

Non – Bee Insect Pollinators of Coriander and Their Foraging Behavior

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Abstract

Coriander provides both nectar and pollen, so it is attractive to various insect visitors. To study the diversity and foraging behaviour, the coriander crop is grown at Research Farm, College of Agriculture, Swami Keshwanand Rajasthan Agricultural University, Bikaner. The non- bee insect pollinators observed in coriander were *Sepsis fulgens* of family Sepsidae of order Diptera, *Diphyus sp.*, and *Ichneumon sarcitorius* of family Ichneumonidae of Hymenopteran order. *Sepsis fulgens* shows peak activity at 15.00 h with 21.73 insect visitors/10 plants / 5 minutes. *Diphyus sp.* shows maximum activity at 13.00 h with 9.55 insect visitors/10 plants /5 minutes. *Ichneumon sarcitorius* shows peak activity at 12.00 h with 11.09 insect visitors /10 plants/5 minutes. The study on foraging speed reveals that the average time spent by *Sepsis fulgens* (9.38 sec) was higher followed by *Diphyus sp.*(9.25 sec), *Ichneumon sarcitorius*(8.72 sec).

Key words: Coriander, Foraging behaviour, Insect visitors, Temporal variation

Introduction

Pollination improves the quality of most crop species, making agricultural production one of the most important economic sectors (Choi *et al.*,2015). Insect pollination (entomophily) accounting for 90 per cent of animal pollination (Buchmann and Nabhan, 1996). Pollinators play an important role in both natural and agro-ecological ecosystem services. Pollinating insects are mainly belongs to three orders: Lepidoptera, Hymenoptera, and Diptera. Ranjitha *et al.*,2019 reported ten different species from four different orders visited coriander flowers. Five species of Hymenoptera, one species of Diptera, two species of Coleoptera, and two species of Lepidoptera make up this group of insects. The degree of pollination mainly depends on foraging speed, foraging rate, strength and diversity of pollinators. Foraging ecology is one of important parameter in successful pollination and is variable from one pollinator species to other, even within the species. Foraging speed (time in

second spent by bee per flower) and foraging rate (number of flower visited by bee per minute) depends upon foraging behaviour of insects species and floral structure of the crop concerned.

Materials and Methods

The diversity of non - bee insect visitors/pollinators was observed daily on ten randomly selected plants for five minutes at hourly interval from 06.00 to 18.00 h throughout the flowering period to document various insect visitors and the abundant species were recorded. The temporal variations (foraging time) were recorded for 5 min from 06.00 h to 18.00 h for major pollinator species at hourly interval and their variations in foraging activities at different timings were expressed as mean number of pollinators per ten plants per five min. The foraging rate (number of flowers visited by foraging species per five minutes) was recorded at peak foraging hour of respective forager species during entire flowering period and average number of flowers visited by pollinator species was expressed as number of flowers visited by a pollinator per five minutes. The foraging speed (time spent by each visitor on flower) were recorded with the help of a stopwatch during the peak foraging hour.

Results

. The non- bee insect pollinators observed in coriander were *Sepsis fulgens* of family Sepsidae of order Diptera, *Diphyus sp.*, and *Ichneumon sarcitorius* of family Ichneumonidae of Hymenopteran order. The foraging activity of *Sepsis fulgens* was initiated at 13.00 h and maximum activity was observed at 14.00 h to 16.00 h (14.55 to 12.18 insect visitors/10 plants / 5 minutes) with peak activity at 15.00 h (21.73 insect visitors/10 plants / 5 minutes). The lowest activity was observed at 17.00h (6.36 insect visitors/10 plants /5 minutes). No activity was observed during morning hours. *Diphyus sp.* started its foraging activity from 12.00 h showing an increasing trend up to 14.00 h with maximum activity at 13.00 h (9.55 insect visitors/10 plants /5 minutes) and later the activity declined thereafter with minimum at 15.00 h (2.36 insect visitors/10 plants /5 minutes) of the day. The *Ichneumon sarcitorius* started foraging activity from 10.00 h and maximum activity was observed at 11.00 h to 14.00 h (5.09 to 4.45 insect visitors /10 plants /5 minutes) with peak activity at 12.00 h (11.09 insect visitors /10 plants/5 minutes). The lowest activity was observed at 15.00 h (2.18 insect visitors /10 plants/5 minutes).

Table 1. Temporal variations in activity of major insect visitors/ pollinators on coriander

Time (hr)	Mean number of insect visitors/pollinators/10 plants/5min		
	<i>Diphyus sp.</i>	<i>Sepsis fulgens</i>	<i>Icheneumon sarcitorius</i>
6.00	0.00 (1.00) ^e	0.00 (1.00) ^f	0.00 (1.00) ^g
7.00	0.00 (1.00) ^e	0.00 (1.00) ^f	0.00 (1.00) ^g
8.00	0.00 (1.00) ^e	0.00 (1.00) ^f	0.00 (1.00) ^g
9.00	0.00 (1.00) ^e	0.00 (1.00) ^f	0.00 (1.00) ^g
10.00	0.00 (1.00) ^e	0.00 (1.00) ^f	3.00 (1.99) ^e
11.00	0.00 (1.00) ^e	0.00 (1.00) ^f	5.09 (2.46) ^c
12.00	2.82 (1.93) ^c	0.00 (1.00) ^f	11.09 (3.48)^a
13.00	9.55 (3.24)^a	9.27 (3.20) ^d	8.00 (3.00) ^b
14.00	5.00 (2.44) ^b	14.55 (3.94) ^b	4.45 (2.33) ^d
15.00	2.36 (1.82) ^d	21.73 (4.76)^a	2.18 (1.77) ^f
16.00	0.00 (1.00) ^e	12.18 (3.62) ^c	0.00 (1.00) ^g
17.00	0.00 (1.00) ^e	6.36 (2.71) ^e	0.00 (1.00) ^g
18.00	0.00 (1.00) ^e	0.00 (1.00) ^f	0.00 (1.00) ^g
	1.52	4.93	2.60

Mean	(1.42)	(2.02)	(1.69)
S.Em±	0.04	0.03	0.03
CD @5%	0.12	0.09	0.10

- Figures in parenthesis are $\sqrt{(X + 1)}$ transformed values
- The values followed by same letters do not differ significantly as per DMRT at 5 per cent level.

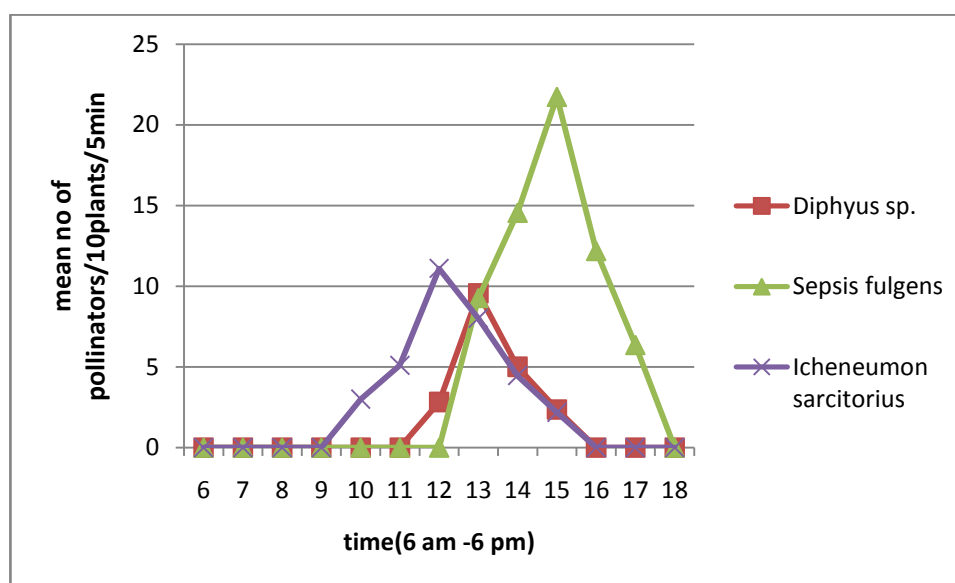


Fig.1. Temporal variations in activity of major insect visitors/ pollinators on coriander

The foraging rate is higher in *Sepsis fulgens* (9.38 flowers visited / 5min) followed by *Diphyus s* (9.25 flowers visited / 5min) and *Icheneumon sarcitorius* (8.72 flowers visited / 5min) . All the pollinators are more active during day time when there is more sunshine.

Table 2. Foraging rate of major insect visitors/ pollinator species on coriander

Insect visitor/ pollinator species	Foraging rate (flowers visited / 5min)	Peak foraging hour (h)	Mean no. of pollinators/ 5 min
<i>Diphyus sp.</i>	9.25	13.00	9.55
<i>Sepsis fulgens</i>	9.38	15.00	21.73
<i>Icheneumon sarcitorius</i>	8.72	12.00	11.09

The data showed that *Diphyus sp* spent maximum time (75 sec) with mean foraging activity of 9.25 sec per flower among the major non – bee insect visitors/ pollinators on coriander flowers . This was followed by *Sepsis fulgens* which spent maximum time of 65 sec and minimum of 2 sec with mean foraging time 9.38 sec. The literature on foraging rate and speed of these insect pollinators was very scarce.

Table.3. Foraging speed of major insect visitors/pollinator species on coriander flowers

Insect visitors/pollinator species	Time spent on each flower (sec)		
	Max	Min	Average
<i>Diphyus sp.</i>	75	2	9.25
<i>Sepsis fulgens</i>	65	2	9.38
<i>Icheneumon sarcitorius</i>	42	13	8.72

Conclusion

Among the major pollinators in Coriander, the peak foraging time was observed at 12.00 h, 13.00 h for *Icheneumon sarcitorius* and *Diphyus sp.* respectively. The foraging rate was higher in *Sepsis fulgens* followed by *Diphyus sp.*, *Icheneumon sarcitorius*. The average time spent by *Sepsis fulgens* was higher followed by *Diphyus sp.*, *Icheneumon sarcitorius*.

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