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Research Article

EFFECT OF WINTER STORES ON COLONY DEVELOPMENT IN *Apis cerana* F. AT KATRAIN AREA OF KULLU VALLEY IN INDIAN HIMALAYAN REGION

SHARMA NIRUPMA*, GUPTA J.K. AND SHARMA HARISH
Department of Entomology and Apiculture, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, 173230, Himachal Pradesh, India
*Corresponding Author: Email - nirupamasharma999@gmail.com

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Abstract: Successful over wintering of bee colonies depends on large number of factors including the amount of winter stores. These stores are equally important for the colony built up during spring season. In the upper Himalayan region, bees experience severe winter from November to March, and as much as 30 per cent of colonies are lost annually due to poor wintering. It is, therefore, important to know as to how much winter store should be available to colonies at the fall so that they over winter as well as build up in the spring to an appropriate strength. Observations were recorded on the effect of different amounts of winter stores kept in the colonies (1 to 3 kg per colony) on bee population, brood area and food stores, on three groups of colonies during the months of February to April at Katrain situated at 32.1ºN and 77.2ºE longitude with altitude of 1473. The results confirmed that *A cerana* colonies should have at least 3 kg of honey store per colony at the fall under Katrain conditions of Himachal Pradesh.

Keywords: Over wintering, colony built up, honey store, colony strength

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Introduction

Apis cerana is a part of natural heritage of mountain communities. Traditionally farmers keep this bee species in log, wall, pitcher and box hives1 [1-2]. *Apis 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 attitudes. 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. In this Himalayan region bee colonies require special care particularly in the winter months. During winter months, bee activities are reduced to a minimum due to the low outside environmental temperatures particularly during January and February. Consequently there are problems of inadequate food reserves, queenlessness, reduced fecundity and diseases. As a result of this *Apis cerana* colonies often abscond or desert the hives [3] Successful over wintering of bee colonies depends on large number of factors including the amount of winter stores. These stores are equally important for the colony built up during spring season. In the upper Himalayan region, bees experience severe winter from November to March, and as much as 30 per cent of colonies are lost annually due to poor wintering. However, colonies with adequate food stores can overwinter successfully. Sufficient stores should be ensured, may be by feeding concentrated sugar syrup before winter packing in hilly areas. This facilitates bees in making a compact cluster that has food stores closeby Suryanarayana and Rao, (1998) [4]. It is, therefore, important to know as to how much winter should be available to colonies at the fall so that they over winter as well as build up in the spring to an appropriate strength. It may thus be possible to start economical bee keeping with *Apis cerana* on small scale at farmers'/ orchardists' level who cannot afford time and money for commercial bee keeping with *Apis mellifera* by adopting migration during winter months. This will definitely boost even horticulture production in the Himalayan states. Different workers have also analyzed these aspects. Singh (1943) [5] had suggested that the sugar feedings should be provided in large quantities, 2-3 times in dearth season, rather than in small quantities each day. It also helped avoiding robbing behaviour. Effect of different types of artificial feedings was observed by Bisht and Pant (1968) [6]. They found that the colonies fed on 50 per cent sugar syrup during dearth period *i.e.* October – January under Delhi conditions continued brood rearing whereas colonies fed on 50 per cent cane jaggery stopped brood rearing and absconded in November. The unfed colonies also behaved similarly and absconded. The colonies given sugar feeding 14 times per month were having larger brood areas in December and January as compared to those given 7-8 sugar feedings per month. Swarming took place one month earlier in the colonies given more number of feedings than the other colony, which was given less number of feedings.

Materials and Methods

The present investigations were carried out in the apiary of Beekeeping and Horticulture Research Sub-Station of Dr. Y.S. Parmar University of Horticulture and Forestry at Katrain, Kullu situated at 32.1ºN and 77.2ºE longitude with altitude of 1473 m amsl. Nine colonies, each on 5-6 frames were selected and were divided into three groups. These colonies were equalized in terms of brood and food stores. To group A, three kilograms of sugar syrup (50% sugar syrup) was artificially fed. Similarly to group B, two kilograms and to group C, one-kilogram sugar syrup was fed. Effect of these feedings was studied on the colony build-up and food stores during February – April, 2011.The data were statistically analyzed using Randomized Block Design, after undertaking the necessary transformations [7]. The other statistical tests *viz*., t-test, standard errors, coefficient of variation and correlation were also used for analysis of the data.

Results and Discussions

Observations were recorded on the effect of different amounts of winter stores kept in the colonies (1 to 3 kg per colony) on bee population, brood area and food stores, on three groups of colonies during February to April months at Katrain (Distt. Kullu). The findings are presented in tables 1 to 4.

Effect of winter stores on colony population

The results (Table1) showed that irrespective of the months of observations, the colonies having 3 kg of winter stores have a bee population of 11080, which was statistically at par with the population in colonies having 2 kg of winter stores (8681 bees per colony). However, differences were significant when compared to colonies having 1 kg of winter stores. The differences, irrespective of amount of winter stores during different months were non significant, varying between 7209 to 9279 bees per colony.

Table-1 Effect of winter stores on the colony population of *A. cerana* at Katrain (District Kullu) during February –April months

Amount of winter store per colony	Colony Population (number of bees)			Mean
	February	March	April	
3 kg	8980 (3.95)	10489 (4.02)	13770 (4.14)	11080 (4.04)
2 kg	7184 (3.85)	8681 (3.92)	10180 (3.99)	8681 (3.92)
1 kg	5464 (3.66)	4789 (2.57)	3891 (2.50)	4715 (2.91)
Mean	7209 (3.82)	7982 (3.50)	9279 (3.54)	

EffectsCD$_{0.05}$, Food Stores 0.93, Months NS, Food store x month NS,
Figures in parentheses indicate log transformed values

Effect of winter stores on brood rearing

The effect of different amount of winter stores on the brood area of *A. cerana* is shown in table 2. Maximum brood rearing amounting to 1194 cm^2 brood area per colony was found in colonies having 3 kg of winter stores followed by 754.6 and 309.7 cm2 in colonies having 2 kg and 1 kg winter stores, respectively, irrespective of the months of observations. The brood was significantly more in colonies having 3 kg of winter stores (1194 cm^2) as compared to those having 1 kg (309.7 cm^2). However, differences were non significant between colonies having winter stores of 3 kg and 2 kg as well as those having 2 kg and 1 kg, respectively. The brood area, irrespective of amount of winter store was only 181.7 cm^2 in February, which increased significantly to 810.2 cm^2 in March. The differences were non significant during March and April. Differences were non significant during February but more brood was found during March and April in colonies having higher winter food stores.

Table- 2 Effect of winter stores on the brood area of *A. cerana* at Katrain (District Kullu) during February-April months

Amount of winter store per colony	Brood area (cm^2 / colony)			Mean
	February	March	April	
3 kg	221.9	1370	1991	1194
2 kg	194.1	658.7	1411	754.6
1 kg	129.2	402.1	397.9	309.7
Mean	181.7	810.2	1267	

EffectsCD0.05, Food Stores 498.25, Months 498.25, Food store x month, 863.05

Effect of winter stores on honey collection

The maximum amount of honey store, irrespective of the dates of observations was 816.4 g in colonies having 3 kg of winter stores (Table 3), which was significantly higher than those colonies having 2 and 1 kg of winter stores. The average honey stores were 401.2 and 341.9 g per colony, respectively (difference non-significant) in colonies having 2 and 1 kg of winter stores. Irrespective of amount of winter stores, more honey was present during April (610.1 g) as compared to February (437.2 g).

Table-3 Effect of winter stores on the honey collection of *A. cerana* at Katrain (District Kullu) during February-April months

Amount of winter store per colony	Honey stores (g / colony)			Mean
	February	March	April	
3 kg	637	881.3	930.8	816.4
2 kg	384.8	355.9	462.8	401.2
1 kg	289.8	299.0	436.8	341.9
Mean	437.2	512.1	610.1	

EffectsCD$_{0.05}$, Food Stores 146.28, Months 146.28, Food store x month 253.34

Effect of winter stores on the pollen collection

The results (Table 4) showed that irrespective of months of observations the colonies having 3 kg of winter stores have pollen area of 320.6 cm^2, which was statistically at par with the pollen area (155.1 cm^2) in colonies having 2 kg of winter stores. However, the differences were significant when compared to colonies having 1 kg of winter stores. The differences, irrespective of amount of winter stores during different months were non-significant, varying between 115.3 to 292.4 cm^2 per colony.

Table-4 Effect of winter stores on the pollen collection of *A. cerana* at Katrain (District Kullu) during February-April months

Amount of winter store per colony	Pollen stores (cm^2 / colony)			Mean
	February	March	April	
3 kg	290.4	165.0	506.2	320.6
2 kg	69.83	107.9	287.5	155.1
1 kg	61.14	72.92	83.33	72.46
Mean	140.5	115.3	292.4	

EffectsCD$_{0.05}$, Food Stores 203.51, Months NS, Food store x month 352.56

Conclusion

It can thus be concluded from the study that winter stores of 3 kg per colony increased bee population, brood rearing as well as honey and pollen stores significantly by the month of April as compared to colonies, which had only 1 kg of stores. However, differences between bee population, brood and pollen stores were non significant between the colonies having 3 kg or 2 kg of stores. Interestingly, even then the honey stores were significantly more in the former than the latter. It is thus, concluded from the present studies that the A. cerana colonies should have at least 3 kg of honey store per colony at the fall under Katrain condition of Himachal Pradesh.

Application of research: The findings of the study will help in commercial adoption of *Apis cerana* in mountainous regions as successful overwintering will be possible through application of the research findings

Research Category: Apiculture, Technology Generation

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***Research Guide or Chairperson of research: Dr Nirupma Sharma**
University: Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, 173230, Himachal Pradesh, India
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References

[1] Pratap U. and Verma L.R. (2000) *Asian bees and beekeeping: issues and initiatives In: Asian Bees and Beekeeping Progress of Research and Development. (eds., M. Matsuka et al.). Oxford and IBH Publishing Co., New Delhi, pp.* 3-14.

[2] Sharma H.K.; Verma L.R. and Gupta J.K. (2000) *Traditional beekeeping with Apis cerana in Kullu Valley of Himachal Pradesh. In: Asian Bees and Beekeeping Progress of Research and Development. (eds. M. Matsuka et al.). Oxford and IBH Publishing Co., New Delhi, pp.* 259-261.

[3] Verma L.R. (1990) *Beekeeping in Integrated Mountain Development. Oxford and IBH Publishing Co., New Delhi*, 367.
[4] Suryanarayana M.C. and Rao K.S. (1998) *Apis cerana F. for Indian apiculture and its management technology.In: Perspectives in Indian Apiculture (ed., R.C. Mishra) Agro Botanica, Bikaner,*66-118
[5] Singh S. (1943) *Indian Bee Journal,* 5, 41-44.
[6] Bisht D.S. and Pant N.C. (1968) *Indian Journal of Entomology,* 30, 223-228.
[7] Gomez K.A. and Gomez A.A. (1984) *Statistical procedures for Agricultural Research. 2nd ed., John Wiley and Sons, New York*, 680 p.