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Abundance of different flower visitors and their foraging behaviour in cucumber (*Cucumis sativus* L.)

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Abstract

Insect pollinators are flower visiting insects that forage on flowering plants to obtain plant provided food. Flower-visiting insects have the potential to transfer male gametes to the female gametes while foraging, resulting in pollination. Cucurbits like cucumber, squash, pumpkin, Cantaloupes and melons are cross pollinated crops. They need insect pollinators, especially honey bees for pollination and proper fruit set. In case of poor pollination, small sized and deformed fruit are produced. The experiment on the abundance of different flower visitors and their foraging behaviour in cucumber was undertaken at college farm of Navsari Agricultural University, Navsari during *summer*, 2018. Cucumber flowers visited by three species of honey bees viz., *Apis florea*, *A. cerana*, *A. dorsata* as well as lepidopterans, dipterans, coleopterans and hemipterans. Among different flower visitors, honey bees were the major visitors of cucumber flower constituted 70.45 per cent which was followed by coleopterans (9.34%), hemipterans (9.09%), lepidopterans (7.58%) and dipterans (3.54%). The mean foraging activity of flower visitors was more at 10:00h.

Keywords: cucumber, flower visitors, foraging behaviour, honey bees, pollinators

1. Introduction

Cucumber (*Cucumis sativa* L.) is a widely cultivated summer vegetable crop in the gourd family Cucurbitaceae. It is a monoecious annual climber that has been cultivated for more 3,000 years and is still widely cultivated till today ^[1]. Flowering phenology of cucumber ensures better cross pollination, as it produces male and female flowers separately on the same plant at different internodes. The maximum pollination occurs in the forenoon. Female flower closes in the afternoon and never reopens whether or not pollination has taken place; furthermore, the highest per cent of fruit set results from deposition of pollen on the stigma between 09:00 a.m to 12:00 noon ^[2]. Among the insect pollinators, honey bees are the most important pollinators. Honey bees pollinate 16 per cent of the total of 0.25 million of flowering plant species in the world and nearly 40,000 species of agricultural plants ^[4]. Utilization of bees in pollination not only increased the yield of various crops but also improves their quality. It helps for uniform maturity and early harvest of the crop. Looking to the importance of pollination in cucumber, the experiment was planned to investigate the “abundance of different flower visitors and their foraging behaviour in cucumber”.

2. Materials and Methods

The field experiment was laid out in randomized block design (RBD) conducted during *Summer*-2018 at college farm of Navsari Agricultural University, Navsari (Gujarat), India. The cucumber variety Gujarat cucumber-1 was shown on 20th of April with a spacing of 120cm × 60cm in plots measuring 6.0m x 6.0m. The crop was kept unsprayed throughout the crop season. The observation on number of different insect foraging for nectar or pollen at different hours of the day starting from 06:00h to 18:00h were recorded at weekly interval with initiation of flowering. The abundance of different visitors were recorded by counting number of different visitors visiting flowers of 1m² area per five minutes of different hours of day. Relative abundance of each species was determined by using the following formula:

$$\text{Relative abundance of species} = \frac{\text{Mean Number of individuals visiting flower}}{\text{Mean number of pollinators counted}} \times 100$$

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3. Results and Discussion

Flower visitors of cucumber: During the present investigations on flower visitor of cucumber and foraging behaviour of different pollinators, the observations were recorded on the kind of flower visitors on cucumber. The cucumber flowers were found to be visited by three species of honey bees viz., *A. florea*,

A. cerana, *A. dorsata* as well as lepidopterans, dipterans, coleopterans and hemipterans. Among different flower visitors, honey bees were the major visitors of cucumber

flower constituted 70.45 per cent which was followed by coleopterans (9.34%), hemipterans (9.09%), lepidopterans (7.58%) and dipterans (3.54%). Among different honey bee species, *A. florea* was predominant (39.14%) visitors of cucumber flower followed by *A. dorsata* (18.18%) and *A. cerana* (13.13%). The data are graphically depicted in Figure 1. The predominance of honey bees as flower visitors of the cucumber was previously reported by Rao and Suryanarayana (1988) [8], Sajjanar (2004) [10], Shah *et al.* (2015) [11], Dorjay *et al.* (2017) [5] which supports the present findings.

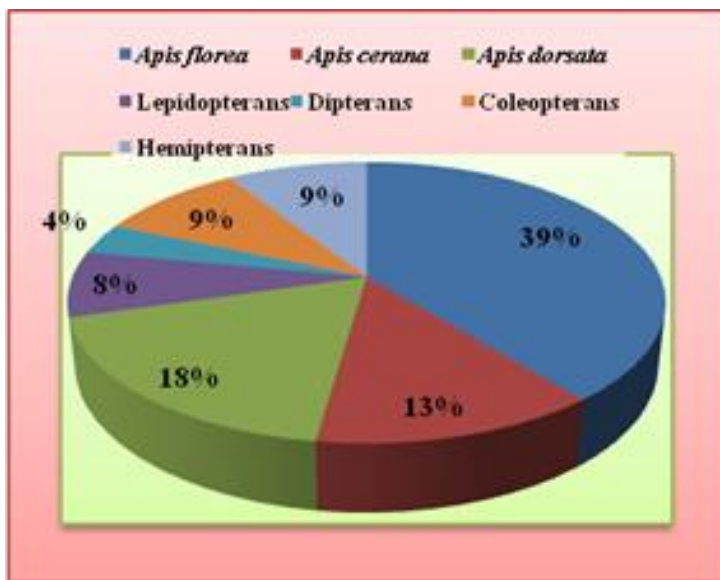


Fig 1: Relative abundance of the flower visitor on cucumber flowers

3.2 Foraging activity of flower visitors of cucumber

The data recorded on the activity of different flower visitors at different hours of the day (irrespective of day of observation *i.e.* mean of five observations) in 1m² area for the period of five minutes presented in Table 1 indicated that among different bee species, the *A. florea* was the predominant flower visitors (0.60bees/m²/5min) constituting 39.14 per cent of total flower visitors followed by *A. dorsata* (0.28bees/m²/5min) and *A. cerana* (0.20bees/m²/5min) constituting 18.18 per cent and 13.13 per cent of total flower

visitors, respectively. Apart from honey bees, the activity of lepidopterans, coleopterans, dipterans and hemipterans was reported to be 0.12, 0.05, 0.14 and 0.14visitors/m²/5min constituting 7.58, 3.54, 9.34 and 9.09 per cent of the total visitors, respectively as presented in Table 1. Among different bee species, *A. florea* was found predominant during present study, the reason may be the large number of *A. florea* colonies in the vicinity of experimental site. Similar finding was reported by Kapil and Chaudhury (1974) [6] and Saeed *et al.* (2012) [9].

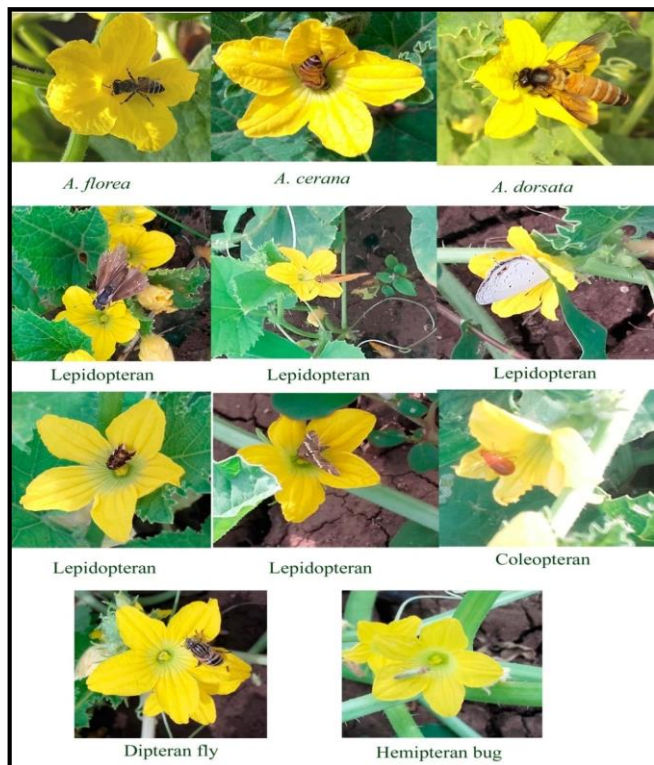
Table 1: Activity of flower visitors on cucumber flowers at different hours of the day

| Time (h) | *Mean number of visitors/m ² /5 min | | | | | | | Total |
|----------|--|------------------|-------------------|---------------|--------------|-----------|-------------|--------|
| | <i>A. florea</i> | <i>A. cerana</i> | <i>A. dorsata</i> | Lepidopterans | Coleopterans | Dipterans | Hemipterans | |
| 06 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 | 00.10 | 00.05 | 00.15 |
| 08 00 | 01.25 | 00.20 | 00.20 | 00.15 | 00.00 | 00.10 | 00.10 | 02.00 |
| 09 00 | 01.80 | 00.30 | 00.75 | 00.20 | 00.25 | 00.30 | 00.25 | 03.85 |
| 10 00 | 02.25 | 01.00 | 00.95 | 00.40 | 00.25 | 00.60 | 00.55 | 06.00 |
| 11 00 | 00.80 | 00.35 | 00.45 | 00.20 | 00.00 | 00.25 | 00.20 | 02.25 |
| 12 00 | 00.50 | 00.20 | 00.35 | 00.00 | 00.00 | 00.15 | 00.10 | 01.30 |
| 13 00 | 00.00 | 00.00 | 00.00 | 00.00 | 00.00 | 00.00 | 00.00 | 00.00 |
| 14 00 | 00.10 | 00.00 | 00.00 | 00.00 | 00.05 | 00.00 | 00.00 | 00.15 |
| 15 00 | 00.55 | 00.10 | 00.40 | 00.15 | 00.10 | 00.05 | 00.20 | 01.55 |
| 16 00 | 00.45 | 00.25 | 00.50 | 00.35 | 00.05 | 00.25 | 00.30 | 02.15 |
| 17 00 | 00.05 | 00.20 | 00.00 | 00.05 | 00.00 | 00.05 | 00.05 | 00.40 |
| 18 00 | 00.00 | 00.00 | 00.00 | 00.00 | 00.00 | 00.00 | 00.00 | 00.00 |
| Mean | 00.60 | 00.20 | 00.28 | 00.12 | 00.05 | 00.14 | 00.14 | 01.52 |
| Per cent | 39.14 | 13.13 | 18.18 | 07.58 | 03.54 | 09.34 | 09.09 | 100.00 |

*Mean of five observations taken during flowering period of cucumber

Table 2: Activity of flower visitors of cucumber flowers at different periods

| Periods | Mean number of visitors/m ² /5min | | | | | | | Total |
|----------------------|--|------------------|-------------------|---------------|--------------|-----------|-------------|-------|
| | <i>A. florea</i> | <i>A. cerana</i> | <i>A. dorsata</i> | Lepidopterans | Coleopterans | Dipterans | Hemipterans | |
| 1 st week | 0.71 | 0.22 | 0.29 | 0.14 | 0.05 | 0.14 | 0.14 | 1.69 |
| 2 nd week | 0.74 | 0.26 | 0.43 | 0.15 | 0.05 | 0.2 | 0.18 | 2.01 |
| 3 rd week | 0.52 | 0.18 | 0.28 | 0.09 | 0.06 | 0.12 | 0.12 | 1.37 |
| 4 th week | 0.42 | 0.14 | 0.11 | 0.08 | 0.05 | 0.11 | 0.11 | 1.02 |
| Mean | 0.60 | 0.20 | 0.28 | 0.12 | 0.05 | 0.14 | 0.14 | 1.52 |

**Plate 1:** Flower visitors of cucumber flowers

Further, the perusal of data presented in Table-1 revealed that, the mean activity of flower visitors was more at 10:00h (6.0visitors/m²/5min) followed by 09:00h (3.85visitors/m²/5min) and 11:00h (2.25visitors/m²/5min) and low at 07:00h and 14:00h (0.15visitors/m²/5min) and 17:00h (0.40visitors/m²/5min). No activity of flower visitors was observed at 06:00h, 13:00h and 18:00h.

Among different bee species, the activity of *A. florea* was observed from 08:00-12:00h and 14:00-17:00h with maximum activity at 10:00h (2.25bees/m²/5min) followed by 09:00h (1.80bees/m²/5min), 08:00h (1.25bees/m²/5min), 11:00h (0.80bees/m²/5min) and 15:00h (0.55bees/m²/5min). The activity of

A. dorsata was reported from 08:00-12:00h and 15:00-16:00h with maximum activity 10:00h (0.95bees/m²/5min) followed by 09:00h (0.75bees/m²/5min), 11:00h (0.45bees/m²/5min), 15:00h (0.40bees/m²/5min) and 16:00h (0.50bees/m²/5min). The activity of *A. cerana* was observed from 08:00-12:00h and 15:00-17:00h with maximum activity at 10:00h (1.0bees/m²/5min) followed by 11:00h (0.35bees/m²/5min), 09:00h (0.30bees/m²/5min) and 16:00h (0.25bees/m²/5min).

Apart from honey bees, the activity of lepidopterans was observed from 08:00-11:00h and 15:00-17:00h with maximum activity at 10:00h (0.40lepidopterans/m²/5min) followed by 16:00h (0.35lepidopterans/m²/5min) and 11:00h (0.20lepidopterans/m²/5min). The activity of dipteran flies was observed from 07:00-12:00h and 15:00-17:00h with maximum at 10:00h (0.60flies/m²/5min) followed by 09:00h

(0.30flies/m²/5min), 11:00h and 16:00h (0.25flies/m²/5min). The activity of coleopterans was observed from 08:00-10:00h and 14:00-16:00h with maximum activity at 09:00h and 10:00h (0.25beetles/m²/5min) followed by 15:00h (0.10beetles/m²/5min). The activity of hemipteran bugs was observed from 07:00-12:00h and 15:00-17:00h with maximum activity at 10:00h (0.55bugs/m²/5min) followed by 16:00h (0.30bugs/m²/5min) and 09:00h (0.25bugs/m²/5min). The present finding on activities of honey bees is in line with Meena and Rana (2008) [7] and Balachandran *et al.* (2017) [3]. Considering the activity of different visitors at different days of observation (irrespective of the hour of the day) presented in Table-2 indicated that the maximum activity was observed on 2nd week of flowering (2.01visitors/m²/5min) followed by 1st week of flowering (1.69visitors/m²/5min) and 3rd week of flowering (1.37visitors/m²/5min) and minimum activity on 4th week of flowering (1.02visitors/m²/5min). The higher activity of visitors during second week of flowering is coincided with the peak flowering period of the crop.

4. Conclusion

The cucumber flowers were found to be visited by three species of honey bees *viz.*, *Apis florea*, *A. cerana*, *A. dorsata* as well as lepidopterans, dipterans, coleopterans and hemipterans. Among different flower visitors, honey bees were the major visitors of cucumber flower constituted 70.45 per cent which was followed by coleopterans (9.34%), hemipterans (9.09%), lepidopterans (7.58%) and dipterans (3.54%). Among different bee species, the *A. florea* was the predominant flower visitors constituting 39.14 per cent of total flower visitors followed by *A. dorsata* and *A. cerana* constituting 18.18 per cent and 13.13 per cent of total flower visitors, respectively. The mean activity of flower visitors was more at 10:00h and low at 07:00h, 14:00h and 17:00h. No activity of flower visitors was observed at 06:00h, 13:00h and 18:00h. Activity of different bee species was observed from 08:00-12:00h and 14:00-17:00h with maximum activity at 10:00h. Apart from honey bees, the activity of lepidopterans, dipterans, coleopterans and hemipterans was observed from 07:00-12:00h and 15:00-17:00h with maximum activity at 10:00h. The maximum activity of pollinators was observed on 2nd week of flowering followed by 1st week of flowering and 3rd week of flowering and minimum activity on 4th week of flowering.

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