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Variation in honey yield per hive of Africanized bees depending on the introducing time of young queens

Variação na produção de mel por colmeias de abelhas africanizadas em função da época de introdução de rainhas jovens

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ABSTRACT

The objective of this research was to evaluate the honey production per hive and the egg laying rates of queens produced in 2007, 2008 and 2010. Thirty colonies initiated with a queen per colony at each climatic season were used during the three years. The years, started on January (summer), April (autumn), July (winter) and October (spring) and ended 12 months later, at the same periods related to each season of the later years. Honey supply were weighed before and after centrifugation to evaluate the quantity of the stored honey. Colonies with queens introduced during autumn and winter in the three years produced 57.2±6.0kg and 60.7±7.5kg of honey, respectively. In the first year of production activity, after the introduction of queens in the initial colonies, values were significantly higher than those obtained in colonies with queens introduced in the summer (39.3±7.6kg) and spring (41.8±3.7kg). Egg laying rates of queens were higher in spring (98.2±3.9%) and summer (88.4±7%), indicating greater food flow (flowerings) in these seasons compared to the averages in autumn (30.3±8.1%) and winter (24.5±7.2%). Produce and introduce queens of Africanized ***Apis mellifera*** *in colonies initiated during autumn and winter was found to be economically feasible. Honey production of colonies initiated in these periods were higher and they had greater population stability in times of scarcity of flowerings.*

Key words: *apiculture, climatic season, egg laying rate.*

RESUMO

O objetivo deste trabalho foi avaliar a produção de mel por colmeia e as taxas de postura de ovos das rainhas produzidas nos anos de 2007, 2008 e 2010. Foram utilizadas 30 colônias iniciadas com uma rainha/colônia por estação climática, durante os três anos. A cada ano, iniciou-se em: janeiro (verão), abril (outono), julho (inverno) e outubro (primavera) e encerrou-se doze meses depois, nos mesmos períodos referentes a cada estação dos anos posteriores. As melgueiras foram pesadas antes e depois da centrifugação para avaliar a quantidade do mel estocado. As colônias com rainhas introduzidas durante o outono e o inverno nos três anos produziram 57,2±6,0kg e 60,7±7,5kg de mel, respectivamente, no primeiro ano de atividade de produção após a introdução das rainhas nas colônias iniciais, valores significativamente superiores aos obtidos para as colônias com rainhas introduzidas no verão (39,3±7,6kg) e na primavera (41,8±3,7kg). As taxas de postura de ovos das rainhas foram mais altas na primavera e no verão (98,2±3,9% e 88,4±7%, respectivamente), indicando maior fluxo de alimento (floradas) nessas épocas, quando comparadas às médias do outono e inverno (30,3±8,1% e 24,5±7,2%, respectivamente). Constatou-se que é economicamente viável produzir rainhas e introduzir em colônias iniciais de ***Apis mellifera*** *africanizada durante o outono e inverno. Além da produção de mel das colônias iniciadas nesses períodos ser superior, elas terão maior estabilidade populacional em épocas de escassez de floradas.*

Palavras-chave: *apicultura, estação climática, taxa de postura.*

INTRODUCTION

In the last few decades, there are inumerous scientific researches applied to the Brazilian apiculture. These researches are of high quality and enable acquisition about management techniques that ensures an increase in honey production per hive (SABBAG & NICODEMO, 2011). The various productive activities involved in apiculture are very influenced by adult bee population present in each colony. Therefore, beekeepers must know the queens age, and periodically

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assess the performance of their colonies, and they may intervene in the queen natural replacement process when necessary, replacing an old queen for a younger one with the desired characteristics and at the right time (MORETTO et al., 2004).

In the region of Dourados, MS, most beekeepers work with swarms captured in the wild, which have several behavioral characteristics, which are similar to those presented by African bees originally introduced in Brazil, expressing a wide phenotypic diversity (FAITA et al., 2014). SILVA & FREITAS (2004) reported that losses resulting from the low honey productivity are caused by genetic inheritance of unfavorable characteristics that these colonies captured in the wild may have, and that these swarms possibly carry parasites and potential vectors of harmful diseases to the bees.

MILFONT et al. (2009) evaluating honey production in hives of Africanized ***Apis mellifera*** from unknown origin and hybridization degree, in a commercial plantation of castor beans (***Ricinus communis*** L.) in the state of Piaui, reported a wide variation in honey yield per colony, with a 24.1kg difference between the most and least productive hives. DE SOUZA et al. (2012) collected swarms in the wild and evaluated the honey production of the obtained colonies at the time of greatest nectar flow (August to November) in the region of Salvador, BA, and reported an average yield per hive of 12.8±10.9kg per year. The low annual average production may be related to the genetic diversity of the queens captured with wild swarms (AL-GHZAWI & ZAITOUN, 2008), emphasizing the importance of producing selected queens in their own apiaries.

There is a positive correlation between the offspring production and the nectar and pollen foraging intensity (FEWELL & WINSTON, 1992). Colony expansion depends on the offspring production and population size, which stimulate honey production in times of abundance of nectar and pollen. Thus, understanding the appropriate biology and development cycle of the colonies to the environmental conditions of each location where the apiculture is practiced, is very important.

Therefore, beekeepers must determine the favorable months for management and exchange of queens in their apiaries, comparing the honey yields of the colonies with young queens in different seasons, seeking to understand the interaction between the amount of offspring produced by a young queen and food availability (pollen and nectar), in order to make maximum use of the main flowerings in the places where the hives are located.

Considering the scarcity of information in the literature related to the favorable time to initiate colonies and to introduce queens of Africanized ***Apis mellifera***, the objective of this research was to evaluate the honey yield per hive and the egg laying rate of queens depending on different climatic seasons in different years.

MATERIALS AND METHODS

This research was carried out in a region with humid subtropical climate and hot summers, located in a remnant of Atlantic Forest in Dourados, southern Mato Grosso do Sul, Brazilian Midwest (22°13’04”S 54°55’22”W). This area is characterized by hot, rainy springs and summers, and semi-arid conditions in autumns and winters with sudden drops in temperature (KOTTEK et al., 2006). The apiary was installed near an Atlantic Forest reserve (about 200ha), surrounding by pasture, corn and soy crops, and areas containing riparian forests.

The queens used in this research were obtained by transferece of larvae using the technique described by DOOLITTLE (1899) cited by TOLEDO et al. (2012), from colonies that yielded more than 70kg of honey per year. After fertilization, the queens were introduced to the colonies initiated in Langstroth model boxes with 10 frames: five containing a beeswax honey combed layer and five with brood combs, honey, pollen and sufficient worker bees to cover the offspring and food, in order to minimize the population difference between colonies.

Evaluations were conducted in 10 colonies at each climatic season each year (2007, 2008 and 2010), i.e., 30 colonies per season, totaling 120 colonies evaluated during the three years. Introduction of queens and evaluations started in the following periods: January (summer), April (autumn), July (winter) and October (spring) and ended 12 months later, at the same periods related to each climatic season of later years (2008, 2009 and 2011). Thus, honey production per hive was evaluated with new queens fertilized during the first year after their introduction, since young queens are more productive during the first year (KOSTARELOU-DAMIANIDOU et al., 1995). Visits were carried out every 30 days to add layers (honney supers) when necessary to suply the colony expansion needs and honey deposition, thus avoiding possible overcrowding because of lack of space. At the end of each repetition (one year), all supers were withdrew and weighed before and after centrifugation to evaluate honey stored weight in each hive.

A clean honeycomb was introduced in the central part of each hive after oviposition of 10 fertilized queens have started at each climatic season of each year. Honeycombs were inspected using a labeled frame with horizontal and vertical wires divided into 40 equal quadrants, thus obtaining the number of quadrants which had eggs two days after clean honeycomb introduction, enabling to compare the egg laying rates of four climatic seasons.

To compare whether the four treatments (climatic seasons when queens were introduced) and three replicates (years) presented significant differences in honey yields, the parametric analysis of variance (ANOVA) was applied followed by the Tukey test, at 5% of significance level. The Kruskal-Wallis test at 5% significance level was also applied, in order to determine whether the four treatments (climatic seasons) and three replicates (years) presented significative differences in egg laying rates. The Kruskal-Wallis test, a nonparametric analysis, was chosen because the variables did not fit the normal distribution, as recommended by DAWSON & TRAPP (2003).

Pearson's correlation coefficient was calculated at 5% significance level to establish the association between egg laying rate (the independent variable) and honey production (dependent variable), which were grouped by average values of each climatic season. The BioEstat program was used to calculate the ANOVA, the Kruskal-Wallis test and the Pearson correlation coefficient, as proposed by AYRES et al. (2007).

RESULTS AND DISCUSSION

The average honey yield from hives containing fertilized queens introduced in the autumn (57.2±6.0kg) and winter (60.7±7.5kg) were significantly higher than that reported for hives whose queens were introduced summer (39.3±7.6kg) and spring (41.8±3.7kg) (Figure 1).

The egg laying rates during spring (98.2±3.9%) were significantly higher than the rates from other seasons. Autumn (30.3±8.1%) and winter (24.5±7.2%) rates were significantly lower when compared to summer (88.4±7%) and spring (Figure 2) rates, confirming a greater nectar and pollen flow during the spring and summer.

Significant negative correlation between egg laying rate and honey yield in the evaluated colonies ($r_{(3)}$=-0.955; P=0.0446) indicated that queens introduced in autumn and winter had sufficient time to increase population in the colony (see Figure 2), showing a better use of flowerings that began in spring and ended in mid-summer of the following year, when the largest egg laying rates were reported in

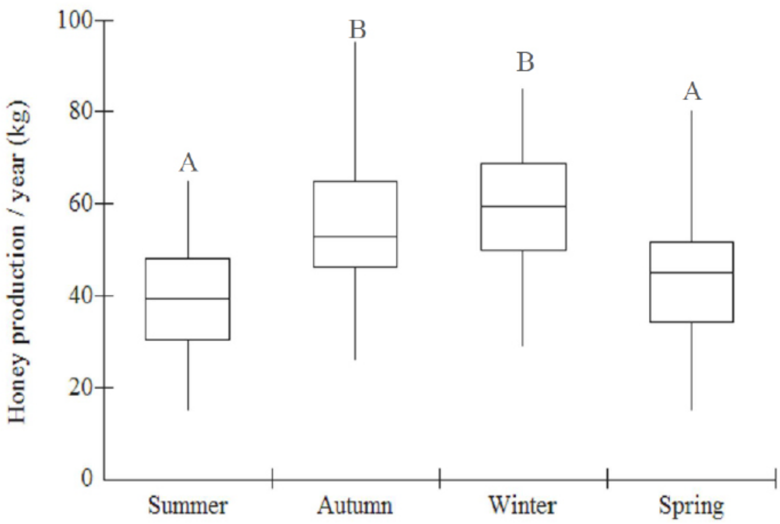

Figure 1 - Honey production per hive thoughout a year depending on the climate season the queen bee was introduced. Equal letters indicate no significant difference (F(3)=14.00, P<0.0001).

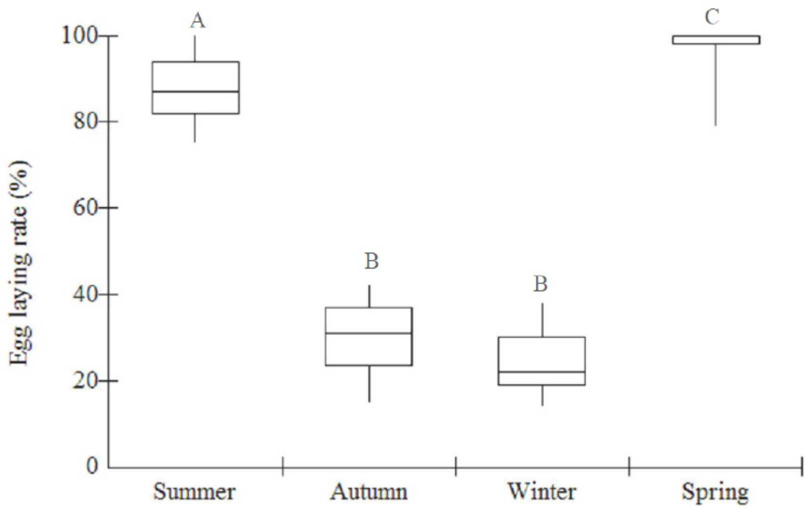

Figure 2 - Egg laying rate (in percentages) per hive depending on the climate season the queen bee was introduced. Equal letters indicate no significant difference (H(3)=99.49, P<0.0001).

the studied region. The higher the food flow, the better the queen is feeded, stimulating it to increase the egg laying rate and, consequently, offspring production, colony population size and number of forage workers (LE CONTE et al., 2001 ; PANKIW 2004).

The offspring stimulate the foraging for food resources in general, thus the amount of pollen and nectar (honey) collected by a colony of ***Apis mellifera*** depends on the amount of forage workers and the offspring (eggs, larvae and pupae) present in this colony, and these two variables depends on the population size of the colony (PEGORARO et al., 1999). The evaluated colonies were initiated with the same population size, thus there was no enough time for the colonies with queens introduced in the period of largest egg laying rates (spring and summer) to reach a satisfactory population in the most favorable period (flowering) for a good honey production.

TOLEDO et al. (2012) observed Africanized bees producing more queen cells in periods with plenty food, even with young queens, confirming its swarming trend, resulting in the natural replacement of queens. This factor was inhibited during the experiment by adding layers (honney supers) for honey deposition before the periods of greater nectar flow, hence inhibiting the queen cell production due to lack of space.

According to informations from beekeepers who are working in the region for more than 20 years, the periods of greater nectar flow and/or honey input in hives are during spring and summer (September to March). DEGRANDI-HOFFMAN et al. (2007) justified the advantages of introducing queens in hives, few months before, in Arizona (USA), explaining that the colonies would spend the winter with a new queen, ensuring a large number of young bees during the winter and a better colony population stability in early spring when the flowerings become abundant.

In tropical climate regions, autumn and winter are not unstable enough to hinder the production and replacement of queens, thus ensuring an increase in the annual production of honey per hive. In addition, the colonies reached population stability even with low nectar and pollen flow, since, according to KOSTARELOU-DAMIANIDOU et al. (1995), young queens are more prolific. These facts can be directly related to the lower weakening of colonies caused by less stable climatic conditions during autumn and winter in the evaluated region. Queens introduced in the spring and summer became stable and productive when approximately half of the main flowering period had passed, thus decreasing the annual honey production.

CONCLUSION

The better use of the annual flowering was reported in colonies initiated with queens fertilized and introduced during the autumn and winter, greatly increasing the honey annual yield per hive and the economic viability of apiaries. Thus, the production and introduction of new queens (selected) in hives during these periods is suggested to beekeepers, in order to ensure them a greater production of honey for their colonies and; therefore, a better financial return.

BIOETHICS AND BIOSSECURITY COMMITTEE APPROVAL

We authors of the article entitled "Variation in honey yield per hive of Africanized bees depending on the introducing time of young queens" declared, for all due purposes, the project that gave rise to the present data of the same has not been submitted for evaluation to the Ethics Committee of the Universidade Estadual Paulista "Júlio de Mesquita Filho", but we are aware of the content of the Brazilian resolutions of the National Council for Control of Animal Experimentation - CONCEA <http://www.mct.gov.br/index.php/content/view/310553.html> if it involves animals.

Thus, the authors assume full responsibility for the presented data and are available for possible questions, should they be required by the competent authorities.

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