



ACTIVITY OF HONEY BEES ON BRASSICA CROPS IN HIMACHAL PRADESH

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ABSTRACT

Behavioral studies of honey bees are very important to promote pollination. Foraging speed and rate are such vital behavioral patterns. This study evaluates the foraging attributes of honey bees on Brassica with experiments done at different sites chosen in Kangra district of Himachal Pradesh. *Apis mellifera* is observed to show a significantly maximum foraging rate of 13.25 and 13.89 flowers/ min on toria and mustard, respectively. Whereas, the foraging speed was maximum for *A. cerana* (5.20 sec/ flower) on toria and *A. mellifera* (4.42 sec/ flower) on mustard.

Key words: Foraging, honey bees, fidelity, Brassica, speed, behaviour, Himachal Pradesh, foraging rate, attribute, mustard, toria, *Apis mellifera*, *Apis cerana*, *Apis dorsata*

Pollination is a fundamental ecological process for the maintenance of diversity of flowering plants and lack of it leads to poor fertilization, uneven fruit or seed set, non-symmetrical fruits and fruit drop (Fell, 2005). Brassica is an excellent crop to study variations in pollinator behaviour as it is excessively pollinated by insects (Stewart, 2002). Honey bees alone are considered as major pollinators on Brassica, however many other insects also visit them during blooming period (Kunjwal et al., 2014). Pollination indices on the basis of relative abundance, foraging behavior, foraging speed, rate, amount of loose pollen carried on the body had been found as an alternate parameter to evaluate the pollination efficiency (Sharma, 1990). Kangra district in Himachal Pradesh is considered to be the hub of beekeepers and hence has the potential for commercial beekeeping (Kumar and Kundal, 2016). Since, it has been a concern to seek options for enhancing pollination as the pollinators survive and multiply on blooms of various plants; and importance of their presence is imperative to farming community for their conservation and utilization. The present study was carried out to know the behavioral response of honey bees on two commonly cultivated Brassica crops, which in turn will give the farmers an idea about the honey bees behaviour on these two crops.

MATERIALS AND METHODS

The study was carried out at the Bee Research Station, Nagrota Bagwan of Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishvavidyalaya, Palampur,

District Kangra, Himachal Pradesh. Experiments were laid on two Brassica crops namely toria and mustard under mid hill conditions. Toria was observed at four sites namely; Malan (32.1134° N, 76.4202° E), Dhoran (32.0927° N, 76.4346° E), Nagrota (32.1054° N, 76.3789° E) and Tharu (32.1080° N, 76.3669° E); while mustard at Sungal (32.0835° N, 76.5821° E), Dhraman (32.2246° N, 76.1653° E), Banuri (32.1018° N, 76.5575° E) and Palampur (32.1109° N, 76.5363° E).

Foraging rate was recorded as number of flowers visited/ min including flying time from one flower to another (Free, 1993; Bharti et al., 2015; Srivastava et al., 2017; Dalio, 2018; Sharma et al., 2018). Foraging speed was observed daily in terms of the time (sec) spent by each bee species/ flower (Free, 1993). The time spent to insert the proboscis and suck up the nectar or brushing/ collecting pollens was considered as time spent/ flower (Rani et al., 2017; Singh et al., 2017). The data were subjected to statistical analysis in factorial randomized block design (RBD) using CPCS1 software. The significance of treatments was evaluated by critical difference (C.D.) at $p=0.05$ after subjecting to appropriate transformations.

RESULTS AND DISCUSSION

Foraging rate: On toria, it is evident from Fig. 1 that *Apis mellifera* (13.25) has the maximum foraging rate followed by *A. cerana* (12.10) and the minimum was of *A. dorsata* (11.00). The foraging rates of *Apis* spp. were significantly variable at locations surveyed.

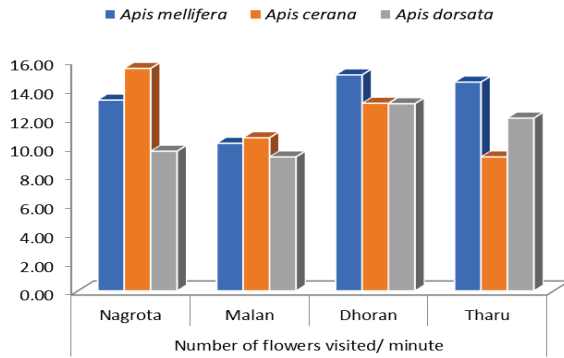


Fig. 1. Foraging rate of *Apis* spp. on

Maximum foraging rate of *A. mellifera* (15.00) and *A. dorsata* (13.00) was observed at Dhoran; and *A. cerana* has significantly maximum foraging rate at Nagrota (15.45). These results agree with those of Tara and Sharma (2010) who had reported the maximum foraging rate for *A. mellifera* (13.31) followed by *A. cerana* (12.48) and *A. dorsata* (11.31). Number of visited flowers/ min for *A. cerana* was 13.3 by Adlakha and Dhaliwal (1979). Kumar et al. (2015) observed foraging rate of *A. mellifera* as 10.83. On mustard, maximum number of flowers/ min was observed with *A. mellifera* (13.89) followed by *A. cerana* (13.22) whereas the least is of *A. dorsata* (12.56), significantly varying at different locations (Fig. 2). Location wise, *A. mellifera* had maximum foraging rate at Palampur (16.53). *Apis cerana* (18.00) and *Apis dorsata* (13.75) has significantly maximum foraging rate at Banuri. Devi et al. (2011) reported the foraging rate of *A. mellifera* as 14.40 to 19.20. These results are also in agreement

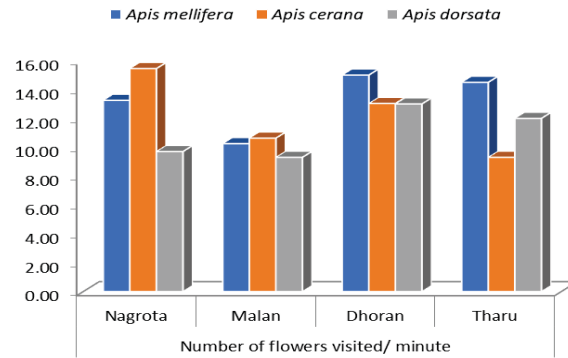


Fig. 2. Foraging rate of *Apis* spp. on mustard

with those of Kunjwal et al. (2014) on the maximum foraging rate of *A. mellifera*.

Foraging speed: On toria, as given in Table 1, *A. cerana* (5.20) was observed with the maximum speed followed by *A. dorsata* (4.99) and *A. mellifera* (4.21); at the different locations, *A. mellifera* spent more time on a flower at Tharu (4.33). However, *A. cerana* (5.75) and *A. dorsata* (5.95) recorded significantly maximum foraging speed at Dhoran. Murell and Nash (1981) reported *A. cerana* and *A. dorsata* with speed of 4.5 and 6.5, respectively; and Adlakha and Dhaliwal (1979) in *A. cerana* as 4.61. In contrast, Nderitu et al. (2008) observed that *A. mellifera* spent more time/ flower head. On mustard, *A. mellifera* (4.42) has the maximum foraging speed followed by *A. cerana* (4.10) and being minimum for *A. dorsata* (3.53), with variations between locations being significant; maximum speed of *A. mellifera* was observed at Sungal (5.03); *A.*

Table 1. Foraging speed of *Apis* spp. on toria and mustard at different locations

Insects	Location		Time spent by honeybee/ flower (sec)							
			Toria				Mustard			
	Nagrota	Malan	Dhoran	Tharu	Mean	Sungal	Dhraman	Banuri	Palampur	Mean
<i>Apis mellifera</i>	4.08 (2.24)	4.28 (2.30)	4.15 (2.26)	4.33 (2.31)	4.21 (2.28)	5.03 (2.50)	4.23 (2.29)	3.68 (2.05)	4.73 (2.38)	4.42 (2.30)
<i>Apis cerana</i>	5.05 (2.46)	5.48 (2.55)	5.75 (2.62)	4.50 (2.40)	5.20 (2.51)	3.70 (2.14)	4.63 (2.40)	4.10 (2.26)	3.95 (2.23)	4.10 (2.26)
<i>Apis dorsata</i>	4.83 (2.41)	5.53 (2.56)	5.95 (2.62)	3.65 (2.16)	4.99 (2.44)	4.38 (2.27)	3.43 (2.13)	3.23 (2.07)	3.08 (2.02)	3.53 (2.12)
Mean	4.65 (2.37)	5.10 (2.47)	5.28 (2.50)	4.16 (2.29)		4.37 (2.30)	4.10 (2.27)	3.67 (2.13)	3.92 (2.21)	

Toria	
	C D (p=0.05)
Insect pollinator	0.05
Location	0.06
Insect pollinator x location	0.11
C.V.	3.17

Mustard	
	C D (p=0.05)
Insect pollinator	0.01
Location	0.11
Insect pollinator x location	0.20
C.V.	6.19

Figures in parentheses means of $\sqrt{n+1}$ transformation

cerana has significantly maximum foraging speed at Dhraman (4.63) whereas Sungal (4.38) showed significantly maximum rate for *A. dorsata*. Pradeep (2018) supports the present results on *A. mellifera* as the most efficient pollinator as compared to *A. cerana* and *A. dorsata*.

Thus, it can be concluded that both toria and mustard attracted three *Apis* spp., which played an important role in pollination. *Apis mellifera* had the maximum foraging rate and speed was maximum for *A. cerana* on toria and *A. mellifera* on mustard.

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