Furgala B, Noetzel DM, Robinson RG. Observations on the pollination of hybrid sunflowers. In: Proc. IVth International Symposium on Pollination, Md Agric Exp Sta Spec Misc Publ. 1979;1:45-48.
6. Goswami V, Khan MS, Usha. Studies on pollinator fauna and their relative abundance of sunflower (*Helianthus annuus* L.) at Pantnagar, Uttarakhand, India Journal of Applied and Natural Science. 2013;5(2):294-296.
7. Greenleaf SS, Kremen C. Wild bees enhance honeybees' pollination of hybrid sunflower. Proc Natl Acad Sci USA. 2006;103:13890-13895.
8. Hoffmann DG, Watkins JC. The foraging activity of honeybees *Apis mellifera* and non Apis bees on hybrid sunflower (*Helianthus annuus*) and its influence on cross-pollination and seed set. Journal of Apiculture Research. 2000;39:37-45.
9. Hoffmann M. Observações sobre a polinizacao entomófila de *Helianthus annuus* L. em Viamão, Rio Grande do Sul. *An Soc Entomol Bras, Londrina*. 1994;23(3):391-397.
10. Jyoti J, Brewer GJ. Effect of honeybee (Hymenoptera: Apidae) pollination on sunflower hybrids. In: Proceeding of 21st Sunflower Research Workshop. National Sunflower Association; c1999. p. 103-107.
11. Kumar R, Srivastava P. Abundance and diversity of pollinator fauna of sunflower (*Helianthus annuus* L.) at honey bee research and training center, Pantnagar, Uttarakhand. The Pharma Innovation Journal. 2021;10(10):845-848.
12. Moreti AC, Silva ECED, Alves MLTMF, Silva RMB, Otsuk IP. Initial observations regarding the pollination of sunflower (*Helianthus annuus* L.) by *Apis mellifera* L. Pindamonhangaba, Sào Paulo. Boletim de Indústra Animal, 1993;50:31-34.
13. Moreti AC, Silva RMB, Silva ECA, Alves MLT, Otsuk IP. Increase of sunflower (*H. annuus* L.) seed production by pollinating insect action. Scientia Agricola. 1996;53(2, 3):280-284.
14. Morse RA, Calderone NW. The value of honey bees as pollinators of US crops in 2000. Bee Culture. 2001;128(3):1-15.
15. Nderitu J, Nyamasyo G, Kasina M, Oronje ML. Diversity of sunflower pollinators and their effect on seed yield in

Makueni District, Eastern Kenya, Spanish Journal of Agricultural Research. 2008;6(2):271-278.
16. Perrot T, Gaba S, Roncoroni M, Gautier JL, Saintilan A, Bretagnolle V. Experimental quantification of insect pollination on sunflower yield, reconciling plant and field scale estimates. Basic and Applied Ecology. 2019;34:75-84.
17. Radford B, Nelson R, Rhodes J. Agents of pollination in sunflower crops in the central Darlingdowns, Queensland. Australian Journal of Exp Agric Animal Husbandry. 1979;19:565-69.
18. Raghavendra D, Jagadish KS, Reddy SKM, Belavadi VV, Shadakshari YG, Naik BK. Abundance and diversity of pollinator fauna of sunflower (*Helianthus annuus* L.) Journal of Entomology and Zoology Studies. 2018;6(5):211-216.