Electronic Journal of Polish Agricultural Universities is the very first Polish scientific journal published exclusively on the Internet, founded on January 1, 1998 by the following agricultural universities and higher schools of agriculture: University of Technology and Agriculture of Bydgoszcz, Agricultural University of Cracow, Agricultural University of Lublin, Agricultural University of Poznan, Higher School of Agriculture and Teacher Training Siedlce, Agricultural University of Szczecin, and Agricultural University of Wroclaw.

ELECTRONIC JOURNAL OF POLISH AGRICULTURAL UNIVERSITIES

2003
Volume 6
Issue 2
Series BIOLOGY

CZEKOŃSKA K., TOFILSKI A., KLEPACZ J. 2003. INFLUENCE OF AGE OF WORKERS IN MATING NUCLEI ON HONEYBEE (*APIS MELLIFERA*) QUEENS **Electronic Journal of Polish Agricultural Universities**, Biology, Volume 6, Issue 2.
Available Online http://www.ejpau.media.pl

INFLUENCE OF AGE OF WORKERS IN MATING NUCLEI ON HONEYBEE (*APIS MELLIFERA*) QUEENS

Krystyna Czekońska, Adam Tofilski, Joanna Klepacz
Bee Research Department, Agricultural University of Cracow, Poland

ABSTRACT

Virgin queens were introduced into mating nuclei containing workers of different ages. The study verified whether workers younger than 8 days, comprising the younger group, are more suitable for mating nuclei than workers older than 10 days, comprising the older group. In both groups, 7 (35%) queens were lost during mating flights. The time from introduction of queens into mating nuclei to the start of egg laying in mating nuclei with younger and older workers was 13.69 and 13.73 days, respectively. Two queens in mating nuclei with older workers did not start egg laying before the 20th day when the experiment was terminated. No influence of age of workers in mating nuclei on the performance of honeybee queens was found.

Key words: *Apis mellifera*, honeybee queen, workers age, mating nuclei.

INTRODUCTION

Mating nuclei are small colonies into which young honeybee queens are introduced before their mating flights [14,17]. Age of workers in the mating nuclei can be an important factor affecting the performance of the queens. Only old workers have been observed to attack queens to persuade them to leave the hive for the mating flight [8,15]. Thus the presence of old workers in mating nuclei can be profitable because they can stimulate the queen to earlier mating flights and in effect earlier egg laying. However, other forms of aggression of old workers towards the queen can lead to its death [18,22], and older workers are more likely to be infected with *Nosema apis* or other pathogens and pass them to the queen [2,6,10]. Queens infected with *N. apis* spread the parasite not only among colony members but also among different apiaries when distributed by queen-breeding farms

[3,5,10,12]. The use of young workers in mating nuclei can significantly reduce the spread of the parasite [7,12], but workers used to populate mating nuclei cannot be too young. Very young workers are not able to regulate temperature [13] and probably cannot provide optimal conditions for their queen. As it is known that workers younger than 4 days are not suitable for mating nuclei [8], we verified whether workers younger than 8 days can be used instead. We compared acceptance of queens, mortality during mating flights, and age of queens at the start of egg laying, in mating nuclei with workers younger than 8 days or older than 10 days.

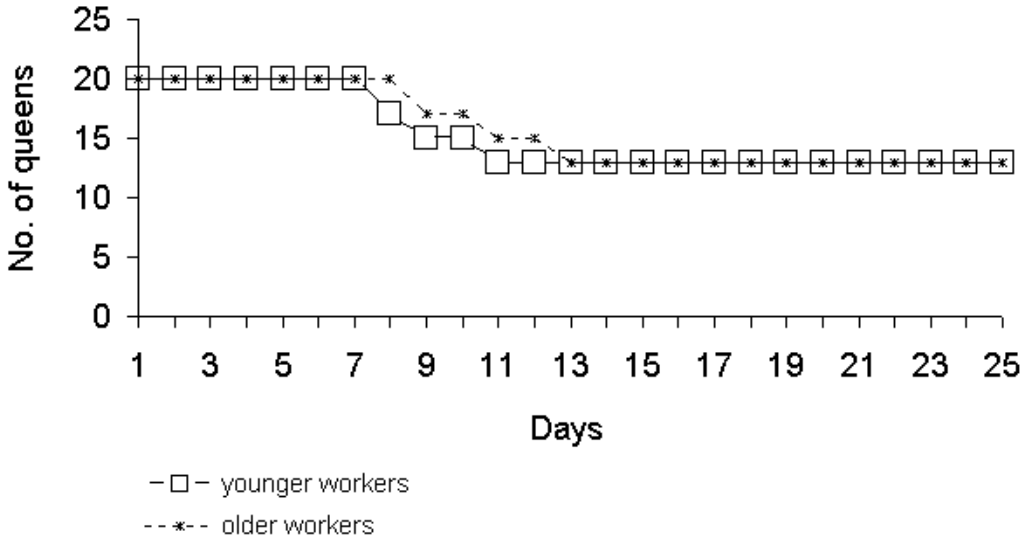
MATERIALS AND METHODS

The experiment was carried out in June 2000. Honeybee queens (*Apis mellifera carnica*) were derived from one queen inseminated with semen of one drone. The difference in age between the youngest and oldest queens was not greater than 12 hours. Two groups of 20 mating nuclei were created, one with younger workers and the other with older workers. Age of the workers in the younger group was between 1 and 8 days. To obtain those workers, 20 frames with sealed brood but without workers were moved to empty boxes placed above large colonies 9 days before formation of the mating nuclei. Workers from the bottom boxes provided the appropriate temperature for the brood in the upper boxes. Wire mesh was placed between the boxes to prevent the emerging workers from mixing with workers from the bottom boxes. In the older group the workers were older than 10 days. To obtain those workers, all sealed brood were removed from the colony and only unsealed brood and eggs were left 10 days before mating nuclei formation. Eight days later the colony was dequeened and moved to another place in the apiary. Before mating nuclei formation the workers from both groups were moved to a swarm box and sprayed with sugar solution. About 1/3 L of workers, two frames with foundations and one frame with newly built comb in each mating nuclei. After introduction of a queen the newly created mating nuclei were kept at 14°C for two days. On the first day of the experiment, assumed to be the day of formation of mating nuclei, the queens were in their first day of life. The mating nuclei were placed in 6 rows 1.5 m apart, and separated 1.5 within each row. The mating nuclei were inspected every day. During the inspection the presence of the queen and eggs was verified and food was replenished if needed. Meteorological data were obtained from a meteorological station 200 m from the apiary. The G test and Mann-Whitney U test were used for statistics [21].

RESULTS

In both groups all introduced queens were accepted. In both groups, 7 (35%) queens were lost. In the younger group the queens were lost between 8th and 11th day of experiment. In the older group the queens were lost between 9th and 12th day of experiment (Fig. 1). The differences in the ages of queens lost were not statistically significant between groups (Mann-Whitney U test: $U = 114.5$, $p > 0.05$).

Fig.1. Losses of queens in mating nuclei with workers younger than 8 days and older than 10 days



During the experiment the weather was variable, and particularly unfavorable between days 7 and 11, when it rained occasionally, wind speed was up to 7.9 m/s, and daily average temperature ranged between 11.9 and 20.8°C.

Queens in mating nuclei with younger and older workers started egg laying at age 13.69 ± 1.32 and 13.73 ± 1.27 days (average ± SD), respectively. The differences between the groups in the ages of queens at first egg laying were not statistically significant (Mann-Whitney U test: $U = 71.5$, $p > 0.05$). Two queens from the older group did not start egg laying before the end of the experiment. Microscopic analysis revealed that their ovaries were degenerated.

DISCUSSION

It has been suggested that the age of workers in mating nuclei affects the acceptance of introduced queens [7]. This was not confirmed in the present study; all queens were accepted in both groups. Nor did the age of the workers influence the start of egg laying. In other studies such an effect has been found only in the case of very young workers [8,11].

Most losses of honeybee queens happen during mating flights [4,14,16,20], can range from 20% to 43% [9,16], and can be due to unfavorable weather, predators or getting lost [9,16]. According to Sliva et al. [19] a very important factor is wind. During the experiment presented here the weather conditions were unfavorable. This can explain the high mortality of queens we observed. The age of the workers in the mating nuclei did not affect queen mortality.

According to Allen [1], the workers feeding the queen are younger than 8 days. In our experiment the queens performed as well in mating nuclei with workers younger than 8 days as in those with workers older than 10 days. Because younger workers are healthier than older ones as a rule, we suggest that workers younger than 8 days are more suitable than older workers for mating nuclei.

CONCLUSIONS

The age of the workers in the mating nuclei affected neither the mortality of virgin queens nor the time before the queens started egg laying. Therefore we suggest that workers younger than 8 days, which were exposed to risk of infection during shorter time, are more suitable for mating nuclei than older workers.

ACKNOWLEDGMENTS

We thank Michael Jacobs for helpful comments on earlier versions of this paper. This work was supported by KBN grant 5P06C01314

REFERENCES

1. Allen M.D. (1960) - The honey queen and her attendants. Anim. Behav. 8: 201-208.
2. Bailey L., Ball B.V. (1991) - Honey bee pathology. Academic Press, London.
3. Camazine S., Cakmak I., Cramp K., Finley J., Fisher J., Frazier M., Rozo A. (1998) - How healthy are commercially – produced U.S. honey bee queens? Am. Bee J. 138: 677-680.
4. Czekońska K. (2000) - The influence of *Nosema apis* on young honeybee queens and transmission of the disease from queens to workers. Apidologie 31: 701-706.
5. Czekońska K. (2001) - Quality of honeybee queens commercially available in southern Poland. J. Apic. Science 45: 5-11.
6. Fries I. (1997) - Protozoa, in: Morse R.A. and Flottum K. (Eds.), Honey bee pests, predators, and diseases, A.I. Root Company, Medina, Ohio, USA, pp. 57-76.
7. Gregorc A., Fijan N., Poklukar J. (1992) - The effect of *Apis mellifera carnica* Polm worker bee source for populating mating nuclei on degree of infection by *Nosema apis* Zander. Apidologie 23: 241-244.
8. Hammann E. (1957) - Wer hat die initiative bei den Ausflügen der Jungkönigin, die Königin oder die Arbeitsbienen? Insectes Soc. 4 (2):91-106.
9. Hellmich R.L., Danka R.G., Rinderer T.E., Collins A.M. (1986) - Comparsion of Africanized and European queen-mating colonies in Venezuela. Apidologie 17 (3): 217-226.
10. Jay S.C. (1967) - The problem of infertile and Nosema experiment infected queens. Manitoba Entomol. 1: 14-17.
11. Konopacka Z. (1989) - Czynniki wpływające na wyniki sztucznego unasieniania matek pszczelich i ich jakość. Praca habilitacyjna, Puławy.
12. Loskotova J., Peroutka M., Vesely V. (1980) - Nosema disease of honeybee queens (*Apis mellifica* L.). Apidologie 11: 153-161.
13. Roth M. (1965) - La production de chaleur chez *Apis mellifera* L. Ann. Abeille 8 (1): 5-77.
14. Ruttner F. (1983) - Queen rearing. Apimondia Publishing House, Bukarest, Romania.
15. Ruttner F. (1985) - Reproductive behaviour in honeybees, in: Hölldobler B., Lindauer M. (Eds.), Experimental behavioral ecology and sociobiology, Sinauer Associates, Inc. Sunderland, Massachusetts, pp. 225-236.
16. Ruttner F. (1988) - Biogeography and Taxonomy of Honeybees. Springer-Verlag, Berlin.
17. Szabo T.I. (1987) – Queen rearing in northern California. Am. Bee. J. 6: 444-448.

18. Szabo T.I., Townsend G.F. (1974) - Behavioural studies on queen introduction in the honeybee, 1. Effect of the age workers (from a colony with a laying queen) on their behaviour towards an introduced virgin queen. J. Apic. Res.13 (1): 19-25.
19. Silva da E.C.A., Silva da R.M.B., Chaud-Netto J., Moreti A.C.C.C., Otsuk I.P. (1995) - Influence of management and environmental factors on mating success of Africanized queen honey bees. J. Apic. Res. 34 (3): 169-175.
20. Soczek Z. (1958) - Obserwacje nad lotami matek pszczelich. Pszczel. Zesz. Nauk. 2 (2): 79-91.
21. Sokal R.R. Rohlf F.J. (1981) - Biometry. W.H. Freeman and company. N. York.
22. Yadava R.P.S., Smith M.V. (1971) - Aggressive behavior of *Apis mellifera* L. workers towards introduced queens. III. Relationship between the attractiveness of the queen and worker aggression. Can. J. Zool. 49: 1359-1362.

Krystyna Czekońska, Adam Tofilski, Joanna Klepacz
Bee Research Department
Agricultural University of Cracow
29 Listopada 52, 31-425 Cracow, Poland
Tel: +48 12 4173443
Fax: +48 12 4111322
e-mail: kczekon@ogr.ar.krakow.pl