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Short communication

EFFECT OF AUTUMN AND WINTER BROOD INTERRUPTION ON QUEEN SURVIVABILITY AND SPRING DEVELOPMENT OF HONEY BEE (*APIS MELLIFERA* L.) COLONIES WITH USE OF CHMARA ISOLATOR

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Abstract

Queen isolation, the prevention of egg laying in autumn and winter, is beneficial in temperate climates. Brood rearing in autumn weakens colonies because feeding the larvae shortens the lives of bees. Workers which emerge during this time do not live until spring; moreover, winter stores are used for their rearing. The Chmara isolator consists of two queen excluders only 1 cm apart, which is why bees do not build a comb in it. The queen is isolated for more than three weeks; the absence of a sealed brood allows for successful control of the *Varroa destructor*. The aim of the study was to investigate queen mortality and spring development in bee colonies after the use of the Chmara isolator in the autumn and winter. All together, seventy-eight colonies were examined during a three-year period. In half of the colonies, the queens were closed in Chmara isolators for five or six months, from either September or October till March. Three queens died during the winter, one in an isolator and two in colonies without an isolator. Colonies, in which a Chmara isolator was used in autumn and winter, reared significantly more brood in spring compared to colonies without an isolator.

Keywords: brood interruption, Chmara isolator, queen mortality, spring development, *Varroa* control

INTRODUCTION

Confining the queen in an isolator that prevents her from oviposition in the fall and winter seems to be beneficial. Brood rearing in autumn results in weakened colonies during winter (Gąbka et al., 2023) because feeding the larvae shortens the lives of bees (Woyke, 1984). Bees produced during this time do not live until spring, and winter stores are used up to rear them (Ostrowska, 1974). The Chmara isolator consists of two plastic queen excluders with a distance of 1 cm between them, so that the bees do not build a comb in it. Its biggest advantage is the possibility of effective control of *Varroa destructor* three weeks after the queens are closed when there are no more sealed brood. In addition, parasites brought in during autumn from other apiaries will not reproduce. However, according to some beekeepers or bee scientists (Wilde, personal information), the use of such isolators during winter causes high queen losses. The purpose of this experiment was to determine queen mortality and the spring development of bee colonies after the use of the Chmara isolator during autumn and winter.

MATERIAL AND METHODS

The experiments were conducted in the Dadant hives of two apiaries in Warsaw, from autumn 2016 to spring 2019. One of the apiaries was located in the city centre (52º13’34’’N 21º01’47’’E) and the other on the outskirts (52º09’36’’N 21º05’55’’E). At each location, from twelve to fourteen *Apis mellifera carnica* bee colonies were overwintered annually. In half of them in each apiary, the queens were closed in Chmara isolators for five to six months from September or October until the first cleansing flight. In total, seventy-eight colonies were examined over three years. To control *Varroa* mites, Biowar strips containing 500 mg of amitraz were used in September and October. After three weeks of isolating queens, Apiwarol fumigation tablets containing 12.5 mg of amitraz were used. In the spring, three weeks after the release of queens from isolators, the amount of brood in both experimental groups was determined on the basis of brood area by measuring two ellipse diameters. Each year, new queens were introduced in all colonies, most often in July. Four-way ANOVA and Duncan's test were used for statistical analysis.

RESULTS AND DISCUSSION

Queen mortality

During the three years of the study, three queens died during the winter, one in an isolator and two in colonies without an isolator, representing only 3.8% of all queens. In our apiaries in previous years, we had often observed higher queen losses during the winter (up to 10%), when the queens were not isolated. Therefore, other beekeepers' reports concerning large losses of queens in Chmara isolators were unconfirmed. They were probably caused by too many combs being left over the winter. If the isolator with the queen is placed in the centre of an eight-comb nest, and after some time a winter cluster occupies four or five combs, the queen will be on the edge or even outside it. The prerequisite for good queen overwintering is to keep strong colonies, to tighten the nest firmly and provide more food per comb. The Chmara isolator is effective for *Varroa* control, but the disadvantage is that the queens cannot move around the entire nest. Alternative to Chmara isolator is queen ringing (Uzunov & Chen, 2023, Uzunov et al., 2024), which involves putting plastic "skirts" on the abdomens of the queens which prevents the queens from laying eggs but allows them mobility throughout the nest. However, in this case, queen losses also occur. The risk factor could be damage caused during the long ringing period in winter. Additional studies should be conducted comparing winter losses of queens in rings and in Chmara isolators.

Spring development

A four-way ANOVA showed that Chmara isolators used in the fall and winter significantly affected the amount of brood reared in the spring ($F_{1,74}$=15.380, $p<0.001$). A total of 25% more brood was found in these colonies three weeks after the queens were released from the isolators than in the control colonies (Tab. 1). The ANOVA also showed that colony strength ($F_{2,74}$=7.748, p=0.001), apiary location ($F_{1,74}$=4.414, p=0.041) and year of study ($F_{2,74}$=13.582, $p<0.001$) effected the amount of brood. There were no significant interactions between these factors ($p>0.05$). Colonies that

Table 1.

Brood area (dm²) 3 weeks after releasing of queens from isolators

Group	Number of colonies*	Min - Max	Mean ± se
Control	37	5.62 - 28.68	16.95 ± 5.12 a**
Isolator	38	5.00 - 42.10	21.17 ± 8.26 b

*Total number of colonies in the three years of study
**Different letters indicate significant differences between the means

Table 2.

Brood area (dm²) depending on number of combs covered by bees

Number of combs	Number of colonies*	Min - Max	Mean ± se
4	37	5.00 - 29.54	16.63 ± 5.37 a**
5	29	5.62 - 34.53	21.20 ± 7.96 b
6	9	13.27 - 42.10	22.37 ± 8.20 b

*Total number of colonies in the three years of study
**Different letters indicate significant differences between the means

overwintered on five and six combs reared 27% and 35% more brood, respectively, in the spring than those that were stocked on four combs in the autumn (Tab. 2). A significant positive correlation (r=0.637, p<0.001) was found between the number of combs occupied by the bees and the amount of brood. In other studies, this correlation was also positive but ranged from r=0.26 to r=0.99 (Woyke, 1984; Bhusal & Thapa, 2006; Gąbka, 2014). There were significantly more broods on the outskirts of Warsaw (19%) than in the city centre (Tab. 3), probably due to the greater number of pollen-producing plants in early spring there. In 2018 and 2019, there were 46% and 49% more brood, respectively, than in 2017 (Tab. 4), and this is due to different weather conditions in each year and different timing of brood measurement.

Table 5 shows that when the queens were isolated earlier in the fall, there was more brood in the spring compared to the control group. The differences shown in the table are not due to different conditions in successive years, since the amount of brood was compared to the control group in each year. The opportunities for spring development were the same for both groups in a given year. Thus, in the weather conditions of central Europe, queens should be isolated as early as the beginning of September but not in August, when the long-lived winter bees are reared. Gąbka et al. (2023) confined queens in Chmara isolators from September 10th to the end of February. In these colonies, significantly more bees which emerged at the end of September survived until spring compared to those in control colonies in which queens were not isolated. Such colonies raise more brood in the spring because the bees in the autumn do not work to feed the larvae. This would explain the better spring development of colonies with queens isolated in September than those isolated in October. Isolation contributes to more effective control of *Varroa destructor* in broodless colonies and improve bee longevity and as a result both colony development and honey production (Gąbka et al., 2025). Thus, periodic

Table 3.

Brood area (dm²) depending on location of apiary

Apiary	Number of colonies*	Min - Max	Mean ± se
Center of Warsaw	34	5.62 - 34.31	17.27 ± 6.63 a**
Outskirt of Warsaw	41	5.00 - 42.10	20.60 ± 7.32 b

*Total number of colonies in the three years of study
**Different letters indicate significant differences between the means

Table 4.

Brood area (dm²) depending on year of study

Year	Number of colonies	Min - Max	Mean ± se
2017	24	5.00 - 28.10	14.44 ± 5.80 a*
2018	27	11.42 - 34.31	21.09 ± 5.50 b
2019	24	11.26 - 42.10	21.49 ± 8.00 b

*Different letters indicate significant differences between the means

Table 5.

Amount of brood in spring after release of queens from isolators compared to control group

Date			Amount of brood
Isolation of queens	Releasing of queens	Measurement of brood	
4.10.2016	4.03.2017	27.03.2017	23.4% more
18.10.2017	13.03.2018	7.04.2018	13.9% more
3.09.2018	27.02.2019	23.03.2019	31.4% more

brood interruption is economically justified in apiary management, and this becomes even more important in view of the threat of the spread of the *Tropilaelaps mercedesae* parasite in Europe (Brandorf et al., 2024; Janashia et al., 2024).

REFERENCES

Bhusal, S. J., & Thapa, R. B. (2006). Response of colony strenght to honey production: regression and correlation analysis. *Journal of the Institute of Agriculture and Animal Science, 27,* 133-137. DOI: https://doi.org/10.3126/jiaas.v27i0.706

Brandorf, A., Ivoilova, M. M., Yañez, O., Neumann, P., Soroker, V. (2024). First report of established mite populations, *Tropilaelaps mercedesae*, in Europe. *Journal of Apicultural Research,* 1-3. https://doi.org/10.1080/00218839.2024.2343976

Gąbka, J. (2014). Correlations between the strength, amount of brood and honey production of the honey bee colony. *Medycyna Weterynaryjna, 70*(12), 754-756.

Gąbka J., Gąbka J., Zajdel B. (2023). Przeżywalność pszczół zimujących w rodzinach niewychowujących czerwiu jesienią. *60. Naukowa Konferencja Pszczelarska, Pulawy*, 21.

Gąbka J., Gąbka J. Zajdel B. (2025) Wpływ przerywania czerwienia w lipcu na kondycję rodzin pszczelich w kolejnym sezonie pasiecznym. *62. Naukowa Konferencja Pszczelarska. Puławy*, 47-48.

Janashia, I., Uzunov, A., Chen, C., Costa, C., Cilia, G. (2024). First report on *Tropilaelaps mercedesae* presence in Georgia: the mite is heading westward! *Journal of Apicultural Science, 68*(2), 183-188. DOI: 10.2478/JAS-2024-0010

Ostrowska, W. (1974). Gospodarka pasieczna. Państwowe Wydawnictwo Rolnicze i Leśne. Warszawa, ss. 412.

Uzunov, A., & Chen, C. (2023). Queen ringing - an alternative method for inducing brood interruption. *Bee World, 100*(3-4), 67-70. https://doi.org/10.1080/0005772X.2023.2263285

Uzunov, A., Chen, C., Gabel, M., Kovačić, M. (2024). Queen ringing vs. queen caging for summer brood interruption. *Journal of Apicultural Research, 63*(4), 660-663. https://doi.org/10.1080/00218839.2024.2354087

Woyke J. (1984). Correlations and interactions between population, length of worker life and honey production by honeybees in a temperate region. *Journal of Apicultural Research, 23*(3), 148-156. https://doi.org/10.1080/00218839.1984.11100624