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Foraging activity of different species of honey bees in onion ecosystem

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Abstract

The investigation was carried out to study the Foraging activities of different honey bees in onion ecosystem during rabi-summer 2010-2011 at farmers field at Benkanakonda village near KVK, Hanumanamatti, Haveri District the results revealed that the dammer bee, *T. iridipennis* started its activity at 0800 hr with an average of 1.50 bees/sq.mt/ 5 min and attained peak at 1200 hr (4.37 bees/sq.mt /5 min). The foraging activity trend remained almost same upto to 1400 hr it gradually decreased with lowest foraging activity measured at 1800 hr. The rock bee started visiting the onion plot early at 0600 hr with an average of 0.55 bees/sq.mt/5 min. It gradually increased and peak activity was observed at 1000 hr with an average of 5.13 bees/sq.mt / 5min. *A. cerana* started foraging activity after 5 per cent flowering commenced at 0600 hr with an average of 0.62 bees/sq.mt/ 5 min. The maximum activity was found between 1000 to 1200 hr which varied with an average of 5.64 to 4.04 bees/sq.mt/5 min. The foraging activity of *A. florea* was not found at 600 but 800 onwards. The peak activity of *A. florea* on onion crop was recorded from 1000 to 1400. On an onion umbel 4 to 5 individuals were found at a time for foraging. The comparative foraging activity of different honey bee species indicated that, among the four species *A. florea* was predominant as maximum bees visited with an average of 4.99 bee/sq.mt/5 min, followed by *A. dorsata* (2.69 bees/sq.mt/5 min) and *A. cerana* (2.45 bees/sq.mt / 5min). The less activity was observed with *T. iridipennis* (1.69 bees/ sq.mt/5 min).

Keywords: Foraging activity, honey bees, season, pollinators

Introduction

Honey bees are highly evolved social insects and are efficient pollinators. It is due to bee pollination that the crop yield increases and improves in quality and quantity of seed and fruit yield. Therefore, bee keeping can play a vital role in improving crop yields besides resulting into an additional source of income through honey and bee-wax (Pateel and Sattagi, 2007) [6]. Many investigations have consistently confirmed that yield levels can be increased to an extent of 50 to 60 per cent in fruits and plantation crops, 45 to 50 per cent in sunflower, sesamum and niger and 100 to 150 per cent in cucurbitaceous crops, through good management of pollinators (Melnichenko and Khalifman, 1960) [7]. Insect pollination of crops is an essential crop management practice that should be utilized skillfully by harnessing the activity of domestic honey bees, wild bees and other pollinators including solitary bees. Achievement of desired pollination lies in the planned and efficient use of honey bees to increase the yield as well as improving qualitative and quantitative parameters of the crop (Pateel and Sattagi, 2007) [6]. The Indian bee, *Apis cerana* Fab. is a predominant bee in Karnataka among other species, such as *Apis dorsata* Fab., *Apis florea* Fab., *Trigona irridipennis* Smith, *Apis mellifera* L. Indian honey bee, *A. cerana* is the base of Indian beekeeping and is widely distributed in India. The Indian honey bee, *A. cerana* is also distributed in Pakistan, Sri Lanka, Malaysia, Indo-China, Philippines, China, USSR, Japan and Indonesia (Ruttner, 1988; Hepburn *et al.*, 2001) [8,9]. It thrives up to 2500 m above mean sea level.

Material and Methods

The investigation was made on onion crop raised during rabi -summer of 2010-2011 during flowering period in farmers fields at Benakanakonda village near by Krishi Vigyana Kendra (KVK), Hanumanamatti, Haveri (14° 17', 15° 01", 75° 35" to 75° 50", 750 m msl). This study was undertaken in the unsprayed plots of the crop raised for studying the pollinator fauna.

The observations on number of bees visiting were recorded at two hours intervals from 0600 to 1800 hours for 5 minutes at 5 spots in a square meter area at weekly intervals. Observations were at each spot with ten flower heads they selected randomly in each plot for the observations and continued from 5 percent flowering to the end of flowering. The data was collected about the average number of bees species visited to compare the different groups and the conclusion which group at what time dominated the other group. The methodology followed by Kalmath (2002) [3] was used for the study.

Results and Discussion

Foraging activity of *T. iridipennis* on onion

The important characteristics of dammar bee is that it's requires a small secluded niche and not much vegetations for survival and reproduction but this species of bee is highly vulnerable to pesticide toxicity and human interventions. Present study, indicated that

T. iridipennis started its activity at 0800 hr with an average of 1.50 bees/sq.mt/ 5 min and attained peak at 1200 hr (4.37 bees/ sq.mt /5 min). The foraging activity trend remained almost same upto to 1400 hr and gradually decreased and lowest foraging activity was found at 1800 hrs (Table 1).

Table 1: Foraging activity of *T. iridipennis* on onion flower / umbel

Hours	Number of bees/m ² /5min				Total	Mean
	Flowering					
	1 st week	2 nd week	3 rd week	4 th week		
0600	0.00±0.0*	0.00±0.0	0.00±0.0	0.00±0.0	0.00	0.00
0800	1.50±0.7	1.40±0.2	1.20±0.1	1.90±0.2	6.00	1.50
1000	2.10±0.2	5.20±0.1	5.00±0.6	2.60±0.2	14.90	3.72
1200	1.80±0.3	6.30±0.2	7.30±0.2	2.10±0.2	17.50	4.37
1400	1.10±0.2	5.00±0.4	6.60±0.3	0.40±0.1	13.10	3.27
1600	0.60±0.4	0.90±0.2	0.90±0.2	0.70±0.5	3.10	0.78
1800	0.00±0.1	0.40±0.0	0.60±0.3	0.00±0.0	1.00	0.25

*Mean±SD

Foraging activity of *A. dorsata* on onion

The data on foraging activity of Rock bee, *A. dorsata* on onion is presented in (Table 2). The foraging activity was intense from 1000 to 1400 then it reduced. It overlapped with the foraging activity of *T. iridipennis* on an average of 2 to 3 *A. dorsata* bee were found foraging in the onion cultivated patch. It may be noted that it is a dominant pollinator of onion and sustenance of its activity and conservation of the colonies near cultivated patches is crucial for the productivity of the onion crop. The foraging activity of *A. dorsata* on onion was observed from 0800 hr to 1600 hr during first week after 5 per cent flowering. No foraging activity observed at 0600 hr and 1800 hr. It gradually increased and attained the peak (2.80 bees/sq.mt/5 min) at 1200 hr and decreased slightly, thereafter (Table 2).

During the second week after 5 per cent flowering, the bees activity was started at 0800 hr with 3.80 bees/sq.mt/ 5 min. the activity increased suddenly (7.50 bees/sq.mt/ 5 min) at 1000 hr. However, the peak activity was noticed at 1000 hr and 1200 hr with 7.50 and 5.40 bees/sq.mt/5 min, respectively. Thereafter, it suddenly decreased to reach the lowest activity at 1800 hr which recorded 2.00 bees/sq.mt/5 min.

The foraging activity started at 0600 hr with 2.00 bees/sq.mt/5 min during 3rd week after 5 per cent flowering and reached maximum at 1000 hr (7.90 bees/ sq.mt/5 min). Later, it gradually decreased and reached minimum activity of 1.70 bees/sq.mt/5 min at 1800 hr.

The similar trend was observed during 4th week after 5 per cent flowering. The rock bee activity commenced at 0800 hr with 3.00 bees/sq.mt/5 min and highest activity was recorded (3.40 to 5.50 bees/sq.mt/5 min) between 1000 hr to 1200 hr. At 1600 hr, the activity almost subsided and no activity was observed at 1800 hr.

Similarly, when the bee foraging activity was compared between different hours of the day, it revealed that the rock bee started visiting the onion plot early at 0600 hr with an average of 0.55 bees/sq.mt/5 min. It gradually increased and peak activity was observed at 1000 hr with an average of 5.13 bees/sq.mt / 5min. The activity of bees was slight decrease from 1200 to 1600 hr. The lowest activity was observed at 1800 hr with an average of 0.93 bees/ sq.mt/5 min. The present result collaborate the findings of Jadhav (1981) who reported that *A. dorsata* was active between 1100 to 1200 hr of the day. Kumar *et al.* (1994) reported that *A. dorsata* activity was peak at 0900 to 1100 am.

Table 2: Foraging activity of *A. dorsata* on onion flower / umbel

Hours	Number of bees/m ² /5 min				Total	Mean
	Flowering					
	1 st week	2 nd week	3 rd week	4 th week		
0600	0.00±0.0*	0.00±0.0	2.00±0.0	0.20±0.1	2.20	0.55
0800	1.00±0.1	3.80±0.2	3.30±0.3	3.00±0.0	11.10	2.78
1000	1.70±0.5	7.50±0.1	7.90±0.3	3.40±0.1	20.50	5.13
1200	2.80±0.1	5.40±0.2	6.10±0.1	5.50±0.2	19.80	4.95
1400	1.90±0.2	3.10±0.3	2.90±0.4	2.40±0.4	10.30	2.58
1600	1.40±0.4	2.30±0.2	2.10±0.1	1.80±0.5	7.60	1.90
1800	0.00±0.0	2.00±0.0	1.70±0.0	0.00±0.0	3.70	0.93

*Mean±SD

Foraging activity of *A. cerana* on onion

This is a moderate sized bee whose activity on onion crop was

observed from 0600 to 1800 but the peak activity was observed from 0800 to 1200. This species is an early visitor

compare to *A. dorsata* and *A. florea* and at a time 1 to 2 individuals were observed attending onion umbels. This bee needs to be conserved in and around cultivated ecosystem it served as a source of fertilization for varied crop and as source of honey and wax. Pesticidal applications on onion need to be timed and scheduled so that the pollinator fauna is not affected ((Table 3).

The foraging activity during 1st week after 5 per cent flowering, started at 0800 h with 1.10 bees/sq.mt/ 5min, which indicated that there was no activity at 0600 h, it suddenly increased and reached the peak at 1000 hr (2.70 bees/sq.mt/5 min). However, the foraging activity started at 1600 h with 0.80 bees/sq.mt/5 min and decreased to 0.50 bees/sq.mt/5 min at 1800 h. During 2nd week after 5 per cent flowering foraging activity commenced early at 0600 hr with only 1.00 bees/sq.mt/5 min. The peak activity was observed at 1000 h and 1200 h with maximum of 4.20 and 3.00 bees/sq.mt/5 min, respectively. Thereafter, activity decreased at 1400 h to 1800 h.

Similar trend was observed during 3rd week after 5 per cent flowering as foraging activity was observed from 0600 hr to 1800 h. At 0600 h, only 1.50 bees/sq.mt/5 min were recorded which gradually increased and the highest was recorded at

1000 h with 5.90 bees/sq.mt/5 min. The foraging activity of Indian bees decreased at 1200 h and 1400 h showed 2.80 to 1.50 bees/sq.mt/5 min. and after that it slightly decreased at 1800 h with 1.20 bees/sq.mt/5 min.

The bees started visiting the plot at 0800 h with 2.70 bees/sq.mt/5 min during 4th week after 5 per cent flowering. The activity attained maximum at 1200 h (2.40 bees/sq.mt/5 min). Further, it decreased at 1400 h with 1.30 bees/sq.mt/5 min.

The foraging activity at different hours of the day indicated that the foraging activity after 5 per cent flowering commenced at 0600 h with an average of 0.62 bees/sq.mt/ 5min. The maximum activity was found between 1000 to 1200 h which varied with an average of 5.64 to 4.04 bees/sq.mt/5 min. Foraging activity decreased at 1400 h and 1600 h that varied from 2.16 to 1.60 bees/sq.mt/5 min. This is probably due to inherent character of bees (Biological clock) and they like cool hours of the day as they always live in cool and concealed places. These findings are in line with the report of Mohana Rao and Suryanarayana (1988 and 1989) [4] and Sattigi *et al.* (1996) [5] who reported that *A. cerana* activity was observed between 0600 hr to 1100 hr and 1600 hr to 1800 hr.

Table 3: Foraging activity of *A. cerana* on onion flower / umbel

Hours	Number of bees/m ² /5 min				Total	Mean
	Flowering					
	1 st week	2 nd week	3 rd week	4 th week		
0600	0.00±0.0*	1.00±0.0	1.50±0.0	0.00±0.0	2.50	0.62
0800	1.10±0.1	2.40±0.1	3.20±0.2	2.70±0.1	9.4	2.35
1000	2.70±0.3	4.20±0.3	5.90±0.1	1.30±0.1	14.1	5.64
1200	1.90±0.1	3.00±0.1	2.80±0.4	2.40±0.1	10.1	4.04
1400	1.00±0.2	1.60±0.1	1.50±0.1	1.30±0.2	5.4	2.16
1600	0.80±0.1	1.20±0.1	1.10±0.2	0.90±0.4	4.0	1.60
1800	0.50±0.1	0.40±0.3	1.20±0.3	0.90±0.2	3.0	0.75

*Mean±SD

Foraging activity of *A. florea* on onion

The foraging activity of *A. florea* was observed at 0600 but 0800h onwards. The peak activity of *A. florea* in onion was recorded from 1000 to 1400. On an onion umbel 4 to 5 individuals were found at a time for foraging. This is obviously because the bee size was smaller and the presence of more number of natural colonies nearby in and around study area. The field observations indicated that the frequency of visits to onion umbel was more compared to the other species of *Apis* bee.

The foraging activity during 1st week after 5 per cent flowering started at 0800 h with 2.20 bees/sq.mt/5 min and maximum was attained at 1000 h (8.40 bees/sq.mt/5 min). It decreased at 1200 h with foraging activity of 6.20 bees/sq.mt/5 min. Later, the foraging activity suddenly decreased at 1600 h and reached the lowest at 1800 h with 1.20 bees/sq.mt/5 min. This was perhaps due to the presence of a wide variety of floral vegetation available around the experimental field (Table 4).

During 2nd week after 5 per cent flowering, the foraging activity started early at 0800 hr with 4.00 bees/s.mt/ 5min and suddenly increased by 1000 h upto 1400 h ranging from 8.60 to 16.20 bees/sq.mt/ 5min. However, peak foraging activity of 16.20 bees/sq.mt/5 min was observed at 1000 h. Again at

1800 h, the foraging activity was minimum with 1.50 bees/sq.mt/5 min.

The foraging activity of little bees commenced at 0800 h with 3.70 bees/sq.mt/ 5 min during 3rd week after 5 per cent flowering and maximum activity was observed at 1000 h with 15.20 bees/sq.mt/ 5 min. After 1200 h, the foraging activity decreased gradually till 1600 h and suddenly fell to 1.30 bees/sq.mt/ 5 min at 1800 h.

No foraging activity by little bees was observed at 0600 h during 4th week after 5 per cent flowering. However, the foraging activity started with slow rate at 0800 h and continued upto 1600 h with maximum activity (7.90 bees/sq.mt/5 min) at 1000 h. Thereafter, it decreased reaching the lowest activity with 1.00 bees/sq.mt/5 min at 1800 h.

When foraging activity of little bee was compared different hours of the day, the results indicated that the activity began with an average of 3.13 bees/sq.mt/5 min at 0800 hr and its peak at 1000 h with 11.92 bees/sq.mt/5 min. Thereafter, it gradually decreased upto 1600 h and reached the lowest average foraging activity of 1.25 bees/ sq.mt /5 min. The present findings are in agreement with the report of Kumar *et al.* (1998) and Mohan Rao and Suryanarayana (1989) [4] who reported that little bee initiated foraging at 0900 to 1130 h and peak was attained at 1200h.

Table 4: Foraging activity *A. florea* on onion flower / umbel

Hours	Number of bees/m ² /5 min				Total	Mean
	Flowering					
	1 st week	2 nd week	3 rd week	4 th week		
0600	0.00±0.0*	0.00±0.0	0.00±0.0	0.00±0.0	0.00	0.00
0800	2.20±0.1	4.00±0.1	3.70 ±0.3	2.60±0.3	12.5	3.13
1000	8.40±0.3	16.20±0.4	15.20±0.2	7.90±0.1	47.7	11.92
1200	6.20±0.1	9.70±0.3	9.10±0.1	6.70±0.4	31.7	7.92
1400	4.50±0.2	8.60±0.4	8.10±0.2	5.80±0.1	27.0	6.75
1600	3.00±0.1	4.70±0.1	4.40±0.2	3.80±0.1	15.9	3.97
1800	1.20±0.2	1.50±0.3	1.30±0.2	1.00±0.3	5.0	1.25

*Mean±SD

Foraging activity of different bee species

The comparatively foraging activity of different honey bee species indicated that,

A. florea was more predominant as maximum bees visited with an average of 4.99 bees /sq.mt/5 min, followed by *A. dorsata* (2.69 bees/sq.mt/5 min) and *A. cerana* (2.45 bees/sq.mt / 5min). The foraging activity of *T. iridipennis* (1.69 bees/ sq.mt/5 min) was low throughout the flowering period of onion crop (Table 5).

Among different honey bees species, the foraging activity of

A. florea was maximum between 1000 to 1400 h (11.92 to 6.75 bees/sq.mt/5 min), whereas activity started at 0800 h but peak was noticed at 1000 h (11.92 bees/sq.mt / 5min). The foraging activity of *A. dorsata* was maximum and attained two peaks between 1000 hr and 1200 h (5.13 to 4.95 bees / sq.mt / 5min). Further, the activity of *A. cerana* was more between 1000 to 1200 h (5.64 to 4.04 bees/sq.mt/ 5min), which was almost same as that of *A. dorsata*. On an average, the overall foraging activity of bees was maximum from 1000 to 1400 h.

Table 5: Comparative Foraging behavior of different species of honey bees

Hours	Average honey bees/m ² /5 min				Total	Mean
	<i>T. iridipennis</i>	<i>A. dorsata</i>	<i>A. cerana</i>	<i>A. florea</i>		
0600	0.00	0.55	0.62	0.00	1.37	0.34
0800	1.50	2.78	2.35	3.13	9.05	2.26
1000	3.72	5.13	5.64	11.92	25.9	6.48
1200	4.37	4.95	4.04	7.92	20.03	5.01
1400	3.27	2.58	2.16	6.75	14.76	3.69
1600	0.78	1.90	1.60	3.97	8.25	2.06
1800	0.25	0.93	0.75	1.25	3.75	0.94
Total	13.89	18.82	17.16	34.94	84.81	-
Mean	1.98	2.69	2.45	4.99	-	-

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