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Effect of rearing method, age of brood and queenliness of cell-builder colony on weight of *Apis mellifera* Linnaeus queen bees

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Abstract

Influence of developmental stage of brood (<24 h old eggs, 24-48 h old eggs and <24 h old larvae) transferred to the cell builder colony, type of queen cell cup (Cupkit/ Karl Jenter) and condition of the cell builder colony (with/ without queen bee) on weight of *Apis mellifera* queen bees reared was studied during the autumn breeding season. Queen bees with the highest mean weight (203.83 mg) were obtained when 24-48 h old eggs from Cupkit were transferred to queenless cell builder colonies. Irrespective of the apparatus used and queenliness of the colony, significant effect of the stage of brood transferred to the cell builder colony was observed on the weight of the queen bee produced, as the queen bees reared from 24-48 h old eggs were significantly heavier (198.93 mg) than those reared from <24 h old larvae (189.24 mg) and <24 h old eggs (178.57 mg).

Keywords: Cupkit, Karl Jenter apparatus, queen bee rearing, weight of queen bee

1. Introduction

Queen honey bee is the most important individual in a honey bee colony and keeps the colony alive and productive by laying eggs. There are several factors, combination of which determines the breeding value of a queen bee. These include the age of the queen bee, its breed, emergence weight, rearing conditions, rearing period, ovariole number, diameter of the spermatheca, number of stored spermatozooids and presence or absence of any kind of anatomical abnormalities^[1]. The honey yield of a colony is also influenced by the emergence weight of the queen bee, the number of its ovarioles and its brooding amount^[2].

The age of the brood used for rearing honey bee queens is one of the primary determinants of quality of newly reared queen bees. Eggs as well as young larvae can be used for rearing queen bees. Various workers studied the effect of age of brood used on quality and quantity of queen bees produced. While,^[3] reported that such qualities can be obtained by rearing queen bees from eggs, but^[4] did not find any significant differences between the quality of queens reared from the three-day old eggs and one-day old larvae. On the other hand^[5 & 6] supported the use of eggs for rearing good quality queen bees.

The aim of the present study was to investigate whether development stage of brood, type of queen cell cup and queenliness of the colony has an influence on the weight of newly reared queen bees which ultimately affects the quality of the queen bee.

2. Materials and Methods

Studies on the performance of egg and larval transfer from Cupkit and Karl Jenter apparatus into queen-right and queenless cell builder colonies were conducted during the autumn breeding season at *Apis mellifera* Campus Apiary of Punjab Agricultural University, Ludhiana (Punjab), India.

A raised comb was cut according to the shape and size of the apparatus, and the apparatus was fitted into this cut out portion of the comb. Queen bee was confined in each of the apparatus in the evening and frame was given into the center of the brood chamber of the selected breeder colony to obtain eggs in the queen cell cups of the apparatus. By the next morning, eggs laying was complete in the apparatus, thus the cell cups containing appropriate brood stage were collected and transferred in to the cell builder colonies as described below:

1. Less than 24 h age eggs: Within 24 h of initiation of egg laying, cell cup bases containing eggs of less than 24 h age were collected from the apparatus.

- 24-48 h old eggs: Cell cup bases containing 24-48 h old eggs were collected from the apparatus, after 24 h of initiation of egg laying but before 48 h of initiation of egg laying,
- Less than 24 h age larvae: After 3 days of initiation of egg laying, cell cups containing larval stage were collected.

Thirty cell cups were fitted on the blocks fixed on the bars of the queen rearing frame @ 10 queen cell cups per bar, and were given in the brood chamber of a 15 bee-frame queen less cell builder colony. Sealed queen cells were transferred to the three-partitioned mating nuclei which were checked twice daily for the emergence of queen bees. The weight of the newly emerged queen bees was recorded on an electronic balance by confining the queen bees in already weighed queen cages. Weight of the newly emerged queen bees was worked out by subtracting weight of the empty cage from weight of the cage containing queen bee.

3. Results and Discussion

The results of the effect of different factors i.e. stage of development of brood, type of queen cell cups and queenliness condition of the cell builder colony and their interaction are given in Table 1. Overall highest mean weight of newly emerged queen bees, irrespective of the queenliness

condition of the cell builder colony and the apparatus used, was obtained when the queen bees were raised from 24-48 h old eggs (198.93 mg). Same trend was observed in case of Cupkit and Karl Jenter apparatus where irrespective of the queenliness condition of the colony, the queen bees with the highest weight were obtained from 24-48 h old eggs (200.82 mg and 197.05 mg respectively). Irrespective of the apparatus used, highest weight was observed in newly emerged queen bees raised from 24-48 h old eggs in queenless (199.55 mg) and queen-right (198.32 mg) cell builder colonies. Also there was no significant effect of the queen rearing apparatus or queenliness of the cell builder colony on queen bee's weight in case of this treatment (i.e. 24-48 h old eggs), indicating that the choice of development stage of the brood for queen bee rearing exerts impact on the quality of queen bees produced.

Weight of newly emerged queen bees obtained from queen cells raised from Cupkit cells ranged from 171.66 to 203.83 and 180.30 to 197.80 mg in queen less and queen-right cell builder colonies, respectively (Table 1). Weight of newly emerged queen bees obtained from Karl Jenter apparatus ranged from 170.47 to 195.27 and 191.83 to 198.83 mg in queen less and queen-right cell builder colonies, respectively. In both the apparatuses, weight of queen bees emerged from queen cells raised from 24-48 h old eggs was highest under both queenliness conditions followed by <24 h old larvae and <24 h old eggs.

Table 1: Weight of newly emerged queen bees produced from different developmental stages of *A. mellifera*, in different queen rearing apparatus, during autumn

Developmental stage	Weight of newly emerged queen bees (mg)								
	Cupkit apparatus			Karl Jenter apparatus			Colony condition		Overall Mean
	QL	QR	Mean	QL	QR	Mean	QL	QR	
< 24 h old eggs	171.66	180.30	175.98	170.47	191.83	181.15	171.07	186.07	178.57
24-48 h old eggs	203.83	197.80	200.82	195.27	198.83	197.05	199.55	198.32	198.93
<24 h larvae	181.13	187.47	184.30	193.90	194.47	194.19	187.52	190.97	189.24
Mean	185.54	188.52	187.03	186.55	195.04	190.80	186.05	191.78	188.91

QL: Queenless cell builder colony; QR: Queen-right cell builder colony

LSD (p=0.05)

Apparatus (A)	2.88
Queenliness (B)	2.88
A×B	N.S.
Developmental stage at transfer (C)	3.53
A×C	4.99
B×C	4.99
A×B×C	7.06

Pooled mean of the developmental stages, irrespective of the apparatus used, under queenless and queen-right cell builder colonies showed that the mean weight of the queen bees ranged from 171.07 to 199.55 and 186.07 to 198.32 mg in queenless and queen-right cell builder colonies, respectively (Table 1). Overall mean weight of the different developmental stages showed that mean weight of queen bees emerging from 24-48 h old eggs was significantly more (198.93 mg) than that in < 24 h old eggs and less than 24 h old larvae. On the other hand, mean weight queen bees emerging from less than 24 h old larvae was significantly more (189.24 mg) than that in case of < 24 h old eggs (178.57 mg).

In the present study heaviest queen bees were reared from 24-48 h old eggs followed by <24 h old larvae, which is similar to the observations by [3], who reported that the queen bees with the highest weight were obtained when reared from 3 day old eggs (196-256 mg) followed by 1 day old larvae (182-201 mg). Results indicate that with the increase in age of brood used for rearing, the weight of the queen bee produced

decreased. Overall, queen-right cell builder colonies produced heavier queen bees, which is in conformity with results by [2] who also reported that weight of freshly emerged queen bees in queen-right colonies was more than those in queenless colonies. But results of the study were not in conformity with the results of [10], who reported queens reared in queenless colonies to be heavier than those reared in queen-right colonies. [7] reported high weight in queen bees reared artificially by using <24 h old larvae (191.60±0.90 mg) as compared to the queen bees produced under swarming or emergency conditions. The mean weight of queen bee (188.91 mg) in the present study is supported by earlier study by [8] who reported weight of the queen bees to be 188.62 mg in the autumn season. During the spring season also same trend was observed, where the heaviest queen bees were produced from 1-2 day old eggs (201.88 mg) as compared to < 24 h old eggs (178.77 mg) and < 24 h old larvae (191.12 mg) during spring breeding season [9].

Conclusion

Results of the present study lead to the conclusion that 24-48 h old eggs produced heaviest queen bees followed by <24h old larvae and <24 h old eggs. On the other hand, Karl Jenter apparatus and queen-right cell builder colonies produced heaviest queen bees. Overall, among the different treatments, the best combination for rearing good quality heavy weight queen bees was by transferring 24-48 h old eggs from Cupkit apparatus to queen less cell builder colonies.

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