J. Asia-Pacific Entomol. 8(3): 309~317 (2005)
www.entomology.or.kr

INDUSTRIAL ENTOMOLOGY

Mass Rearing of *Apis cerana* F. Queen

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Abstract The conditions that determine the success of mass rearing of *Apis cerana* F. queens were studied. It was found that artificial queen cell cups with the internal diameter of 6.2mm at base 8.6mm at the mouth and 8.8mm depth were highly preferred by the bees for rearing of queens from the grafted larvae. Likewise, the wax obtained from old comb foundation was preferred over fresh comb foundation. Maximum acceptance was recorded for 12 and 6 number of larval grafts. High percentage and mean volume of queen cells was obtained from 12-6hr. old grafts. However, no significant differences were observed between grafts and those provided with royal jelly. The same was true for single and double grafts. The percentage acceptance was in the order: March, April, August, and September.

Key words *Apis cerana*, cell cup materials, effect of larval age, mass rearing, number of grafts, queens, seasonal variations

Introduction

Productivity of a honey bee colony depends upon the quality of the queen of the colony (Laidlaw, 1979; Morse, 1979; Ruttner, 1986). Therefore, bee stocks must be headed by the queen - having high fecundity and oviposition pattern, gentle temperament, high industriousness, longevity and disease resistance qualities. Besides, queens may be required in large number for breeding and marketing purposes. Though mass rearing of queens has extensively been studied but mostly focused on *Apis mellifera* (Laidlaw and Eckert, 1962; Johansson and Johansson, 1978: Gary 1979; Laidlaw, 1979; Morse, 1979; Ebadi and Gary, 1980; Kither and Pickard, 1983; Ruttner, 1986). Very little is known about this technique in Apis cerana. (Bhat, 1983; Wongsiri *et al.*, 1988; Wongsiri and Pthichot, 1990; Verma and Sharma, 1997). The present paper reports the mass rearing of *A. cerana*.

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(Received August 11, 2005; Accepted September 10, 2005)

Materials and Methods

The studies were conducted at Research Sub-Station of Sher-e-Kashmir University of Agricultural Sciences & technology located at Bhaderwah about 210 km from Jammu city. Nine colonies of *Apis cerana* were selected for the study. All the colonies were of 7-8 frames strength with sufficient stores of honey and pollen. For queen rearing, the method of Laidlaw (1979) was followed. Each set of experiment consisted of three replications with one replication per colony. The effect of following parameters on the acceptance of queen cells was studied.

Size of artificial queen cups

Preparation of artificial queen cell cups. Twenty empty queen cells build under natural conditions from honey bee colonies were collected during swarming seasons (March). The dimensions of these naturally built queen cells was taken as a base and three different sized cell forming rods were made from seasoned hard wood. Bee wax used for making artificial queen cell cups was obtained from old honey bee combs. Wax was wrapped in a muslin cloth and immersed into water contained in a beaker, in a water bath at 63-64℃. The molten wax peculated through the muslin into the beaker which was then put into a trough of cold water. A thick layer of wax which got solidified at the surface of the water was removed. This wax was then placed in a 100 ml beaker and was melted through indirect heat method by placing the beaker over the water bath maintained at 65℃, just above the melting point.

The queen cell cups were prepared with the help of cell forming rods. The rod of desired size was first immersed into the cold water and after draining excess water the rod was dipped up to desired depth into the molten wax. The rod was then lifted and the wax layer was allowed to set. The rod containing wax layer was dipped again in the molten wax but this time to a slightly lesser depth then the first dip.

The process was repeated five times and every time the depth to which the rod was dipped was reduced. After the final dip, the rod was immersed into cold water and the cell cup so formed was then removed by twisting the rod.

Effect of cell cup size. In order to determine the effect of size of cells accepted, three types of cups were prepared (Table 1).

Collection of royal jelly

A strong bee colony with sufficient young brood, nurse bees and pollen stores was dequeened and allowed to raise queen cells. Before sealing, the queen cells were cut and larvae from the cells were removed. A little warm distilled water was added to each such cell and royal jelly was stirred. This diluted royal jelly was taken out by means of a dropper and collection in a small vial which was kept in the freezer for further use. At the time of grafting a small drop of this diluted royal jelly was placed at the bottom of the cell cup with the help of a dropper to prime the artificial queen cell cups and immediately a larva was grafted into such a cell cup over the drop of royal jelly.

Collection of larvae of desired age

The worker cells with freshly laid eggs were marked with the marking fluid to obtain eggs of known age. Marking fluid was prepared by dissolving dyes in thick solution of shellac in absolute ethanol. This fluid was applied to the margins of the cells with the help of a fine camel hair brush. Marked egg combs were then introduced into another colony (incubator colony) for the development of the larvae. A bee colony with sufficient nurse bees, pollen, sealed and emerging brood was chosen for this purpose. The young brood in this colony, if any, was removed. The incubator colony was regularly provided with 40 % sugar syrup. The pollen supplement was given at the time of pollen dearth. After having removed the first batch of eggs from a breeder colony another empty comb was inserted in its place and this sequence was repeated to get a regular supply of eggs of known age.

Grafting of larvae

Honey bee colony with sufficient nurse bees, sealed and emerging brood, and sufficient pollen and honey stores was selected as a cell builder colony for rearing queen honey bees from grafted larvae. The colony was dequeened and young brood, if any, was removed. Such a colony was liberally provided with 40 % sugar syrup throughout the course of experiment starting from one day prior to the introduction of grafted larvae. Desired numbers of wooden bars were fitted in the standard deep frame (interior length 26.5 cm and interior breadth 18 cm) for building the queen cell cups. Required number of wax blocks 0.5 cm thick, 1 cm wide and 1.5 cm long were fixed on the lower surface of these bars to serve as bases for queen cell cups. The queen cell cup bases were dipped into the molten wax and were fixed over these blocks. These frames containing cell cups were then intro-

Table 1. Dimensions of queen cell cups

Queen cell cup	Diameter at base(mm)	Internal diameter at mouth(mm)	Depth (mm)
A	5.4	7.8	7.8
B	7.7	8.7	15.2
C	6.2	8.6	8.8

Table 2. Acceptance of larvae grafted in queen cell cups of different dimensions for rearing *A. cerana* queens

Size	Number of grafts on									Total			
	Top Bar			Central Bar			Lower Bar						
	A	NA	PA	A	NA	PA	A	NA	PA	Graft	A	NA	PA
A	0	12	0	0	12	0	0	12	0	36	0	36	0
B	4	8	33.33	4	8	33.33	5	7	41.7	36	13	23	36
C	7	5	58.33	9	3	75.00	8	4	66.70	36	24	12	66.66
Mean	3.67	8.33	30.55	4.33	7.67	36.11	4.33	7.67	36.11	36	12.33	23.66	34.26

A= Accepted; NA = Not accepted ; PA = Percent accepted, X^2(cal) =35.60; X^2(2 df, 0.05) =5.990;