

Title: Relation of the mortality of honeybees *Apis mellifera* with the management practice of the annual replacement of queens

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Abstract

The whole world is focused on the phenomenon CCD (Colony Collapse Disorder), which has caused the disappearance of honeybees *Apis mellifera*. In Brazil is not different and therefore the objective of this study was to evaluate the efficiency of the replacement of queens to minimize this loss and reduce mortality. The annual replacement of queens showed greater power of adaptability to stress and external factors, maintaining a higher survival of beehives in the two years that the phenomenon CCD occurred, the cause of this mortality in the apiary still unknown. In the production season of 2006/07 the beehives without replacement of queens showed 100% of mortality and the beehives with annual replacement of queens showed 57,77% of mortality. In the production season of 2007/08 the beehives without replacement of queens showed 80% of mortality and the beehives with annual replacement of queens showed 33,33% of mortality, showing a significant difference between the treatments in the two studied seasons.

To maintain the apiary alive and to substitute the dead beehives for another colonies, the capture of natural swarms is an effective practice in Brazil, but only becomes viable for the honey production if is associated with the management of replacement of the queen after the capture.

Introduction

Beekeeping is an essential component of modern agriculture, providing pollination services, production of honey, propolis, royal jelly, wax, apitoxin and pollen. Honey bees play a critical role in many food webs that support wildlife. Last years the vulnerability of the honey bees concerned all beekeepers and researchers, as the bees were showing incapability to support the adverse effects of stress, the variability included the climate and the extreme events.

During the winter of 2006 to 2007, beekeepers in the United States became alarmed that honey bee colonies were dying in large numbers, with reported losses of 30 to 90 percent in some beekeeping operations. The increased stress, management practices, environmental changes or a new, unidentified agent could potentially be responsible. This unexplained cause of death has been given the name “Colony Collapse Disorder,” or CCD (Spivak, M., 2008). Subsequent investigations suggested that these outbreaks of unexplained colony collapse have been occurring for at least two years.

In Brazil, reports about the CCD have been made by beekeepers around the country: Piau , Rio Grande do Sul, Minas Gerais and S o Paulo. There are reports of cases with losses of 400 beehives (Malaspina,O.; et al, 2008).

The symptoms of CCD includes: (i) sudden loss of the colony’s adult bee population with very few bees found near the dead colonies; (ii) several frames with healthy, capped brood with low levels of parasitic mites, indicating that colonies were relatively strong shortly before the loss of adult bees and that the losses cannot be attributed to a recent infestation of mites; (iii) food reserves that have not been robbed, despite active colonies in the same area, suggesting avoidance of the dead colony by other bees; (iv) minimal evidence of wax moth or small hive beetle damage; and (v) a laying queen often present with a small cluster of newly emerged attendants (USDA, 2009).

Management practices and environmental factors have identified a few common factors shared by those beekeepers experiencing CCD. Among the most important management practice is replace the queen every year, in order to maintain the colony strong, healthy and productive.

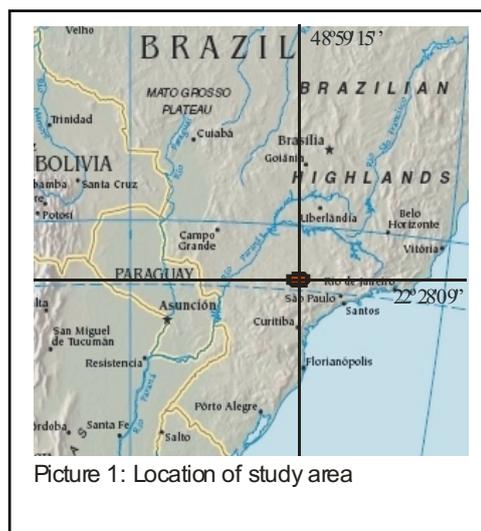
Most beekeepers in Brazil do not replacement failing queens in their hives, because the cost of the queens, the cost of transport to the apiaries, the difficulty to find

the queen in heavily populated colonies (in Brazil only owned queens are marked). Beekeepers in Brazil present low use of technical methods in their colonies, more than 90% do not replace queens, causing a large percentage of beehives that do not produce honey (Soares, A., 1996).

The beekeepers that replace queens in Brazil do it usually at the beginning (September) or at the end (May) of the production season. The most important benefit of requeening is provide prolificacy to the colonies. In addition, the new queen can improve some brood disease and support more stress and climate variability conditions. This work aims to compare the relationship between the mortality of the colonies of honeybees (*Apis mellifera*) with the management of the annual exchange of queens.

Materials and methods

This research was conducted in “Apiário Raiz”. Located at the city of Agudos – Sao Paulo State/ Brazil. Situated on latitude 22°28’09’’S, longitude 48°59’15’’W and altitude 585m. Tropical climate with moderate temperature and hot summer with an annual temperature average of 21°C, annual rainfall average of 1600mm. Region characterized with natural capital of “Cerradão”, a native phytofisionomy of Sao Paulo State.



The “Apiário Raiz” exists since 2003 and had approximately 60 Langstroth beehives distributed 4 meters of distance between hives and never had mortality in the 3 productions seasons before the productions seasons of 2006/07 and 2007/08. To study one of the possible cause of these suddenly mortality, was analyzed one practical management in the apiary: The annual replacement of queens.

In the beginning of the nectar flow in the production season of 2006/07, approximately in middle of September (spring) the apiary had 15 beehives without replacement and control of the queen’s age and 45 beehives with annual replacement of queens using the natural method of queen production. The natural method of production

of queens consists on finds and removes the queen from the beehive, and put the frames with larvae with less than three days in the center of the hive interspersed with frames with emerging bees and mature brood; in the side of hive were put frames with honey and pollen. The colony produces their own queens-cells and consequently a new queen. The natural method of queen production was made on the end of the previously season, on May of 2006.

The production of queen-cells by natural methods in light wax showed an average of $13 \pm 2,53$ and in dark wax showed an average of $5 \pm 1,73$, being viable for all beekeepers (Correa Neto, A.;Ribeiro, A., 2006).

When the colonies started to die on November of 2006 the practice of capture natural swarms was installed to maintain the activity in the next season. This practice consists on install Langstroth hives with 10 frames with wax around the apiary and waits for some natural swarm enter in the hive, were installed 20 hives for capture natural swarms. On May of 2007 all the hives that captured swarms were put together in the apiary.

Near to the end of the production season on April, the practice of multiplication of colonies by the division method was made to increase the number of colonies, facing the big mortality in the present season.

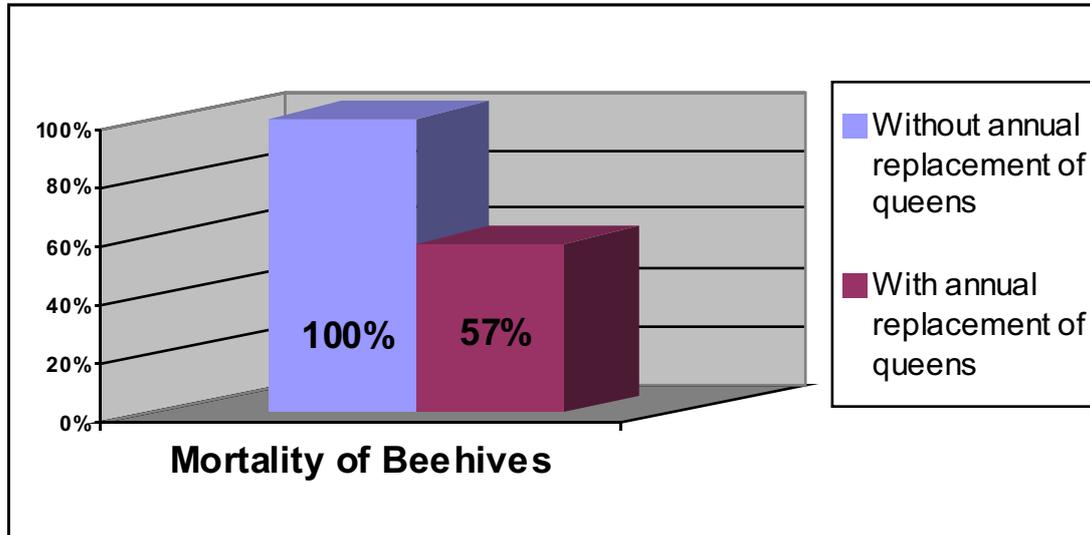
The production season of 2007/08 had 15 beehives without replacement and control of the queen age, and 30 beehives with annual replacement of queens using the natural method of queen production.

In both analyzed productions seasons were considered as a season the period of nectar flow in the region. Period that Begins on September (spring) and finishes on May (end of autumn), one season with approximately 8 months of duration. After the winter, in the beginning of the nectar flow all the beehives were exposed to the same climatic conditions and management practices.

Results and discussion

In the production season of 2006/07 the beehives without replacement and control of the queen age showed 100% of mortality and the beehives with annual replacement of queens using the natural method of queen production showed 57,77%, showing a significant difference between the treatments.

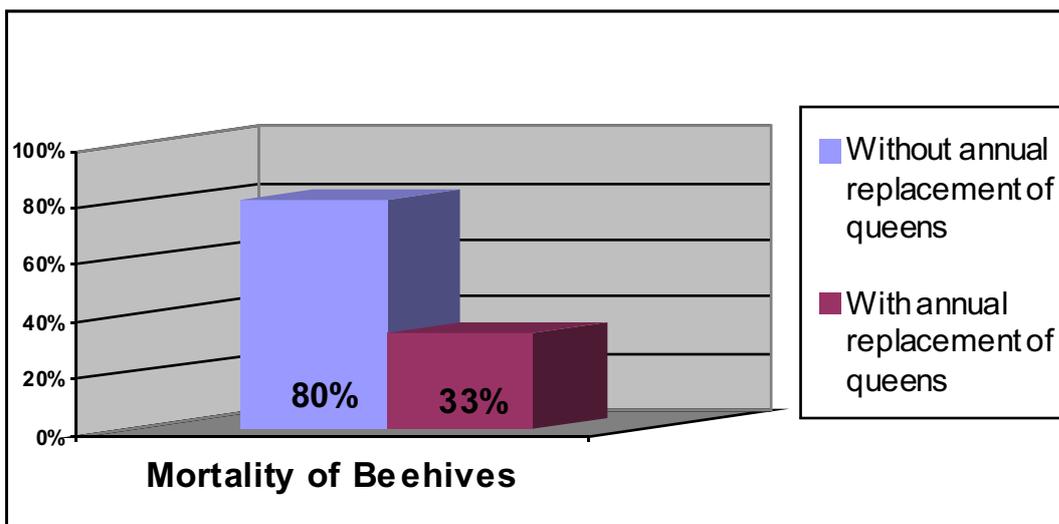
(Silva, E. 1996) reported that the basic condition for an efficient and profitable beekeeping is the creation of the habit of renewing the queens of the apiary. According (Duay, R. 1996) the replacement of the old queen for a selected queen increases in 46% the honey production in the apiary.



Graphic 1: Production season 2006/07

In the production season of 2007/08 the beehives without replacement and control of the queen age showed 80% of mortality and the beehives with annual replacement of queens using the natural method of queen production showed 33,33%, showing a significant difference between the treatments.

(Souza, D. 2001) stated that the practical management of replace the queen every year is the most important practice for the implementation of a productivity beekeeping.



Graphic 2: Production season 2007/08

The apiary including all the beehives in the season of 2006/07 showed 68,33% of mortality and in the season of 2007/08 showed 48,88% of mortality.

The colonies are fixed and located in native vegetation without the influence of crops with pesticides and in the 3 years preceding the apiary had not suffered any mortality of beehives, either with or without an exchange of queens. For these reasons was assumed that some unknown factor or climate change had caused the death of the hives without explanation.

The cause of CCD has not been determined however many theories have been postulated including starvation, viruses, mites, electromagnetic radiation or pesticide exposure (Hayes, J., 2007)

Was noted a recovery of the adaptability of bees with the significant decrease of mortality among the two stations with mortality.

The hives installed to capture natural swarms had an acceptability of 75%, meaning that this practice is viable to increase the number of colonies in the apiary, but to increase the productivity and to maintain the colony alive, the practice of replace the queen every year must be complementary after the swarm start with normal activity in the hive.

The simple replacement of queens in captured natural africanized swarms increased the production of honey in 22%. When the replacement was performed with selected queens this increase reached 41%, and in apiaries without selection the production could be insignificant. (Duay, R. 1996)

Conclusion

The annual replacement of queens showed greater power of adaptability to stress and external factors maintaining greater survival of beehives in the two years that the CCD phenomenon occurred, the causes of mortality in colonies of the apiary which was started in 2006 and lasted for two years still unknown. The capture of natural swarms is an effective practice for increase the number of colonies in Brazilian apiaries, but only becomes viable for the production of honey or other products if is associated with the management of replacement the queen after the capture.

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