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Rearing and Management of *Apis cerana* (F.) and occurrence of pests in honeybee colonies

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Abstract: To study the life history combs of *A. cerana* were collected and studied in the laboratory. General external morphology including head, thorax, mouth parts, antennae, legs and abdomen of *A. cerana* was measured and different body parts were listed. Pollen gathering activity and brood rearing activity were studied throughout the year. The number of pollen gathering bees was the highest in the months of November to January. June to August proved to be the most unfavorable periods for pollen collection. The time of initiation and cessation of pollen gathering activity of *A. cerana* was recorded. The highest brood rearing activity was recorded during the months of December and January. May, June and July were the most unfavorable periods of the year. Artificial feeding of sugar syrup was necessary from May to August. Brood rearing activity in dearth period was increased with the increased amount of feeding. Greater wax moth infestation was controlled with proper management practices to maintain the colonies.

Key words: Bee keeping, brood rearing, dearth period

Introduction

The honey bee species, *A. cerana* (F.) has been partly domesticated and is being used in bee keeping. The species is mild and lives in the hole of tree-trunk and similar dark places. It can be reared and maintained in modified Newton type of wooden boxes to collect honey of commercial importance. The queen along with some workers and drones are captured from nature to rear in boxes. Beekeeping may be an excellent source of income with negligible capital investment. But successful beekeeping needs efficient management of the colonies. Bee colonies are often attacked by diseases and pests resulting in absconding and swarming are major problems in beekeeping programmes. Studies on the causes of occurrence of pests and diseases and their control are essential for successful beekeeping programmes.

Beekeeping acts as a source of farmer's extra income, especially for the small and medium farmers. It has been considered to be a viable and profitable venture to supplement farmers' income. At present beekeeping has been practiced in Bangladesh on part time basis.

The longevity of worker drone and queen are different and the increasing rate of worker's larvae is faster than queen and drone larvae (Morse and Hooper, 1985). Honey bees gather nectar and pollen from plants as their food. The pollen foraging activities of honey bees are varied from time to time. The foraging activity of honey bees *Apis mellifera* was greatest in January, October and November with maximum pollen collection in January, February and November (Hossein, 1992).

Although, there are efforts for beekeeping extension, research on various aspects of beekeeping are not available in Bangladesh (Svention, 1988). Reports on the occurrence of diseases and pests of bee colony from Bangladesh are very few. The only report on the acarine pest is that of Hossain and Sharif (1991) from Chittagong. Kovac and Crailsheim (1988) observed that *Varroa jacobsoni* shorten the life span of *Apis mellifera*. Dumrongsak *et al.* (1988) reported that the original host of *Varroa jacobsoni* is Asian honey bee *Apis cerana* drones. Nazer and Rateb (1991) also recorded Jordan *Varroa* mite in bee colony.

In Bangladesh, generally women remain close to the cottage and have very limited possibilities for cash incomes outside their home. Beekeeping is one of the ways to have women's involvement in the development process. It will help strengthening their self-confidence and make them realize their abilities.

In view of the manifold importance of beekeeping the present study has undertaken with a view to finding out ways and means to rear and maintain the colonies of *A. cerana* successfully throughout the year.

Materials and Methods

The experiments on rearing and management of Indian honey bee, *A. cerana* was set up in Bangladesh Agricultural University campus, Mymensingh and carried out from March, 1998 to February 1999. Experimental data were taken from four rearing boxes. Salient features, relating to identification of the species were studied. Pollen collecting activities of the species were observed by taking data of bee entrance with pollen into boxes from 6.00 am to 4.00 pm The worker bees were observed in different seasons. Occurrence of the pests was recorded while rearing the species throughout the year. The statistical analysis were done by Duncan's multiple range test (DMRT) of Gomez and Gomez (1984).

Study of the life history: The life cycle of *A. cerana* was observed in four colonies maintained in four rearing boxes. Relevant data were collected from these four colonies during the months of December to January. Some areas containing cells of workers, drone and queen were marked in the comb for the study. These cells were observed for collecting data on egg laying, egg hatching, capping of cells and other parameters needed for the study.

Study of pollen gathering activity: The bees entering the four hives with pollen were recorded. The number of bees (average) carrying pollen was recorded at 7.00 am to 4.00 pm once in a week during each month. The worker bees bringing pollen loads from the field were counted at the hive entrance from morning when the bees started pollen collection till the time the bees stopped their foraging activity in the evening.

Availability of the various bee plants: The bee plants were identified in and around Bangladesh Agricultural University campus and graded on the basis of the frequency of visits of the bees to the flowers for collection of nectar and pollen. Identified bee plants were grouped as those available in "Honey flow season" (December to March), in "Dearth period" (April to July), in "Extended period" (August to November) and in "Period during all the year round".

Occurrence of pests in the honey bee colony: Occurrence of pests of honey bee was observed from March, 1998 to February, 1999. During observation all the colonies were closely examined and samples were preserved in the laboratory for wax moth and mite identification. In case of wax moth the caterpillars ate away combs or damaged them by making silken galleries. The level of

infestation was observed. In case of mite identification, the samples of debris found on the bottom board of the hive including the dead adult worker bees were collected from different colonies and examined under low power microscope. To study the level of infestation of wax moth and mites monthly data were made at weekly intervals. The wax moth and mite infestations were determined from the data of the brood frame infestation of a colony.

Results and Discussion

Life history of honey bee: The development of the Indian honey bee. *A. cerana* followed a pattern of growth and metamorphosis. The four developmental stages are the egg, the larva, the pupa and the adult. The life cycle of the species began when the queen deposited a single egg in each cell of a comb. The eggs of worker, drone and queen cells of each frame hatched 3 days (average) after deposition. For the first 2-3 days of their life, honeybees took care of cleaning tasks and the regulation of warmth. The larvae were at the bottom of the cell in a typically curved position. Adult nurse bees that feed voraciously nourished the developing larvae. A healthy larva looked pure white. The general appearance of a healthy larva was the same for all caste. Typically, the larva had a full bodied and firm appearance with distinct body segments. The larval period varied from castes to castes. The larval periods of the workers were 4-5 days while those of drone and queen bees were 5-7 days and 5 days respectively (Table 1). After this larval period the cells were capped over by the worker bees with a waxen cover and the fully fed grub spins a cocoon in the cell enters a period of rest during which it transformed itself into a pupa. During the period of pupation, it became similar in appearance to the adult bee, having developed, mouth parts, legs, head i.e. the bee gradually acquired the physical appearance of the mature adult bee. The sealed worker cells the smallest of the three, with the wax capping flat and almost level with the surface of the comb. The capping of the individual sealed cells appeared light brown in colour, day in appearance and were slightly convex from the face of the comb. Queen cells were distinct from the other two types in that they hanged downward from the face of the comb and when sealed were "present like" in both in colour and appearance with highly convex capping. Drone cells were wider and longer than worker cells while cappings were "bullet" shaped and protruded from the face of the comb.

The pupal period varied from 11-12 days in the case of worker, while 13-14 days for drone and 7-8 days for queen (Table 1). Total period for complete development from egg to adult varied from 19-20 days for the worker, 21-23 days for the drone and 15-16 days for the queen (Table 2). Similar result have been reported by Singh (1962), Mace (1976) and Morse and Hooper (1985).

Table 1: Duration of the life cycle of different caste's of *Apis cerana*

Frame no.	Caste	Egg to larva (Days)	Larva to pupa (Days)	Pupa to adult (Days)	Total period (egg to adult) (Days)
1	Worker	3	5	12	20
2		3	4	12	19
3		3	5	11	19
4		3	5	11	19
	Mean	3.00f	4.75e	11.50b	19.25b
1	Drone	3	6	14	23
2		3	7	13	23
3		3	5	13	21
4		3	6	14	23
	Mean	3.00f	6.00d	13.50a	22.50a
1	Queen	3	5	7	15
2		3	5	8	16
3		3	5	7	15
4		3	5	8	16
	Mean	3.00f	5.00e	7.50c	3.00f
Sx			0.873		
CV. (%)			31.75f		

Within column means followed by some lette did not differ significantly

Table 2: Size of different castes of *Apis cerana*

Castes	Length (mm)	Width (mm)	Wing expansion (mm)
Worker	11.94	3.96	17.79
Drone	13.00	4.50	21.98
Queen	17.64	4.75	21.62

Table 3: Size of cells and comb of different castes of *Apis cerana*

Types of cells	No. of cells in sq. cm.	Size of individual cells (mm)	Depth of cells (mm)	Thickness of comb (mm)
Worker	6.24	4.23	11.65	21.65
Drone	4.10	5.12	12.00	21.99
Queen	-	10.00	17.34	-

Size and shape of different castes of *Apis cerana:* Normally a colony comprises one queen, thousands of workers and at certain seasons of the year, a few hundred or even thousands of drones. The three castes considerably vary in size and appearance (Table 2). The queen cells are built along the outer boundaries of the comb and the cells of worker and drone vary in size. The queen cell is long and tubular in appearance. The queen worker and drone vary in size. (Table 3).

Queen: The queen is much like the worker except that her size is bigger and reproductive organs are fully developed, while the reproductive organs of the workers are not well-developed. The body of the queen is longer than that of the drones. The length and width of her body is 17.64 and 4.75 mm respectively and wing expansion is about 21.62 mm (Table 2). The wings do not cover her abdomen completely. The abdomen is tapering and triangular in shape. She possesses a curved sting which can be used and withdrawn repeatedly only against her rival queens. The hind legs do not have any mechanism for pollen collection.

Workers: The workers are the smallest inhabitant and sole heart of the honey bee hive. They are the most numerous individuals in the colony. Workers are female with imperfectly developed reproductive organs. The mandibles of workers are larger than those of queen and drones. The head is triangular and smaller than that of drone. The length and width of the worker is about 11.94 mm and 3.96 mm and wing expansion is 17.79 mm (Table 2). The sting is poisonous and can be used once against any kind of enemies. The hind legs are highly modified for carrying pollens and propolis.

Drone: In a normal colony drones are present only for a part of the year. The only function of the drone is to fertilize the virgin queens. The drones do not collect nactar or pollen. The body size is longer than that of the worker but smaller than that of the queen. The length and width of the body is about 13.00 and 4.50 mm and wing expansion is 21.98 mm respectively (Table 2). They are stingless. The compound eyes are larger than those of workers and queen. The hind legs do not possesses any mechanism for collecting pollens.

Pollen gathering activity: Honey bees gather nectar and pollen from plants as their food. Most foraging was done within one or two km of the hive. Every minutes the bees remove pollen from their bodies with their pollen brushes and collect surplus pollen in their baskets. The experimental observations indicated that the pollen gathering activity of *A. cerana* continues throughout the year irrespective of climatic condition. The number of bees collecting pollen was the lowest in the months of June, July and August. This activity was found to increase during March. April, May and then from September to February reaching maximum in December (Table 4). The number of bees collecting pollen was considerably high in the months of November, December and January. While the pollen gathering activity varied significantly during different periods of the year, there were also variations in working hours when bees started and finished pollen gathering trips. During March to October pollen gathering activities began

Table 4: Number of pollen collecting bees with time of initiation and cessation of pollen gathering activities

Months	Time										Total no. pollen gathering, bees/day	Mean
	6-7 am	7-8 am	8-9 am	9-10 am	10-11 am	11-12 am	12-1 pm	1-2 pm	2-3pm	3-4 pm		
March 1998	43	141	240	372	681	358	110	53	00	00	1998	199.80abc
April 1998	41	123	209	295	512	294	143	68	00	00	1689	168.90abc
May 1998	31	96	132	165	302	192	85	41	00	00	1044	104.40bc
June 1998	43	61	90	182	153	46	21	13	00	00	609	60.90c
July 1998	18	34	81	143	96	22	13	9	00	00	416	41.60c
August 1998	38	80	129	271	215	53	29	16	00	00	831	83.10bc
September 1998	19	102	284	364	665	259	103	39	00	00	1835	183.50abc
October 1998	13	96	201	334	684	264	87	34	00	00	1711	171.10abc
November 1998	00	00	65	201	965	916	288	98	65	35	2633	263.30ab
December 1998	00	00	00	80	896	1465	406	203	83	41	3165	316.50a
January 1999	00	00	00	84	404	994	396	185	64	24	2151	215.10abc
February 1999	00	00	00	52	543	801	281	64	43	19	1803	180.30abc
Mean	20.5b	61.08b	119.25b	211.92b	509.67a	471.58a	163.33b	68.58b	21.25b	9.92b		
Sx						55.27						
CV (%)						105.48						

Within column means followed by same letter (s) did not differ significantly at $p<0.05$ by DMRT

Table 5: Percent infestation of honey bee colony by greater wax moth *Galleria mellonella*

Months	% of infestation		% Mean
	Colony 1	Colony 2	
March, 1998	15	12	13.5
April, 1998	40	43	41.5
May, 1998	45	49	47.0
June, 1998	55	56	55.5
July, 1998	30	33	31.5
August, 1998	20	21	20.5
September, 1998	15	14	14.5
October, 1998	-	-	-
November, 1998	-	-	-
December, 1998	-	-	-
January, 1999	-	-	-
February, 1999	-	-	-

Table 6: Percent bees infested by mite, *Varroa jacobsoni*

Months	Percent infestation			Mean percent
	Colony 1	Colony 2	Colony 3	
March, 1998	-	-	-	-
April, 1998	12	10	14	12
May, 1998	9	9	8	8.67
June, 1998	-	-	-	-
July, 1998	-	-	-	-
August, 1998	-	-		-
September, 1998	-	-	-	-
October, 1998	-	-	-	-
November, 1998	-	-	-	-
December, 1998	-	-	-	-
January, 1999	-	-	-	-
February, 1999	-	-	-	-

quite early in the morning at 6.00 am Subsequently, in December, January and February bee preferred collecting pollen late in the morning (9 am). Cessation of pollen gathering activity did not follow similar pattern during different periods of the year (Table 4). In the months of March to October bees almost ceased to collect pollen after about 2.00 pm During November to February pollen collection was found to be continued up to 4.00 pm (Table 4).

Pollen gathering activity is dependent upon the availability of pollen yielding flowers and the environmental conditions like sunrise, sunset and day temperature etc. Pollen gathering activity is, therefore, the interaction of available flora and these interactions presumably determine the pattern of pollen gathering activity. In the present investigation also variation in the pollen gathering activities in different periods of the day on different days in a month was observed. Average pollen collection (509.67) was the highest in between 10.00 to 11.00 am and lowest (9.92) in between 3.00 to 4.00 pm (Table 4). During March to October the bees start and finish their pollen trips regularly more or less in the same hours of the day. Rahman and Rahman (1993) observed that in *Apis cerana* colonies the maximum area of stored pollen was recorded in February and the minimum in October. Bisht and Pant (1968) indicated in their studies that the number of pollen gathering bees was the highest during the months of January to March. They also observed lesser activities of the bees during April, August, September and October. The number of pollen gathering bees got reduced further during November and December.

Occurrence of pests in honey bee colonies: Like all animals, bees are attacked by diseases and pests. Some of them are of minor importance either because they are rare or their effects are slight, while others attacking only individual bees, can thus weaken a colony threatening the very existence of the entire population in a year.

During the study period it was revealed that the bee colonies were frequently attacked by pests. Out of four boxes, three were infested by caterpillars of greater wax moth, *Galleria mellonella*. A parasitic mite, *Varroa jacobsoni* was also found to cause considerable damage to the colony and shorten the life span of the honey bee. Similar result were also found by Jong and Jong (1983), Woyke (1987), Kumar *et al.* (1988) and Nazer and Rateb (1991).

The infestation of greater wax moth, *G. mellonella* varied from month to month. In the months of October to February no wax moth was found in the colonies (Table 5). During this period, the colonies were strong, because of the presence of enough flowers in the nature. Thus the population was maximum and the bees were very active. But when the population decreased due to shortage of available sources of honey and nectar the colony became weak and the bees could not cover all the frames of a colony. In this situation of the colony the wax moth got maximum opportunity to infest. This condition prevailed during the months of March to September. The higher infestation (41.5, 47 and 55.5%) of wax moth was recorded during the months of April, May and June (Table 5).

Larvae of the moths were destructive to the combs. Adult moths and larvae were collected from the colonies. The parasitic mite, *V. jacobsoni* did not attack the bees throughout the year. The mite used to attack the colonies only in the months of April and May (Table 6). It usually attacked the workers concentrating mostly on their backs at the point of attachment of wings with the body. Mites were also found at the joints of head to the thorax and the thorax to the abdomen of the bees. Otis and Scott-Dupree (1992) reported that tracheal mites had a substantial negative effect on colonies of honey bees.

Conclusion: Successful beekeeping depends on various factors including skill and knowledge on different aspects of management of bee colonies. Research on beekeeping management therefore is an immense importance. The present study attempts to provide relevant information relating to beekeeping management in Bangladesh. Needless to mentioned that the experiments need to

be repeated throughout several years to observe the stability of the results over a reasonable period of time or seasons. It may also happen that some of the minor problems, not solved here may become major. For adequate knowledge in beekeeping management further study with more coverage will be needed.

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