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Evaluation of economic traits in Buckfast bees in comparison with the hybrids of European Black bees and Caucasian bees

Ocena cech użytkowych pszczół Buckfast w porównaniu z mieszańcami pszczoły środkowoeuropejskiej z pszczołą kaukaską

Summary. The experiments were conducted in the years 2009–10 in the vicinity of Lublin (east Poland). A group of 10 colonies of pure Buckfast bees (bcf) were evaluated against 10 colonies of F_1 hybrids European Black bee × Caucasian bee (mel × cau). The colonies were kept in Dadant Blatt hives. The winter hardiness of the bcf bees was similar to that of the mel × cau bees. The bcf colonies developed faster and had a lower swarming tendency in the spring. They were also definitely superior to mel × cau in honey production (honey supers). However, the groups did not differ in relation to their propensity to hoard honey in the brood chambers. The values of the parameters in the group of the Buckfast colonies were more balanced. Lower variability was identified in: the number of dead bees, the brood area in the second and third measurements, brood increase, colony strength and honey yield. The climatic and nectar flow conditions in the Lublin region (east Poland) are not an obstacle to the keeping of Buckfast bees.

Key words: Buckfast bee, European Black bee, economic traits

INTRODUCTION

In their search for the "best bee" Polish beekeepers readily use imported material, seeing it as a method for quickly increasing honey yield of their bees. The bee, which has already been considered in Poland [Troszkiewicz 1992] and has recently gained increasingly more popularity, is the Buckfast. Its popularity in many countries, especially among commercial beekeepers [Österlund 1983, Büchler 1998a], may reflect con-

siderable adaptability of the Buckfast bee to various natural conditions. Therefore, there are no contraindications to the introduction of the breed also in Poland.

The problems that are being discussed here have become particularly important after Poland's accession to the European Union. Opening Poland's western border facilitated a private inflow of Buckfast queens into Poland, especially from Germany. On the other hand, the question of the usefulness of Buckfast bees has given rise to a lot of controversy among Polish beekeepers and scientists [Troszkiewicz 1992, Żabicki and Skubida 2004]. According to the authors of this research, a large part of the negative opinions on the Buckfast bee primarily stems from the dubious quality of the queens imported and reaed in Poland, and partly from a lack of knowledge about the requirements of the Buckfast bee. There is also positive feedback. What is more, few studies have been carried out to provide answers to the question how the Buckfast bee performs in the local conditions of Poland which considerably differ, especially in eastern regions, from those of Western Europe. Any assessment of a newly introduced bee breed in an area should be performed in comparison with endemic or with the commonly used bees.

The assumption was to compare Buckfast colonies with European Black bee hybrids, as numerous studies had shown that the European Black bee was an invaluable maternal-line component for the creation of hybrids [Prabucki i Chuda-Mickiewicz 1996, 1998, 2000a, 2000b]. Moreover, the genotype of European Black bee crosses contains the component of the native bee, optimally adapted to the local conditions. The Caucasian bee was chose in the paternal line considering its excellent fitness for crossing with other breeds [Ruttner 1992].

The objective of the study was to assess Buckfast bees economic traits in eastern Poland.

MATERIAL AND METHODS

The experiments were conducted in 2009–10 in the vicinity of Lublin (eastern Poland), in a stationary apiary which was made up of Dadant Blatt hives (the brood chamber; 10 frames 435 × 300 mm + one honey super; 10 frames 435 × 145 mm). A group of 10 colonies of pure Buckfast bees (bcf) was assessed against 10 hybrid colonies headed by pure-bred European black bee (*Apis mellifera mellifera*) (mel × cau). Two pure, unrelated Buckfast queens were acquired from the Buckfast Breeder Association of Lower Saxony in Germany. The daughter queens reared from one of them were instrumentally inseminated with the semen of drones derived from another queen. The European Black bee queens (Norweska line) came from National Animal Breeding Centre (Krajowe Centrum Hodowli Zwierząt), they were inseminated with the semen of Caucasian drones (Woźnica line). All queens were reared and introduced to colonies on June 2009. The colonies were of the similar strength and structure. The winter hardiness was evaluated in winter 2009/10. The spring colony development, colony strength, swarming tendency and honey yield were evaluated in 2010.

Nectar flow and climatic conditions

The flying range of the bees was characterised by nectar flow conditions typical of the greater part of Poland, with the highest nectar flow in the first half of the season. Under favourable conditions, it is possible to obtain spring honey from rape (*Brassica*

napus) and the false locust tree (*Robinia pseudoacacia*). An summer, nectar is produced by lindens (*Tilia* ssp.).

Evaluated traits

Winter hardiness was evaluated on the basis of the number of dead bees that were collected each month from the hive bottoms. To allow for the influence of the colony strength on overwintering, the number of the dead bees was calculated not only per one colony but also per one comb. The entire material taken from the hive bottoms (dead bees, wax) was screened in order to separate *Varroa destructor* mites – subsequently counted. The degree of infestation of the colony with *Nosema* ssp. [Hartwig and Topolska 1995] was also evaluated to confirm or to exclude its potential influence on overwintering and spring colony development as well as to check the susceptibility of the analysed groups to those parasites. In order to assess the spring colony development, the brood area was measured three times in each colony [Woyke 1983]. The first measurement was carried out on the day of the spring cleansing flight – 18th March. The interval between the subsequent measurements was 21 days. The brood area was used for computing the daily increase of brood cells at each measurement. Brood increase was calculated from the difference in the brood cell numbers between the subsequent (2nd and 1st; 3rd and 2nd) measurements. The colony strength was expressed as the number of combs fully populated by the bees. That parameter was assessed when performing the brood area measurements and also during the last autumn inspection so as to allow for the influence of the parameter in the assessment of overwintering. Swarming was analysed on the basis of the number of colonies in which the swarming tendency occurred. Inspections of the colonies were conducted at weekly intervals.

Evaluation of the honey yield was performed on the basis of the weight of the extracted honey, calculated by weighing the combs for each colony separately, prior to and after honey extraction. The spring honey was harvested in early June, and summer honey in July. Since honey was extracted only from the combs in the honey super, after the last harvest, the quantity of the honey (kg) left in the brood chamber was also estimated [Woyke 1983].

The results were analysed statistically (variance analysis, Tukey's test) using the SAS suite (2000).

RESULTS

Description of the season

The spring was cool with few warm days in May. Despite the chills, the colonies well exploited the rape (*Brassica napus*) nectar flow, chiefly owing to the small distance from the apiary to the plantation. The weather was not favourable during the false locust tree (*Robinia pseudoacacia*) florescence. On the other hand, lindens (*Tilia* ssp.) had a very good nectar secretion.

Winter hardiness

The bcf and mel × cau colonies overwintered in much the same way. Losses of bees in the two groups of bees were similar (Tab. 1). This was probably due to very similar colony strengths during the overwintering period – colony strength at the last autumn inspection (Tab. 2).

Table 1. Number of dead bees in the Buckfast and European Black bee hybrid colonies during overwintering 2009/10, respectively.
Tabela 1. Liczba pszczół padłych w czasie zimowli 2009/10 w rodzinach pszczół Buckfast i w rodzinach mieszańców pszczół środkowoeuropejskich

Number of dead bees Liczba padłych pszczół	Group – Grupa			
	bcf		mel × cau	
	mean średnio	CV	mean średnio	CV
Per one comb Na jeden plaster	121.24	18.18	128.42	37.21
Per one colony Na rodzinę	606.18	18.18	619.00	31.89

bcf – Buckfast; mel × cau – European Black bee hybrids / mieszańce pszczół środkowoeuropejskich; CV – coefficient of variation / współczynnik zmienności

Spring colony development, colony strength and swarming tendency

The bcf colonies were superior in all the traits that characterise spring colony development (Tab. 2). This group was also found to have a lower trait variability. In May, the swarming tendency was observed in two bcf colonies, as opposed to three mel × cau colonies. In June, the swarming tendency was identified only in four mel × cau colonies. It should be stressed that all the mel × cau colonies had a similar strength in May. Therefore, the different time of swarming tendency appearance did not so much stem from particular colony strengths as from the biology of the bees. Regular monitoring of the colonies and destruction of the queen cells prevented all the colonies from swarming. In the case of the bcf colonies, it was usually enough to destroy the queen cell once to disrupt the swarming tendency. As regards the mel × cau queen cells, the procedure had to be repeated several times.

Honey yield

The bcf colonies had a definitely better honey yield as compared with the mel × cau bees (Tab. 3). More spring and summer honey was collected from the former. Both groups did not differ in their tendency to store honey in the brood chamber.

Traits variability

The values of the parameters in the group of the Buckfast colonies were more balanced. Lower variability was identified in: the number of dead bees, the brood area at the second and third measurement, brood increase, colony strength and honey yield.

Table 2. Spring colony development in the Buckfast and European Black bee hybrid colonies
Tabela 2. Rozwój wiosenny rodzin pszczół Buckfast i rodzin mieszańców pszczół środkowoeuropejskich

Traits – Cechy	Group/Grupa			
	bcf		mel × cau	
	mean średnio	CV	mean średnio	CV
Brood area at the first measurement – 18th March (dm^2) Powierzchnia czerwia przy pierwszym pomiarze – 18 marca (dm^2)	12.46^{B}	46.03	6.51^{A}	43.61
Brood area at the second measurement – 8th April (dm^2) Powierzchnia czerwia przy drugim pomiarze – 8 kwietnia (dm^2)	48.93^{b}	16.89	41.89^{a}	22.88
Brood area at the third measurement – 29th April (dm^2) Powierzchnia czerwia przy trzecim pomiarze – 29 kwietnia (dm^2)	62.01^{b}	16.81	51.62^{a}	25.70
Brood increase between 2nd and 1st measurement (number of cells) Przyrost czerwia między drugim a pierwszym pomiarem (liczba komórek)	695	20.95	674	28.47
Brood increase between 3rd and 2nd measurement (number of cells) Przyrost czerwia między trzecim a drugim pomiarem (liczba komórek)	259	73.22	185	97.91
Colony strength at the last autumn inspection in year 2009 (number of combs) Siła rodziny przy ostatnim przeglądzie jesiennym w roku 2009 (liczba plastrów)	5.00	0.00	4.82	8.40
Colony strength at the first brood measurement (number of combs) Siła rodziny przy pierwszym pomiarze czerwia (liczba plastrów)	3.91^{B}	7.71	3.27^{A}	19.76
Colony strength at the second brood measurement (number of combs) Siła rodziny przy drugim pomiarze czerwia (liczba plastrów)	7.91^{B}	11.93	6.55^{A}	19.76
Colony strength at the third brood measurement (number of combs) Siła rodziny przy trzecim pomiarze czerwia (liczba plastrów)	15.00	0.00	14.64	5.53

bcf – Buckfast; mel × cau – European Black bee hybrids / mieszańce pszczół środkowoeuropejskich; CV – coefficient of variation / współczynnik zmienności; a, b – difference significant at $P \leq 0.05$ / różnice istotne przy $P \leq 0,05$; A, B – difference significant at $P \leq 0.01$ / różnice istotne przy $P \leq 0,01$

Table 3. Honey yield in the Buckfast and European Black bee hybrid colonies
Tabela 3. Wydajność miodowa rodzin Buckfast i rodzin mieszańców pszczół środkowoeuropejskich

Honey yield (kg) Wydajność miodowa (kg)	Group			
	bcf		mel × cau	
	mean	CV	mean	CV
Honey extracted in spring Mód pozyskany wiosną	17.79^{B}	28.21	11.35^{A}	37.98
Honey extracted in summer Mód pozyskany latem	20.69^{b}	24.58	15.41^{a}	32.85
Total extracted honey Całość pozyskanego miodu	38.49^{B}	21.92	26.76^{A}	32.05
Honey left in the brood chamber Miód pozostawiony w gniazdach	4.41	22.58	5.14	22.24
Overall honey yield Całkowita wydajność miodowa	42.89^{B}	18.37	31.90^{A}	26.50

bcf – Buckfast; mel × cau – European Black bee hybridsn / mieszańce pszczół środkowoeuropejskich; CV – coefficient of variation / współczynnik zmienności; a, b – difference significant at $P \leq 0.05$ / różnice istotne przy $P \leq 0,05$; A, B – difference significant at $P \leq 0.01$ / różnice istotne przy $P \leq 0,01$

DISCUSSION

Winter hardiness

The Buckfast colonies exhibited a similar winter hardiness to the mel × cau hybrids whose genotype contained the component of the indigenous breed, optimally adapted to the local climate conditions [Ruttner 1992]. According to Ruttner [1992], northern populations of European Black bees are characterised by exceptional winter hardiness. The Norwegian line also overwinters well [Troszkiewicz 2005]. On this basis, it can be concluded that Buckfast bees bred in the maritime climate of Northern Germany (quite different form the one prevalent in Eastern Poland) perform well in the Lublin region in winter. A lack of effect of the breed on winter hardiness was also observed by Hońko and Jasiński [2002] who compared Buckfast bees in Finland with Italian, Carniolan and European Black bees. Buckfast bees overwintered slightly worse than Caucasian hybrids in the northern part of the Lublin region [Olszewski 2009]. On the other hand, F_1 Buckfast hybrid colonies did better than F_1 Caucasian hybrids and F_1 Carniolan crosses [Gerula and Jagiełło 1998] in south-eastern Poland. This, however, may have been connected with the fact that the Buckfast bees originated from a population selected in Norway [Jagiełło – personal communication].

Natural mite fall (*Varroa destructor*) was similar in both groups. The material collected from the hive bottoms was found to contain few mites, which suggests the mites did not affect the overwintering bees. The same was observed for *Nosema ssp.* Only samples from individual colonies were characterised by low bee infestation or contained individual *Nosema ssp.* spores. Therefore, an influence of these parasites on overwintering and spring colony development can be excluded. The bcf colonies were not found to

be more vulnerable to nosema infestation. This is in accordance with the findings of Brother Adam [Bruder Adam 1983] and Olszewski [2009]. On the other hand, Hońko and Jasiński [2002] in Norway found the lowest level of infestation by *Nosema* ssp. in European Black bees, slightly higher in Buckfast bees and the highest in Italian and Carniolan bees.

Spring colony development, colony strength and swarming tendency

Buckfast bees are commonly thought to have a similar rate of spring colony development to Caucasian hybrids [Olszewski *et al.* 2002, Olszewski 2009] and Carniolan and Italian bees, whereas their rate is much faster than that of European Black bees [Liebig 1982, Büchler 2000, Hońko and Jasiński 2002]. German researchers [Pritsch 1993, Büchler 1998a] think that bcf colonies enter the overwintering period in a very strong condition and undergo a quick spring colony development. Therefore, a slower spring colony development of the mel × cau hybrids is not surprising. All the more so since a slow spring colony development is typical of northern populations of European Black bees as an adaptation to variable weather conditions [Gromisz 1981, Ruttner 1992, Konopacka 1999]. However, according to information from the National Animal Breeding Centre (Krajowe Centrum Hodowli Zwierząt), the Norwegian line (probably as a result of selection) develops early and forms strong colonies [Troszkiewicz 2005].

Comparative experiments carried out on Buckfast bees in Germany [Maul 1977, Maul and Petersen 1978, Liebig 1982, Büchler 2000] showed that the bees did not substantially differ from the Carniolan bee in a vast majority of traits. The question arises as to why it is so popular, especially among commercial beekeepers. Many scientists think that it is the extraordinary colony strength achieved by Buckfast with very limited swarming tendency that have gained the bees the appreciation of commercial beekeepers [Maul 1977, Bruder Adam 1983, Pritsch 1993, Büchler 1998b, Maul *et al.* 1999, Golz 2000]. Other researchers, including the present author, have confirmed the opinion commonly held about the low swarming tendency of Buckfast bees [Pritsch 1993, Golz 2000, Olszewski 2009]. Moreover, this breed displayed the swarming tendency only in May, whereas the mel × cau hybrids exhibited the urge even as late as June. That is why Buckfast bees may be suitable for those beekeepers who have limited time for managing their apiaries. Perhaps in the future the low swarming tendency may become the decisive factor for preferring Buckfast bees in Poland, especially by commercial beekeepers, as it is now in other countries [Österlund 1983, Büchler 1998a].

The results of the present study show that Buckfast bees meet the requirements of beekeepers in the Lublin region as to the spring colony development, specifically since benefitting from the nectar flow in the first half of the season is dependent on having bees that perform well in winter and intensively develop.

Honey yield

In the Lublin area, the Buckfast bees were far more efficient than the mel × cau crosses, probably due to the fast spring colony development. In the northern part of the Lublin region, Buckfast bees were almost as productive as F_1 Caucasian bees hybrids, though they performed worse with poor nectar flow [Olszewski 2009]. The highest efficiency in Finland was achieved by Carniolan bees. Buckfast and Italian bees had a simi-

lar or slightly worse performance and European Black bees were the weakest [Hońko and Jasiński 2002].

German scientists and beekeepers think Buckfast bees make excellent use of abundant nectar flow conditions, both early – as a result of intensive spring colony development and later – by maintaining a high colony strength throughout the season [Pritsch 1993, Büchler 1998a, Maul *et al.* 1999, Golz 2000]. They also consider Buckfast to be the best performing breed in migratory beekeeping that ensures nectar supply continuity. The present authors analysed Buckfast bees in an area where the nectar flow culminated in the first half of the season, in a stationary apiary, i.e. in standard conditions for an average Polish apiary. It is in such, according to the German researchers, untoward conditions for the Buckfast that they exhibited higher efficiency than the indigenous European Black bees. Therefore, it can be concluded that the nectar flow specificity of the Lublin region does not constitute an obstacle for the use of Buckfast bees, as additionally confirmed in previous research by Olszewski [2009].

CONCLUSION

Buckfast bees meet the requirements of beekeepers in the Lublin region as to the spring colony development, specifically since benefitting from the nectar flow in the first half of the season is dependent on having bees that perform well in winter and intensively develop. The climatic and nectar flow conditions in the Lublin region (east Poland) are not an obstacle to the keeping of Buckfast bees.

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Streszczenie. Badania prowadzono w latach 2009–10 w okolicach Lublina (Polska wschodnia). Grupę 10 rodzin czystorasowych pszczół Buckfast (bcf) oceniano na tle 10 rodzin mieszańców F_1 pszczół środkowoeuropejskich z pszczołami kaukaskimi (mel × cau). Rodziny były osadzone w ulach typu Dadant Blatt. Zimotrwałość bcf była zbliżona do mieszańców mel × cau. Wiosną bcf rozwijały się szybciej i były mniej skłonne do rójki. Rodziny bcf zdecydowanie przewyższały wydajnością miodową mel × cau (miód pozyskany z nadstawek). Grupy nie różniły się skłonnością do gromadzenia miodu w gniazdach. Wartości cech w grupie rodzin pszczół Buckfast były bardziej wyrównane. Mniejszą zmienność stwierdzono przy liczbie padłych pszczół, powierzchni czerwia przy drugim i trzecim pomiarze, przyroście czerwia, sile rodziny i wydajności miodowej. Warunki klimatyczne i pożytkowe Lubelszczyzny (Polska wschodnia) nie stanowią przeszkody w użytkowaniu pszczół Buckfast.

Słowa kluczowe: pszczoła Buckfast, pszczoła środkowoeuropejska, cechy użytkowe