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Floral biology and diversity of pollinator fauna in bottle gourd in South Gujarat

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Abstract

The study reported the floral biology and insect pollinator diversity in bottle gourd. The bottle gourd flowers found to blooming in the late evening. The anthesis of flowers was started at 17:53 hrs whereas the stigma emergence was started from 17:46 hrs. In case of flower visitors, the bottle gourd flowers were found to be visited by total 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 insects 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 foenicollis* constituting 31.76 per cent and 9.41 per cent respectively. The mean activity of flower visitors was more at 18:00 hrs (30 visits/m²/5min) and no activity of flower visitors was observed at 06:00 hrs to 07:00 hrs and 10:00 hrs to 14:00 hrs.

Keywords: bottle gourd, floral biology, flower visitors, pollinators

Introduction

Among all vegetable cucurbits are extensively cultivated in various states of India. The cucurbitaceous family comprise of many species of vine crops with creeping growth habit. Cucurbitacin is the major biochemical compound present in the cucurbitaceous crops responsible for bitter taste which is more conspicuous in crops like cucumber, bottle gourd and long melon (Dhaliwal, 2017) [2]. Bottle gourd (*Lagenaria siceraria* (Molina) Standl.) also known as *Calabash*, is one of the most important cucurbitaceous vegetable crop grown in both rainy and summer season. Its name bottle gourd is derive from its bottle shape variants. It is also known as white flower gourd. It is originated in Africa and now grown in most part of the world.

Bottle gourd is vigorous, annual, running or climbing vine with large leaves and lush appearance. The vine is branched and climbs by means of the tendrils along the stem. The flowers are white and attractive up to four inches in diameter, with spreading petals. The ovary is inferior and on the shape of the fruits. Fruits have long peduncle, big, fleshy-watery, very variable as to shape and size (Stephens, 2018) [6]. Generally in bottle gourd, flowering starts 40-50 days of sowing. The flowers of bottle gourd are white with five sepals and five petals. The flowers open during night hours and anthesis take place between 17:00 to 20:00 hrs. The pollen remain viable on the day of the anthesis to next morning. The transfer of pollen from anther of one flower to the stigma of another flower is known as pollination. It can be either self-pollinated or cross-pollinated. Approximately 80 per cent of all flowering plants depends on biotic pollinators, and estimated 75 per cent of the world's crops benefit from biotic pollination. About one-third of the global food production depends on the biotic pollinators, particularly bees (Koetz, 2013) [3].

Cucurbitaceous crops mainly depend on insects for the pollination as male and female structure do not occur on the same flower so for fruit formation, transfer of pollen to stigma is very essential. Hence, studies have been carried out to know about the floral biology and pollinator fauna of bottle gourd.

Materials and Methods**Experiment area, season and planting material**

The study was carried out during *Kharif* (July-December 2019) at college farm, Navsari Agricultural University, Navsari, Gujarat. Bottle gourd crop (MGH 4- WARAD) was sown in

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three plot measuring 12m × 12m size comprising three treatments. Planting was done with a spacing of 2m between the rows and 1m between plants.

Floral biology of bottle gourd

To understand the mechanism of cross pollination, the study on floral biology were made. For the purpose, ten flowers (each of male and female flowers) were tagged with initiation of flower buds. The observations on process of flower opening, time of anthesis and time of stigma emergence were recorded from selected flowers.

Diversity of pollinator fauna in bottle gourd

To observe the flower visitors of bottle gourd, the

experimental plot was kept free from any insecticidal spray during the flowering period. Observations were recorded on different flower visitors visited the bottle gourd crop during flowering at 06:00 to 18:00 hrs for five minute at one hour interval in each square meter area from five spot during peak flowering period at weekly interval. The data were averaged time wise and group wise to infer the pollinator fauna as well as dominance of particular group.

Results and Discussion

Floral biology of bottle gourd

As monocious nature of bottle gourd, both male and female flower found on the same plant and male flowers appeared earlier than female flower.

Table 1: Study on floral biology of bottle gourd flower

Sr. No.	Process of flower opening (hrs)	Time of Anthesis (hrs)	Time of Stigma emergence (hrs)
1.	18:01 hrs	18:22 hrs	17:46 hrs
2.	17:22 hrs	17:53 hrs	18:17 hrs
3.	17:45 hrs	18:12 hrs	18:12 hrs
4.	17:35 hrs	18:27 hrs	18:23 hrs
5.	17:49 hrs	18:25 hrs	18:42 hrs
6.	18:08 hrs	18:43 hrs	18:50 hrs
7.	17:55 hrs	18:21 hrs	18:35 hrs
8.	18:02 hrs	18:41 hrs	18:47 hrs
9.	17:52 hrs	18:32 hrs	18:53 hrs
10.	18:32 hrs	18:55 hrs	18:30 hrs
Min.	17:22 hrs	17:53 hrs	17:46 hrs
Max.	18:32 hrs	18:55 hrs	18:53 hrs

In the present study, the first male flower appeared 48 days after planting while first female flower appeared 54 days after planting. The petals of male and female flowers were white in color. The female flower can easily distinguished from the male flower as female flower possess small ovary below the sepals. A higher proportion of male flowers observed per plant. It consist of five sepals, five petals and five anthers, while female flowers have five petals, five sepals, stigma, style and inferior ovary.

The data present on time of anthesis and time of stigma emergence in Table 1 indicated that the anthesis was started from 17:53 hrs and continued up to 18:55 hrs whereas the stigma emergence was started from 17:46 hrs and continued up to 18:53 hrs. Here both male and female flowers open at evening. The results of present investigation are in near agreement with Morimoto (2003) [4] observed that in bottle gourd, flowering normally started between 17:30 hrs and 23:00 hrs taking almost 60 to 90 minutes to open fully and the

flowers closed 08:00 to 20:00 hrs after flowering. Generally the flowering time differed depending on the location and the variety. Balachandran *et al.* (2016) [1] reported that in all the majority cucurbits, male flowers open earlier than the female flower. In case of bitter gourd, cucumber and Mangalore gourd anthesis was commenced before sunrise whereas in case of ridge gourd anthesis observed toward sunset and in snake gourd after sunset.

Diversity of pollinator fauna in bottle gourd

Flower visitors of bottle gourd in open pollination

During the present investigation on pollinator fauna of bottle gourd and foraging behavior of different pollinators, the observations were recorded on the types of flower visitors on the bottle gourd. In present study the bottle gourd flowers were found to be visited by total nine species of pollinators belonging to eight families and five orders.

Table 2: Pollinator fauna of bottle gourd in open pollination

Sr. No.	Order	Family	Species	Total Abundance (%)
1.	Lepidoptera	Sphingidae	<i>Hippotion celerio</i> L.	44.44
2.			<i>Agrius convolvuli</i> L.	
3.		Crambidae	<i>Diaphania indica</i> S.	
4.		Noctuidae	<i>Anadevidia peponis</i> F.	
5.	Coleoptera	Chrysomelidae	<i>Aulacophora foivicollis</i> L.	22.22
6.		Nitidulidae	<i>Haptones</i> spp.	
7.	Hemiptera	Miridae	<i>Nesidiocoris</i> spp.	11.11
8.	Orthoptera	Tettigoniidae	<i>Phaneroptera falcata</i> P.	11.11
9.	Odonata	Libellulidae	<i>Diplacodes trivialis</i> R.	11.11

Among the different flower visitors, lepidopterans were the major flower visitors of the bottle gourd constituted 44.44 per cent which was followed by coleopterans with 22.22 per cent and one species each from hemiptera, orthoptera and odonata

constituting 11.11 per cent (Table 2).

The dominance of lepidopterans as major flower visitors of the bottle gourd flowers was also previously reported by Morimoto *et al.* (2003) [4] and Subhakar and Sreedevi (2015)

[Error! Reference source not found.] which support the present finding. However, Srikanth (2012) [5] reported higher proportion of hymenopterans as major pollinators of bottle gourd.

Foraging activity of insect pollinators of bottle gourd in open pollination

The data recorded on the activity of different flower visitors at different hours of the day in 1m² area for the period of five minutes presented in Table 3 indicate that among the different flower visitors, the *Nesidiocoris* spp. was the predominant flower visitors constituting 37.65 per cent of total flower visitors followed by *Haptones* spp. and *Aulacophora foenicollis* constituting 31.76 per cent and 9.41 per cent flower visitors, respectively.

Apart from these, the activity of *Diaphania indica*, *Hippotion celerio* and *Agrius convolvuli* found same as constituting 4.71 per cent of flower visitors. In case of lepidopterans, the activity of *Anadevidia peponis* was found least with 3.52 per cent visitors. Among all pollinators, the activity of *Diplacodes trivialis* was found least with 1.17 per cent followed by *Phaneroptera falcata* P. with constituted 2.35 per cent flower visitors.

Further, the perusal data presented in Table 3 revealed that, the mean activity of flower visitors was more at 18:00 hrs (30 visits/m²/5min) followed by 08:00 hrs (23 visits/m²/5min) and 17:00 hrs (12 visits/m²/5min) and low at 09:00 hrs (05

visits/m²/5min) followed by 16:00 hrs and 15:00 hrs, which were 07 visits/m²/5min and 08 visits/m²/5min respectively. No activity of flower visitors was observed at 06:00 to 07:00 hrs and 10:00 to 14:00 hrs. The reason may be that, the flowers of bottle gourd closed 08:00-20:00 hrs after flowering.

The present finding on the activity of pollinators is in line with Morimoto *et al.* (2003) [4] who observed that hawk moth (*Hippotion celerio* and *Agrius convolvuli*) and noctuid moth were the major pollinators of bottle gourd among the all pollinators. Subhakar and Sreedevi (2011) [7] found that, among bottle gourd pollinators the proportion of *Diaphania indica* (28.43%) was highest followed by *Hippotion celerio* (25.73%) and *Arthoscista hilarialis* (24.65%) were the most frequent visitors. They also observed that mean foraging activity of pollinators are high during 19:00 hrs and 20:00 hrs. Balachandran *et al.* (2016) [1] observed 24 insect species visited cucurbits flowers. Among them lepidopterans had the highest number of pollinators followed by hymenopterans and dipterans and reported that snake gourd was mainly pollinated by lepidopterans. However, Srikanth (2012) [5] reported hymenopterans as higher pollinators in bottle gourd followed by dipterans and lepidopterans. Among them, *A. dorsata* was constituted 23.28 per cent of the total insect pollinators. It also reported two species from coleoptera and one species from hemiptera.

Table 3: Activity of different flower visitors on bottle gourd flowers at different hours of the day in open pollination

Time	<i>Aulacophora foenicollis</i>	<i>Nesidiocoris</i> spp.	<i>Haptones</i> spp.	<i>Diaphania indica</i>	<i>Hippotion celerio</i>	<i>Phaneroptera falcata</i>	<i>Agrius convolvuli</i>	<i>Anadevidia peponis</i>	<i>Diplacodes trivialis</i>	Total
06:00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00
07:00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00
08:00	00.00	02.00	19.00	00.00	00.00	02.00	00.00	00.00	00.00	23.00
09:00	00.00	05.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	05.00
10:00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00
11:00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00
12:00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00
13:00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00
14:00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00
15:00	04.00	04.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	08.00
16:00	00.00	07.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	07.00
17:00	02.00	10.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	12.00
18:00	02.00	04.00	08.00	04.00	04.00	00.00	04.00	03.00	01.00	30.00
Mean	0.62	2.46	2.08	0.31	0.31	0.15	0.31	0.23	0.08	6.54
Percentage	9.41	37.65	31.76	4.71	4.71	2.35	4.71	3.52	1.18	100

These diverse results may be due to that they used attractant to attract the pollinators. Generally the bottle gourd flowers started blooming after 17:00 hrs hence, there was less scope for diurnal visitors to visit bottle gourd flower.

Conclusion

Overall, the present study has shown that in bottle gourd, flowering start at late evening *i.e.* after 17:00 hrs and the flowers were visited by the nine species of pollinators and among them majority were from the lepidopterans constituting 44.44 per cent of total flower visitors. Due to late blooming of bottle gourd flowers, there were less chances for the diurnal visitors. So, farmers are advice to avoid spraying of toxic pesticides at evening time in bottle gourd for better availability of pollinator fauna and getting higher yield.

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