

# Comparison of post-capping period in different subspecies of honey bee<sup>\*)</sup>

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### Summary

The aim of the assay was to compare the post capping period in different subspecies of the honey bee in Poland. The studies were carried out in 2008-2009. The five subspecies of bees was tested: Carniolan bees represented by two lines: Kortówka and Dobra; Caucasian bees of the Woźnica line; Central European bees of the Augustowska line; Crossbreeds achieved by absorptive crossing of *A. m. capensis* with *A. m. carnica* drones selected for a short PCP, bred at the Apiculture Division in Olsztyn. The shortest PCP was observed in bees from group PCP (285 h), and the longest – in Caucasian bees of the Woźnica line (289.7 h). Apparently, it is worthwhile continuing breeding for a shortened PCP only in colonies of group PCP. The question whether it is possible to select bees with a short PCP significantly limiting the development of *Varroa destructor* in bee colonies remains unanswered.

**Keywords:** *Apis mellifera carnica*, *Apis mellifera caucasica*, *Apis mellifera mellifera*, *Apis mellifera capensis*, PCP line, post-capping period

In honey bee development the post-capping period (PCP) affects the number of mature *Varroa destructor* females that leave the brood cell together with the emerging worker bee (11, 12). Consequently, it also influences the pace of the parasite's development. Individual subspecies of European bees differ from one another in terms of the PCP duration (3, 6, 7). The shortest PCP, that is about 10-11 days long, is observed in the Cape bee (*Apis mellifera capensis*) (8-10). As duration of bee development is a highly heritable trait (8, 16, 22), researchers made an attempt at breeding bees with a short PCP (15, 23, 24). They crossbred the *Apis mellifera carnica* bees which have the wide range of PCP duration of all European bees and hence also the highest selection differential (5). This subspecies is extremely popular among European beekeepers because of its valuable production traits (1).

Bees with a short PCP were bred at the Apiculture Division of the University of Warmia and Mazury in Olsztyn (Poland), in cooperation with the Beekeeping Institute in Oberusel (Germany) (24, 25). Over the 10 years of breeding work, the researchers managed to shorten an average PCP duration to 276.5 h (18). The selected bee line scored high in tests assessing its

usefulness for apiary management, as well as for resistance to *V. destructor* (17). The aim of the study was to compare the post capping period in different subspecies of the honey bee in Poland.

### Material and methods

The studies were carried out in 2008-2009 at the Apiary Division of the University of Warmia and Mazury in Olsztyn, Poland. To assess the bees listed below, we created five experimental groups and marked them with symbols (in brackets):

- Carniolan bees (*Apis mellifera carnica*) – represented by two lines – Kortówka (CarK) and Dobra (CarD),
- Caucasian bees (*A. m. caucasica*) of the Woźnica line (Cau),
- Central European bees (*A. m. mellifera*) of the Augustowska line (Mel),
- Crossbreeds achieved by absorptive crossing of *A. m. capensis* with *A. m. carnica* drones selected to a short PCP, bred at the Apiculture Division in Olsztyn (15, 21, 22-26) (PCP).

The research was conducted in polystyrene trapezoid top-bar mating nuclei (20), where we settled bees each year at the beginning of May. To those colonies, virgin queens from each experimental group were introduced. The queens were then instrumentally inseminated by drones specific to a given line, in accordance with the method

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described by Woyke et al. (27). Each year in August we determined the post-capping time after the complete replacement of bees in mating colonies, using the method worked out by Siuda et al. (21). Using colored waterproof pens, at 8:00 a.m., 2:00 p.m. and 8:00 p.m. we marked newly capped brood cells with specific graphic signs on foil placed over combs. Each time of marking was assigned one, unique symbol. The marking of newly capped brood cells was carried out for 48 hours. After 10 days, in order to determine the cells abandoned by emerging bees, we applied foil on the combs again. Observations were carried out also at 8:00 a.m., 2:00 p.m. and 8:00 p.m., yet this time for 72 hours. It allowed us to determine 9 time brackets, from 252 to 300 hours (every 6 hours), during which bees were emerging their out of marked cells. On the basis of the achieved results we calculated an average PCP duration for worker bees and a percentage of worker bees emerging from their cells within the time of up to 276 hours from cell capping in individual groups.

The data collected in the assay were then analyzed statistically. The significance of differences was assessed using analysis of variance and differences among groups – in accordance with Fisher's test and the chi-square test.

### Results and discussion

The shortest average PCP duration was observed in PCP bees. It was highly significantly different from the PCP of other groups. Worker bees in this group emerged after 285 hours from cell capping, on average. The longest PCP was observed in Cau and it was 289.7 h. No statistical differences were noted among the remaining groups: CarK, CarD, and Mel.

An average PCP for worker bees descended from individual queens coming from their specific groups was also determined. The shortest average PCP was observed in bees bom of the queen from group PCP, and it was 282.4 h. The longest average PCP was noted in worker bees bom of the CarD queen. These worker bees emerged after 294 h from cell capping, on average (Tab. 1).

Tab. 1. PCP in individual groups of bees [h]

Group	n	PCP duration		min. & max. average PCP for offspring of individual queens
		average	min-max	
CarK	15	287.7 <sup>A</sup>	264-300	283.3-291.9
Mel	15	288.3 <sup>A</sup>	270-300	287.0-292.4
CarD	15	288.5 <sup>ACa</sup>	258-300	284.1-294.0
Cau	15	289.7 <sup>Cb</sup>	264-300	285.2-293.9
PCP	16	285.0 <sup>B</sup>	252-300	282.4-289.8

Explanations: letters in upper index denote significant differences: capital letters –  $p \leq 0.01$ ; lowercase letters –  $p \leq 0.05$ ; CarK – *Apis mellifera carnica* (Kortówka line); Mel – *A. m. mellifera* (Augustowska line); CarD – *A. m. carnica* (Dobra line); Cau – *A. m. caucasica* (Woźnica line); PCP – crossbreed of *A. m. carnica* × *A. m. capensis*

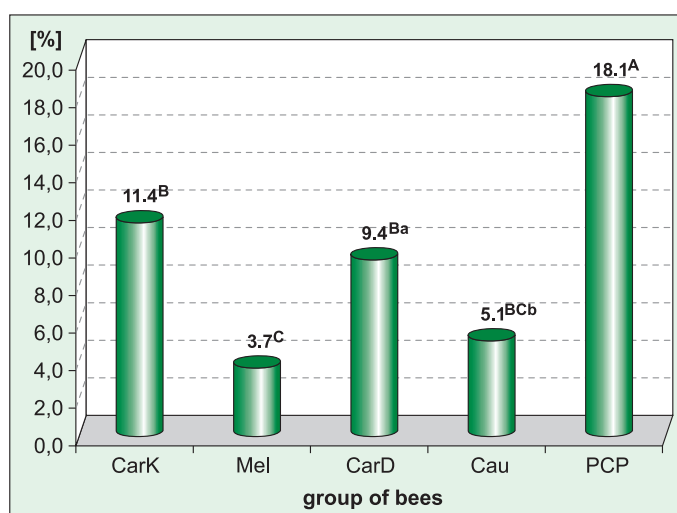


Fig. 1. Average percentage of worker bees emerging from their cells within the time of up to 276 h

Explanations: CarK – *Apis mellifera carnica* (Kortówka line); Mel – *A. m. mellifera* (Augustowska line); CarD – *A. m. carnica* (Dobra line); Cau – *A. m. caucasica* (Woźnica line); PCP – crossbreed of *A. m. carnica* × *A. m. capensis*; letters in upper index denote significant differences: capital letters –  $p \leq 0.01$ ; lowercase letters –  $p \leq 0.05$

Within the time of up to 276 h, 18.1% of PCP worker bees emerged from their cells. In the remaining groups significantly fewer worker bees emerged from their cells within the same time bracket, i.e. 11.4% of CarK, and 9.4% of CarD worker bees. These results were significantly higher than the results achieved in groups Cau and Mel (5.1% and 3.7%, respectively). Significant statistical differences were noted between CarD and Cau (Fig. 1).

PCP bees turned out to have the shortest PCP, i.e. 285 h. Prior to the assay, these bees had been selected for a shortened PCP (15, 19, 21). Siuda and Wilde (14) estimated that an average PCP for this group lasted 274.0 h, and after four years it extended to 279.5 h (18). An analysis of the results achieved by the researchers and the results achieved for earlier generations of the crossbreeds of *A. m. mellifera* × *A. m. capensis* indicate regression of the selected trait instead of the expected breeding progress, which may have resulted from the fact that the breeding was based on absorptive crossing of queens with Carniolan drones whose worker bees are characterized by the shortest PCP (22, 23), and the influx of genes of the Cape bee had been insufficient. However, diversity of the PCP duration for the offspring of individual mothers in the group (from 282.4 to 289.8 h) seems promising with regard to further breeding work.

Carniolan bees manifested a similar PCP to each other, namely 287.7 h for CarK, and 288.5 h for CarD, on average. Similar results were achieved also by other researchers. Konopacka et al. (4) found out that *A. m. carnica* worker bees emerged their way out of brood cells after 288.5 h from cell capping, while Langen-

bach (5), Siuda (13), Siuda and Wilde (17) discovered that bee emergence took place after 288.2 h. Langenbach (5) examined the PCP duration for four subspecies of the honey bee: *A. m. capensis*, *A. m. ligustica*, *A. m. carnica* and *A. m. mellifera*, achieving the results that fall within the time bracket of 10.9 to 12.3 days (261.6-295.2 h).

In the discussed research, Cau showed the longest PCP, which was close to the result achieved by Siuda (13) – 289.6 h, on average. Konopacka et al. (4) obtained different results: Caucasian worker bees showed a similar PCP to the PCP of the Carniolan bee, namely 288.5 h, on average. The variance of results may have been caused by two reasons. First, the assays were conducted under different conditions, particularly the climatic factor makes it hard to compare the results achieved at different time of the season and in different years (1, 2, 15, 22, 23). Second, the assessed bee lines may have differed from each other (8). In the discussed work we examined bees of the Woźnica line, while Konopacka et al. (4) tested the Caucasian bee bred on the genetic material imported in 1964-1968 from the former Soviet Union.

One of the selection criteria, apart from an average PCP, was the assessment of an average percentage of bees emerging from their cells within the time shorter than 276 hours (13). In our research, the best results were achieved by group PCP, with their 18.1%, and the poorest results – by groups Mel and Cau (3.7 i 5.1%, respectively). The research conducted by Siuda (13) showed a different number of crossbreeds of *A. m. carnica* × *A. m. caucasica* emerging from their cells within the time of up to 276 h, depending on the generation. The highest percentage was observed in generation F<sub>3</sub> from 1996, i.e. 43.3%. In one generation of Carniolan bees the percentage of 28.9% of bees emerging within the time of up to 276 h was achieved. In the discussed research this parameter for Carniolan bees turned out to be more than two times shorter (11.4%).

## Conclusions

1. The shortest PCP was observed in bees from group PCP, and the longest – in Caucasian bees of the Woźnica line.

2. Apparently, it is worthwhile continuing breeding for a shortened PCP only in colonies of group PCP.

3. The question whether it is possible to select bees with a short PCP significantly limiting the development of *Varroa destructor* in bee colonies remains unanswered.

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