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Seasonal Diversity of Insect Pollinators on Cucurbit Vegetables

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Total 24 and 23 insect pollinators were observed on cucurbit vegetables from initiation of flowering to cessation of flowering during different hours of the day in *kharif* 2022 and *kharif* 2023, respectively. The insect pollinators represented from four orders *viz*., Hymenoptera, Lepidoptera, Orthoptera and Diptera with the families *viz*., Apidae, Scoliidae, Megachilidae, Vespidae, Muscidae, Syrphidae, Tettigoniidae, Pieridae, Nymphidae, Crambidae, Papilionidae, Hesperiidae, Lycaenidae and Sphingidae. *Apis dorsata* was the prominent insect pollinator throughout the both seasons on cucurbit vegetables.

Keywords: Pollinator diversity; seasonal variation; cucurbit vegetables; lepidoptera; hymenoptera.

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1. INTRODUCTION

Cucurbits belonging to the family Cucurbitacseae, form a large group of vegetables, grown extensively throughout India. It comprises of many species of vine crops with creeping growth habit such as cucumber, bitter gourd, bottle gourd, ash gourd, ridge gourd, sponge gourd, pumpkin *etc*. Pollination is an essential ecosystem service provided by insect pollinators. Cucurbits mainly depend on insects for pollination because they are monoecious bearing male and female flowers separately on the same plant and pollen grains are large and sticky to be carried by wind. Hence, the mechanical transfer of pollen is essential to bear fruits or seeds, in addition to improved quality of fruits and seeds (Free, 1970 and Mc Gregor, 1976). Majority of insect pollinators belong to orders Hymenoptera, Lepidoptera and Diptera (Jadhav et al*.,* 2011). For insects, pollens are used as a source of protein, while nectars are a source of sugar that need for life (Sataral and Rustiawati, 2019). Thus, keeping in view the importance of insect pollinators on Cucurbit vegetables, the present study has been proposed.

2. MATERIALS AND METHODS

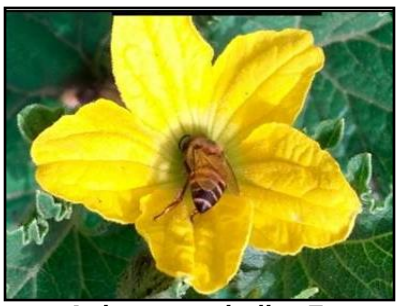
The study on diversity of insect pollinators on cucurbit vegetables was carried out at Horticultural Instructional Farm, C. P. College of Agriculture, S. D. Agricultural University, Sardarkrushinagar during *kharif* 2022 and 2023 in crops *viz.,* bitter gourd, bottle gourd, cucumber, pumpkin and ridge gourd. The cucurbit vegetables were sown during *kharif* 2022 and 2023 by adopting recommend agronomical practices. The plot size of experimental field was 30 m × 10 m. The plot was divided into five sub plots for each crop with the size of 6.0 m × 10.0 m in which the spacing between row to row and crop to crop was 2.0 m × 1.0 m. Five quadrates (2m × 2 m) were marked randomly for each crop. Observations were recorded on different flower visitors commencing from initiation of flowering from each quadrates by carefully observing for five minutes at two-hour interval starting from 06:00 to 18:00 hours during flowering period at 3 days interval. Different insect pollinators visiting flowers were collected, pinned, labeled and identified.

3. RESULTS AND DISCUSSION

3.1 Diversity of Insect Pollinators on Cucurbit Vegetables during *Kharif* 2022

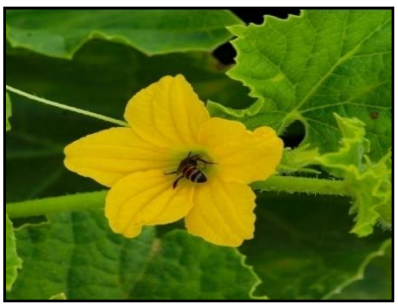
Total 24 insect pollinators were observed on various cucurbit vegetables during *kharif* 2022. These insect pollinators represented from four orders *viz*., Hymenoptera, Lepidoptera, Orthoptera and Diptera with the families *viz*., Apidae, Scoliidae, Megachilidae, Vespidae, Muscidae, Syrphidae, Tettigoniidae, Pieridae, Nymphidae, Crambidae, Papilionidae, Hesperiidae, Lycaenidae and Sphingidae. Among the different insect pollinators, nine species belonged to order Hymenoptera, two species belonged to order Diptera, one species from Orthoptera and twelve species belonged to order Lepidoptera.

A total of 16 insect pollinators were recorded from the bitter gourd flowers during *kharif* 2022. The hymenopterans were the major floral visitors comprising of eight insect species *viz*., *Apis cerana indica, Apis dorsata, Apis florea, Apis mellifera, Xylocopa* sp. of family Apidae, *Dielis plumipes* of family Scoliidae, *Polistes flavus* and *Vespula* sp. of family Vespidae. Lepidopteran pollinators were also found abundantly with six species *viz*., *Danaus chrysippus* and *Hypolimnas misippus* of Nymphidae, *Diaphania indica* of Crambidae, *Papilio demoleus* of Papilionidae, *Pieris rapae* of Pieridae and *Virachola isocrates* of Lycaenidae.

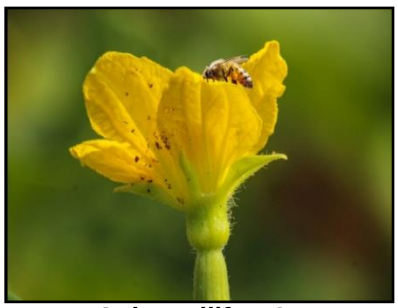


***Apis cerana indica* F.**

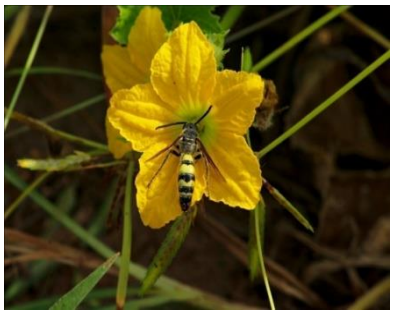
***Apis dorsata* F.**



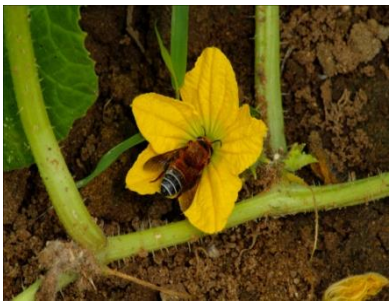
***Apis florea* F.**



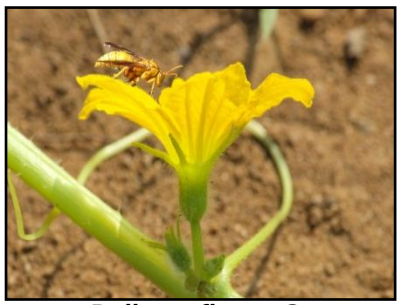
***Apis mellifera* L.**



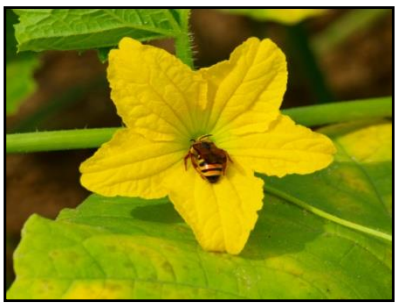
***Dielis plumipes* D.**



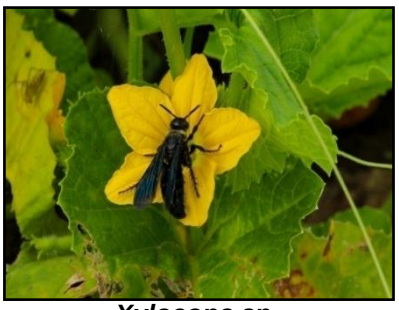
***Mega Chile lanata* F.**



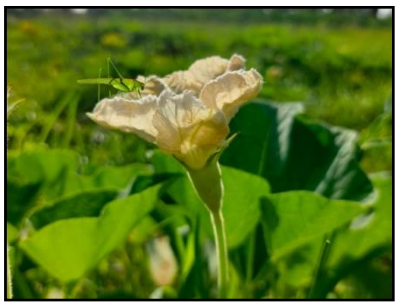
***Polistes flavus* C.**



***Vespula* sp.**

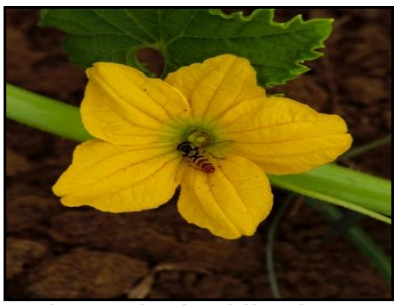


***Xylocopa* sp.**



***Phaneroptera falcata* P.**

***Musca domestica* L.**



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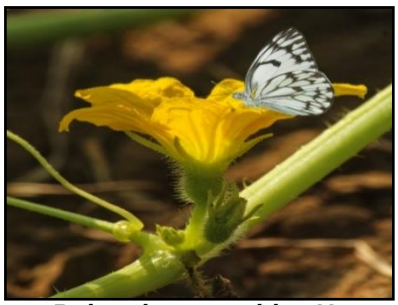
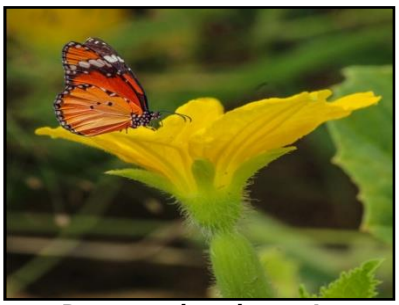
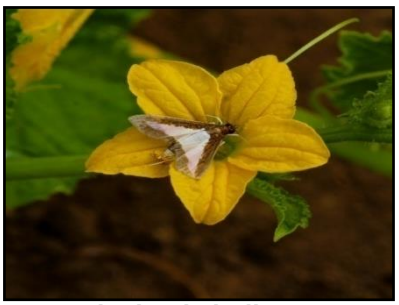


***Belenois mesenitina* H.**

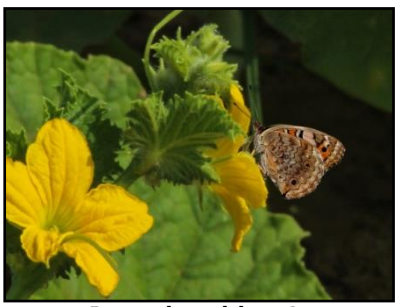


***Danaus chrysippus* L.**

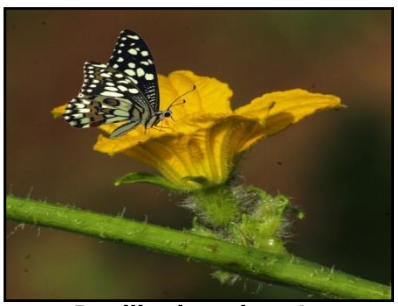


***Diaphania indica* S.**

***Hypolimnas misippus* L.**



***Junonia orithya* L.**



***Papilio demoleus* L.**

***Pelopidas mathias* F.** ***Pieris rapae* L.** ***Vanessa cardui* L.**

***Virachola isocrates* F.** ***Agrius convolvuli* L.** ***Hippotion celerio* L.**

Plate 1. Microphotographs of insect pollinators

In bottle gourd, the lepidopterans were the major floral visitors comprising of five species *viz*., *Agrius convolvuli* and *Hippotion celerio* of family Sphingidae, *D. chrysippus* of family Nymphidae*, D. indica* of family Crambidae and *P. demoleus* of Papilionidae. Three species (*A. cerana indica, A. dorsata* and *Xylocopa* sp.) recorded from order Hymenoptera, whereas two species from order Diptera under family Muscidae (*M. domestica*) and Syrphidae (*S. philanthus*) and *Phaneroptera falcata* was the only orthopteran pollinator (Tettigoniidae) found visiting bottle gourd flowers during *kharif* 2022.

The lepidopteran pollinators appeared in large numbers on cucumber crop comprising of six families *viz*., Pieridae (*B. mesenitina* and *P. rapae*), Nymphidae (*D. chrysippus*, *H. misippus, J. orithya* and *V. cardui*), Crambidae (*D. indica*), Papilionidae (*P. demoleus*), Hesperiidae (*P. mathias*) and Lycaenidae (*V. isocrates*) during *kharif* 2022. The hymenopterans also exhibited diversity in the crop with four families *viz*., Apidae (*A. cerana indica, A. dorsata, A. florea, A. mellifera* and *Xylocopa* sp.), Scoliidae (*D. plumipes*) Megachilidae (*M. lanata*) and Vespidae (*P. flavus* and *Vespula* sp.).

The hymenopteran pollinators consisted of five species *viz*., *A. cerana indica, A. dorsata, A. florea, A. mellifera* and *Xylocopa* sp. from family Apidae, three species *viz*., *D. plumipes, M. lanata* and *Vespula* sp. each from family Scoliidae, Megachilidae and Vespidae, respectively in pollinating pumpkin crop. Two dipterans *viz*., *M. domestica* (Muscidae) and *S. philanthus* (Syrphidae) were also observed visiting the pumpkin flowers during *kharif* 2022.

In ridge gourd, the lepidopterans were the major floral visitors comprising of five species *viz*., *A. convolvuli* and *H. celerio* (Sphingidae), *D. indica* (Crambidae), *H. misippus* (Nymphidae) and *P. demoleus* (Papilionidae). Three species (*Apis cerana indica, Apis dorsata* and *Xylocopa* sp.) were recorded from order Hymenoptera and two species (*M. domestica* and *S. philanthus*) recorded from order Diptera belonged to family Muscidae and Syrphidae, respectively. *Phaneroptera falcate* (Tettigoniidae) was the only orthopteran pollinator found visiting ridge gourd flowers during *kharif* 2022.

3.2 Diversity of Insect Pollinators on Cucurbit Vegetables during *Kharif* 2023

Among the 23 insect pollinators, eight belonged to order Hymenoptera, two belonged to order Diptera, one to Orthoptera and twelve belonged to order Lepidoptera during *kharif* 2023.

Table 1. Insect pollinators observed on cucurbit vegetable flowers during *kharif* 2022

Sr. No.	Pollinators	Family	Order	Bitter gourd	Bottle gourd	Cucumber	Pumpkin	Ridge gourd
1	Honey bee, *Apis cerana indica* F.	Apidae	Hymenoptera	✓	✓	✓	✓	✓
2	Honey bee, *Apis dorsata* F.	Apidae		✓	✓	✓	✓	✓
3	Honey bee, *Apis florea* F.	Apidae		✓	-	✓	✓	-
4	Honey bee, *Apis mellifera* L.	Apidae		✓	-	✓	✓	-
5	Feather-legged scoliidae wasp*, Dielis plumipes* D.	Scoliidae		✓	-	✓	✓	-
6	Leafcutter bees,*Mega Chile lanata* F.	Megachilidae		-	-	✓	✓	-
7	Yellow paper wasp, *Polistes flavus* C.	Vespidae		✓	-	✓	-	-
8	Yellow jacket wasp, *Vespula* sp.	Vespidae		✓	-	✓	✓	-
9	Carpenter bee, *Xylocopa* sp*.*	Apidae		✓	✓	✓	✓	✓
10	House fly, *Musca domestica* L.	Muscidae	Diptera	✓	✓	✓	✓	✓
11	Syrphidae fly,*Sphaerophoria philanthus* M.	Syrphidae		✓	✓	✓	✓	✓
12	Bush cricket*, Phaneroptera falcata* P.	Tettigoniidae	Orthoptera	-	✓	-	-	✓
13	Caper white butterfly*, Belenois mesenitina* H.	Pieridae	Lepidoptera	-	-	✓	-	-
14	Monarch butterfly, *Danaus chrysippus* L.	Nymphidae		✓	✓	✓	-	-
15	Cucumber moth, *Diaphania indica* S.	Crambidae		✓	✓	✓	-	✓
16	Danaid egg fly, *Hypolimnas misippus* L.	Nymphidae		✓	-	✓	-	✓
17	Blue pansy butterfly, *Junonia orithya* L.	Nymphidae		-	-	✓	-	-
18	Lemon butterfly, *Papilio demoleus* L.	Papilionidae		✓	✓	✓	-	✓
19	Rice skipper moth*, Pelopidas mathias* F.	Hesperiidae		-	-	✓	-	-
20	Cabbage butterfly, *Pieris rapae* L.	Pieridae		✓	-	✓	-	-
21	Painted lady, *Vanessa cardui* L.	Nymphidae		-	-	✓	-	-
22	Anar butterfly, *Virachola Isocrates* F.	Lycaenidae		✓	-	✓	-	-
23	Convolvulus hawk moth*, Agrius convolvuli* L.	Sphingidae		-	✓	-	-	✓
24	Vine hawk moth*, Hippotion celerio* L.	Sphingidae		-	✓	-	-	✓
			Total	16	11	21	10	11

(✓): Presence of pollinators; (-):Not found

Table 2. Insect pollinators observed on cucurbit vegetable flowers during *kharif* 2023

Sr. No.	Pollinators	Family	Order	Bitter gourd	Bottle gourd	Cucumber	Pumpkin	Ridge gourd
1	Honey bee, *Apis cerana indica* F.	Apidae	Hymenoptera	✓	✓	✓	✓	✓
2	Honey bee, *Apis dorsata* F.	Apidae		✓	✓	✓	✓	✓
3	Honey bee, *Apis florea* F.	Apidae		✓	-	✓	✓	-
4	Feather-legged scoliidae wasp, *Dielis plumipes* D.	Scoliidae		✓	-	✓	✓	-
5	Leafcutter bees,*Mega Chile lanata* F.	Megachilidae		-	-	✓	✓	-
6	Yellow paper wasp, *Polistes flavus* C.	Vespidae		✓	-	✓	-	-
7	Yellow jacket wasp, *Vespula* sp.	Vespidae		✓	-	✓	✓	-
8	Carpenter bee, *Xylocopa* sp.	Apidae		✓	✓	✓	✓	✓
9	House fly, *Musca domestica* L.	Muscidae	Diptera	✓	✓	✓	✓	✓
10	Syrphidae fly,*Sphaerophoria philanthus* M.	Syrphidae		✓	✓	✓	✓	✓
11	Bush cricket, *Phaneroptera falcata* P.	Tettigoniidae	Orthoptera	-	✓	-	-	✓
12	Caper white butterfly, *Belenois mesenitina* H.	Pieridae	Lepidoptera	-	-	✓	-	-
13	Monarch butterfly, *Danaus chrysippus* L.	Nymphidae		✓	✓	✓	-	-
14	Cucumber moth, *Diaphania indica* S.	Crambidae		✓	✓	✓	-	✓
15	Danaid egg fly, *Hypolimnas misippus* L.	Nymphidae		✓	✓	✓	-	✓
16	Blue pansy butterfly, *Junonia orithya* L.	Nymphidae		-	-	✓	-	-
17	Lemon butterfly, *Papilio demoleus* L.	Papilionidae		✓	✓	✓	-	✓
18	Rice skipper moth, *Pelopidas mathias* F.	Hesperiidae		-	-	✓	-	-
19	Cabbage butterfly, *Pieris rapae* L.	Pieridae		✓	-	✓	-	-
20	Painted lady, *Vanessa cardui* L.	Nymphidae		-	-	✓	-	-
21	Anar butterfly, *Virachola isocrates* F.	Lycaenidae		✓	-	✓	-	-
22	Convolvulus hawk moth, *Agrius convolvuli* L.	Sphingidae		-	✓	-	-	✓
23	Vine hawk moth, *Hippotion celerio* L.	Sphingidae		-	✓	-	-	✓
			Total	15	12	20	9	11

(✓): Presence of pollinators; (-): Not found

A total of 15 insect pollinators were recorded from bitter gourd flowers during *kharif* 2023. The hymenopterans were the major floral visitors comprising of seven insect species *viz*., *A. cerana indica, A. dorsata, A. florea* and *Xylocopa* sp. of family Apidae, *D. plumipes* of family Scoliidae, *P. flavus* and *Vespula* sp. of family Vespidae. Lepidopteran pollinators were also found abundantly with six species *viz*., *D. chrysippus* and *H. misippus* of Nymphidae, *D. indica* of Crambidae, *P. demoleus* of Papilionidae, *P. rapae* of Pieridae and *V. Isocrates* of Lycaenidae.

In case of bottle gourd, lepidopterans were the major pollinators comprising of six species *viz*., *A. convolvuli* and *H. celerio* of family Sphingidae, *D. chrysippus* and *H. misippus* of family Nymphidae, *D. indica* of family Crambidae and *P. demoleus* of Papilionidae during *kharif* 2023.

In cucumber crop, lepidopteran pollinators appeared in large numbers comprising of six families *viz*., Pieridae (*B. mesenitina* and *P. rapae*), Nymphidae (*D. chrysippus*, *H. misippus, J. orithya* and *V. cardui*), Crambidae (*D. indica*), Papilionidae (*P. demoleus*), Hesperiidae (*P. mathias*) and Lycaenidae (*V. isocrates*) with ten insect species. The hymenopterans also exhibited diversity in the crop with four families *viz*., Apidae (*A. cerana indica, A. dorsata, A. florea* and *Xylocopa* sp.), Scoliidae (*D. plumipes*), Megachilidae (*M. lanata*) and Vespidae (*P. flavus* and *Vespula* sp.) with eight insect pollinators.

In pumpkin crop, comparatively lower (09) number of pollinators were recorded during *kharif* 2023. Out of which, the hymenopteran pollinators consisted of four species *viz*., *A. cerana indica, A. dorsata, A. florea* and *Xylocopa* sp. from family Apidae, three species *viz*., *D. plumipes, M. lanata* and *Vespula* Sp. each from family Scoliidae, Megachilidae and Vespidae, respectively.

In ridge gourd, the lepidopterans were the major floral visitors comprising of five species *viz*., *A. convolvuli* and *H. celerio* (Sphingidae), *D. indica* (Crambidae), *H. misippus* (Nymphidae) and *P. demoleus* (Papilionidae) from four families during *kharif* 2023.

The results of present investigations are in near agreement with, Nidagundi and Sattagi (2005) who studied the pollinator fauna in bitter gourd in Dharwad, Karnataka, India and recorded as many as 10 species of pollinators of which, 8 species belonged to Hymenoptera and 2 species to Lepidoptera. Similarly, Bisui and Layek (2020) listed 21 species of flower visitors in bitter gourd flower found to collect both flower rewards and they belongs to four orders *viz.,* Hymenoptera, Diptera, Lepidoptera and Coleoptera. Thus the present findings are in close conformity with earlier workers. Padhiyar and Patel (2021) reported that 9 species of five orders were the major pollinators of bottle gourd in Navsari, Gujarat. In past, Ekeke et al. (2018) reported that *A. mellifera*, *L. fuscipeme*, *H. itama*, *M. domestica*, *P. valida*, *M. agathina*, *A. horta*, *M. pharaonis*, *G. niso* and *J. terea* were major insect pollinators on cucumber flowers. Similarly, Chidananda (2016) recorded eight insects belonging to two orders as the floral visitors of pumpkin. *Apis* bees' population was more bounty than the non *Apis* pollinators. *A.dorsata* and *A. cerana indica* were recorded as efficient pollinators under *Apis* category. The present findings are in conformity with the findings of Gautam and Kumar (2018) who recorded eight insect species visited ridge gourd flowers *viz*., five hymenopterans, two dipterans and one from Odonata. Among these, *A. mellifera*, *A. dorsata, A. florea*, *X. fenestrate* and *Polistes* sp. were found to be most frequent pollinators.

4. CONCLUSION

Around 24 insect pollinators were observed on cucurbit vegetables flowers during different hours of the day. The insect pollinators represented majorly from four orders *viz*., Hymenoptera, Lepidoptera, Orthoptera and Diptera.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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