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Studies on Behavioural Traits of Two Different Strains of Indian Honey Bee *Apis cerana Indica* F.

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Abstract: Productive efficiency of the apicultural industry depends upon improvements in bee breed, bee management and bee forage. The behavioural traits such as pollen carrying capacity, pollen and honey stores and colony population were compared for black and yellow strains of Indian honey bee *Apis. cerana indica* F. Observations of honey bees showing maximum activity support the conjecture that pollen foragers carry relatively little fluid during the hottest periods and pollen foraging decreased at high ambient temperatures. The notable difference in the activity between the species may occur due to availability of pollen source, variation in genetic character, preference for pollen, foraging efficiency, foraging distance and competition for pollen. The mean pollen carrying capacity of foraging bees at different times of the day in the study period and mean pollen stores and honey stores of foraging bees at all seasons of the study period and also population count in a colony acts as a parameter for comparison of black and yellow strains. The final outcome of the study interprets that black strain has higher pollen carrying capacity, maximum area under pollen and honey stores and relatively high population when compared with the yellow strain.

Key words: Black and Yellow strains, Pollen carrying capacity, Pollen and honey stores, Bee population

INTRODUCTION

Honey bees are the prime pollinators; they are involved in pollination of most field and orchard crops. Social bees are especially versatile as they are able to exploit a broad range of different flower forms. Bees live on nectar; they collect pollen also to feed their larvae. The amount of surplus honey that could be gathered from bee colonies is mainly dependent upon the abundance of nectar secreting plants in the vicinity of an apiary [1]. Investigations on evalvation of behavioural traits of different strains of Indian honey bee *Apis cerana indica* F. are carried out. The genus *Apis* has an Indo-Malayan origin where both diploid (*A. florea, A. dorsata*) and earlier tetraploid (*A. indica)* species first appeared. During its northward migration by various land routes across the Himalayan barrier, *A. indica* seems to have gradually differentiated into *A. mellifera* and a number of its African, Eurasian and Sino-Japanese races. Many of these races have accumulated enough genic differentiation and sexual as well as behavioural isolation mechanisms so as to deserve recognition or creation of new species among the tetraploid [2]. The interpretations of the evolution of *Apis* species have been largely based on morphometrical analysis and paleogeography [3].

Amongst the numerous kind of bees found in India, the typical honeybees which are social in habits comprise four different forms, viz. *Apis dorsata.* F. (rock bee), *A. indica.* F. (Indian bee), *A. florae.* F. (little bee) and *Melipona iridipennis,* Dal. (dammar bee) [4]. Deodikar says that dialects of two different races of a species may be so very distinct that intermixing of workers of two races makes their intercommunication impossible resulting in disorganization or even extinction of a colony [5]. This illustrates how ethological or behavioural differences can function as effective isolation mechanisms in the process of taxonomic differentiation even at infraspecific levels. According to Traynor weather is a prime determinant of bee activity and until man is able to control the weather, beekeepers and growers will have to do their best to work around it [6]. Heinrich reported that honey bees regulated thoracic temperature above 25°C ambient and that evaporation of water from mouth is used at high ambient temperatures to prevent overheating [7, 8]. In the study of

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foraging patterns of bees on *Agave schottii* in the Sonoran desert, bees were observed to stop foraging at ambient temperatures of 35°C [9]. Ages of bees do not influence the foraging distance or the tendency to collect pollen [10]. Infestation by mites of *A. cerana* is at a lower level than in *A. mellifera* [11]. A thorough knowledge of morphometrics and behavioural traits are an essential prerequisite for a rational approach to the selection and breeding.

MATERIALS AND METHODS

The study was conducted on behavioural traits of Indian honeybee *A. cerana indica* of Shivamogga district, Karnataka. The area is Semi Malnad region and is situated 1972 feet above sea level, 13°43' latitude and 75°38' longitude having a wide regime of climatic variations. The temperature varying from 9°C to 39°C and average rainfall of 800 to 1030 mm mainly from South-West monsoon during June to September. The area posses sandy loamy soil, clay loamy soil, red soil and black soil. Climatic condition supports dry deciduous forest type of vegetation. Study was made on different strains of *A. cerana* viz. black and yellow bee colonies under Shivamogga floral conditions and compared for the results.

Experiment-1: Pollen load carrying capacity of black and yellow strains of *Apis. cerana indica* F.-Individual honey bee colonies were selected and were designated for studying. The hive entrance was closed for a short while at the time of observation. Ten foraging bees returning with pollen load were collected from each hive and pollen pellets were brushed off from the pollen basket and fresh weight of pollen pellets was taken. Such observations were recorded at 09.00h, 12.00h and 15.00h during the day at an interval of 15days and compared the peak hours of activity.

Experiment-2: Pollen and honey stores of black and yellow strains of *Apis. cerana indica* F.-Observations on pollen and honey stores were recorded at 15 days intervals in all the experimental colonies using the marked transparent sheet, which consisted of number of squares and each square with an area of $1cm^2$. This sheet was placed on brood and super frames and number of squares with honey and pollen were recorded. Cells filled with pollen or honey scattered in different parts in a comb were counted separately and converted into square centimeter area. The above parameters were recorded on both faces of all brood and super frames.

Experiment-3: Bee population of black and yellow strains of *Apis. cerana indica* F.-Bee population per colony was estimated at an interval of one month. Population of honey bees in terms of number of bees per colony was calculated. The hive entrance was closed at late night, next day morning weight of the whole colony (C), empty box (B) and frames along with comb without bees (F) were taken. The weight of frames (F) and empty box (B) were subtracted from weight of whole colony (C), which gives the net weight of bees (E) [E=C-B-F]. Three samples of 100 bees were anaesthetized using anesthetic ether and weighed, the average individual bee weight was calculated; net weight of the bee colony (E) was converted to number of bees to study the bee population of the colony.

The present studies regarding the bee behavioural traits have been conducted in this area during rainy, winter and summer seasons of 2000-2004 with the hope that the information will help the local bee keepers in assessing the seasonal availability of bee forage and in managing their colonies accordingly.

RESULTS

Results of the present investigations carried out to determine the seasonal variations in behaviour of both strains of Indian honeybee *Apis. cerana indica* F. viz., black strain and yellow strain bee colonies under Shivamogga floral conditions showed that the worker bees of both strains carried less quantum of pollen during rainy (BS-4.48, 4.58, 4.39, 4.60; YS-4.30, 4.37, 4.22, 4.42), lesser amount in summer (BS-4.82, 4.90, 4.77, 4.95; YS-4.70, 4.78, 4.66, 4.85) and maximum at winter season (BS-7.08, 7.12, 7.00, 7.24; YS-6.89, 6.96, 6.81, 7.00) of study period. The data are presented in the Tables 1 and 2, which also indicate that black strain brought heavier pollen pellets throughout the year compared to yellow strain. Both the strains stored higher amount of pollen and honey in winter season than summer and rainy season. Among the strains, black strain recorded more pollen and honey stores compared to yellow strain. The variations in area under pollen and honey stores are graphed out in Fig. 1 and 2. Bee population in both black and yellow strain colonies were more in winter decreased continuously from summer to rainy season. The variation in number of population with season is shown in graph 3. In the present study black strain colony was recorded more bee population throughout the season compared to yellow strain colony.

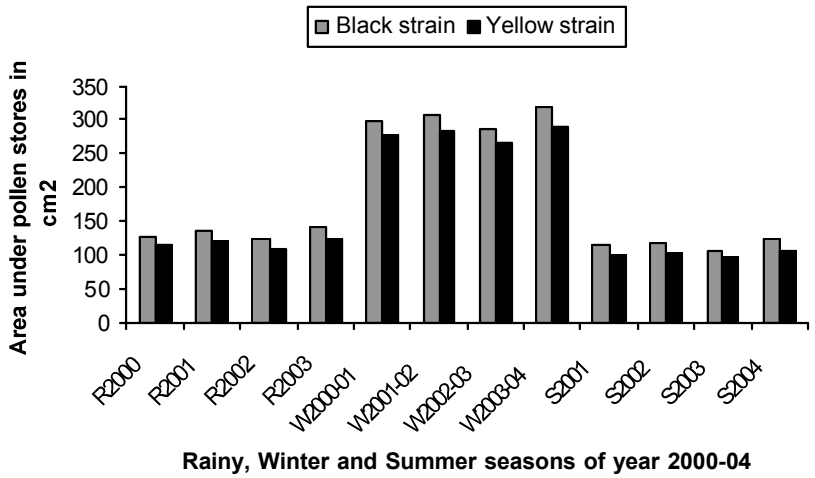

Fig. 1: Graph showing Variation in pollen stores of Black and Yellow strain of *Apis cerana indica* F.

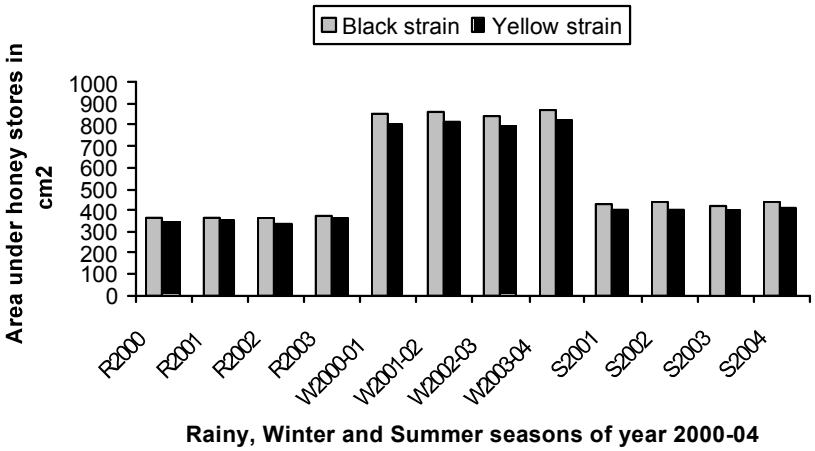

Fig. 2: Graph showing Variation in honey stores of Black and Yellow strain of *Apis cerana indica* F.

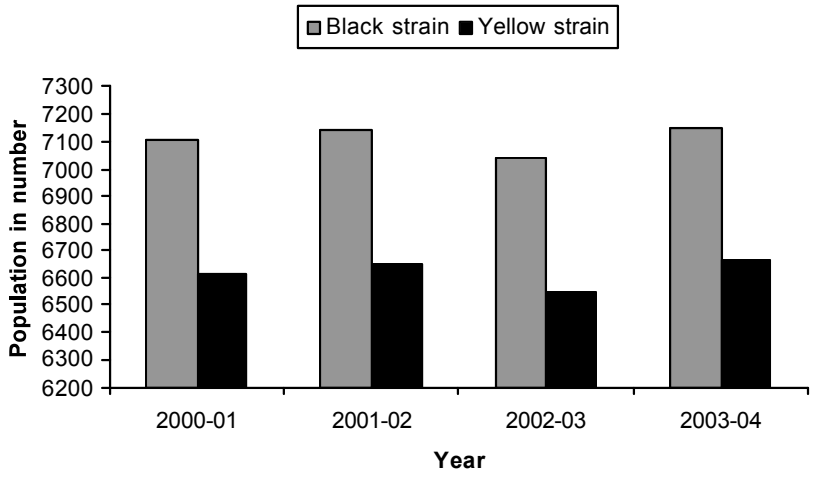

Fig. 3: Graph showing Variation in bee population of both Black and Yellow strain of *Apis cerana indica* F.

Table 1: Pollen carrying capacity and seasonal variations of Black strain of *Apis cerana indica* F

			Pollen carrying capacity in mg			
			Different times of day			
Black Strain	Season	Year	9.00 Hr	12.00 Hr	15.00 Hr	Values (mean) in mg
	Rainy(Jun-Sep)	2000	4.68	4.43	4.33	4.48
		2001	4.81	4.54	4.39	4.58
		2002	4.61	4.34	4.23	4.39
		2003	4.88	4.50	4.43	4.60
	Winter (Oct-Jan)	2000-01	7.26	7.06	6.92	7.08
		2001-02	7.28	7.10	6.99	7.12
		2002-03	7.21	6.96	6.85	7.00
		2003-04	7.46	7.23	7.03	7.24
	Summer (Feb-May)	2001	5.03	4.78	4.67	4.82
		2002	5.11	4.84	4.75	4.90
		2003	5.00	4.71	4.62	4.77
		2004	5.21	4.87	4.79	4.95

Table 2: Pollen carrying capacity and seasonal variations of Yellow strain of *Apis cerana indica* F

			Pollen carrying capacity in mg			
			Different times of day			
Yellow Strain	Season	Year	9.00 Hr	12.00 Hr	15.00 Hr	Values (mean) in mg
	Rainy (Jun-Sep)	2000	4.49	4.29	4.13	4.30
		2001	4.55	4.38	4.19	4.37
		2002	4.42	4.20	4.05	4.22
		2003	4.67	4.39	4.22	4.42
	Winter (Oct-Jan)	2000-01	7.03	6.87	6.77	6.89
		2001-02	7.09	6.94	6.85	6.96
		2002-03	6.96	6.79	6.68	6.81
		2003-04	7.19	6.98	6.84	7.00
	Summer (Feb-May)	2001	4.87	4.68	4.55	4.70
		2002	4.96	4.75	4.65	4.78
		2003	4.86	4.63	4.50	4.66
		2004	4.99	4.84	4.73	4.85

DISCUSSION

One of the pre requisites for the improvement of bee keeping industry with the native hive bee *Apis. cerana indica* F. is the identification of the different natural sub-species/ecotypes of this native bee species in the region and their further genetic improvement by selection and breeding. This study was successful not only in identification and selective breeding programme of honey bees but also in improving the management practices for better honey production as well as to increase pollination services for higher crop productivity. Geographical features, altitude of place, morphological characters and many other factors determine the distribution of honeybee races [12]. The behaviour of honey bees depends on racial characters of queen bee and availability of bee flora. The reason that worker bees of both strains carried less quantum of pollen during rainy season of study period may be attributed to the availability of pollen grains because; bee flora was very less during early period of rainy season. Sharma reported that less amount of pollen pellets are carried by

worker bees during rainy season [13]. Pollen carrying capacity of both black and yellow strains was maximum in winter season. Dhaliwal reported that more amount of pollen is collected by hill station of *Apis cerana* and stated that weight of pollen load depends upon the sources of pollen and weather conditions prevailing during the season [14]. Bees carried heavier pollen load at 09.00 h followed by 12.00 h and least at 15.00 h. The difference may be due to high humidity, low temperature and more moisture content on the pollen at morning hours. Further bee's efficiency may be decreased due to continuous foraging as the day advances.

Pollen and honey stores in black and yellow strain were recorded throughout the year. Verma *et al*., reported greater pollen and honey stores in summer and autumn, while minimum in rainy season which supported our result [15]. Higher amount of pollen and honey in winter season than summer and rainy are attributed to availability of bee flora in study area at different periods. Verma *et al*., recorded greater quantity of pollen and honey stores in autumn at Shimla, Himachal Pradesh. These variations were possibly due to increased foraging activity and availability of pollen and nectar.

The population number of bees was maximum in winter season. Similar results were reported by Ramachandran and Mahadevan at Coimbatore [16]. However, bee population in both black and yellow strain bees was highest during winter due to the availability of pollen and nectar yielding plants around apiary. Verma *et al*., reported maximum population of bees in summer and autumn and minimum in the rainy season at Shimla.

Among two strains, the black strain showed better performance in pollen carrying, honey store, pollen store and had comparatively higher population throughout the year compared to yellow strain. This may be due to variation in genetic character, preference for pollen, foraging efficiency, competition for pollen between the species, tongue length, pollen load carrying capacity, floral preference, floral availability, competition in foraging between the species, pollen and nectar gathering capacity and brood rearing activities. Hence, the black colonies are better for breeding work.

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