

tically this information to a friend, the author was retaliated with a story about a pet racoon who rid himself of fleas in a similar manner.'

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15. FORAGING ACTIVITY OF *APIS DORSATA* FAB. ON *BRASSICA JUNCEA* HOOK. AND THOMAS

Like other species of *Apis* bees, *Apis dorsata* Fab. the wild bee, also lives in socialised colonies. Its food requirements as nectar and pollen are constant throughout the year. On account of domestication and management of *Apis cerana* Fab. and *A. mellifera* Linn., their colonies are either moved close to the selected crops serving as bee host plants or they are fed artificially during lean periods by man. *Apis dorsata*, however, migrates from one location to another in search of new crops. It suggests that *Apis dorsata* may be adapted to a large variety of seasonal flowers differing structurally and to the attractants offered by them. Previous experience shows that in the plains of the Punjab and Haryana, *Apis dorsata* is associated with flowers of rape-seed and mustard (Family Cruciferae) during winter (Kapil *et al.* 1969) and with crops belonging to

the families Solanaceae, Cucurbitaceae and Leguminosae from summer through autumn (data unpublished). This wide spectrum of adaptation will make behavioural differences by this bee on different flowers and it would be of interest to determine the differential behaviour in relation to the plants with which it is associated. The present study, however, aims to explore the behaviour of *Apis dorsata* on the flowers of raya, *Brassica juncea* Hook. & Thomas.

METHOD

A normal crop of (*Brassica juncea*) raya var. R.L.-18 was selected on the University Farm for observations. The bees visiting the crop on marked areas of 3 square metre were observed and the time each bee took to visit a certain number of flowers was recorded with a chronometer having an accuracy of ± 10 seconds. Temperature and humidity during the hours of observations, ranged between 1.1 to 22.2°C and 42-100%, respectively. The observations were taken at intervals of 10 days.

RESULTS AND DISCUSSION

The four petals of the flowers of *Brassica* are not joined with each other and have nectaries at their bases. The anther sutures face the stigma at the time of dehiscence (Singh 1958). The bee on alighting on the petal should presumably behave in a manner that she could collect her requirements of pollen and nectar and at the same time pollinate the flowers. The posture or attitude she adopts on the flowers would be the parameter, constituting her foraging activity.

Type of visits : *Apis dorsata* foragers have been observed assuming different types of postures on *B. juncea* flowers. These postures for the purpose of pollination have been categorised as follows :—

- (a) the bee alights on the petal and inserts her proboscis for nectar once only;
- (b) a bee alights as in (a) and while holding the genital parts of the flowers, makes a second probe on the opposite end,
- (c) a bee steals nectar between the petals without entering the flower.

Of all the behavioural postures, (a) and (b) attitudes appear purposive and evidently useful for the pollination of the flowers. Attitude (b) is superior to (a). Hence a bee performing more of (b) type behaviour will obviously be superior as a pollinator. Table 1 contains the data on the types of behaviour and it is observed that generally a bee performed maximum (b) type visits, only on January 22, 1968 (a) type visits far exceeded the (b). Behavioural indices (a/b) between visits type (a) and

TABLE 1
FREQUENCY OF DIFFERENT TYPES OF VISITS BY *Apis dorsata* ON *Brassica juncea* FLOWERS

Observation hours	Bees observed	Date and type of visits														
		22-1-1968			1-2-1968			12-2-1968			23-2-1968			1-3-1968		
		a	b	c	a	b	c	a	b	c	a	b	c	a	b	c
10.30-11.00	10	125	18	5	20	204	—	32	143	1	4	31	1	11	90	—
11.30-12.00	17	45	31	19	7	143	—	30	124	10	32	257	3	10	135	—
12.30-13.00	25	119	47	6	13	160	—	8	90	1	20	178	—	13	148	—
13.30-14.00	21	80	49	3	11	116	—	16	138	1	4	501	—	5	88	—
14.30-15.00	21	119	47	6	13	160	—	16	138	1	4	100	2	20	140	—
15.30-16.00	25	80	49	3	11	116	—	10	126	—	20	20	1	19	127	—
16.30-17.00	6	80	49	3	11	116	—	10	126	—	20	20	1	14	139	—
Total	125	369	145	33	51	623	—	96	621	13	127	1087	7	92	867	—

(b) varied from 4 to 25 during different hours of the day with larger aggregation between 7-13. The attitudes (a) and (b) are meant to collect nectar by the foragers but the pollen gets accidentally attached to their bodies, for which chances are seemingly more when a bee adopts (b) type attitude. The high frequency of nectar collecting attitudes (Table 1) is indicative of the fact that *B. juncea* flowers are relatively high nectar yielding types. The observation conforms with the data on greater abundance of nectar collectors on *juncea* flowers (Table 2, Col. 4). The flowers need only 14% crossing (Howard & Khan 1915, Singh 1958) and the rest of their pollination occurs through selfing. The data suggests that the high nectar producing property of the flowers, serving as a factor of attractiveness, is probably in some way correlated with their self-compatibility.

Visitation of flowers : Tables 2 and 3 show that *Apis dorsata* foragers started field activity at about 09.30 hr on February 18, 1966, around 10.00 hr on February 23 and March 1, 1968 and at 12.30 hr on January 22 and February 1, 1968. Notwithstanding these variations in the timings, it is observed that the prevailing temperature in all the cases is never less than 15°C at the hour the activity started. Before the hours of activity, the temperature was less than 15°C and the bees did not visit the crop. The higher temperatures, however, do not seem to affect their activity to any great extent. The bees were found coming in fairly good numbers and actively visiting a number of flowers even at 17.00 hr when the temperatures ranged between 21° and 23°C in early March where as they stopped their activity as early as at 16.00 hr when the temperatures were much lower in January and February. It is clear, therefore, that it is not the temperature alone that regulates their activity but there

TABLE 2
NUMBER OF *Brassica juncea* FLOWERS VISITED PER MINUTE BY *Apis dorsata*
ON 18.2.1966 (HOURLY OBSERVATIONS)

Observation hour	Temp. °C	Bees observed	Nectar collector	Pollen collector	Flowers visited/minute
9.35-10.00	15.0	10	9	1	9.23
10.30-10.45	17.0	10	6	4	11.87
11.00-11.15	18.0	8	6	2	11.51
11.45-12.00	20.5	10	8	2	12.39
12.30-12.45	21.0	10	7	3	12.10
14.00-14.15	19.5	10	10	—	10.19
14.45-15.00	19.0	10	9	1	15.04
15.30-15.45	19.0	10	9	1	16.00
Average					12.29

TABLE 3
NUMBER OF *Brassica juncea* FLOWERS VISITED PER MINUTE BY *Apis dorsata* DURING 1968 (HOURLY OBSERVATIONS)

Observation hour	Observation Dates														
	22.1.1968			1.2.1968			12.2.1968			23.2.1968			1.3.1968		
	No. of bees	Flowers visited/minute	Temp. °C	No. of bees	Flowers visited/minute	Temp. °C	No. of bees	Flowers visited/minute	Temp. °C	No. of bees	Flowers visited/minute	Temp. °C	No. of bees	Flowers visited/minute	Temp. °C
10.30-11.00	—	—	10.0	—	—	—	—	—	13	—	—	—	—	—	—
11.30-12.00	—	—	12.0	—	—	—	—	—	15.5	—	—	—	—	—	—
12.30-13.00	4	8.39	15.5	6	11.41	15.0	6	9.50	17.5	6	11.19	19	5	13.45	21.0
13.30-14.00	4	4.73	15.0	4	9.58	15.5	4	10.76	19.0	5	13.16	20	5	12.69	23.0
14.30-15.00	6	6.38	16.0	3	9.64	15.5	3	11.95	19.0	3	11.65	21	4	14.76	23.5
15.30-16.00	3	5.61	15.0	3	7.45	15.0	6	10.04	18.5	7	16.43	21	6	15.45	23.3
16.30-17.00	—	—	15.0	—	—	—	—	8.15	17.5	—	14.17	17	6	14.43	23.5
17.30-18.00	—	—	—	—	—	—	—	—	—	—	—	—	—	10.97	21.0
Average	—	6.28	—	—	9.52	—	—	10.08	—	—	12.39	—	—	13.24	—

Temp. at 11.45 h = 13°C	Temp. at 9.30 h = 14.2°C
12.00 h = 13°C	Pollen
Pollen Collector(s) = 1	Collector(s) = 0
	Collector(s) = 4
	Pollen Collectors = 13
	Pollen Collectors = 0

are other factors which actively participate individually and in combination with the temperature. A similar observation was recorded on the field activity of the foragers of *Apis florea* Fab. (Brar 1968).

Tables 2 and 3 indicate that *Apis dorsata* foragers visited an average of 12.30 and 10.79 *juncea* flowers/minute (range 9.23-16.00 and 4.73 to 16.43) and visits were comparatively larger in number at the start of days' activity on January 22 and February 1, 1968 and their visits thereafter decreased toward the end of diurnal activity with some marginal fluctuations occurring during the hours of observation. Observations taken on February 8, 1966 and February 23, and March 1, 1968 show that the number of flowers visited per minute were less in the morning between 09.30-11.00 hr and the number visited increased with the advance of the day and their maximum visits occurred between 14.30 and 15.45 hr. It seems that during the early blooming period (January 22-February 1, 1968) of the crop, the temperature during forenoon was less than 15°C, that affected both nectar secretion and bee activity. During the latter part of blooming period, the temperature rose during early hours and, therefore, the bees started working in the field by about 10.00 hr when the air temperature was around 15°C.

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