

Research Article

Evaluation of Morris Board Queen Rearing Technique in Central Rift Valley of Ethiopia

Desta Abi Gemedi , **Mekonnen Wolditsadik Beyi** , **Taye Beyene Lema**

Oromia Agricultural Research Institute (IQQO), Adami Tulu Agricultural Research Center (ATARC), Finfine, Ethiopia

Abstract

The Agricultural Research Center of Adami Tulu, Ethiopia, conducted experiments to artificially rear bee queens using Morris Board and Splitting-methods. Six colonies of bees were randomly assigned to conduct experiments. In three honeybee colonies, the queens were isolated during the experiment and remained in Brood Chamber/Box using a screen board, while the remaining colonies were split to rear the queens. The two methods of breeding the honeybee queen show a very significant difference ($P=0.001$) in the number of cells constructed, the number of sealed honeybee queen cells, and the number of egg-producing honeybee queens. In addition, there was very significant difference ($P=0.001$) between the two methods used in the cost-benefit aspect. The honeybee queen was found to have cost significantly reduced when raising the honeybee queen with Morris boards compared to a split one. However, the current experiment does not have a significant difference in honeybee bred populations and honey yield, and other honeybee colonies receive young queens raised in two ways. It follows that Morris-board's honeybee breeding techniques are highly effective and cost-effective in producing honeybee queens for the multiplication of honeybee colonies to the best of ordinary farmers' skills and financial capabilities. Therefore, demonstration of technology is of principally important considering the country's widespread biophysical differences in order to exploit the technology in an attempt to artificially grow honeybee queens.

Keywords

Beekeeping, Honeybee Queen, Queen Rearing, Morris Board, Splitting

1. Introduction

The loss of honeybee colonies or their subpar productivity has been a major problem that has had a negative impact on the ecosystem and agriculture. The global population of feral honeybees has been declining and is predicted to do so in the foreseeable future [2]. In these conditions, beekeeping in Africa has proven problematic, making it difficult, if not impossible, to maintain honeybee colonies. Almost all sources of bee colonies in Africa rely on capturing natural swarms. In addition, it is recommended that well-established bee colo-

nies replace their queens every two years to achieve commercially significant excess honey product in a particular beekeeping location.

The process of raising bee queens is a crucial component of contemporary apiculture and is essential to the finest possible beekeeping operations [6]. The ability to raise new queens has been essential to the survival of the bee species (*Apis mellifera*) for millions of years. Man has observed and learned about the biology of honeybees in general and the

*Corresponding author: gurree2007@gmail.com (Desta Abi Gemedi)

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technique of raising queens in particular during his longest stay with them.

The first queen rearing was done in ancient Greece by beekeepers that placed combs containing young larvae into queen less colonies, despite the fact that very little was understood about the biology of honey bee colonies [1]. Since Langstroth invented the moveable frame hive, several techniques [3] for raising honeybee queens for breeding and production initiatives have been developed and researched. However, raising honeybee queens in African beekeeping has often shown to be insufficiently feasible thus far, despite the fact that the fundamental goal of queen rearing is to produce the maximum number of superior queens with the fewest resources [5]. When it comes to raising queens, an efficient method is to minimize the number of bees that become queens for the shortest period of time, produce the greatest number of laying queens at the end, and maximize the standard of care provided to the queen candidates. The local honeybee colony has been steadily declining [6], making it harder than ever to raise bees, even while demand for honeybees has increased dramatically in recent years.

A few methods [8] of raising honeybee queens have been researched in Ethiopia in an effort to address the lack of honeybee colonies and increase the benefits of beekeeping. Even though producing more and better-quality queens is the ultimate goal of queen rearing, research on this topic has so far shown that the techniques' actual application has been inadequate for the needs of local beekeepers, and the quantity and quality of daughter queens produced are frequently observed to be insignificant [7]. The ease of use and relatively low cost of beekeeping methods are among the variables that have been identified as contributing to their reduced use. Therefore, the aim of the current study is to experimentally evaluate effect of Morris Board [4], simple splitting, and overcrowding and miller methods of queen rearing on manual honeybee queen production and reproduction efficiency as studied under local beekeeping condition.

Objectives

- 1) To determine number of honeybee queens produced by different methods of honeybee queen rearing under local condition
- 2) To assess honey production and brooding condition of honeybee colonies received honeybee queens produced by different honeybee queen rearing methods as a means to change the old ones
- 3) To assess economic feasibility of application of these method for manual honeybee queen rearing

2. Materials and Methods

2.1. Description of the Study Area

The experiment was conducted at Adami Tulu Agricultural Research Center. The research center is located to the south of Addis Ababa 173Km, the capital of Ethiopia, on the main

road to Awassa the main city for Sidama Regional State, Ethiopia.

2.2. Experimental Design and Honeybee Colonies

In this experiment two honeybee queen rearing methods (Morris Board and Splitting) were compared on the aspects of efficiency and cost effectiveness in rearing honeybee queen. A total of six honeybee colonies (three colonies to each technique) were randomly assigned to the different queen rearing methods on random complete block design basis depending on initial honeybee population.

2.3. Queen Rearing Methods: Morris Board, Simple Splitting and Miller

2.3.1. Morris Board Construction Procedures

The conditions and method were brought about by the use of:

- 1) a single-walled hive that has two brood chambers will be used.
- 2) a third brood chamber which was divided into two four-comb chambers by the means of a bee-tight division board (an essential requirement).
- 3) A specifically designed division board.

The screen board was made from a clearer board especially for the purpose. The board was made in such a way that both compartments are bee tight. It should have exactly the same outside dimensions as the hive on which it is to be used. A sheet of plywood or hardboard was framed on both sides with 8mm thick x 25mm wide fillets to provide bee-ways on both sides. The topside of the screen was made to contain a central fillet which divides this side of the screen into two equal parts/divisions. Pieces of the screen board, 100mm x 100mm, were removed from the centre of each side and the openings were covered with robust zinc queen excluder. Parts of the framing fillets were sawn out and pinned in such a box, the screen board and the new compartmentalized brood chamber. The top box was needed to be covered with a separate quilt or crown board, so arranged that bees could not, and might not be allowed to pass from one compartment to the other. Provision was also needed for feeders to be placed on each compartment. The front entrances in the board were opened and the bees quickly adjust to entering the hive in the middle instead of the bottom.

2.3.2. Assembling of Parts and Queen Rearing Operation with Morris Board

The design of the Morris Board is indicated by figure 1 below. A day when the bees were flying freely was chosen. Any queen cell present in the top box was checked and removed. The metal slide was inserted through the front entrance to one compartment (A, say) so as to exclude the bees

in it from the queen below. This entrance was left open and the other two (B and C) were closed. At the same time, the rear entrance (D) in the screen board was opened so that the bees could fly from the bottom box. All flying bees were compelled to crowd into the one top compartment and they are immediately queen less since they can no longer pass through the queen excluder. Bees which made their exit from the hive by means of the rear entrance were also fly back to the front and join the throng. Way as to provide entrances above and below the screen board was in the following positions:

- 1) Below - in the front centre (C)
- 2) Below - in the back centre (D)
- 3) Above - to the whole left-hand side (A)
- 4) Above - to the whole right-hand side (B)

A metal slide was inserted through the upper entrances so as to cover the queen excluder and so make that portion of

the board bee-tight. A liberal smearing of petroleum jelly allows ease of operation. The board can be made to any design provided that it fulfills the following requirements.

- 1) Along with a divided brood chamber which would be placed over the screen board, the board ensured that the two halves of this box are each bee-tight, as previously stated, which was an essential requirement for the success of the procedure. If not, it would fail.
- 2) Entrance from the front can be ensured to each top compartment (A and B) and also, when required, the queen excluder section can be blanked out.
- 3) There is a front entrance (C) to the lower part of the hive in such a position that the bees were not able to distinguish the separate entrances.
- 4) There is a back escape (D) for drones and flying bees from the lower part of the hive.

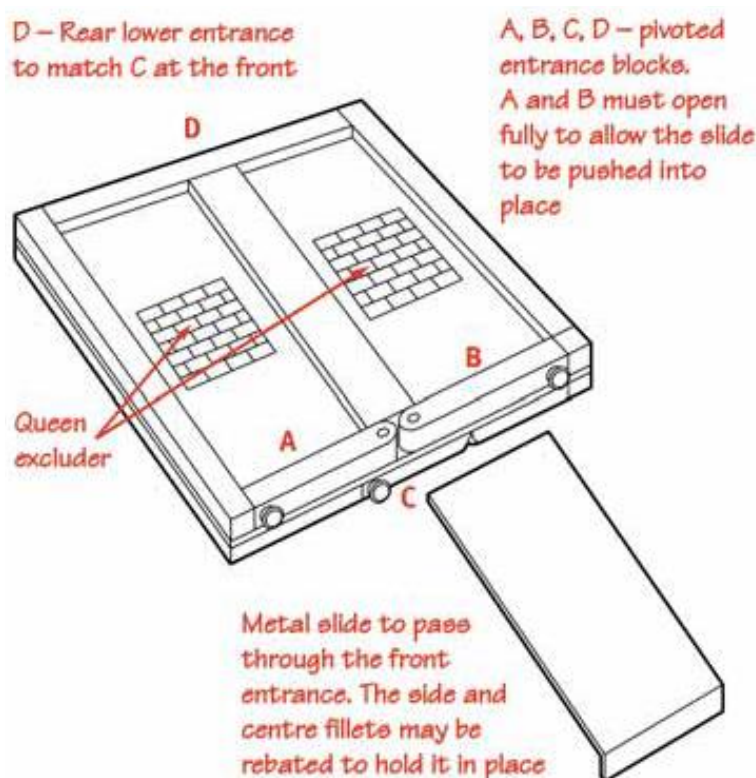


Figure 1. Morris Board Design.

A very strong doubled-up colony, covering 20-22 combs was selected. the third brood chamber, the one divided into two-compartments, was placed alongside the hive and four combs complete with bees were transferred into each compartment - the outer combs with food (honey and pollen) and the inner ones of brood. Each compartment would hold five combs so that there is room for one frame of foundation in the centre of each. The bottom brood chamber is disturbed as little as possible but it is necessary to ensure that the queen is retained in this box. Two or three combs may be left over after the hive has been re-

arranged and these may be utilized elsewhere.

The normal bottom entrance to the hive should be closed or the floor removed and replaced with a flat board with a 'bee space', giving the bees no access. The rearranged hive should comprise the original brood. Each compartment will hold five combs so that there is room for one frame of foundation in the centre of each. The bottom brood chamber is disturbed as little as possible but it is necessary to ensure that the queen is retained in this box.

2.4. Honeybee Queen Rearing Using Splitting Method

Therefore, for this study a total of 3 honeybee colonies in frame hives were used. Those selected honeybee colonies were then further strengthened through provision of supplementary food (sugar syrup in a 2: 1 ratio) before executing the experiment and during the experimental periods and were kept under uniform environmental conditions to forage nectar and pollen sources. Before the starting of the experiment, conditions like the presence of adequate brood and drones were checked. Then after, the experiment was done following the scientific procedures of splitting queen-rearing technique. During experimentation, daughter colonies after splitting were kept in the original apiary and the mother colonies were moved some 500 meters away from the apiary for about 25 days until they established their own mature queens. Follow ups, starting from the third day after splitting, were undertaken and less strong and deformed queen cells were removed on the eighth day. Emergency of the queen was also checked on the sixteenth day after splitting.

3. Results

3.1. Effect of Morris Board and Split Methods on Inducing Honeybee Queen Rearing

Table 1. Effect of Morris Board and Splitting Methods on honeybee queen rearing.

Treatments	Mean+S. E of different queen rearing measurement parameters using Morris and split methods of queen rearing				
	NoQCC	NoQCS	NoQCH	NoNCF	NoQSLE
Morris	29+7.8 ^a	22.2+6.7 ^a	15.7+3.4 ^a	7.7+3.4 ^a	7.7+3.4 ^a
Split	4.5+1.10 ^b	3.1+1.0 ^b	1.6+0.4 ^b	0.45+0.25 ^b	0.42+0.21 ^b

NoQCC=Number of queen cells constructed; NoQCS=number of queen cells sealed; NoQCH=number of queen cells hatched; NoNCF=number of nuclei colony formed; NoQSLE=number of queen started laying eggs

2.5. Data Collection Techniques

During the study the following data were collected using data collection sheets prepared for this purpose: number of queen cells constructed, number of queen larvae developed in to pupae, queen pupae harvested, queens hatched, mated and started laying eggs from parent colonies in the frame, number of multiplied honeybee colonies adapted and time of each reproductive pattern were collected, systematically analyzed and interpreted using appropriate statistical tools.

2.6. Method of Data Analysis

Data was analyzed using SPSS software version 20. Descriptive statistical techniques (mean and frequency) and statistical tests like Paired Test-tests were employed. Independent T-test procedure of SPSS was used for the comparison of the means.





Figure 2. A) Morris Board Constructed with its sliding board at Assella Agricultural Engineering Research Center; B) Morris Board installation procedure; C) Addition of top box after installation of Morris Board during Queen Rearing Operation.

The induction effect of two honeybee queen breeding methods (Morris Board and Split techniques) is shown in Table 1. The study revealed that there were very significant differences ($P < 0.001$) between the two methods of the breeding of honeybee queens in terms of the number of honeybee queen cells constructed, the number of sealed honeybee

queen cells and the number of hatched honeybee queens. Therefore, it was known that Morris Board's honeybee queen breeding method surpassed its counterpart breeding method in all aspects or parameters of honeybee queen breeding activities. However, Morris's management efficiency in the breeding of honeybee queens was far below expectations. This can be mainly explained by the impact of inappropriate climates (high/long rainy seasons or low/short rainy seasons) on current research sites throughout the duration of the experiment.

3.2. Hive Performance of Honeybee Queens Reared Using Different Practices

Table 2 shows the performance of honeybee queens raised with Morris boards and splitting methods. It was known that there was no significant difference ($P > 0.05$) in brood population and pollen and honey store between the treatment groups over the time of observations. This may demonstrate that the present honeybee queen rearing techniques do not have any influence on the quality of honeybee queens produced.

Table 2. Mean of number of comb cells of different hive parameters practices on queen fecundity and honey bee colony performance.

Queen Rearing methods	Worker sealed brood comb cells (Mean $\pm$ S. E)	Pollen store comb cells (Mean $\pm$ S. E)	Honey store comb cells (Mean $\pm$ S. E)
Morris Board	1477.23 $\pm$ 15.58	646.76 $\pm$ 16.98	1425.53 $\pm$ 19.31
Split	1682.53 $\pm$ 40.81	756.22 $\pm$ 17.91	$\pm$ 29.15

3.3. Cost of Honeybee Queen Rearing Methods

In the present experiment, Morris Board's method of breeding honeybee queens showed significant net income

compared to the method of splitting honeybee queens (Table 3). Net income from the breeding of honey bee queens with the help of the Morris Board was up to 34266.6 ETB, while income from the division method fell disappointingly to negative 5833.2 ETB.

Table 3. Financial comparison of Morris Board and Splitting Methods on rearing bee queens.

Queen rearing methods	Variables	R	Q	Price = P	(R*P)	(Q*P)	D
Morris Board	Honey (in KG)	0	20	1000	0	20000	20000
	Labor (Man-days)	2	0	66.7	133.4	0	-133.4
	Morris board	1	0	1000	1000	0	-1000
	Queen bee	0	7.7	2000	0	15400	15400
Total Generated revenue		34267					
Splitting	Honey (in KG)	0	5	1000	0	5000	5000

Queen rearing methods	Variables	R	Q	Price = P	(R*P)	(Q*P)	D
	Labor (Man-days)	4	0	16.7	66.8	0	-66.8
	Morris	0	0	1000	0	0	0
	Queen bee	0	0.45	2000	0	900	900
Total Generated revenue		5833					

4. Conclusion and Recommendation

In recent years, shortage of managed colonies of honeybees has been remained a global problem. A bee breeding has become an integral part of modern beekeeping, and at best plays an important role in supporting beekeeping activities. In the present study, two methods of raising honeybee queens, i.e. the Morris board (new method) and the simple separation method (previous method), were assessed for their performance in raising honeybee queens and operating costs. It was demonstrated that the Morris board method for multiplying the honeybee queen was more promising than the previous practice (departure). It was shown that the average honeybee queen cells were 29 and 5 for the Morris board and the split method, respectively. In addition, the net revenues generated for honeybee queen breeding with Morris board was significantly higher than that generated by the separation method. Therefore, in view of the facts and figures of the study, the following recommendations have been put forward: Farmers should apply Morris board for breeding honeybee queens at low cost and with greater number of breeding honeybee queens. Therefore, demonstration of technology is of principally important considering the country's widespread biophysical differences in order to exploit the technology in an attempt to artificially grow honeybee queens.

Abbreviations

R	Number/Amount of Variable Purchased
Q	Number/Amount of Variable Sold
P	Price of Each Variable in ETB
R*P	Total Cost of Variables
Q*P	Gross Return from Variables
(Q*P)-(R*P) = D	Net Income from Variables

Conflicts of Interest

The authors declare no conflicts of interest.

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