EFFECTS OF ADJUSTING THE COLONY STRUCTURE OF CAUCASIAN (*Apis mellifera caucasica* Gorb.) AND CARNIOLAN (*Apis mellifera carnica* Pollm.) BEES UNDER DIFFERENT FLOW CONDITIONS

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Summary

In the years 2002 and 2003 a comparison was made of honey outputs of honeybee colonies in which the queens were allowed different numbers of combs to lay eggs in. In each group colonies with Caucasian and Carniolan naturally mated queens were included. The following colony groups were compared:

A: queens were confined in queen cages with a queen excluder 29 days prior to the expected date of the termination of commercial honey flow,

B: queens were put in metal three frames insulators,

C: colony brood chambers were limited to 6 Dadant frames at the turn of April/May with bees being stimulated very early to move to the super,

D: (control) colonies with queens allowed to lay eggs without restriction, the number of combs being decided by colony strength.

The size of honey flow varied between the two years so the average honey output by all Caucasian colonies was 17.8 kg and by Carniolan colonies 13.6 kg in the first year (2002) and 32.2 kg and 27.7 kg, respectively in the second year (2003).

In 2002 there was no significant difference in total honey output among individual test groups even though the bee colonies of groups A and B, with more stringent egg-laying restrictions imposed on the queens, produced slightly more honey. In the second year, groups A and B were found to be the best concerning the amount of honey produced, the differences relative to the control group having been statistically proved for colonies with Carniolan queens. In both years Carniolan bees produced less honey than Caucasian ones. In 2003, during the main honey flow and immediately after it the Carniolan colonies reared significantly more brood than did the Caucasian colonies.

Correlation coefficients between the total amount of honey and the number of brood at the beginning of May were $r=0.30$ in 2002 and $r=0.28$ in 2003. In 2003 there was a negative correlation between the amount of brood counted at the onset of the main flow and the total amount of honey.

Keywords: queen insulator, restriction of egg-laying, honey yield, Caucasian bees, Carniolan bees.

INTRODUCTION

The amount of honey gathered by bees is influenced by the size of honey flow and colony strength. Colony strength is related to amount of brood reared at the beginning of the season and to bee longevity (Woyke 1984, Moeller 1958). Honey output is also greatly affected by colony structure. In colonies in which adult bees highly outnumber brood honey yields are significantly increased (Gromisz 1972, Gromisz et al. 1979). Under Poland's conditions natural seasonal development of honeybee colonies is delayed in relation to honey flows meaningful for honey production. There are many apiary management methods used to ensure appropriate colony structure consisting in imposing limitations on egg-laying before and during the expected flow. It makes sense because the workers reared from eggs laid later than 29 days before the end of the flow do not contribute to honey production from that flow (Taranov 1946, Szabo and Lefkovitch 1989).

Radical termination of egg-laying is through isolating the queen in the queen cage. The result is that in certain periods there is no brood in the colony. The bees are solely engaged in work related to gathering nectar and ripening of honey (Konopacka 1986 , Muszyńska 1995).

The use of insulators to confine the queen to 1 to 3 frames does not only facilitates centrifugation of honey but also allows a multiplication of honey output (Mazurek 1992, 2000). However, the effects of such restriction are dependent on many other factors. Marcinkowski and Skubida (1996) failed to obtain a significant difference in honey production between control colonies and those in which queens were confined to 3 or 1 Dadant frame.

Reducing the nest to 6 Dadant frames while at the same time encouraging the bees to move to the supers separates honey from the brood and also increases the honey output (Budzyn 1982). Restrictions of egg-laying, unless exceedingly long, do not compromise colony strength after the flow is ended (Simpson and Greenwood 1975, Sanzenbacher 1996, Pidek 1989, Marcinkowski and Skubida 1996).

The objective of the study was to investigate the effect of imposing several brood rearing restriction schemes in Carniolan and Caucasian bees during both weak and havy honey flows on colonies' honey production.

MATERIAL AND METHODS

The study carried out in the Apiculture Division apiary located in the Puławy area involved 78 bee colonies in 2002 and 63 colonies in 2003. The colonies were established in Dadant hives.

Honey yield was compared in groups of bee colonies differing in the number of combs available to naturally mated queens in 2001. The colonies were assigned to groups at random. However, care was taken that each group be composed of very strong and weaker colonies in similar proportions and each group be made up of Caucasian (*Cau*) and Carniolan (*Car*) queens in equal numbers. The experiment layout was as follows:

group A (queen cage): queens were put in queen cages with a queen excluder on ca. the 29th day before the expected termination of a main honey flow. Until that time they were allowed to lay eggs throughout the nest area,

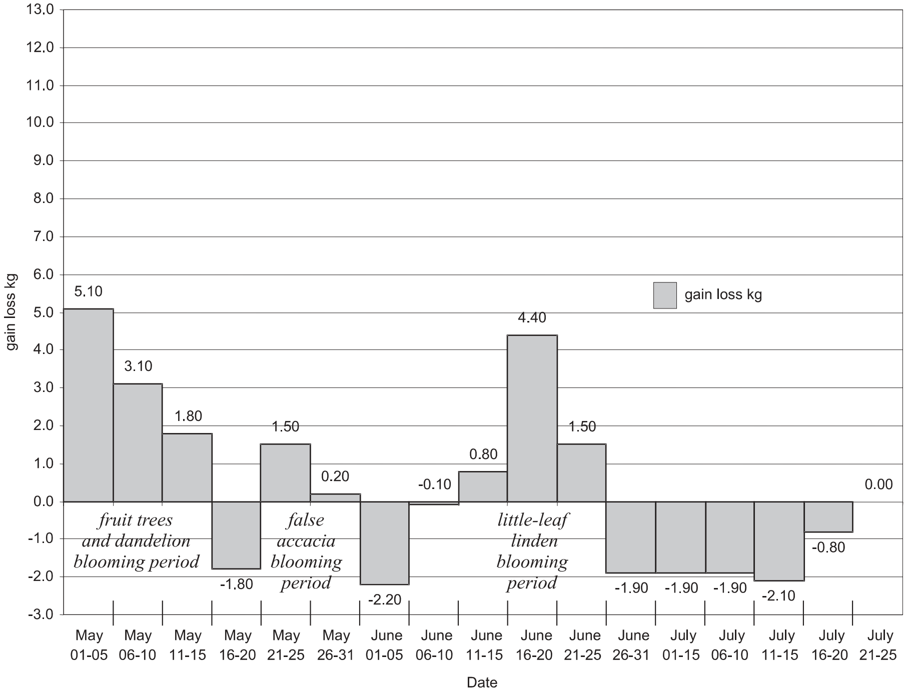
group B (queen insulator): queens were confined to three Dadant frames in metal insulators,

group C (brood nest reduced to 6 frames): from the end of April to the termination of main honey flow the colony nest area was confined to 6 frames while at the same time the bees were encouraged to move to the supers and the super space was extended as necessary,

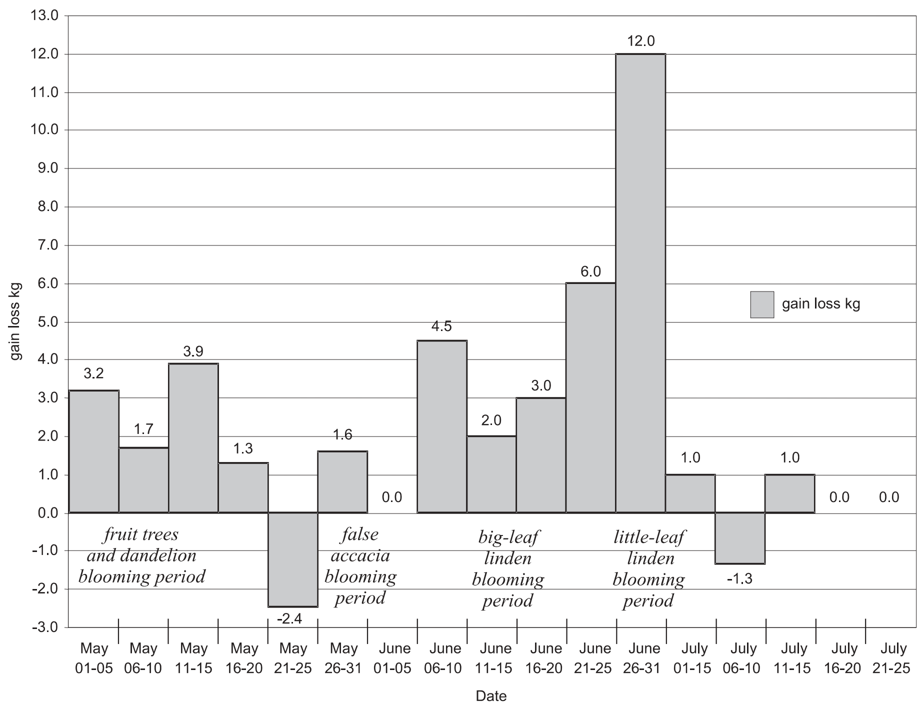
group D (control): colonies with unrestricted oviposition.

In groups A and B the queen cells on the combs separated from the queen were destroyed after 7 days.

In order to give an accurate account of the intensity and time of honey flows the reference hive was weighed at 5-day



Graph 1. Weight gains and losses of the scale hive for the 5-day periods of 2002



Graph 2. Weight gains and losses of the scale hive for the 5-day periods of 2003

intervals starting from 2000. The data from 2002 and 2003 are given in Graphs 1 and 2.

Treatment dates and duration of egg-laying restriction were determined based on the expected date of main flow occurrence based on previous years' record. In group A queens were caged for the period from May 21 to June 30 in 2002 and from June 3 to July 3 in 2003. In group B queens were insulated from May 14 to June 30 in 2002 and from May 23 to July 11 in 2003. Group C colonies were given that treatment from April 29 to June 27 in 2002 and from May 5 to July 15 in 2003.

Honey output by colonies was expressed in terms of weight of produced honey. The following distinctions were made:

I. multifloral honey obtained from early honey flows;
II. linden honey (from linden flow);
III. total amount of honey (the sum of item I, item II and the estimated honey left in the nests as storage).

The number of the brood reared was determined by making three measurements of the brood area at 21-day intervals over the duration of the experiment, and one measurement 21 days after its termination to check the effect of the treatments on the strength of the colonies ready to hibernate. The brood area was converted to the number of brood cells by assuming 400 cells per 1 dm^2. In 2002, the measurements were taken on April 23, May 14, and June 4 and, after the queen confinement was terminated, on July 18. In 2003, the measurements were taken on May 5, May 26, June 16 and July 23.

In order to check the effect of the egg-laying adjustment methods on colony strength records were taken of the number of combs settled immediately before the main flow, after this flow and in the following spring during the first colony inspection (super combs were converted to nest combs using the ratio of 2 super combs to 1 nest comb). Throughout the season observations of the swarming fever in the colonies were kept.

The data were subjected to ANOVA. Duncan's test was used to estimate the significance of mean-to-mean differences. Regression analysis was performed to determine the correlation between the amount of brood reared and honey output by the colony.

RESULTS

Swarming fever, swarming and queen losses in the colonies

In both study years colonies with Carniolan queens went into a swarming fever much more frequently than did the colonies with Caucasian queens (Table 1). Likewise, Carniolan bees swarmed more frequently. There were no year-to-year differences in the number of colonies which went into a swarming fever and of those which actually swarmed. The Caucasian colonies responded better to anti-swarming treatments as only 18% of those in the swarming fever swarmed whereas as many as 56% of Carniolan colonies that got into a swarming fever swarmed. The most frequent to get into a swarming fever and to swarm were the bees of group D (15 colonies in swarming fever, 6 colonies actually swarmed) and those of group C (10 and 4, respectively).

In both years some of the colonies were discarded from the study for reasons unrelated to egg-laying restriction such as supersedure or queen replacement by beekeeper due to inferior queen quality (2 cases), queen's departure from the cage (1 case), supersedure or death of the queen in an insulator (3 cases), exit of the swarm before the queen was put in confinement (3 cases). As a result, for the assessment of

Table 1

Occurrence of swarming fever and swarming over colony groups and races (totals of 2002 and 2003)

Race	Experiment group	Colonies in swarming fever	Colonies that swarmed
Cau (n=66)	A (queen cage)	2	1*
	B (queen insulator)	4	1*
	C (brood nest reduced to 6 frames)	1	-
	D (control)	4	-
	Total	**11**	**2***
Car (n=69)	A (queen cage)	2	1* + 1
	B (queen insulator)	3	2
	C (brood nest reduced to 6 frames)	9	4
	D (control)	11	6
	Total	**25**	**14**

* colony swarmed before the queen's confinement in cage or in insulator

Table 2

Combined honey output (kg/colony) of the two races in 2002 and 2003

Year	Experiment group	Honey from early flow (I)	Linden honey (II)		Total honey (III)	
		all colonies in the group	combined output of all colonies within group	swarming colonies excluded	combined output of all colonies within group	swarming colonies excluded
	1	2	3	4	5	6
2002	A (queen cage)	**7.3** n=16	**6.5** n=16	**6.7** n=15	**16.2** n=16	**16.4** n=15
	B (queen insulator)	**7.8** n=17	**5.8** n=17	**6.2** n=16	**16.5** n=17	**17.2** n=16
	C (brood nest reduced to 6 frames)	**6.9** n=19	**7.0** n=19	**7.0** n=18	**14.0** n=19	**14.9** n=18
	D (control)	**6.7** n=18	**4.5** n=18	**4.8** n=15	**14.7** n=18	**14.8** n=15
2003	A (queen cage)	**7.2** n=15	**23.0 b** n=16	**23.4 b** n=15	**30.9 b** n=16	**32.1 b** n=15
	B (queen insulator)	**9.7** n=16	**21.0 b** n=17	**21.6 b** n=16	**33.1 b** n=17	**33.6 b** n=16
	C (brood nest reduced to 6 frames)	**7.1** n=13	**17.1 b** n=14	**17.4 ab** n=13	**26.2 ab** n=14	**26.6 a** n=13
	D (control)	**5.3** n=12	**8.8 a** n=15	**15.6 a** n=12	**20.0 a** n=15	**25.9 a** n=12

means within columns followed by different characters are statistically different at (p 0.05),
n- number of observations

Table 3

Honey output (kg/colony) of the two races in 2002

Experiment groups	Honey from early flow (I)		Linden honey (II)		Total honey (III)	
	Caucasian	Carniolan	Caucasian	Carniolan	Caucasian	Carniolan
1	2	3	4	5	6	7
A (queen cage)	**9.4** (3.3-15.3) n=8	**5.1** (1.6-8.4) n=8	**7.1** (2.6-12.5) n=8	**5.8 b*** (2.4-9.2) n=8	**18.6** (8.2-25.5) n=8	**13.0** (10.5-17.3) n=8
B (queen insulator)	**9.4** (4.3-13.8) n=6	**6.9** (2.5-11.0) n=11	**7.4** (2.5-15.7) n=6	**5.0 b*** (2.0-9.7) n=11	**19.1** (12.0-27.7) n=6	**15.6** (7.3-21.5) n=11
C (brood nest reduced to 6 frames)	**7.8** (2.5-14.4) n=10	**6.1** (2.5-11.4) n=9	**7.6** (4.9-12.2) n=10	**5.8 b*** (1.0-10.2) n=9	**16.7** (11.9-22.8) n=10	**13.2** (9.3-17.8) n=9
D (control)	**6.8** (1.7-16.8) n=9	**6.6** (1.8-15.4) n=9	**6.4** (2.7-21.9) n=9	**2.5 a*** (1.0-5.7) n=9	**17.1** (11.3-23.9) n=9	**12.3** (6.0-20.1) n=9
averaged across groups	**8.2** (1.7-16.8) n=33	**6.2** (1.6-15.4) n=37	**7.1 b**** (2.5-15.7) n=33	**4.9 a**** (1.0-10.2) n=37	**17.8 b**** (8.2-27.7) n=33	**13.6 a**** (6.0-21.5) n=37

range in parentheses, n- number of observations,

* means within columns are significantly different at (p 0.05)

** means in the bottom line are significantly different (p 0.01)

honey efficiency there remained 70 colonies in 2002 and 62 colonies in 2003.

After being released from the cage 7 Caucasian and 2 Carniolan queens were lost for unexplained reasons. The queens were released on a fine day after the last honey harvest, no cases of robbery were recorded.

Honey efficiency of the colonies

The last and the most abundant honey flow in the apiary was supplied by linden trees. In both study years honey was harvested twice. Before the linden flow multifloral honey was centrifuged. Linden honey was harvested after the end of blooming of the linden trees.

Weight increments ended around June 25 in 2002 (Graph 1) and around July 15 in 2003 (Graph 2). In 2003 they were much larger than in 2002, in the latter year the vegetation developing ca. 10 days earlier compared to the average conditions in the area and frequent cold spells preventing the bees from foraging.

Average honey output per colony was 15.8 kg in 2002 and 30.0 kg in 2003. The analysis of variation for total amounts of honey produced by the colonies of the two races in 2002 did not show significant differences among the colonies even though the largest amounts were produced by group B colonies, group A coming second. Significant differences between groups occurred in 2003 for linden honey and for total honey (Table 2). Groups A and B were found to be far and significantly superior to the control group both when all colonies, including the swarming ones, were included in honey output calculations (Table 2, columns 3 and 5) or when the swarmed colonies were omitted (colums 4 and 6). In the former case, (all colonies)

Table 4

Honey output (kg/colony) of the two races in 2003

Experiment groups	Honey from early flow (I)		Linden honey (II)		Total honey (III)	
	Caucasian	Carniolan	Caucasian	Carniolan	Caucasian	Carniolan
1	2	3	4	5	6	7
A (queen cage)	**8.6** (1.0-16.5) n=8	**5.9** (0.0-11.5) n=7	**21.3 ab*** (6.5-31.0) n=8	**25.1 b*** (17.5-28.7) n=7	**31.8 ab*** (15.0-39.0) n=8	**32.6 ab*** (20.0-41.3) n=7
B (queen insulator)	**11.2** (6.5-19.5) n=8	**8.3** (0.0-28.5) n=8	**21.2 ab*** (13.7-33.4) n=8	**22.0 b*** (16.9-36.9) n=8	**35.8 b*** (26.5-45.9) n=8	**31.5 ab*** (17.9-52.5) n=8
C (brood nest reduced to 6 frames)	**8.9** (5.0-14.5) n=6	**5.6** (0.0-8.0) n=7	**20.9 ab*** (15.1-24.6) n=6	**14.3 a*** (11.0-16.4) n=7	**32.2 ab*** (27.1-32.8) n=6	**21.8 a*** (18.0-25.8) n=7
D (control)	**5.6** (4.0-9.0) n=6	**4.9** (1.8-15.4) n=9	**16.8 a*** (11.8-23.7) n=6	**14.4 a*** (0.0-29.0) n=6	**28.0 ab*** (21.9-36.7) n=6	**23.8 a*** (2.0-41.5) n=6
averaged across groups	**8.8** (1.0-19.5) n=28	**6.2** (1.6-15.4) n=28	**19.7** (6.5-33.4) n=28	**19.2** (0.0-36.9) n=28	**32.2 b**** (15.0-45.9) n=28	**27.7 a**** (2.0-52.5) n=28

range in parentheses, n- number of observations,
* means within columns are significantly different at (p 0.05)
** means in the bottom line are significantly different (p 0.01)

the differences for groups A and B vs. the control group were 14.2 and 12.2 kg for linden honey, respectively, and 10.9 and 13.0 kg, respectively, for total honey. In the latter case (swarming colonies excluded) the respective differeces were 7.8 kg and 6.0 kg for linden honey and 6.2 and 7.7 kg for total honey. Group C took an intermediate place. Since the difficulties in bringing swarming under control occurred, as was shown before, most frequently in the control group it can be assumed that the queen confinement-related increase in honey output obtained in this study averaged 11 to 14 kg per colony.

The data in Table 2 might indicate that swarms were the only factor responsible for the lower output of the control group. However, when the swarmed colonies were left out of the calculation the control group still gave less honey than groups A and B with group C taking an intermediate position.

The bee races were observed to differ with the amount of honey produced so in Tables 3 and 4 honey outputs by the Caucasian and the Carniolan colonies were listed separately (Tables 3 and 4). In either year, the honey yield in the Caucasian colonies was higher than that in the Carniolan ones and the difference in the outputs of linden honey (II) and of total honey (III) was statistically significant.

In 2002, with weak honey flows (Table 3) the honey yield from the early pastures and the total honey yield was not significantly different among groups. There were significant differences in the output of linden honey but only for the Carniolan race.

In 2003, the colonies produced from early pastures almost the same amount of

Table 5

Number of brood cells (1,000) over experiment groups and bee races in 2002 and 2003

Year	Experiment group	Number of brood cells (1,000)					
		Caucasian			Carniolan		
		1st count	2nd count	3rd count	1st count	2nd count	3rd count
2002	A (queen cage)	12.5	23.8	6.9 a	11.3	23.0	7.0 a
	B (queen insulator)	12.9	21.9	19.2 b	11.3	22.5	18.1 b
	C (brood nest reduced to 6 frames)	12.1	22.2	25.1 c	12.3	23.6	23.8 c
	D (control)	10.2	22.7	24.8 c	12.0	25.0	29.3 c
2003	1 (queen cage)	12.6	19.0	7.2 a	13.2	25.2	6.7 a
	2 (queen insulator)	12.1	20.2	17.2 b	14.6	24.7	21.7 b
	3 (brood nest reduced to 6 frames)	13.0	17.3	24.0 c	14.0	21.8	32.7 c
	D (control)	12.6	23.5	23.5 c	12.3	25.1	33.8 c

means within columns followed by different characters are statistically different at (p   0.05)

honey as they did in 2002 and the differences among groups were also non-significant. Much larger differences were recorded in the output of linden and total honey (Table 4). Group-to-group differences in linden honey output were found to be significant only for Carniolan bees in which groups A and B (with caged or insulated queens) produced more honey than did groups C and D. Similar relationships were found for total honey output. There was a substantial colony-to-colony variability in honey output which, in many cases, doubtlessly contributed to the absence of statistically valid differences between groups.

To sum up, it can be stated that in terms of linden and total honey output the restriction of egg-laying imposed on the queens by caging or insulating them increased the yield of honey as compared to that in the control group in which the queens were free to lay eggs on many combs. However, it was true only of the Carniolan race.

Brood rearing and colony strength

Treatments to restrict egg-laying were imposed on different dates depending on the degree to which they suppressed oviposition so that the colonies did not become excessively weakened. The number of brood cells on the date of the first brood count did not vary either over the years or over the groups. It indicates the initial uniformity of colony strength. At the second count, done 21 days after the first one, there were also no significant differences among groups. It is only the third count,

Table 6

Number of brood cells (1,000) in colonies of both bee races during the successive brood counts in 2002 and 2003 (averaged across groups)

Year	Race	Number of brood cells (1,000)			
		1st count	2nd count	3rd count	Σ
2002	*cau*	11.9	22.7	19.4	54.0
	car	11.7	23.5	19.2	54.5
2003	*cau*	12.6	19.2 a	17.2 a	49.0 a
	car	13.8	24.2 b	23.7 b	61.7 b

means within columns followed by different characters are statistically different at (p 0.05)

made shortly before the onset of the main flow in 2002 and at the start of that flow in 2003, that reflects the manner in which the treatments restricted egg-laying in the colonies for the duration of that flow (Table 5). In group A (cage) at the third brood count there were remnants of the brood that emerged within a few days to come. Thus during the time of linden blooming the colonies of that group did not have any brood at all. At the same time, the number of brood cells in the Caucasian colonies of group B (insulator) was lower than that in the control. Colonies of group C (brood nest reduced to 6 frames) and of group D (control) showed similar brood counts and they were significantly higher than those in the first two groups. It shows that reducing the nest to 6 frames did not restrict egg-laying by the queen but only allowed the separation of the honey chamber from the brood chamber. Since 6 Dadant frames contain ca. 51.8 thoudsand cells the queens of that group had enough space to lay eggs.

The brood count means were listed across groups and compared over count dates and races (Table 6). During inferior honey flow conditions (the year 2002) the colonies of both bee races reared the similar number of brood as determined by each brood count but when nectar flow increased (the year 2003) the colonies with Carniolan queens had significantly more brood on the dates of the 2nd and the 3rd brood count.

Once the honey from the last nectar flow was centrifuged the queens were released from confinement and they were free to lay eggs without restriction. In order to find out if the earlier adopted methods to restrict egg-laying affected the colony strength another brood count was made 21 days later. The colonies within the groups tested reared similar number of brood in that period.

In order to define more precisely the relationship between brood counts and honey outputs in the colonies correlation coefficients were calculated for the two traits. In both study years significant correlation coefficients were found between the honey output and the brood count at the beginning of May, indicative of colony strength ($r=0.30$ in 2002 and $r=0.28$ in 2003). In 2003 there was a negative correlation between the total honey output and the brood count at the onset of the main honey flow ($r=-0.35$).

In 2003, the correlation coefficients for linden vs. total honey were calculated for the races, Caucasian and Carniolan, separately. In the colonies with Caucasian queens there was no significant correlation between the output of linden honey and the brood counts over the successive dates. Instead, in the colonies with Carniolan queens linden and total honey outputs were negatively correlated with the number of brood on the third counting date (*r=-0.43* and *r=-0.42*, respectively). It means that the stronger the colonies were at the beginning of May and the less brood they had before the main linden nectar flow the greater the honey output was. It must be noted that low correlation coefficients indicate that the traits were poorly related to each other.

Before the onset of the main flow honeybee colonies varied for the number of covered frames. It was the highest in the controls (D): Caucasians and Carniolans showed 13.1 in 2002, and 13.7 and 15.6, respectively in 2003. The lowest number of covered frames was in group C: Caucasians - 10.5, Carniolans 9.7 in 2002 and 10.3 for each in 2003. In that group tight-spaced nests were maintained to get the bees to move to the supers.

After the main flow the highest number of covered frames was also in group D colonies: Caucasians 11.1, Carniolans 9.7 in 2002 and 10.6 and 11.0, respectively in 2003. In 2002, the fewest covered frames were found in group C: Caucasians 8.4 and Carniolans 9.7. In 2003 the fewest frames were covered in group A colonies: Caucasians 5.8 and Carniolans 7.4. In that year the colonies of that group clearly weakened following an intensive harvest of linden nectar. In the spring of the following year colonies of both races and of all groups covered a similar number of frames.

DISCUSSION

In this study restricting brood population in experiment groups during the main nectar flow increased honey output which is in agreement with data reported by Gromisz (1962) and Pidek (1989). At the same time, no increased honey output from early flows was found which can be explained by the fact that time elapsed from the egg-laying restriction treatments was not sufficient for the colonies to reach an appropriate structure (Gromisz 1962).

The major factor affecting the size of honey flow in both seasons was the alternate nectar secretion by little-leaf linden (*Tilia cordata* Mill.) (Szklanowska et al. 1999) which bloomed more profusely and secreted more nectar in 2003.

In this study the increase of honey output was particularly manifest in Carniolan colonies. The three-frame metal insulators distinctly lowered the number of brood in third count. However, the insulation-dependent honey production increase (by ca. 8 kg) was not as large as calculated by Mazurek (1996, 2000) who predicted a “saving” of 20 to 35 kg of honey due to brood rearing restriction. According to Mazurek (2000) 3-frame insulators for Dadant frames are too large to restrict egg-laying effectively. His assertion seems plausible enough. That opinion is supported by Marcinkowski and Skubida (1996) who obtained more honey by confining the queens in 1- rather than 3-frame insulators.

In this study the correlation coefficients between the number of brood in the spring and the honey output are lower than those reported by Woyke (1984) - *r=0.83-0.8*5 or by Soller and Bar-Cohen (1967) *r=0.45-0.5*1. Likewise, the negative correlation coefficient calculated by Taranov (1946) between the amount of brood during the main flow and the amount of harvested honey (*r=-0.8*) was nearly twice as high as that obtained in this study.

The restriction in the number of frames available to the queen for egg-laying did not promote swarming fever which was also confirmed by Simpson and Greenwood (1975), Marcinkowski and Skubida (1996), Liebig et al. (1996).

The study showed that in both years the Caucasian bees produced more honey than did the Carniolan bees and it was also true of early bee pastures. Obviously, the Caucasian breeding line used in the study was more productive than the Carniolan line. The importance of that trait, along with brood rearing and longevity, is emphasized by Moeller (1958) and Woyke (1984). It was only the Carniolan race that responded with increased honey production to brood rearing restriction treatments. Upon the imposition of brood rearing restrictions, the Caucasian bees actually produced a few kg of honey more than did the controls but the differences between groups were not significant. In the year 2003 (with better bee pasture conditions than the year 2002) the colonies with Caucasian colonies reared in the nectar flow period significantly less brood than did the Carniolan colonies. Supposedly, it was due to the ability of the bees to restrict egg-laying spontaneously. It may well be that Marcinkowski and Skubida (1996) failed to observe increased honey production upon putting the queens either in 1-frame or 3-frame insulators because the colonies used for the study had naturally mated Caucasian queens.

Among the unquestioned advantages of insulators is the ease with which honey can be harvested from the colony without the necessity to centrifuge combs with brood. Also the separation of the honey chamber from the brood chamber effectively shortens the work about the hive and facilitates locating the queen (Budzyn 1982, Liebig et al. 1996). Caging the queens with queen excluder has similar advantages. What is disturbing are considerable queen losses upon their release from the cages. In the studies by Konopacka (1986) and Muszyńska (1995) such losses were sporadic.

Investigations on the effect of insulators on honey production should be continued especially in terms of the magnitude of that impact and concerning the timing for concrete pastures.

CONCLUSIONS

1. Under any conditions honeybee colonies with insulated queens produced the highest amounts of honey.
2. Caging the queen significantly increased honey output.
3. Reducing the nest to 6 frames failed to decrease the number of reared brood but, to some extent, promoted increased honey output.
4. Twenty-one days after the queen's release the colonies had similar numbers of brood.
5. Brood rearing restrictions did not adversely affect colony preparation for wintering or colony strength the following year.
6. Colonies with no restrictions imposed on egg-laying by the queen went into swarming fever more frequently which lowered honey production.
7. Differences in honey output by bee colonies were primarily race-dependent and related to pasture conditions.

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EFEKTY REGULOWANIA STRUKTURY RODZIN PSZCZELICH RASY KAUKASKIEJ (*Apis mellifera caucasica* Gorb.) I KRAIŃSKIEJ (*Apis mellifera carnica* Pollm.) W RÓŻNYCH WARUNKACH POŻYTKOWYCH

Gerula D.

Streszczenie

W latach 2002 i 2003 porównywano wydajność miodową rodzin, w których matki miały do dyspozycji różną liczbę plastrów do czerwienia. W każdej grupie były rodziny z pszczołami rasy kaukaskiej i kraińskiej. Porównywano następujące grupy rodzin:

A: matki były izolowane w klateczkach matecznikowych z kratą odgrodową na ok. 29 dni przed spodziewanym zakończeniem pożytku towarowego,

B: matki były odgrodzone kratą w izolatorach metalowych na trzech plastrach,

C: gniazda rodzin zostały ograniczone do 6 ramek Dadanta na przełomie kwietnia i maja, z bardzo wczesną stymulacją pszczół do przechodzenia do nadstawki,

D: (kontrolna): rodziny, w których matki czerwiły bez ograniczeń, a o liczbie plastrów w gnieździe decydowała siła rodzin.

Nasilenie pożytków w obu latach badań różniło się, to też w pierwszym roku (2002) średnia wydajność miodowa wszystkich rodzin kaukaskich wynosiła 17,8 kg, a kraińskich 13,6 kg, natomiast w drugim roku (2003) odpowiednio 32,2 i 27,7 kg.

W 2002 roku nie stwierdzono istotnej różnicy w ogólnej wydajności miodowej poszczególnych grup doświadczalnych, mimo iż rodziny pszczele z grup A i B, w których zastosowano bardziej radykalne ograniczanie czerwienia matek, wyprodukowały nieco więcej miodu. W drugim roku badań najlepsze pod względem ilości wyprodukowanego miodu okazały się grupy A i B, a różnice w stosunku do grupy kontrolnej potwierdzono statystycznie dla rodzin rasy kraińskiej. W obu latach badań pszczoły kraińskie wyprodukowały mniej miodu niż kaukaskie. W 2003 rodziny kraińskie wychowywały w czasie trwania pożytku głównego i bezpośrednio przed nim istotnie więcej czerwiu w porównaniu z rodzinami rasy kaukaskiej.

Współczynniki korelacji między ogólną ilością miodu a ilością czerwiu na początku maja wynosiły w 2002 roku *r=0,30*, a w 2003 *r=0,28*. W roku 2003 wystąpiła korelacja ujemna między ilością czerwiu w czasie pomiaru na początku pożytku głównego a ogólną ilością wyprodukowanego przez rodziny miodu *r=-0,35*.

Stosunkowo niskie współczynniki korelacji pomiędzy ilością wychowanego czerwiu przez rodziny pszczele a ich wydajnością miodową świadczą o wpływie również innych czynników na tę cechę.

Słowa kluczowe: izolator, ograniczanie czerwienia, wydajność miodowa, pszczoły kaukaskie, pszczoły kraińskie.