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The Effect of Queen Cell Size Difference in Morphometrics of Bees Queen *Apis cerana*

Sri Minarti*[1)], Arga Rama Yusryansyah[1)] and Dewi Masyithoh[2)]

[1)]Faculty of Animal Science, Brawijaya University, Malang
[2)]Kembang Joyo Sriwijaya Malang

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ABSTRACT: The purpose of the study is to know the influence of *Queen Cell*'s queen on body length, weight, and length of the wing of the ApisCerana bee. The material used is the larvae of *honey bees, honey, royal jelly, and queen's cells*. The method used was a trial using a completely random design with three treatments in each with five repeats. The tested treatment is *Queen Cell* with small, medium, and large sizes. The variable measured is body length, weight, and the length of the queen bee wing. Data analyzed using variance analysis or ANOVA, and if there is a significant effect it will be continued with the double distance test of Duncan. The results showed that the different Queen Cell treatment gives a very significant effect ($P < 0.01$) on each body weight with an average value is 57,30 ± 8,30; 68,20 ± 5,41 and 81,00 ± 7,42 mg, but on length of the body, length of wings and width of thoracic do not give significant effect ($P > 0,05$). The average value of the consecutive body length is12,43 ± 0,41; 12,57 ± 0,09 dan 12,28 ± 0,18 mm, the average value of the consecutive wings is 8,48 ± 0,29; 8,67 ± 0,17 and 8,74 ± 0,17 mm while the average result of the thoracic width size is 4.04 ± 0.11, 4.14 ± 0.05 and 4.22 ± 0.39 mm

Keywords: Honey bee; *Apis cerana;* Queen bee

*Corresponding Author: minartiherman@ub.ac.id

INTRODUCTION

Bee cultivation is an environmentally friendly agribusiness activity and is known to be very beneficial to improve people's welfare. The benefits of bee cultivation development activities are increasing the income and nutritional quality of society. The result of bee cultivation is honey, pollen, royal jelly, beeswax, and propolis. Honeybees also play an important role in assisting the process of plant pollination and natural preservation. Indonesia has several types of honey bees producers*; Apis cerana, Apis dorsata, Apis hoshevinihovi, Apis migrocincita, Apis florae, Apisnullensis,* and*Apismellifera*. One type of bee that has not been developed by the community is *Apiscerana* (local bees) because of its somewhat malignant nature. However, this bee has the advantage of being resistant to bad environments, and not easy to migrate. Its production can reach 20 kg/colony/year.

Development of *Apis cerana* bee still uses in the traditional way including the development of bee queens. Queen bees can be developed by grafting worker larvae into the Queen Cell because the queen's larva and worker larvae come from the same fertile eggs. By moving the larvae into the Queen Cell, automatically the worker bees will take care of the larvae inside. At sufficient times, this larva will develop into a pupa and hatch into a queen bee. With this modern technology, the queen can be obtained quickly, easily, and in mass, so it is expected to increase the productivity of the honey bee *Apis cerana.* The problem is not yet available *Queen Cell* data made in from the making of queen*ApisCerana*. Eventually, it is required to make research on *Queen Cell* size in making *queen Apis cerana*. The purpose of the study is to examine the influence of *Queen Cell* size on body weight, length, length and thorax of bee queen *Apis cerana*

MATERIALS AND METHODS

The research material used is the bee larva *Apis Cerana* age one day, *royal jelly,* and *grafting* equipment. The supporting equipment used is digital scales with 0.01 g precision, a digital wheelbarrow with a thoroughness of 0.01 cm, a scalpel, and tweezers.

Research Method

This research was conducted using the experimental method, consisting of 3 treatments and 5 replications with a *completely randomized design.*

Studied treatment:

P1: Use of the small *Queen Cell*

P2: Use of the medium *Queen Cell*

P3: The use of the large *Queen Cell*

Research Procedure

Research Preparation

Stage of making *Queen Cell*

a. preparing wax as the material for making *the Queen Cell*

- Melt wax then prints with mold in the form of a cylinder-shaped stick with the appropriate size to be tested in table 1.
- The mold of the cylinder-shaped wood is then inserted into the melted wax.
- After the wax sticks to the molded wood, then lifted and left until cold.

After a cold, the wax stuck to the cylinder-shaped stick was removed so that the results were obtained by the artificial *Queen Cell*.

b. The transplant stage of the worker larvae.

- Determining the source colony of the larva is grafted.
- Make a special mark on the nest containing the egg of prospective worker bees.
- When the eggs hatch into larvae. Next, they are grafted into the Queen Cell which has been prepared in advance with the royal jelly in the base. Queen Cell is mounted on a bar frame with a capacity of 20 Queen Cells.
- Then the bar frame with a Queen Cell that has been filled with the larvae grafts is inserted into the special colony (cell builder) until the queen candidate hatches on the next 16 days.

Table 1. The *Queen Cell* size used in research

Treatment	Queen Cell Section (cm)				
	Queen Cell Size Group	Depth	Top Width	Middle Width	Bottom Width
P_1	Small	0,75	0,52	0,65	0,44
P_2	Medium	0,85	0,52	0,71	0,54
P_3	Large	1	0,58	0,71	0,62

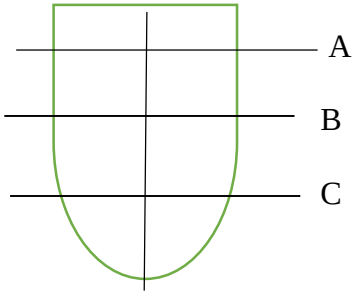

Figure 1. Part of *the Queen cell*

Description:
A: the top width of the *Queen cell*
B: the center width of *the Queen cell*
C: the bottom width of *the Queen cell*
D: the depth width of *the Queen cell*

Research implementation

- Research started when the bar frame with *Queen Cell* artificial inserted into the *cell builder*
- During the growth process, the development of *the Queen Cell* is observed every morning at 07.00
- Humidity and temperature in the colony's box are recorded daily 3 (three) times a day each at 07.00, 12.00 and 16.00
- The colony's table foot is inserted into the container of water so that the *cell builder* is free from ant and insect disorders
- For 16 days the new queen will hatch out of the *Queen Cell*
- Observation of the variables set to be tested
- For ease of measurement, anesthesia is performed against the queen using CO_2

Research Variables

The variables observed in this study are the morphology of the queen produced

Weight

- Measurement of body weight is conducted by the referring method developed by Sutriyono et al (2013)
- Weigh the queen using analytical scales with a capacity of 210 grams with a precision of 0.01
- The queen bees are turned off with alcohol 70% before weighed

Body length

- Measuring body length is conducted by referring to methods developed by Sutriyono et al (2013)
- Using a ruler and a camera with 5x magnification

The bees are turned off with alcohol 70% and then placed on the glass object next to it has been pinned the iron ruler.

Wings length

- Measuring the length of the wings following the method developed by Sutriyono et al (2013)

- Measuring the length of the wings uses a ruler and a camera with 5x magnification
- The bees are turned off with alcohol 70% before being measured and then the queen's bee wing is released from the body of the queen's Bees using tweezers then put on the glass object

Thorax Width

- Measuring the width of the thorax following the method developed by Xiaobo Wu (2018)
- Measuring the width of the thorax using digital calipers
- The bees are turned off with alcohol 70% before being measured and then the queen's bee wing is released from the body of the queen's Bees using tweezers then put on the glass object

Data Analysis

Data is analyzed using analysis of variants if there is a difference, followed by a double distance test Duncan. The best treatment determination is done using De Garmo's effectiveness index. The complete random design, *a* linear model is as follows:

$$Y_{ij} = \mu + \tau_i + \varepsilon_{ij}$$

Description:
Y_{ij}= Observations on the i-treatment and repetition on j
μ = Mean population (common middle value)
τ_i= Influence of i-treatment
ε_{ij}= Treatment test error at i then repeat to j, which is (i = 1,2,.., t dan j =1,2,…r)

RESULT AND DISCUSSION

Influence of treatment of bees body weight queen *Apis Cerana*

It is based on the results of the observation of queen *Apis Cerana* bees as in table 2. It is based on table 2, the average weight of the queen bee body at P_1 = 57.30± 8.30, at P_2 = 68.20± 5.41, and P_3 = 81.00± 7.42 g/queen. Statistical calculations result, indicating that there is a very significant difference in body weight ($P < 0.01$). This factor affects the growth of body weight according to Arun (2011) that with the use of a *Queen Cell* with a diameter of 9 mm, the body weight of a virgin queen is found significantly higher. But the weight of the virgin queen is produced from *Queen Cell* with diameters 8 mm, 10 mm and 11 mm lower than *the Queen Cell* with a diameter of 9 mm.

Table 2. explain the weight rating of queen *Apis Cerana bees.*

Treatment	± SD Average (mg)
P1	57.30± 8.30[a]
P2	68.20± 5.41[b]
P3	81.00± 7.42[c]

Description: [A, B, c] different superscript on the same column indicates a very noticeable effect ($P < 0.01$).

Emsen (2004) and Akyol*et al*. (2008) found a positive correlation between the weight of the queen bee body with the number of *spermatozoa* in *spermatheca* and egg-laying ability. The findings are in line with the research results of Gencer*et al*. (2000) stating that the queen bees with higher body weight produced a wider taller than the queen with lighter body weight. Kuntadi (2013) stated that the larvae have been slightly *royal jelly* with the main content more derived from the *hypopharyngeal* gland. They will develop into individuals who have the characteristics of worker bees. The amount of *royal jelly* given by the worker bees depends on the shape and size of the *Queen cell*s where the larvae develop so that the larger the Queen

Cells' size the higher the weight of the queen bees.

Influence of treatment of Queen Apis Cerana Bee length

It is based on the results of long observations of queen*ApisCerana* bees as in table 3. Based on table 3, the length of the queen bee body is on P1 = 12.43 ± 0.41 mm, P2 = 12.57 ± 0.09 mm, and at P3 = 12.28 ± 0.18 mm. Based on statistical calculations, there are no noticeable differences (P. 0.05) Because of the important factors to get the length of the queen's bee body accordingly that is desired not through *the Queen Cell* size factor but there are other factors that there is the age of bee larva and nutrition factor feed. It is following the opinion of Arun (2011). That*Queen Cell* size does not affect the growth of the body's long bee queen. Kuntadi (2013) also stated that the quality of the queen will be further down with the increasing age of larvae and also the development of queen bees determined by nutritional factors, both number, and composition. It is further explained that the larvae that get more royal jelly with the main ingredient derived from the secretion of mandibular glands will develop into individuals with the characteristics of the queen bees. In contrast, the larvae that get a small amount of royal jelly with more major content are derived from the *hypopharyngea*l gland and will develop into individuals who have characteristics of worker bees and larvae transferred at the age of four days, only a few survive and usually the individual that is born more like a worker bee, but it has several characters of queen bees.

The length or short of the queen's bee body also depends on its race. It can be known that the body of the bee itself serves as the place for important organs to thrive because of one factor ideally capacity *Spermateka* and saving power quantity. The egg can be seen from the queen's body length. This is according to the opinion of Kuntadi (2013) which states that the relative size of the body is relatively larger and weighs more weight which allows the queen bees to have a greater amount of ovariole and sperm-saving power.

Table 3. Describes the average length of the queen*ApisCerana.*

Treatment	Average ± SD (mm)
P1	12.43 ± 0.41
P2	12.57 ± 0.09
P3	12.28 ± 0.18

Effect of treatment on the wings length of queen Apis Cerana

It is based on the results of observations of the queen's bee wings *Apis cerana* as in table 4.

Based on table 4, the length of the queen bees' long rate at P1 = 8.48 ± 0.29 mm, P2 = 8.67 ± 0.17 mm and P3 = 8.74 ± 0.17 mm. Based on statistical calculation results there is an unreal difference between the three treatments due to the age of larvae used to make the queen being similar to 1 day with the same larval grafting method. However, the highest size of the wingspan is produced by the Queen Cell of the largest. Kuntadi (2013) stated that the age of larvae in the transfer method greatly determines the characteristics of the resulting queen. The larvae transferred at the age of 4 (four) days are only slightly sustained and are usually individuals that are born more like worker bees but have some characteristics of queen bees.

According to (Amano et al. 2000) that the body size and size of the wings greatly affect the flying distance of bees looking for food. The bigger the bee's body the farther the distance. *Trigonasp* with a wing size of 5 cm has a flying distance of about 600 m. It can be concluded that there is a link between the length of the body and the length of the wings because the length of the wings will adjust to the length. The wings of the queen bees are useful for the marital process only and this marriage process takes place outside the hive and takes a long time. Therefore it

is anatomically needed the queen of bees with the size of wings according to the body of the queen bees so that the process of marriage runs perfectly.

Table 4. The average length of the queen's bee wings *Apis cerana*

Treatment	Average ± Sd (mm)
P1	8,48 ± 0,29
P2	8,67 ± 0,17
P3	8,74 ± 0,17

Effect of Queen cell size treatment on thoracic width

The results of the observation of thoracic width are presented in table 5.

Based on the results of research on the measurement of thoracic width in table 6, it shows that the average value at P1 is 4.04±0.11 mm, P2 is 4.14±0.05 mm and P3 is 4.22±0.39. Based on the results of statistical analysis, showed that the average result of the thoracic width size of the three treatments had an unreal difference (P > 0.05). This is thought to be because the age of the larvae used is the same, which is 1 (one) day old so the difference in the size of the Queen cell which is not too far does not have a noticeable effect on the size of the thoracic width. The results of the research of Gilley et. Al. (2003) on the physical development of prospective queen bees that develop from younger larvae that have a thoracic width, spermatheca diameter, and greater ovarian weight than queen-to-be individuals derived from old larvae. This means that when the queen comes from the same age as the larvae, then the results of the physical development of the future queen will not differ. This is also strengthened by the opinion of Kuntadi (2013) who states that the larvae of young queen bees will develop perfectly caused of the longer feeding period by worker bees, So that young larvae get a larger portion of royal jelly food. The better the future queen bee, the more perfect the body size of the larva, starting from the pupa to the body weight of the young bee (Delaplane, Van der Steen, and Guzman, 2013).

Table 5. Average Value of the Thoracic Size of the Queen Apis Cerana Bee

Treatment	Average ± Sd (mm)
P1	4.04 ± 0.11
P2	4.14 ± 0.05
P3	4.22± 0.39

The size of the thorax of the queen bee is larger than that of the worker bee and the male bee, causing the queen bee not to easily escape or get out of the stup. Furthermore, Sihombing (1997) stated that the thorax in bees has a hard structure with a 4-segment funnel shape, where the segments of the thorax are closely related.

The largest part of the internal thoracic is filled with muscles that serve to move the wings, legs, head, and abdomen under the coordination of the nervous system. The thoracic segments are; the Prothorax which supports the first pair of legs, the Mesothorax the largest part that supports the wings and the middle leg pair, the Methatorax is a small belt between the second and fourth segment supporting the rear wing pair and the rear leg pair, the Propodeum is an olate. Based on this statement, it is understandable that the larger the size of the thorax, the more cells in the thorax will be strong and strongly support the activities of bees to be able to fly longer distances

CONCLUSIONS

The results of this research can be concluded that the best queen cell is a queen cell with a large size. It is reviewed from the

body weight, length, and length of the wings of the queen bees produced.

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