Effect of handling frequencies on colony development in Indian honey bees (*Apis cerana* F) in Kullu district of Himachal Pradesh

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ABSTRACT

Apis cerana F is a part of natural heritage of mountain communities. It is an excellent pollinator of mountain crops and helps in maintenance of biodiversity. This native beehive species has not been popular amongst the beekeepers because of its several behavioural characteristics like frequent swarming, absconding etc. It needs specific management strategies for *A cerana* so as to sustain the traditional beekeeping systems of the mountain people. This experiment was therefore conducted to work out optimum inspections required for *A cerana* management and also to know the effect of normal observations taken by the beekeepers during a year. The present investigations were carried out in the apiaries of Regional Horticulture Research Sub-Station, Katrain, Kullu, Himachal Pradesh. Significant differences were found between frequently-handled and less frequently-handled colonies.

Keywords: *Apis cerana*; handling frequencies; colony; beekeepers

INTRODUCTION

Apis cerana F is a part of natural heritage of mountain communities. Traditionally farmers keep this bee species in logs, walls, pitchers and box hives (Pratap and Verma 1997, Sharma et al 2000). *A cerana* with the development of subspecies suited to specific climatic zones has well adaptation to diverse and often extreme climatic, biological and agricultural conditions that exist at higher altitudes. It is an excellent pollinator of mountain crops which bloom during early spring season such as almond, apple, pear, plum and different vegetable seed crops and helps in maintenance of biodiversity. Unfortunately the long established craft of beekeeping with *A cerana* is being neglected in our country with its gradual replacement with *A mellifera* (Anon 1994, Verma 1993).

The native beehive species *A cerana* has not been popular amongst the beekeepers because of its several behavioural characteristics like frequent swarming, absconding, tendency to rob, production of a large number of laying workers and low honey yield. One of the major constraints in beekeeping with this bee is its absconding behaviour. Frequent absconding may be beneficial for the survival of the species but it poses a serious threat to beekeeping. Absconding may either be due to disturbances created by predators and pests, frequent manipulations by beekeepers, smoke, fire, inferior nesting site etc or seasonal due to dearth of resources or environment fluctuations.

There are limited reports on the aspects of handling frequencies along with other management aspects. Frequent handling which causes disturbance to the colonies can lead to absconding as well as less food stores. Therefore it needs specific management strategies for this species so as to sustain the traditional beekeeping systems of the mountain people. It is further needed due to many valuable characters of biological and economic importance. Present study was therefore conducted to work out optimum inspections required for *A cerana* management and also to know effect of normal observations taken by the beekeepers during a year. By combining different strategies it may be possible to restart economical beekeeping with *A cerana* on small scale at farmers'/orchardists' level who can not afford time and money for commercial

beekeeping with *A mellifera* by adopting migration. This will definitely boost even horticulture production of the state. No systematiic studies have been undertaken in the Himalayan state of Himachal Pradesh on these aspects hence the proposed research work was conducted with the objective of studying the effect of handling frequencies on colony development in *A cerana*.

Different workers have studied the absconding tendency and its possible causes in *A cerana* colonies. Colony contents and behaviour of *A cerana* colonies which absconded were also observed by Woyke (1976). Colonies left viable eggs in the combs along with the larvae. The number of sealed cells ranged from 4 to 331 in absconded colonies. Dulta et al (1988) also studied the absconding behaviour of *A cerana*. In absconding colonies the average honey store area showed a decline from 1099.00 cm^2 in June to 704.00 cm^2 in October whereas in normal colonies the stores were more in October (1846.00 cm^2). Pollen stores declined from 111.66 in June to 17.50 cm^2 in October in absconding colonies. In normal colonies this decline was less (770.66 cm^2 in June to 362.00 cm^2 in October). Similarly a decrease in area under eggs, larvae, sealed brood and total brood was observed in absconding colonies from July to October. It was concluded that absconding took place when the area under honey, pollen stores, eggs, larvae, sealed brood and total brood was less than 710.00, 20.00, 50.00, 1.00, 10.00 and 60.00 cm^2 respectively. Fletcher (1975) opined that this reduction may possibly be means to conserve energy so as to enable the colony to reach a new site. Significant differences in the reactions of different colonies to pollen and nectar flows have been found. The absconding tendency can be delayed or checked by giving honey, pollen and brood combs to the colonies preparing for absconding at proper times because these biological and economic characters are inter-related (Woyke 1976, Verma 1988). Olsson (1995) observed that the absconding behaviour in *A cerana* was only a tendency triggered by external factors other than that of simple dearth of forage that manifests itself in different intensities from strain to strain, colony to colony and location to location. Thus *A cerana* should not be treated with beekeeping practices relevant to *A mellifera* but it must be treated according to its own specific attributes. In south India the most obvious cause of absconding was starvation. Olsson (1995) found that disturbance by the beekeeper was another main cause of absconding. Any kind of manipulation of the colonies which involved taking-off the lid or the hive during periods when the bees had not gathered and processed food for at least 10 days caused absconding within 6-9 days of 80-90 per cent of the disturbed colonies. This was especially true with new swarms that had voluntarily entered an empty box. This also holds true with established colonies even if disturbance is due to provision of feeding in period of dearth. Attempts to feed the colonies during the lean season were more disturbing to the bees than if these were left to starve. The author suggested that 4-5 inspections per year were probably as a routine sufficient and necessary. Further disturbances were harmful and unnecessary. Other causes given for absconding were attack of predators like wasps, forest martens, improper location and general stress. Correlation between colony strength and the tendency to abscond if disturbed were found. Smaller colonies which could not cover all the combs in the brood box absconded if they were inspected or fed during dearth period. Bigger colonies to some extent accepted disturbance since they most often had good stores and brood of all stages in progress even if only in 2-3 combs.

MATERIAL and METHODS

The investigations were carried out in the apiaries of Regional Horticulture Research Sub-Station Katrain, Kullu, Himachal Pradesh situated at 32.1°N and 77.2°E longitude with altitude of 1473 m amsl.

Two groups each having 3 honeybee colonies were selected during November 2001. The experimental colonies were having bee strength of 5-6 frames and were equalized in terms of winter stores. In one group the colonies were manipulated/checked only five times during a year viz in the second week of February to record the initial reading at the start of build up period, at the time of swarming in April, on honey harvesting in July, during autumn in September and for autumn honey harvesting in October.

In the second group colonies were manipulated at an interval of 30 days throughout the year for different feedings and other hive operations like cleaning, recording of data etc. The data on the performance of these two groups of colonies were compared for the period of February-September 2002 in terms of different parameters like strength (bee population), brood area, food stores, extent of swarming or absconding and extractable amount of honey.

The data were statistically analyzed using randomized block design after undertaking the necessary transformations (Gomez and Gomez 1984). The other statistical tests viz t-test, standard errors, coefficient of variation and correlation were also used for analysis of the data.

RESULTS and DISCUSSION

This experiment was conducted to know the impact of frequent handling of colonies on their development and to work out minimum number of handling frequency during a year which is sufficient for effective management. The effect of different frequencies of handling was studied in relation to bee population, brood rearing, honey store and pollen store and colony development and the data are given in Table 1.

Frequency of handling and its effect on bee population

The average bee population irrespective of period of observation was 9878 in the colonies manipulated/managed five times a year as compared to 9653 found in those manipulated/managed sixteen times a year. However these differences were non-significant. In general the population of colonies in both types of handling followed a similar trend during different months. This revealed that irrespective of frequency of handling of colonies there were no significant differences in the bee population in colonies of *A cerana.*

Frequency of handling and its effect on brood rearing

The average brood area irrespective of period of observation was found to be 1183 and 755.3 cm^2 in the colonies handled five and sixteen times respectively. The differences in these values were however non-significant. Brood area irrespective of handling frequency was less during February (258.8 cm^2) which increased significantly to 1919 cm^2 by April and declined to 900 and 797.5 cm^2 by July and September respectively differences being non-significant. Though the trend in brood rearing in both types was identical yet the values of brood for colonies handled less were slightly on higher side.

Frequency of handling and its effect on honey store

The amount of honey stored in the colonies irrespective of months of observation was 1216 g in colonies handled five times as compared to 1079 g in those handled sixteen times. However these differences were non-significant. Similarly irrespective of frequency of handling honey stores varied non-significantly between 604.5 in February to 2400 g in July. The trend of honey stores during different months in the colonies manipulated five times indicated that colonies had more honey stores in July (3007 g/colony) than those handled sixteen times (1794 g/colony) though overall differences in these two different types of handling were non-significant.

Frequency of handling and its effect on pollen store

The amount of pollen stores in the colonies irrespective of frequency of handling averaged to 464.7 cm^2 per colony when handled five times as compared to 148.9 cm^2 when handled sixteen times the difference being non-significant. Similarly during different months irrespective of frequency of handling the pollen contents varied non-significantly between 104.75 to 443.8 cm^2 per colony. The trend of pollen stores in the colonies handled 5 and 16 times showed that the amount of pollen in colonies handled five times had more pollen during different months though the differences were non-significant.

The results revealed that there were no significant differences in the quantitative parameters like average population of bees, brood area, honey and pollen stores in colonies handled more frequently or less frequently handled ones. However some qualitative variations were found in the two types of colonies. The absconding tendency was more in disturbed colonies and needed more vigilance to catch the absconding colonies as compared to those handled less frequently. On an average four kg of additional feed was given to the colony attempting to abscond in case of frequent handling. Such treatments were not required in less frequently-handled colonies. However in undisturbed colonies swarming tendency was more as compared to disturbed colonies. These colonies made 2-3 swarming attempts as compared to only one in frequently handled colonies. Non-significant differences observed in these two types of colonies can be explained due to the fact that in less frequently handled colonies these parameters were almost same as in case of more frequently-handled colonies in spite of swarming in the former. Interestingly the incidence of disease was also less in the less frequently-handled than the more frequently-handled colonies. From the study it can thus be concluded that for effective

Table 1. Frequency of handling of *A cerana* colonies and its effect on bees at Katrain (Kullu), Himachal Pradesh

Frequency of handling/year	Colony population (number of bees)				
	February	April	July	September	Mean
Colony population (number of bees)					
5	8980 (3.95)	14370 (4.15)	8082 (3.83)	8082 (3.71)	9878 (3.91)
16	8980 (3.95)	13470 (4.13)	8980 (3.95)	7184 (3.84)	9653 (3.97)
Mean	8980 (3.95)	13920 (4.14)	8531 (3.89)	7633 (3.77)	
Brood area (cm^2)/colony					
5	289.5 (2.44)	2220.00 (3.33)	1150.00 (2.89)	1070 (2.67)	1183 (2.84)
16	228.1 (2.36)	1618 (3.12)	650 (2.71)	525 (2.70)	755.3 (2.72)
Mean	258.8 (2.40)	1919 (3.23)	900 (2.80)	797.5 (2.69)	
Honey stores (g/colony)					
5	495.3 (2.70)	741 (2.85)	3007 (3.18)	620.1 (2.59)	1216 (2.83)
16	713.7 (2.85)	916.5 (2.95)	1794 (3.14)	893.1 (2.94)	1079 (2.97)
Mean	604.5 (2.77)	828.7 (2.90)	2400 (3.16)	756.6 (2.77)	
Pollen stores (cm^2)/colony					
5	136.3 (2.12)	618.7 (2.70)	215.6 (2.25)	238.3 (1.45)	464.7 (2.13)
16	72.81 (1.86)	268.8 (2.34)	104.7 (2.01)	149.4 (2.08)	148.9 (2.07)
Mean	104.75 (1.99)	443.8 (2.52)	160.2 (2.13)	193.9 (1.77)	

Figures in parentheses indicate log transformed values

$CD_{0.05}$

	Colony population	Brood area	Honey stores	Pollen stores
Handling	NS	NS	NS	NS
Months	NS	0.69	NS	NS
Handling x months	NS	NS	NS	NS

manipulation five handlings during February (second week), April (second week), July (second week), September (second week) and October (last week) are sufficient but care needs to be taken to meet the colony requirements (feeding, provision of combs, honey extraction etc) during these observation periods.

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