

Resource Partitioning among *Apis mellifera* and *Apis cerana* under Mid-hill Conditions of Himachal Pradesh

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Activity of the honeybee is largely governed by available bee forage and competition among bee species and other nectarivores. With the successful establishment of the exotic bee, *Apis mellifera*, competition for available food resources has arisen with the native bee, *A. cerana*. Little work appears to have been done to identify and evaluate important bee plants in relation to hive bees, although a lot of information on the bee plants of Punjab, Himachal Pradesh and Western Ghats is available (Atwal *et al.* 1970; Divan and Rao, 1971; Sharma and Raj, 1985). The present study was undertaken to find out whether bees of the two species are utilising the same floral sources or diversified ones.

Material and Methods

Studies were undertaken in the Solan area of Himachal Pradesh where beekeeping is practised with both *A. cerana* and *A. mellifera*. Observations on resource partitioning of flora by the bees were recorded by counting the number of bees per m² bloom (branch) area per five minutes at different day hours. Since bees visited a large number of flora during a year, the data have been tabulated

for only those flora on which bee activity (of either species) was more than 2 bees/m²/5 min. However, data for flora exclusively visited by either of the bee species are given irrespective of the number of bees.

Results and Discussion

Results are presented in Tables 1, 2 and 3.

Data presented in Table 1 reveal that *A. mellifera* and *A. cerana* shared 23 important bee flora. However, the activity of the two bee species on these flora varied to a great extent. During spring, *A. mellifera* preferred *Rubus ellipticus* (7.85 bees) and *Prunus armeniaca* (7.6 bees), whereas *A. cerana* was more active on *Malus domestica* (9.91 bees). In addition to these, *A. cerana* visited five plant species not visited by *A. mellifera* (Table 3) and similarly *A. mellifera* visited four plant species not visited by *A. cerana* (Table 2). During early summer (April–May), of the six plant species shared by the hive bees, activity of *A. mellifera* was maximum on *Eucalyptus* sp. (12.07 bees) and *Toona ciliata* (8.77 bees). *Apis cerana* foraged on these plants in good numbers but also utilised *Trigonella* to a great extent (6.17 bees).

Table 1. Comparative activity of hive bees (number of bees/m²/5 min average of three day hours) on preferred bee flora during a year

Sr. No.	Plant	<i>Apis mellifera</i>	<i>Apis cerana</i>	Period (month)
1	<i>Prunus amygdalus</i>	2.36	2.88	2-3
2	<i>Rubus ellipticus</i>	7.85	5.26	2-3
3	<i>Malus domestica</i>	2.82	9.91	2-3
4	<i>Pyrus communis</i>	3.49	2.23	2-3
5	<i>Prunus persica</i>	5.07	3.42	2-3
6	<i>Prunus armeniaca</i>	7.60	5.52	2-3
7	<i>Callistemon lanceolatus</i>	5.67	5.62	4-5
8	<i>Eucalyptus hybrida</i>	12.07	3.96	4-5
9	<i>Robinia pseudoacacia</i>	5.48	0.82	4-5
10	<i>Trigonella foenum-graecum</i>	3.11	6.17	4-5
11	<i>Brassica oleracea</i> var. <i>botrytis</i>	1.12	4.61	4-5
12	<i>Toona ciliata</i>	8.77	6.73	4-5
13	<i>Opuntia dellenii</i>	7.50	1.07	5-6
14	<i>Rhus wallichii</i>	5.21	2.94	5-6
15	<i>Acacia catechu</i>	2.65	2.39	7-8
16	<i>Chenopodium album</i>	3.40	6.37	7-8
17	<i>Mallotus philippinensis</i>	2.90	3.68	7-8
18	<i>Rhamnus trilquetra</i>	4.74	2.35	7-8
19	<i>Cannabis sativa</i>	2.40	1.03	9-10
20	<i>Spermadictyon suayeoaleus</i>	1.44	8.04	10-11
21	<i>Tagetes minuta</i>	0.72	4.78	10-11
22	<i>Dipsacus inermis</i>	4.53	1.33	10-11
23	<i>Ocimum sanctum</i>	1.87	8.42	10-11

Apis mellifera, in addition, exploited six other plant species of which *Cnicus* and *Lonicera* were the most important. Later in the summer (May-June) competition was restricted to only two main flora, *Opuntia* and *Rhus wallichii*, on which *A. mellifera* predominated (respective values being 7.5 and 5.21 bees). However, *A. cerana* broadened its foraging during this period by foraging on four additional plants of which *Woodfordia fruticosa* was the most preferred (5.18 bees).

During monsoon (July-August), out of four flora shared by the hive bees, *A. cerana* was more active on *Chenopodium album* (6.37 bees), whereas *A. mellifera* foraged more on *Rhamnus trilquetra* (4.74 bees). However, *A. mellifera* also foraged on six additional plant species, *Malvastrum* being the most important (3.73 bees).

During autumn (September-November), of the five shared flora, activity of *A. cerana* was

Table 2. Activity of *Apis mellifera* on flora not visited by *Apis cerana* during different period of the year (number of bees/m²/5 min)

Sr. No.	Plant	No. of bees	Period
1	<i>Pyrus pashia</i>	6.58	2-3
2	<i>Viola tricolor</i>	1.99	2-3
3	<i>Hypericum oblongifolium</i>	7.81	2-3
4	<i>Elaeagnus umbellata</i>	2.70	2-3
5	<i>Lonicera angustifolia</i>	6.81	4-5
6	<i>Calendula officinalis</i>	5.84	4-5
7	<i>Trifolium repens</i>	5.59	4-5
8	<i>Centaurea cyanus</i>	2.51	4-5
9	<i>Lotus corniculata</i>	1.81	4-5
10	<i>Cnicus argyranthus</i>	6.58	4-5
11	<i>Oenothera rosea</i>	1.69	7-8
12	<i>Datura stramonium</i>	0.88	7-8
13	<i>Oxalis corniculata</i>	2.21	7-8
14	<i>Echinops niveus</i>	1.29	7-8
15	<i>Malvastrum tricuspidatum</i>	3.73	7-8
16	<i>Myriactis nepalensis</i>	0.81	7-8

Table 3. Activity of *Apis cerana* on flora not visited by *Apis mellifera* during different period of the year (number of bees/m²/5 min)

Sr. No.	Plant	No. of bees	Period
1	<i>Mesembryanthemum criniiflorum</i>	-	2-3
2	<i>Salix tetrasperma</i>	1.70	2-3
3	<i>Wistaria sinensis</i>	0.73	2-3
4	<i>Medicago denticulata</i>	0.99	2-3
5	<i>Berberis lycium</i>	0.70	2-3
6	<i>Woodfordia fruticosa</i>	5.18	5-6
7	<i>Millettia auriculata</i>	0.77	5-6
8	<i>Sapium sebiferum</i>	7.55	5-6
9	<i>Albizia chinensis</i>	2.81	5-6
10	<i>Cynoglossum furcatum</i>	2.27	7-8
11	<i>Koelreutaria paniculata</i>	1.27	7-8
12	<i>Plectranthus rugosus</i>	8.59	10-11
13	<i>Salvia lanata</i>	7.03	10-11
14	<i>Solidago canadensis</i>	14.22	10-11

greater on *Spermadictyon* (8.04 bees) and *Ocimum* (8.42 bees), whereas *A. mellifera* foraged on these flora in low numbers and had its maximum activity was on *Dipsacus* (4.53 bees). Interestingly, *A. cerana* also exploited three additional flora during this period (Table 3), activity ranging between 7.03 to 14.22 bees. This suggests that in autumn during colder climatic conditions, *A. cerana* exploited more flora than *A. mellifera*.

These observations indicate that the two hive bees share bee flora as well as show resource partitioning to some extent when in the same ecological niche. Even on shared flora, each bee species avoided competition as is evident from varying density of the two species on the flora flowering at the same time. In this manner both hive bees are reducing competition to some extent by exploring diversified flora and making it possible to co-exist. Thus the fear that one bee species could be exterminated by the other due to competition for bee flora can be set aside. Further, it must be made clear that data shown in Tables 1-3 were collected at a time when the

two bee species faced competition. In the absence of competition either of the bee species may visit flora that in this study were shown not to be visited by them.

References

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