FORAGING AND HOARDING EFFICIENCY IN BUCKFAST PUREBREDS AND NORWEGIAN BLACK BEE (*A. m. mellifera*) HYBRIDS PART 2. COMPARISON WITH THE CAUCASIAN BEE HYBRIDS UNDER FLYING CAGE AND LABORATORY TEST CONDITIONS

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Summary

Three genetically different bee groups: Buckfast (Bcf), crossbreeds derived from mating Norwegian queens (*A. mellifera mellifera*) with Caucasian drones (Nor x Cau) and hybrids derived from mating Caucasian queens with Carniolan drones (Cau x Car) were compared for their ability to forage and store sugar food in field tests under flying cages and in laboratory tests. Cau x Car were used as reference/background for the former two groups. In the field trial, Cau x Car foraged the greatest amount of syrup followed by Bcf and Nor x Cau. The same results were obtained when the collection of candy by caged bees was evaluated in the laboratory. The amount of syrup foraged by bees bore no relationship to its amounts hoarded in the combs nor to the amount of candy collected in the laboratory. The greatest amount of supplies were hoarded by Bcf to be followed by Cau x Car and Nor x Cau. It was because Bcf processed the greatest amount of foraged syrup into stores and Nor x Cau were superior to Cau x Car, the latter being the worst performing sugar syrup hoarders. Bcf bees can be recommended for use and their performance can be due, to a large extent, to their general combining ability. In Norwegian bees specific combining ability can be a factor of much importance.

Keywords: Buckfast, *Apis m. mellifera*, cage tests, foraging, hoarding.

INTRODUCTION

Two issues continue to be the subject of much debate in beekeeping circles. The first one is the choice of “the best” hive type and the other one, still more important, is to adapt one of fairly numerous races or lines of bees to local conditions. Among the beekeepers, especially commercial beekeepers the Buckfast bee enjoys much popularity (Büchler 1988). The interest in that bee has been growing among Polish beekeepers as well despite conflicting opinions on its usefulness. Following Poland’s accession to the European Union increased imports of Buckfast queens are to be expected. For that reason the commercial value and behaviour of Buckfast bees under Poland’s conditions were the subject of our earlier investigations (Paleolog et al. 2003a, Paleolog et al. 2003b, Olszewski et al. 2002, Paleolog et al. 1999). To date, the productivity of F_1 Buckfast hybrids as well as effectiveness and strategies of pollen collection, hygienic behaviour and competing ability for forage sources by pure-bred bees have been studied. Studies for foraging and hoarding efficiency have been also started lately (Olszewski and Paleolog 2005).

Recently, the native European black bee (*Apis mellifera mellifera*) has been given increasing attention. The results of studies carried out not so long ago confirmed that the native European bee, including the Norwegian black bee, was a valuable component of crossbreeds (Prabucki and Chuda-Mickiewicz 2000a, 2000b, Prabucki and Chuda-Mickiewicz 1998). An increased interest in black bee has not been confined to Poland (Neumayer 2003, Fried 2002, Layec 2002). Therefore, the crossbreeds of that bee were also the subject of our earlier investigations (Paleolog 2002, Paleolog et al. 1999).

Honey yield is a complex character that has the single greatest effect on the economic performance of an apiary. Honey yield is first of all influenced by the foraging and hoarding efficiency and also it depends on that, how much of the stored supplies are used to meet the colony's subsistence needs (Paleolog 1996). Those processes are controlled by environmental and genetic factors (Woyke 1998, Woyke 1984). When run in the apiary, the evaluation of complex characters which, on top of that, are largely influenced by the environment is fraught with difficulties. In order to focus on genetically-controlled factors while at the same time minimizing the impact of the environment some investigators used cage tests (Milne 1985b, Kulincevic and Rothenbuhler 1982). Such tests are also less expensive and allow the study to be run under similar conditions at different laboratories. There are, however, conflicting views on whether the effectiveness of syrup/candy collection in the cage test and honey yield are actually correlated (Paleolog and Flis 1999; Milne 1985a, 1985b; Milne 1977; Cale and Rothenbuhler 1975).

Therefore, in this study it was decided to determine the ability of Buckfast bees and of the crossbreeds of Norwegian queens (*Apis mellifera meliffera*) by Caucasian drones to forage/collect and to store sugar syrup/candy using both field and laboratory tests. It was thus a continuation of and a meaningful addition to earlier studies on the suitability of these both imported races to be used in Poland and also on the factors that influence the reliability of cage tests. It is advisable that the imported bees should be tested against the bees commonly used in a given area. In the case of the experiments performed in this study the reference bees were Caucasian crossbreeds that are well--known, popular and recommended for central-eastern Poland (Bornus 1974). Also Prabucki and Chuda-Mickiewicz (2000b) confirmed the suitability of Caucasian crossbreeds, especially those derived from mating Caucasian queens to Carniolan drones, for the Lublin region.

METHODS

The experiment consisted of a field test in which sugar syrup foraging and hoarding efficiency was evaluated under flying cages and in a laboratory test in which candy collection rate was tested in cages. The field test lasted fourteen days and the laboratory test was of 60-day duration. The following three bee groups were used in the study:

- pure Buckfast bees (Bcf) - 10 colonies
- Caucasian x Carniolan crossbreds (Cau x Car) - 10 colonies
- crossbred bees derived from Norwegian queens (Nor x Cau) - 7 colonies

Bees used in this part originated from the different lines than those examined on the part 1. (Olszewski and Paleolog 2005). Also part 1. and part 2. were performed in different seasons.

Field test

From each colony within each of the three groups (Bcf, Cau x Car, Nor x Cau) a artificially made nucleus was formed by sampling 750 ml of bees on a non-flight day (in order to obtain the samples of the balanced age structure of worker bees). The bees were settled in three-frame, two-colony hives (frame size 120 x 190 mm), on empty combs that had been weighed. The nuclei of each group were put under separate mesh flying cages (400 x 400 x 180 cm in size) to prevent competition from other bee colonies. Graded artificial feeding stations were put under flying cages. Each day the amount of sugar syrup taken up by the bees from the stations was recorded and the combs were weighed to estimate the amount of stores hoarded in them. For more details concerning the method see in Olszewski and Paleolog (2005).

However, bees taking similar amounts of syrup may show a different rate of utilizing it to meet their subsistence requirements and thereby to accumulate stores. Therefore, the authors calculated the coefficient of syrup processing efficiency (EP%) in the following manner:

EP% = (amount of hoarded syrup hoarded / amount of syrup foraged) x 100%

Laboratory test

One day-old bees were sampled from the combs with emerging brood from each colony within each of the three groups and put in a separate traveling box. Subsequently, in the laboratory, the bees were anesthetized and three cages were settled, each with 60 bees from each of the colonies. Thus Bcf and Cau x Car groups involved 30 cages whereas the Nor x Cau group involved 21 cages. All cages were fitted with candy feeders and placed in an air-conditioned chamber at 28°C and relative humidity of 65%. The candy was replenished and dead bees were removed every day. The feeders were weighed every second day. The differences in feeder weight between two consecutive measurements was the measure of the amount of candy taken in by bees. By dividing the value by the number of living bees at a given time interval the average amount of candy taken in by a single bee was obtained. The amount of food in the honey sacs of dead bees was not determined because its presence in the honey sac of a bee, dead or alive, was the result of an earlier collection of candy from the feeder. For more details concerning the method see in Olszewski and Paleolog (2005).

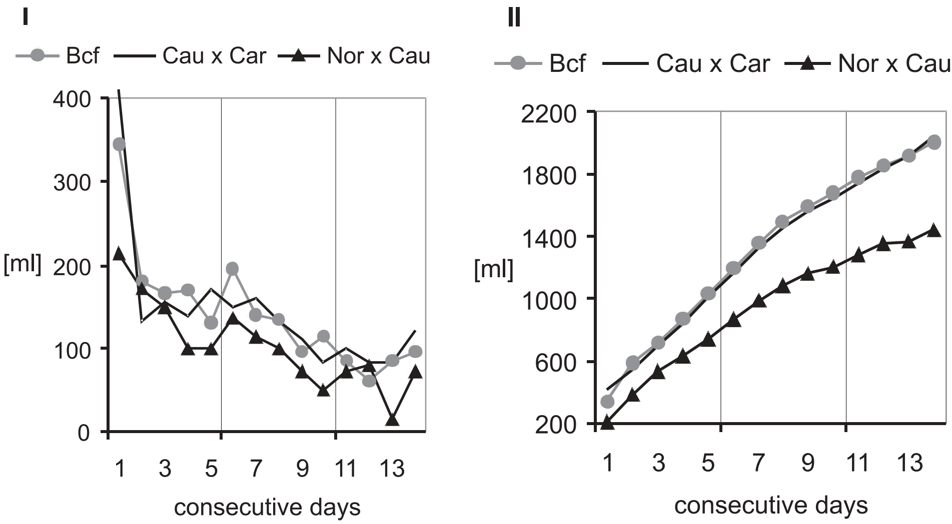
RESULTS

Field test

The amounts of collected vs. hoarded syrup were expressed as functions in time unit and presented graphically in two ways:

1. as amounts of syrup collected/hoarded on each successive day of the experiment. Those amounts presented on Fig 1.**I** / 2.**I** will be further referred to as “daily” syrup collecting/hoarding rates,
2. as total amount of collected/hoarded syrup from the commencement of the experiment to each of the successive record-taking dates. For instance, on the 10th day it was the total amount of collected/hoarded syrup over the period from day 1 to day 10. Those amounts shown on Fig 1.**II** / 2.**II** will be further referred to as “cumulated” syrup collecting/hoarding rates.

The Nor x Cau crossbreeds collected less syrup from the feeding stations than did the bees of the remaining two groups, the latter not differing from each other in this respect (Fig. 1.**I** and 2.**I**). It is reflected in Table 1 which shows the values averaged over the entire test. The amount of syrup foraged each day (Fig. 1.**I**) declined as if the bees after collecting large amounts of it were less active during the days to follow. Probably, the bees were also unable to maintain an even rate of collecting syrup because they ran short of the space available to hoard the supplies after collecting it. It can be supposed that during the periods of reduced collection the bees were busy evaporating water from the hoarded syrup thereby preparing room for new supplies. However, the syrup continued to be collected which is indicated by a systematic rise of the curves that describe its cumulated collection



Part **I** - day 6 – day10: Bcf (A), Cau x Car (A), Nor x Cau (B).
Part **II** – day 11 day 14: Bcf (A), Cau x Car (A), Nor x Cau (B).
Cau x Car – crossbreeds Caucasian x Carniolan,
Bcf – Buckfast, Nor x Cau – Nor x Cau – crossbreeds Norwegian x Caucasian.

Fig. 1. Amount of syrup collected from feeders for each of the three groups under flying cage tests expressed as daily average (part I) and cumulated values (part II).

Duration of the test was divided into three periods: from day 1 to day 5, from day 6 to day 10 and from day 11 to day 14. For each of those periods the curves were tested separately for the significance of differences between them; (**A, B**) - a difference is significant at P 0.01.

Table 1

Amount of syrup collected from feeders and amount of stores hoarded in combs by the bees of three groups per 1 colony/nucleus under flying cages

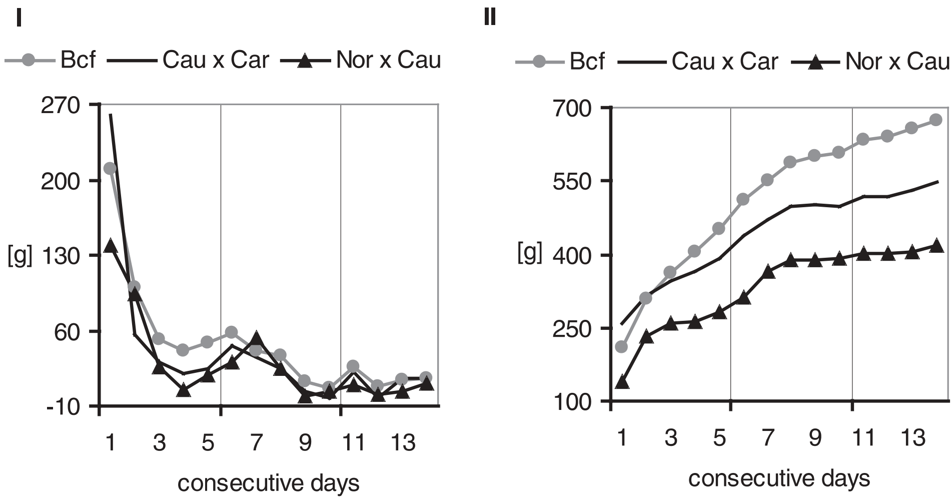
Group	Throughout the test		per 1 test day	
	amount of syrup collected [ml]	amount of food hoarded [g]	amount of syrup collected [ml]	amount of food hoarded [g]
Cau x Car	2039	534.81	145.63	38.20
Bcf	1995	667.59 a	142.50	47.69 a
Nor x Cau	1443	417.70 b	103.06	29.84 b

Cau x Car – crossbreeds Caucasian x Carniolan, Bcf – Buckfast, Nor x Cau – crossbreeds Norwegian x Caucasian; (**a**, **b**) - a difference is significant at P 0.05.

(Fig. 1.**II**). The situation may have been due to stable good weather that prevailed throughout the field test.

Bcf bees hoarded the greatest amounts of supplies in the combs even though they collected amounts of syrup similar to those collected by Cau x Car (Fig. 1.**II** and 2.**II**). It is borne out by the data listed in Table 1.

Values of EP% coefficient are shown in Table 2. Bcf bees turned out to be superior in both periods under testing. Nor x Cau bees, the lowest amounts of syrup collected notwithstanding, showed a higher food hoarding efficiency, than did Cau x x Car bees – the best performing syrup collectors. The EP% values were higher



Part **I** - day 11 – day14: Bcf (a), Nor x Cau (b).
Part **II** – day 6 – day 10: Bcf (A), Nor x Cau (B).
Part **II** – day 11 – day 14: Bcf (A), Nor x Cau (B).
Cau x Car – crossbreeds Caucasian x Carniolan,
Bcf – Buckfast, Nor x Cau – Nor x Cau – crossbreeds Norwegian x Caucasian

Fig. 2. Amount of syrup stored in the combs of each of the three groups under flying cage tests expressed as daily average (part I) and cumulated (part II) values**.**

Duration of the test was divided into three periods: from day 1 to day 5, from day 6 to day 10 and from day 11 to day 14. For each of those periods the curves were tested separately for the significance of differences between them.
(a, b) - a difference is significant at P 0.05;
(A, B) - a difference is significant at P 0.01.

Table 2

Syrup processing coefficients (EP%) in the three groups of bees

Group	EP% from day 1 to day 7 of the field test	EP% from day 8 to day 14 of the field test
Cau x Car	35.67	10.54
Bcf	41.65	17.93
Nor x Cau	37.1	11.55

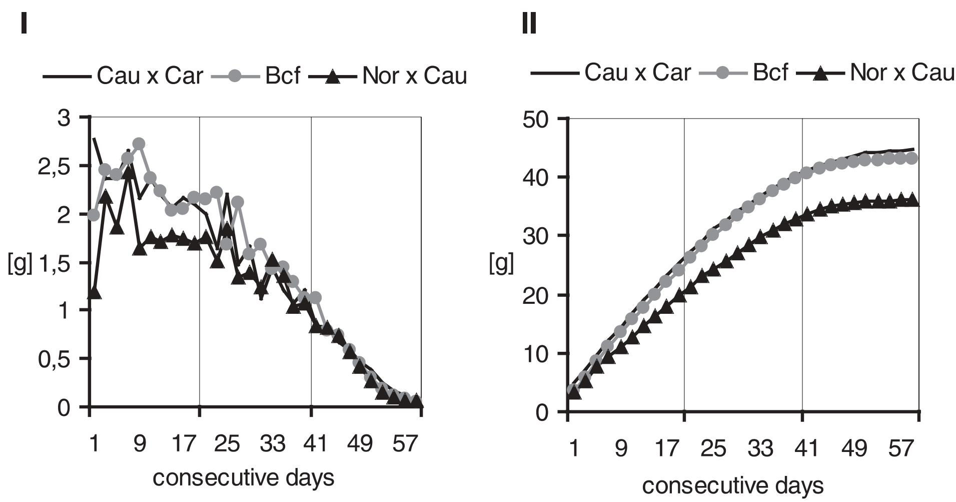
Cau x Car – crossbreeds Caucasian x Carniolan,
Bcf – Buckfast, Nor x Cau crossbreeds Norwegian x Caucasian

during the first period of the test. Probably, in the first period the bees did not manage to evaporate all excess water from the syrup. In the second period the amounts of collected syrup declined with the subsistence needs of the colonies remaining the same.

Laboratory test

The collection of candy from the feeders was presented in several ways as functions of candy amount in time unit:

1. daily collection rate – or the amount of candy collected by bees from a given cage on each of the successive test days (Fig. 3.**I**),
2. cumulated collection rate – or the amount of candy collected by the bees from a given cage from the start of the test to each successive record-taking day e.g. on day 10 it was the total amount of candy collected over the period from day 1 to day 10 (Fig. 3.**II**),
3. single and cumulated collection of candy per 1 bee – the relevant values described under items 1 and 2 were converted to a single bee – the amount of candy collected by bees from a given cage were divided by the number of living bees in that cage Fig. 4.**I** and 4.**II**) for each of the second day and next averaged. It was done so because, due to different mortalities, the numbers of bees in



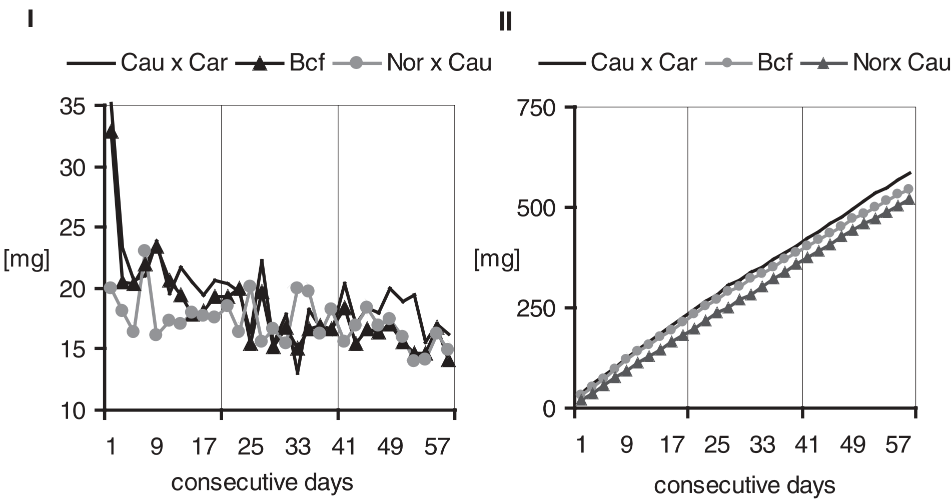
Part **I** - day 1 – day 20: Bcf (A), Cau x Car (A), Nor x Cau (B).
Part **I** - day 21 – day 40: Bcf (A), Cau x Car (A), Nor x Cau (B).
Part **I** - day 41 – day 60: Bcf (A), Cau x Car (Bb), Nor x Cau (a).
Part **II** - day 1 – day 20: Bcf (A), Cau x Car (A), Nor x Cau (B).
Part **II** - day 21 – day 40: Bcf (A), Cau x Car (A), Nor x Cau (B).
Part **II** - day 41 – day 60: Bcf (A), Cau x Car (Bb), Nor x Cau (a).
Cau x Car – crossbreeds Caucasian x Carniolan, Bcf – Buckfast,
Nor x Cau – Nor x Cau – crossbreeds Norwegian x Caucasian

Fig. 3. Average amount of candy collected by bees per 1 cage of each of the three groups in the laboratory test expressed as daily average (part I) and cumulated (part II) values.

As seen in the figure duration of the test (60 days) was divided into three periods: from day 1 to day 20, from day 21 to day 40 and from day 41 to day 60. For each of those periods the curves were tested separately for the significance of differences between them.
(**a**) signifies a difference significant at P 0.05;
(**A**) signifies differences significant at P 0.01.

individual cages varied (especially in later test periods) which affected the amounts of candy collected.

Over the nearly entire duration of the cage test, except for the last 10 days the bees of Cau x Car and Bcf groups did not differ significantly for their daily candy taking rate per cage (Fig. 3.**I**). Instead, Nor x Cau initially taken in substantially less candy per cage but only during the first 21 days. This notwithstanding, it became reflected as lower cumulated candy taking rate by those bees (Fig. 3.**II**). Clear-cut differences between Cau x Car and Bcf on the one side and Nor x Cau on the other in daily candy taking rate per bee occurred during the first days of the test (Fig. 4.**I**). In terms of cumulated values Nor x Cau again were found to be inferior to Cau x Car and to Bcf, the latter two groups did not differ from each other, although in the final period Bcf were slightly inferior. When figures 3, 4 and Table 3 are compared with the mortality data (Fig. 5) it turns out that cage-to-cage differences in mortality rate may affect the outcome of the laboratory test. However, Table 3 shows that despite differences in mortality (longevity) the major differences between groups were conspicuous with Nor x Car being the worst performing group. Then the comparison of Figures 3.**I** and 4.**I** indicates that the decline in the amount collected candy was brought about solely by the drop in the number of bees in the cages.



Part **I** - day 1 – day 20: Bcf (A), Cau x Car (A), Nor x Cau (B).
Part **I** - day 21 – day 40: Bcf (A), Cau x Car (A), Nor x Cau (B).
Part **I** - day 41 – day 60: Bcf (A), Cau x Car (Bb), Nor x Cau (a).
Part **II** - day 1 – day 20: Bcf (A), Cau x Car (A), Nor x Cau (B).
Part **II** - day 21 – day 40: Bcf (A), Cau x Car (A), Nor x Cau (B).
Part **II** - day 41 – day 60: Bcf (A), Cau x Car (Bb), Nor x Cau (a).
Cau x Car – crossbreeds Caucasian x Carniolan, Bcf – Buckfast,
Nor x Cau – Nor x Cau – crossbreeds Norwegian x Caucasian

Fig. 4. Average amount of candy collected per 1 bee of each of the three groups in the laboratory test expressed as daily average (part I) and cumulated (part II) values.

As seen in the figure duration of the test (60 days) was divided into three periods:
from day 1 to day 20, from day 21 to day 40 and from day 41 to day 60. For each of those periods the curves were tested separately for the significance of differences between them.
(**a**) signifies a difference significant at P 0.05;
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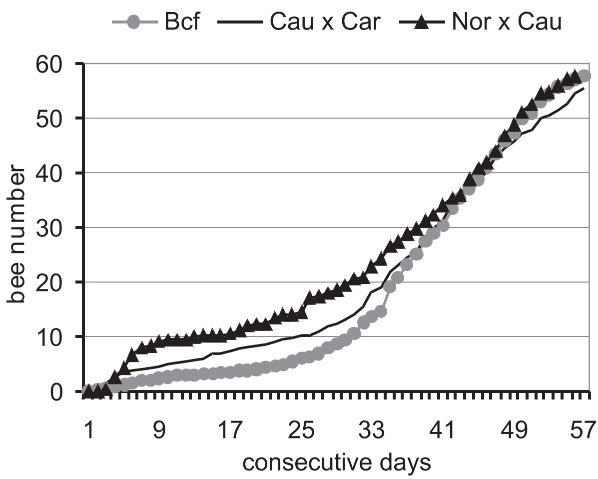

Cau x Car – crossbreeds Caucasian x Carniolan, Bcf – Buckfast,
Nor x Cau – Nor x Cau – crossbreeds Norwegian x Caucasian

Fig. 5. Average bee mortality rate in each of the three groups under a laboratory test conditions

Table 3

Amount of candy collected by the bees of the three groups per 1 day of the laboratory test of the laboratory test

Group	Candy collection - [mg] per bee	Candy collection - [g] per cage
Cau x Car	20.26 **A**	1.382 **A**
Bcf	18.89 **Ba**	1.375 **A**
Nor x Cau	18.34 **Bb**	1.136 **B**

Cau x Car – crossbreeds Caucasian x Carniolan, Bcf – Buckfast, Nor x Cau – crossbreeds Norwegian x Caucasian; (**a**, **b**) - a difference is significant at P 0.05; (**A**, **B**) - a difference is significant at P 0.01

DISCUSSION

Performance of Bcf purebreds and of Nor x Cau crossbreeds

Bcf bees performed very well in this study whereas Nor x Cau crossbreeds can hardly be considered successful. These results fit to those presented in the part 1. (Olszewski and Paleolog 2005). In a previous study involving field tests of small artificially made nuclei Buckfast bees or their crossbreeds did not perform badly although when compared to Caucasian and Carniolan bees they were either superior (Flis and Paleolog 2000) or inferior. In the study that involved regular full-size colonies Buckfast bees were only slightly inferior to Caucasian x x Carniolan crossbreeds with regard to the amount of pollen collected (Paleolog at al. 2003a). Nor did Buckfast crossbreeds depart form Caucasian bees for their honey yield (Olszewski at al. 2002). Thus in spite their variable performance Buckfast bees seem to be recommendable for use. However, in the majority of cases under study, Buckfast (maybe because it is an introduced race) turned out to be vulnerable to competition from other bee races (Paleolog 2002). Under the same conditions Buckfast proved to be competitive against Norwegian bees. Plausibly, the diversity of data reported in different studies was due to different sources from which the bees were taken for testing. It must be noted that Buckfast bees making its way to Poland from a variety of sources as well as Norwegian bees frequently differ among themselves depending on their origin. The confrontation of the results obtained in this study with those obtained by us earlier on, in the years 1998-2004, seems to bear out that view.

According to Prabucki and Chuda--Mickiewicz (2002) honey efficiency of the hybrids of Norwegian bees with Carniolan or Caucasian bees substantially surpasses that of purebred bees. Moreover, it was found that the use of the Norwegian bee as a paternal parent produces better effects. Nor x Cau crossbreeds tested in this study, including those used by Olszewski and Paleolog (2005), proved to be by far the worst when compared to those investigated earlier which usually performed well. All those observations suggest that when Norwegian bees are using as a component of crossbreds a substantial effect of specific combining ability (SCA) including effects related to mating direction should be taken into account. On the other hand, when Buckfast bees are using as a component of crossbreds we can count on more stable results most probably due to a larger contribution of general combining ability (GCA).

Laboratory tests

When laboratory tests were used much deliberation was given as to what extent the results obtained in the laboratory would be compatible with those obtained in the apiary (Milne 1985a, 1985b; Kulincevic and Rothenbuhler 1982; Cale and Rothenbuhler 1977; Milne 1977). In this study both tests reflected the differences among the investigated groups to the same degree since the results obtained in the field test performed under flying cages and those obtained in the laboratory cage test were in agreement (in both cases the order of groups was the same; Cau x Car, Bcf, Nor x Cau). At the same time, it was shown that the candy hoarding rate (evaluated in the cages) can be just as an useful measure of the predisposition of bee colonies to efficient nectar foraging as it was the sugar syrup hoarding rate monitored in the other cage tests (Pham-Delegue at al. 1987; Milne 1985b; Kulincevic and Rothenbuhler 1973). It is worth probing into which factors are responsible for the fact that the rate of syrup/candy collection in laboratory tests is not always correlated with honey yield. One of those may be a different ability to convert syrup/nectar into stores/honey (EP%). In this study the bees which collected the greatest amounts of syrup in the field test performed under flying cages were not always the best honey hoarders. Thus the determination of foraging efficiency as a sole criterion proved to be insufficient to predict the colony honey yield of the both in the field and in the cages. In our earlier studies (Flis and Paleolog 2000) it was shown that the amount of collected syrup may be used as a prediction of future honey yield but only if the differences among colonies are large. If the differences were smaller the ultimate ranking results of the colonies under investigation were largely dependent on EP%. By juxtaposing the performance of Nor x Cau bees with that of Cau x Car and Bcf bees it can be said that these suggestions were confirmed in this study and also fit to the results obtained during the first part of these researches (Olszewski and Paleolog 2005). Another important factor can be different ability to compete for forage shown by different bees. In an as yet unpublished study the authors of this paper observed that the results of the field test and the laboratory test were more compatible if the field test was run under flying cages. In this study the bees were also kept under flying cages during the field test and the tests for candy collection in the cages and for syrup collection in the field gave similar results.

The comparison of the candy collection rate by bees per single cage with the candy collection rate per single bee indicates that the decline in candy collection rate over the test was due to the drop in the number of bees in the cages. Thus the bees collected similar amounts of candy throughout the duration of the laboratory test which was probably the result of their subsistence needs. During the first days of the field test the bees collected much syrup and then the collection rate substantially declined. Subsequently, following a brief period of rise, the bees collected increasingly lower amounts of syrup. The similar pattern of syrup collection was observed in small test nuclei in our previous studies (Paleolog 2002; Flis and Paleolog 2000, Paleolog at al. 1999). However, in that case the number of bees did not decrease to the extent that might affect the amount of sugar food collected. Rather than that it is the large amount of food that had to be converted into stores that may have hindered its further collection. The results obtained by Fewell and Winston (1996) suggest that, unlike that of pollen, the amount of accumulated nectar/honey supplies does not diminish the rate of its collection neither does it interfere with the work intensity of the foragers. However, in the case of this study (conducted in small test nuclei) the shortage of room to accommodate successive loads of syrup and the necessity to engage a substantial number of bees to evaporate excess water may have restricted the work intensity of the foragers. Those problems are worth taking account of when results of field and laboratory tests are compared.

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CONCLUSIONS

1. The Bcf bees were not inferior to the bees Cau x Car recommended for south--eastern Poland. Bcf proved to be more economical as they stored the greatest amounts of collected syrup while using the least amount for their own sustenance. The confrontation of the results from this study and those obtained earlier suggests that the productivity of Bcf may have been affected to a large extent by general combining ability.
2. The crossbreeds Nor x Cau were the worst-performing bees but, which is noteworthy, they outperformed Cau x x Car, the best sugar food collectors, for their syrup processing coefficient. The confrontation of the previous data with the present ones suggests that the performance of Nor x Cau may have been affected to a large extent by specific combining ability including mating direction.
3. The results concerning the collection of syrup/candy in the field vs. laboratory test were found to be in agreement. However, the best syrup/candy collectors were not always the best hoarders. Along with foraging ability the colony honey yield was also dependent

on the ability to convert the foraged syrup into stores.

4. Variation in food hoarding efficiency and variable degree of competitiveness against other bees may affect the compatibility of the results obtained in the field with those obtained in the laboratory as those phenomena occur only in the field and have no place in cages.

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EFEKTYWNOŚĆ POZYSKIWANIA I MAGAZYNOWANIA WZIĄTKU U PSZCZÓŁ BUCKFAST I MIESZAŃCÓW NORWESKIEJ CZARNEJ PSZCZOŁY (*A. m. mellifera*) CZĘŚĆ 2. PORÓWNANIE Z MIESZAŃCAMI PSZCZOŁY KAUKASKIEJ W TESTACH POD IZOLATORAMI I W TESTACH LABORATORYJNYCH

Paleolog J., Olszewski K.

Streszczenie

Prezentowane badania były kontynuacją cyklu doświadczeń z pszczołą Buckfast oraz pszczołą norweską (*A. m. mellifera*) prowadzonych w celu poznania ich wartości użytkowej oraz behawioru. Tym razem postanowiono porównać efektywność pozyskiwania i magazynowania syropu cukrowego w polowym teście pod izolatorami z efektywnością pobierania ciasta cukrowego z podkarmiaczek w klatkowym teście laboratoryjnym. Grupę rodzin Buckfast (Bcf) oraz grupę rodzin mieszańców pszczół norweskich z trutniami kaukaskimi (Nor x Cau) porównano na tle zalecanych dla Polski południowo wschodniej mieszańców kaukaskie x krainki (Cau x Car). W teście polowym (tab. 1., ryc.1.) najwięcej syropu pozyskały Cau x Car, nieco mniej Bcf, a najmniej Nor x Cau. Ilość pozyskanego syropu nie w pełni korespondowała z ilością zgromadzonych zapasów (tab. 1., ryc. 2.). Pod tym względem najlepsze okazały się Bcf, a drugie miejsce zajęły Cau x Car. Mieszańce Nor x Cau znów okazały się najgorsze. Pszczoły Bcf najefektywniej przetwarzały przyniesiony syrop w zapasy (tab. 2). Pod tym względem Cau x Car były najgorsze mimo największej ilości pozyskanego syropu, natomiast Nor x Cau, które pozyskały najmniej syropu, zajęły drugą pozycję. Wydaje się, ze pszczoły Buckfast mogą być godne polecenia, a ich wydajność w znacznym stopniu może być uwarunkowana przez ogólną zdolność krzyżowniczą. Natomiast w przypadku pszczół norweskich można liczyć się ze znacznymi wpływami specyficznej zdolności kombinacyjnej, w tym kierunku krzyżowania. Wyniki uzyskane w teście laboratoryjnym (tab. 3. oraz ryc. 3. i 4.) były zbieżne z wynikami dotyczącymi pozyskiwania (nie magazynowania) syropu w teście polowym. Dane uzyskane w prezentowanym doświadczeniu potwierdzają tezę, że oprócz zdolności do pozyskiwania wziątku o wydajności miodowej rodziny decyduje również to, jaki procent z przyniesionego pokarmu przetworzony zostanie w zapasy. Drugim czynnikiem może być przejawiana przez różne pszczoły różna zdolność do konkurowania o źródła wziątku, z czym mamy do czynienia tylko w polu. Z tej przyczyny określanie efektywności pobierania pokarmu jedynie w warunkach laboratoryjnych może okazać się niewystarczające do oceny produkcyjności rodziny, chociaż tak uzyskane dane mogą okazać się przydatne.

Słowa kluczowe: Buckfast, *Apis m. mellifera*, test klatkowy, zbieranie wziątku, magazynowanie zapasów.