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Distribution and Abundance of Insect Pollinators on Organic Bottle Gourd [*Lagenaria Siceraria* (Molina) Standley]

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ABSTRACT:

The present study was carried out on "Distribution and Abundance of Insect Pollinators on organic Bottle gourd [*Lagenaria siceraria* (Molina) Standley]" during summer 2020 and 2021 at certified organic farming unit, Navsari Agricultural University, Navsari (Gujarat). A total of 19 species and 17 genera of different insect pollinators were recorded in the bottle gourd crop during the summer of 2020 and 2021, which was belonging to a total of 14 families under five orders *viz*., Hymenoptera, Diptera, Lepidoptera, Hemiptera and Coleoptera. As per order-wise distribution, Coleoptera order was found to be dominated followed by Hymenoptera, Lepidoptera, Hemiptera and Diptera a total of 3194 insect pollinators from organic bottle gourd crops were observed during two consecutive summer season. Among which 1607 insects were reported under Coleoptera having three different families followed by Hemiptera (683) from three families, Hymenoptera (414) from four families, Lepidoptera (143) from three families and Diptera (385) from only one family.

Keywords: Pollination, Hymenoptera, Diptera, Lepidoptera, Hemiptera, Coleoptera , Organic, Bottle gourd

1. INTRODUCTION

The bottle gourd [*Lagenaria siceraria* (Molina) Standley] producing major countries in the world are India, Sri Lanka, Indonesia, Malaysia, Philippines, China, Hong Kong, Tropical Africa, Columbia and Brazil. India is the second largest producer of bottle gourd in the world after China. It is extensively grown in India (U. P., Punjab, Gujarat, Assam, Rajasthan, Tamil Nadu, and Karnataka). Bottle gourd [*L. siceraria*] also known as Calabash, is one of the most important cucurbitaceous vegetable crops grown in both rainy and summer seasons. It is also known as the white flower gourd. It is originated in Africa and now grown in most of the world. It is variously called *alabu* in Sanskrit, *kaddu*, *lauki*, and *tumri* in Hindi, *sorakaya* in Telugu, *shorakkai* in Tamil, *sorekayi* and halagumbala in Kannada, *lau* in Bengali and Assamese, and *ghiya* in Punjabi (Sivaraj and Pandravada, 2005). In Gujarat, it is known as *Dudhi*. In India, it is cultivated in about 155 thousand ha area with a production of 2573 thousand MT (Anon., 2021). The unripe fruits of bottle gourd are eaten as vegetables and the matured dried fruits are used for making storage jars, utensils and musical instruments (Dhatt and Khosa, 2015). The 100 g fruits of bottle gourd contain 96.1 g water, 2.5 g carbohydrates, 0.6g fibers, 0.5 g minerals, 0.2 g protein and 0.1g fats edible parts (Gopalan *et al*, 1989). It is also used as medicinal values and used as a cardio-tonic, aphrodisiac, hepatoprotective, analgesic, anti-inflammatory, expectorant, diuretic and antioxidant agent (Dhatt and Khosa, 2015). The information on the Distribution and Abundance of Insect Pollinators on organic Bottle gourd is lacking in South Gujarat situations. Therefore, it is necessary to evaluate the Distribution and Abundance of Insect Pollinators on organic Bottle gourd [*L. siceraria*].

2. MATERIALS AND METHODS

Studies on "Distribution and Abundance of Insect Pollinators on Organic Bottle gourd [*Lagenaria siceraria* (Molina) Standley]" during summer 2020 and 2021 at certified organic farming unit, Navsari Agricultural University, Navsari (Gujarat). The counts on pollinators were made using Ad-libitum sampling of flower visitors for a sampling time of ten minutes with a time interval of 60 min. All insects visiting flowers per sampling time were counted and recorded.

The Insect Pollinators were brought to the laboratory and killed by placing a small cotton swab dipped in ethyl acetate or chloroform inside the polythene bags. The identification of the collected specimens from the organic farming system was confirmed taxonomically. The data were used to calculate species abundance, species richness, and evenness; Shannon and Weaver diversity index for each taxonomic order in organic fields.

Close-up photographs of Insect Pollinators were captured with the help of the digital camera. Live specimens of Insect Pollinators in the field condition were photographed so that natural colouration and specific behavioural postures can be documented. The photograph of preserved pinned pollinators was

documented when live specimens couldn't be photographed. Finally, a photographic catalogue, which is a useful tool for the identification of Insect Pollinators in the state, of all the species was prepared.

3. RESULTS AND DISCUSSION

3.1 Species-wise Distribution of Insect Pollinators of Bottle gourd in Different Families

Species-wise distribution of insect pollinators in different families from bottle gourd crops was worked out and classified as given in Table 1 and depicted in Fig. 1 During the present study, a total of 19 species and 17 genera of different insect pollinators were recorded in the bottle gourd crop during the summer of 2020 and 2021, which was belonging to a total of 14 families under five orders *viz*., Hymenoptera, Dipteral, Lepidoptera, Hemiptera and Coleoptera. As per order-wise distribution, Coleoptera order was found to be dominated followed by Hymenoptera, Lepidoptera, Hemiptera and Diptera. However, as far as species-wise distribution is concerned, in Coleopteran the family Chrysomelidae was found to be reached three species (15.79%) under three genera (17.65%) followed by Chrysomelidae with two species (10.53%), Nitidulidae with one species (5.88%) under two genera (5.88%) in each family. While in the case of Hymenoptera, the family Apidae with two species (10.53%), Formicidae, Megachilidae and xylocopidae with one species (5.26%) and one genus (5.88%) in each family.

In the case of Lepidoptera, four different species with four genera were distributed under three different families. *viz*., Crambidae with 10.53 per cent species and 11.76 per cent genus, Nymphalidae, Pieridae and with 5.26, 5.88 per cent sharing of each species and genus, respectively (Table 1 and Fig. 1).

Table 1: Species distribution of insect pollinators in different families in bottle gourd crop

Order	Family	Genera		Species		Order
		Number	%	Number	%	%
1. Hymenoptera	Apidae	1	5.88	2	10.53	26.31
	Formicidae	1	5.88	1	5.26	
	Megachilidae	1	5.88	1	5.26	
	Xylocopidae	1	5.88	1	5.26	
2. Diptera	Tephritidae	1	5.88	1	5.26	5.26
3. Lepidoptera	Nymphalidae	1	5.88	1	5.26	21.05
	Pieridae	1	5.88	1	5.26	
	Crambidae	2	11.76	2	10.53	
4.Hemiptera	Miridae	1	5.88	1	5.26	15.18
	Pentatomidae	1	5.88	1	5.26	
	Pyrrhocoridae	1	5.88	1	5.26	
5. Coleoptera	Nitidulidae	1	5.88	1	5.26	31.58
	Coccinellidae	3	17.65	3	15.79	
	Chrysomelidae	1	5.88	2	10.53	
05	**14**	**17**	100.00	**19**	100.00	**100.00**

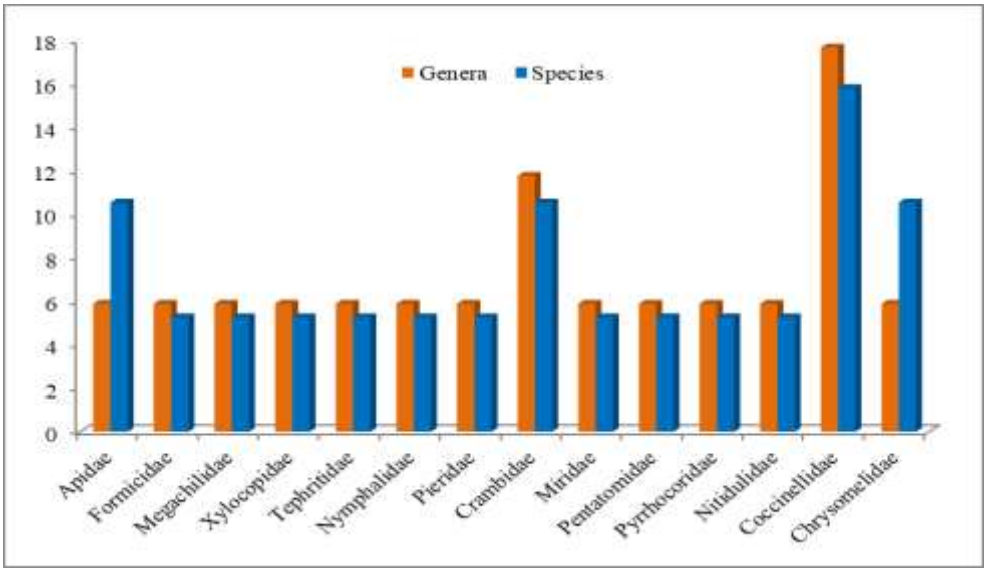


Fig. 1: Family-wise distribution of insect pollinators in bottle gourd

The present results are found in confirmation with the work of Revanasidda and Belavadi (2019), who reported that the muskmelon flowers were visited by 16 insect species, distributed under three orders and six families, among which 13 species from Hymenopterans, two from Lepidopterans and one from Diptera. Likely, the results of the present work are in close agreement with Bhardwaj and Srivastava (2012) who reported that 20 species of pollinators distributed under Hymenoptera, Lepidopteran and Diptera, whereas contradictorily one Hemipteran and two odonate insect species were also reported by them on bottle gourd flower at Bikaner. While in the case of ridge gourd, the distribution of insect pollinators under Hymenopterans, Dipterans, Lepidopterans, odonates, Orthopterans and Hemipteran insects was reported by Bhardwaj and Srivastava (2012), the results are affirmative and contradictory with the results of the present investigation. The contradictory results might be due to the different environmental situations of the research location.

3.2 Abundance of Insect Pollinators of Organic Bottle gourd

The observations of insect pollinators were recorded at an interval of fifteen days from onset of flowering to end of flowering in organic bottle gourd crop during the summer season of 2020 and 2021. The data was summed up and analyzed. The results thus obtained are presented in Table 2. The data presented in Table 2 revealed that a total of 3194 insect pollinators from organic bottle gourd crops were observed during the summer season of 2020 and 2021. Among which 1607 insects were reported under Coleoptera having three different families followed by Hemiptera (683) from three families, Hymenoptera (414) from four families, Lepidoptera (143) from three families and Diptera (385) from only one family.

The data presented in Table 2 showed that 3194 insect pollinators were recorded from three different orders; among which the Coleopteran pollinators were found the most abundant with 31.58 per cent abundance in bottle gourd crop followed by Hymenoptera with 26.31 per cent, Lepidoptera with 21.05 per cent, Hemiptera and Diptera with 15.18 and 5.26 per cent abundance, respectively. The most species-reach family Coccinellidae was found the most abundant with 17.65 per cent sharing of insect pollinators, followed by Chrysomelidae and Nitidulidae (5.88%) from the order Coleoptera. The family Crambidae (11.76%) was abundant amongst Lepidoptera order followed by Nymphalidae and Pieridae (5.88%). However, amongst Hymenoptera, all families share the same abundance with 5.88 per cent. The descending order of abundance of families of different insect pollinators was recorded as Coccinelidae > Crambidae > Chrysomelidae > Nitidulidae > Nymphalidae > Pieridae > Apidae > Formicidae > Megachilidae > Xylocopidae > Tephritidae > Miridae > Pentatomidae and Pyrrhocoridae.

Hymenoptera

Ten Hymenopteran insect pollinators were sampled from bottle gourd crops at the blooming stage during the summer season of 2020 and 2021. Among the Hymenopteran pollinators, *Apis dorsata* (186 population) was found the most abundant with 5.82 per cent in bottle gourd crop followed by *Camponotus compressus* (141) and *Apis cerana indica* (58) with 4.41 and 1.82 per cent abundance respectively, as very common species. Whereas, three species *viz*., *Xylocopa fenestrata* (14), *Megachile (Eutricharaea) hera* (15) with 0.47 and 0.44 per cent abundance observed in bottle gourd crop (Table 2).

Table 2: Diversity of insect pollinators in organic bottle gourd during the summer season of 2020 and 2021

Sr. No.	Name of Insect pollinators	Number of Insect Pollinators	Abundance %
Hymenoptera			
1	*Apis dorsata* (Fabricius, 1793)	186	5.82
2	*Apis cerana indica* (Fabricius, 1793)	58	1.82
3	*Camponotus compressus* Fabricius	141	4.41
4	*Xylocopa* sp.*(Fabricius, 1798)*	14	0.47
5	*Megachile (Eutricharaea)* sp. *(Bingham, 1897)*	15	0.44
Diptera			
6	*Bactrecra (Dacus) cucurbitae* (Coquillet)	385	12.05
Hemiptera			
7	*Nesidiocoris* spp.	543	17.00
8	*Dysdercus cingulatus* Fabricius	22	0.69
9	*Nezara virudula* Linnaeus	118	3.69
Coleoptera			
10	*Haptones* spp.	391	12.24
11	*Cheilomenes sexmaculata* Fabricius	232	7.26
12	*Coccinella transversalis* Fabricius	105	3.29
13	*Illeis cincta Fabricius*	10	0.31
14	*Aulacophora intermedia* Jacoby	38	1.19
15	*Aulacophora foveicollis* Lucas	861	26.96
Lepidoptera			

16	*Diaphania indica* Saunders	20	0.63
17	*Spoladea recurvallis* Fabricius	18	0.56
18	*Danaus chrysippus* Linnaeus	23	0.72
19	*Eurema hecabe* Linnaeus	14	0.44
Total		3194	100.00
Shanon index- 1.07 Evenness- 0.87			

Diptera

Only one Dipteran insect pollinator was sampled from the bottle gourd crop at the blooming stage during the summer season of 2020 and 2021. The results of Dipteran pollinators presented in Table 4.17 showed that the melon fruit fly, *Bactrocera cucurbitae* (385) was found the most abundant Dipteran pollinator species with 12.05 per cent abundance in bottle gourd.

Hemiptera

Three Hemipteran insect pollinators were collected from organic bottle gourd crops during the summer season of 2020 and 2021. The results of Hemipteran pollinators presented in Table 4.17 showed that the *Nesidiocoris* spp. (543) was found the most abundant Hemipteran pollinator species with 17.00 per cent abundance followed by a species *Nezara virudula* (118) with 3.69 per cent abundance as common species.

Lepidoptera

The Lepidoptera set up the fourth position with three different species of insect pollinators in bottle gourd during the summer season of 2020 and 2021. Among Lepidopterans, *Danaus chrysippus* (23) was found the most abundant with 0.72 per cent followed by *Diaphania indica* (20) with 0.63 per cent abundance species in bottle gourd crop. Whereas, three species *viz.*, *Spoladea recurvallis* (18) and *Eurema hecabe* (14) with 0.56 and 0.44 per cent abundance as rare species of bottle gourd crop (Table 4.17).

Coleoptera

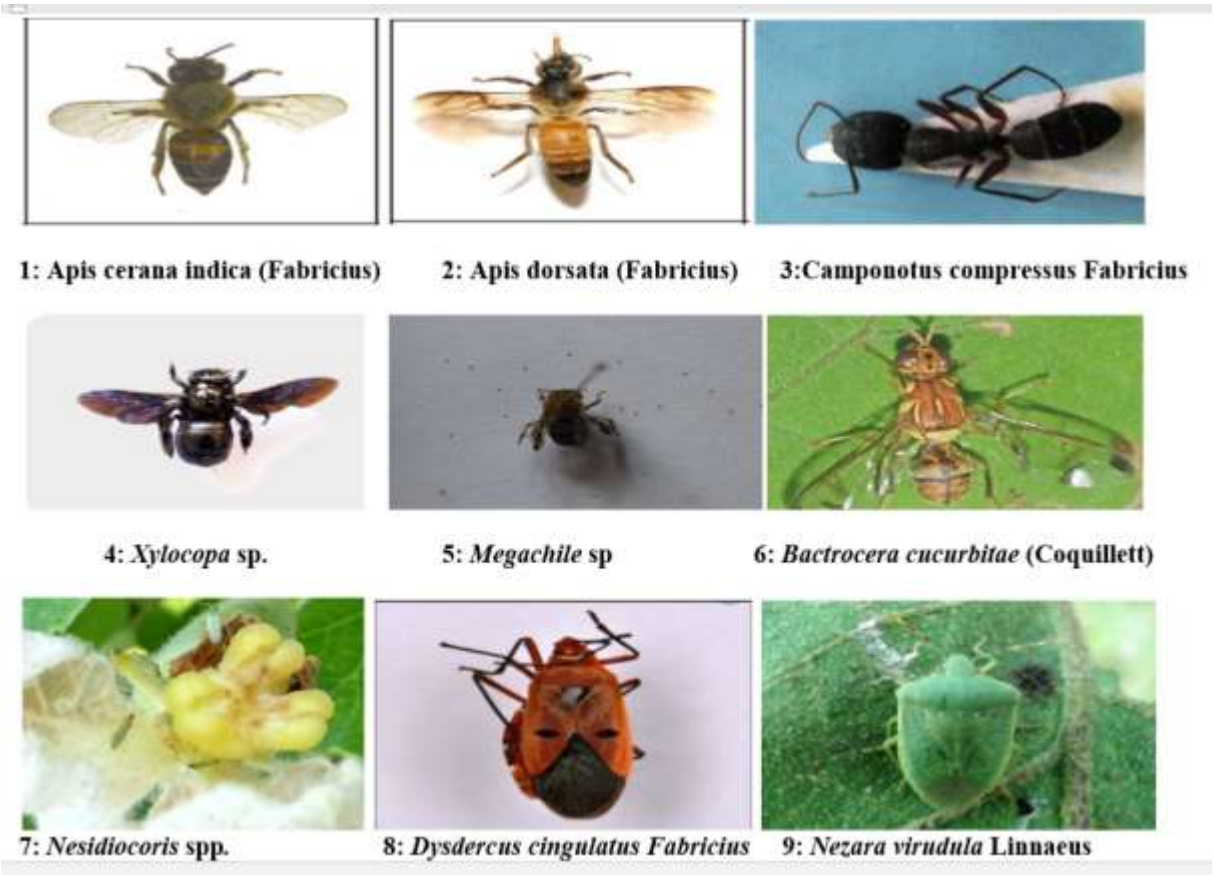
Six Coleopteran insect pollinators were sampled from bottle gourd crops during the summer season of 2020 and 2021. Among the Coleopteran pollinators, *Aulacophora foveicollis* (861 populations) was found the most abundant with 26.96 per cent abundance in bottle gourd crop followed by *Haptones* spp. (391), *Cheilomenes sexmaculata* (232) and *Coccinella transversalis* (105) with 12.24, 7.26 and 3.29 per cent abundance respectively, as very common species. Whereas, two species *viz*., *Aulacophora intermedia* (38) and *Illeis cincta* (10) with 1.19 and 0.31 per cent abundance observed in bottle gourd crop (Table 4.17).

Species richness, species evenness and species diversity index

Shannon's diversity index and species evenness of insect pollinators of bottle gourd were recorded as 1.07 and 0.87, respectively. The species evenness index (0.87) with a great range of moving towards one indicated huge species inequatability within the community. Species inequality was also reflected in the variation of abundance in the range between 1.18 to 16.90 per cent (Table 2).

The work of Jadhav *et al*. (2010) is in close confirmation with the present study with high species richness in Hymenoptera followed by Lepidoptera and Coleoptera at Tirupati, (Andhra Pradesh). The results are more or less comparable with the results of Belavadi (2015) in Karnataka, who worked out a diversity index (H'=2.49; D=0.90) for insect pollinators of muskmelon.

The results of the present work are in contradiction with Padhiyar and Patel (2021) reported that the bottle gourd in the case of flower visitors was found to be visited by a total of nine species of pollinators belonging to eight families and five orders. The species constituted four lepidopterans, two coleopterans and one each from Hemiptera, orthoptera and Odonata. Among all the insect visitors, lepidopterans were the major visitors (44.44%) followed by Coleoptera (22.22%), Hemiptera (11.11%), Orthoptera (11.11%) and Odonata (11.11%). Among all the species, *Nesidiocoris* spp. was the predominant (37.65%) followed by *Haptones* spp. and *Aulacophora foevicollis* constituting 31.76 per cent and 9.41 per cent, respectively. Kannagi *et al*. (2013) indicated less variation between the species in communities with a higher species evenness index. Similarly, Bashir *et al*. (2015), recorded the highest values of Simpson index (0.94) and Shannon index (3.48) during summer in a forest ecosystem in Southern Punjab Pakistan. This might be due to the change in the ecosystem for the insect pollinators, as the previous work done in a forest ecosystem, the insect pollinators got the diverse kind of flora.



1: Apis cerana indica (Fabricius) 2: Apis dorsata (Fabricius) 3:Camponotus compressus Fabricius

4: *Xylocopa* sp. 5: *Megachile* sp 6: *Bactrocera cucurbitae* (Coquillett)

7: *Nesidiocoris* spp. 8: *Dysdercus cingulatus Fabricius* 9: *Nezara virudula* Linnaeus

10: *Haptones* spp. 11: *Cheilomenes sexmaculata* Fabricius 12: *Coccinella transversalis* Fabricius

13: *Illeis cincta* Fabricius 14: *Aulacophora foveicollis* Lucas 15: *Aulacophora intermedia* Jacoby

16: *Diaphania indica* Saunders 17: *Spoladea recurvallis* (Fabricius) 18:*Danaus chrysippus* Linnaeus 19: *Eurema hecabe* Linnaeus

CONCLUSION

Pollinators support biodiversity and help in crop pollination. As per order-wise distribution, Coleoptera order was found to be dominated followed by Hymenoptera, Lepidoptera, Hemiptera and Diptera.3194 insect pollinators were recorded from three different orders; among which the Coleopteran pollinators were found the most abundant with 31.58 per cent abundance in bottle gourd crop followed by Hymenoptera with 26.31 per cent, Lepidoptera with 21.05 per cent, Hemiptera and Diptera with 15.18 and 5.26 per cent abundance, respectively. Shannon's diversity index and species evenness of insect pollinators of bottle gourd were recorded as 1.07 and 0.87, respectively. The species evenness index (0.87) with a great range of moving towards one indicated huge species inequatability within the community.

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