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# Demonstration and Participatory Evaluation of Different Honey Bee Queen Rearing Techniques at Ramada Station of Shebedino Woreda, Sidama Zone, SNNPR, Ethiopia

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**Abstract:** The objectives of this study was to determent the type of queen rearing technique which was more appropriate to local conditions, productive, simple and practice. To conduct the study Strong and uniform colony population was selected and bought from beekeepers. Then after bee colonies were transferred to Kenya top bar hives /KTBH/ and Zander model and allowed establishing by keeping under favourable management conditions. Three types of colony multiplication were practiced to identify the best suitable technique for the study area for both in farmers and research centres practice. The techniques were practiced on the two annual potential season of the area. The trial period was September and November on which ample of flowers exists and the second season was May to June. On both seasons the colonies were supplied with sugar syrup feeding. The splitting, overcrowding and miller methods were practiced on zander and KTBH under a similar feeding and management environment. Since the underlying concept of queen rearing is to get the most number of queens from the least resources from the genetics chosen traits the keeper wants, at the trial period 6 to 5 queen larvae's were obtained from splitting techniques, 3 to 2 cells from overcrowding and 2 to 0 queens from miller techniques per hive were obtained. According to this study, although there is an annual seasons effect on honeybee queen rearing and no significance difference between the techniques, the study shows that the splitting method (either pre-arranged or random) could be used to be better stimulate worker bees in a queen less colony to rear their own queen and evaluated based on its efficiency, easiness, time saving, practicality, strength, and productivity and of the multiplied colony. Therefore, it is better for institutions to establishment bee centers committed for research and bee breeding and extension should target on capacity building on splitting queen rearing programs.

**Keywords:** Honey Bee, Queen Rearing, Reproduction, Splitting, Ethiopia

## 1. Introduction

Honeybee (Apis mellifera.) workers in queen less colonies are able to rear queens from larvae primarily destined to be workers (Winston, 1979; Fell and Morse, 1984). Larvae for queen rearing often are available in a range of ages. The reproductive quality (as defined by Tarpy et al., 2000) of queens reared from younger larvae can be higher (Eckert, 1937; Boch and Jamieson, 1960; Weaver, 1957; Woyke, 1971; Tarpy et al., 2000). On the other hand, rearing queens from older larvae can shorten the queenlessness period (Tarpy et al., 2000). Hatch et al. (1999) demonstrated that honeybee workers rear emergency queens from brood that at the time of dequeening are 1 to 5 days old. However, their experimental setup did not allow the age of brood in queen cells to be determined directly. Instead they estimated it based on the time of queen cell capping, assuming that queen cells are capped 8 days after egg laying (Winston, 1987). This type of estimation has often been used in studies of emergency queen rearing (Winston, 1979; Fell and Morse,

1984; Hatch et al., 1999; Schneider and DeGrandi-Hoffman, 2002). The accuracy of this estimation has never been determined even though it is known that the time of queen cell capping varies considerably.

The underlying concept of queen rearing is to get the greatest number of highest quality queens from the least resources. If we make a strong hive queenless, they could have, during that 24 days of having no laying queen, reared a full turnover of brood. The queen could have been laying several thousand eggs a day and a strong hive could easily rear those several thousand brood. They have lost the potential for many or more workers by making the hive queenless and resulted in only one queen. The trial hives made many queen cells, but they were all destroyed by the first queen out. An efficient approach to queen rearing involves making the least proportionate number of bees queenless for the least amount of time and resulting in the most number of laying queens when we are done while maximizing the quality of the care of the queen candidates.

Generally queen rearing is an integral part of beekeeping and has many advantages like: -

*To improve the genetic conditions of a stock*: The various behaviour of a colony like: - aggressiveness, swarming and migratory tendencies, hording ability and others partly governed by heritable traits that pass from the parent. The productivity of a colony in most cases proportional to the population size of a colony, which is, again depending on the prolific and population build up nature of a queen.

*To re-queen the old queens*: The life expectance of a queen is 3-5 years; however after 2 years, the performance of a queen is gradually become decline and the colony become less productive. As that of replacement of a stock in commercial poultry, in beekeeping also the old queens have to be replaced timely. When a queen become old, the number of eggs laid becomes less or the queen may run out of stored sperm in spermatica and it may, only lay unfertilized eggs, which become only drones that bring the colony totally unproductive.

*To replace a sudden loss of a queen*: During hive operation or some other reasons a queen may die as a result very strong colony may become queen less. Having extra queens is very important to rescue such queen less colonies.

*To multiply colonies*: To restock honeybee population density which have been declining in many parts of the country particularly in potential Southern parts of the country.

*As a source of income*: Multiplications of colony through queen rearing can be one of area of income generation or mean of diversification of income. Multiplication and selling colonies can be also area of specialization. In some areas, a colony multiplication is more attractive than honey selling as a price of colony rises up to 350 - 500 birr.

Therefore, the objective of this study was to determent the type of queen rearing technique which was more appropriate to local conditions, productive, simple and practical as related to management, improve bee behaviour, colony multiplication and honey productivity.

# 2. Materials and Methods

### *2.1. Description of Study Area*

Sidama zone has a variety of climatic conditions. Warm conditions cover 54% of the area. Locally known as Gamoojje or Woinadega, this is a temperate zone ranging from an elevation of 1500 m to 2500 m above sea level. The mean annual rainfall of the area varies between 1200 mm and 1599 mm, with 15°C to 19.9°C average annual temperature. A hot climatic zone, Kola, covers 30% of the total area. Its elevation ranges from 500 m to 1500 m above sea level. The experiment was conducted at Remeda research site at shebedino district (32°30" N, 35°59" E) with an elevation of 1780-2300 above sea levels. This area is characterized by hot and dry summers and rainy and cold winters. In the zone in genera and in shebedino woreda in particular, the main nectar flow occurs from September to November, mostly from Adey abeba and citrus spp., while the other from May to June from fruit trees and native wild flowers, and other flowering plants.

### *2.2. Queen Rearing Experiments*

The experiment was carried out in May and June and September to November of the year 2013/2014, and used four colonies of honeybees considered to be Apis mellifera. Bee colony purchasing and transporting to the Apiary site were facilitated. Before transferring, the colonies were stayed for fifteen days in apiary site. Starting from fifteen days the colonies were transferred to the modern bee hives. When the colonies become adapted and strong, and after carrying out their first honey production, the Overcrowding, miller and splitting method of simple queen rearing technique were used. Both external and internal inspection and follow up was carried out and consecutive data were collected. The colonies were fed similar amount of feed and water at the same season. The experiments started with a known bee production season of the area with a prior strengthening of those selected colonies and the colonies were of similar size, and each occupied three zander and Kenyan model containing 10 and 28 frames a piece. The frames were of the local type locally used in the southern region. Combs containing brood ranging in age from 1-day old eggs to 5-day old larvae, honey and pollen stores were practiced with and without queen excluder. The combs with brood of different ages were placed in a different order in each colony. To obtain eggs, larvae of known age, with brood from each colony with a frame of comb in a cage made of wood and marked for 72 hours on a queen less colony in each rearing technique. This procedure was repeated 3 times in two areal honey production seasons. Every day the follow-up for queen's cell were made. At the end of the procedure queen cell in all colonies were observed and counted.

When splitting (both random and pre-arranged) the more number of queen cell observed. Meanwhile, the queen less nuclei colonies were prepared with queen excluder after supering on which the super is as queen less colony and

transferred to zander hive. In Kenya top bar hives, the partition was used as a super and practiced in overcrowding and splitting experiments, but as our trial shows, KTBH is not suitable for miller. At that time the queen pupas where inserted on queen less super with wooden queen cages and queen cell comb cutting method.

***Figure 1.*** *Queen cell (Arkena- in Amharic) counting.*

*Counting of larvae*: After the queens cells were counted, the colonies were examined every day at the same time of day until all queen cells were either emerged or destroyed. If a regular round opening was found at the bottom of the queen cell it was categorized as emerged. If an opening was found in the side of the queen cell it was categorized as destroyed. The easiness of the techniques, number of queen larvae observed, queen cell developed to adult stage, the colony strength after new queens were reared, swarming of colonies, cost effectiveness and practicability at farmers' level were recorded and observed. Some queens may emerge on day 15; while all queens start laying 15 days after emerge. These are the dates that something should have happened. But many times, dates are sooner than suggested. The previous Research has shown that a queen that is allowed to lay up until it's 21 days old will be a better queen (David Tarpy).

## 3. Results and Discussion

Since the underlying concept of queen rearing is to get the most number of queens from the least resources from the genetics chosen traits. The easiness, number of queen larvae observed, queen cell developed to adult stage, easiness, practicability of the technique, cost effectiveness and better queen cell observation data's were collected and described.

***Table 1.*** *Queen rearing performance of different techniques in the study area.*

| **Techniques** | | **splitting** | | | **overcrowding** | | | **Miller** | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **No.** | **stage of development** | **Se** | **No** | **Jun** | **Se** | **No** | **Jun** | **Se** | **No** | **Jun** |
| 1 | Number of queen larvae | 6 | 5 | 5 | 3 | 3 | 2 | 4 | 2 | 0 |
| 2 | Number of larvae developed to adult | 6 | 5 | 5 | 3 | 3 | 0 | 4 | 0 | 0 |
| 3 | Number of queens observed | 6 | 5 | 5 | 3 | 3 | 0 | 4 | 0 | 0 |
| 4 | Number of queen emerged and produced egg | 6 | 5 | 4 | 3 | 3 | 0 | 4 | 0 | 0 |
| Average number of larvae observed perqueens produced egg (%) | | 100 | 100 | 83.33 | 100 | 100 | 0 | 100 | 0 | 0 |

* Se=September, No= November, Jun= June.

When prearranged and random splitting were practiced in zander and Kenya top bar hives in two seasons, 5-6 queen larvae per colony in each season were observed and they were grown to queen cell, possible to control the growth and they emerged as the schedule.

By overcrowding in two hive types, 3 best queen larvae per hive observed twice and they emerged without our control, but difficulty to now the schedule when is their emergence.

When set the comb by cutting zigzag fashion, challenging with Kenya top bar hives and, after a month delay zander colonies accepted it, some colonies were lost by disturbance and they started and accepted their own larvae.

Although numerical differences in all methods, there is no statistically significance difference between splitting, overcrowding and miller methods average and within hive types, the practicability and more number of queen emergence and cell formation was taken as a good idea.

However, in all rearing techniques examined, the queens started laying after fifteen days (2 weeks) of emerge, on which the decision on quality queen is confusing.

***Figure 2.*** *Splitting of colonies with comb cutting and plastic queen cage.*

***Figure 3.*** *Farmer's discussion and practice at queen rearing evaluation trial.*

As the observation from the experiment and the participatory farmers suggestion and perception, the splitting (both random and pre-arranged) method was the better technique compared to other rearing techniques. This was due to its possibility to carry out with and without supers and queen excluders, possible to easily practice in both hives (Zander and KTBH), Easiness of the technique:- just splitting the colony in to 2 or more, Simple technique:- needs no more materials, Practicable at farmers level:- farmer's acceptance, Low costly:- it reduces the cost of rearing equipment's and frames, easily attaching of the combs, Possible to get many larvae's and easy to now when is the larval, pupa and adult stages exists.

According to beekeepers participatory evaluation, this technology was technically feasible and enables them to get additional honeybee colonies. The colonies productivity has shown no significance differences. This study also indicated that the rearing time throughout the different months of the year has direct effects on queen emergence. There were significant queen cell emergence differences at seasons. These results were in agreement with Kaftanoğlu and Kumova (1992) who studied the effects of rearing season on the quality of the queen bees and found that the acceptance rates from April to July were lower and relatively good in September to November.

## Recommendations

From this study, although the experimental data has no significance difference between the rearing techniques, the farmers practical evaluation and numerical values of seasonal emerged queen has shown that splitting queen rearing is in the first place possible and which is more appropriate to local conditions, simple and practical as related to management, bee colony multiplication, productivity, and more appropriate in Sidama zone in general and other similar agro-ecological zones in particular. Honey bee queen rearing was greatly affected by queen subspecies and rearing season. Beekeepers can raise queens during most flowering time of the year but to get queens with high quality, it is necessary to conduct further evaluation research. This technology should be further scaled up to other beekeeping potential districts of the eastern parts of regions with similar agro-ecology and where there are promising bee forage resources.

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