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HONEY PRODUCTION IN QUEEN-BREEDING APIARY

Summary. The objective of this study was to assess the honey yield of rearing bee colonies from an apiary specializing in the production of bee queens. The quantity of honey obtained from colonies rearing queens from 1-day old worker larvae and quantity of honey obtained from colonies that were the source of young bees for the settlement of mating hives, was compared. Additionally, brood frames for establishing bee nuclei were being constantly removed from all colonies. No difference was found between experimental colonies from different groups in terms of honey yield. It was also found that despite of breeding works mean honey yield per colony was quite good and it was similar to the average honey yields recorded countrywide.

Key words: honey bee, honey production, queen rearing, colony's strength

Introduction

Honey yields of bee colonies depend on numerous factors, among others, on the colony strength (HARBO 1986, DELAPLANE 1997, GENC and AKSOY 1993, KUMAR et AL. 1995, GONTARZ and SOCHA 2001, LEBIEDIEW and SOFIULLIN 2005), on the distance of beehives from the source of the nectar (WENNING 1999), the type of nectar (GERULA 1999, GROMISZ et AL. 1978, SCHMID-HEMPEL et AL. 1993, SEELEY 1986, 1989, JABŁOŃSKI and KOŁTOWSKI 2003) and the age of the queen. SZABO et AL. (1992) demonstrated that bee colonies with a one-year old queens produced by up to 50% more honey in comparison with the colonies having two-year old queens. NELSON and SMIRL (1977) maintain that colonies deprived of the queen or those whose queens are old and produce little brood will not produce large quantities of honey. In addition, weather conditions can exert a strong influence on honey production. The main objective of a queen-rearing apiary is the production of queens and the honey harvested from these colonies can provide an additional source of income for the beekeeper.

The aim of this study was to assess the honey yield of rearing bee colonies from a queen-rearing apiary located in three different sites characterized by similar nectar source-weather conditions.

Material and methods

The experiment was carried out in the period extending from March to July 2006 in a "Socha" apiary in Czmoń near Kórnik (Wielkopolska Voivodeship) on the honey bee of Carniolan breed (*Apis mellifera carnica*). The apiary is carried out in bee-hives of the Wielkopolski type. This is a bee farm specializing in mass production of bee queens and nuclei intended for sale of which significant numbers of colonies are to be used as rearing colonies, for the settlement of mating hives and development of nuclei.

The experimental colonies originated from and were situated in three different sites separated from one another by the distance of 4 km.

Site 1: these hives were located close to the laboratory; there were 43 bee-hives placed in two rows and 20 settled wedding hives.

Site 2: these hives were placed in a mid-field clearing; there were 40 bee-hives in two rows.

Site 3: these hives were situated on a meadow and consisted of 10 bee-hives in one row.

The approximate assessment of the bee pasture failed to show significant differences in honey resources between the three sites. The assessed resources in the case of sites 1 and 3 amounted to 11 364 kg, while in site 2 – to 11 130 kg. The main nectar source plants in each of the above-mentioned bee pastures within the radius of 2 km included: fruit and maple trees, rape seed, phacelia, mustard, acacia, lime, pine, bilberry and raspberry.

The total of 15 bee colonies, five colonies from each site, was selected for experiments. The following criteria were adopted during the selection of individual beehives for the purposes of these investigations:

1. The level of the winter debris – the analysis of the debris on removable floorboards was carried out on March the 8th 2006; colonies with a small or moderate debris were selected (up to 200 insects on the floorboard, JĘDRUSZUK 1999).
2. Strength of the bee colony – on March the 28th 2006, during the first spring inspection, colonies with 7-8 frames completely covered by bees were selected for investigations.

The authors selected for the experiment colonies with one-year old *car PWJOT* (10 colonies) and *car Wielka* (5 colonies) queens for which a national program of bee genetic improvement is being realized. Both the above-mentioned lines are characterized by early and dynamic development and establishment of strong colonies. They are gentle bees and well-suited for early nectar sources. (Informator o hodowli pszczół 2006).

The development of colonies in the course of the experiment was determined on the basis of the increase in the number of honeycombs covered by bees assessed at the interval of 21 days from the moment of the first main inspections, i.e. from the 28th March 2006.

Honey yields from the first and second honey harvests (20.06.2006 and 24.07.2006) were determined weighing the removed frames with honey before and after honey extraction; in addition, wax cappings were also weighed.

Table 1 presents the rearing operations carried out in the experimental colonies.

Table 1. Apiary and rearing operations carried out in the experimental colonies in the course of the entire experimental period

Tabela 1. Prace pasieczne i hodowlane prowadzone w rodzinach doświadczalnych w całym okresie doświadczenia

Number of hive	Rearing of queens (number of series)	Material collected for mating hives (number of nurse bees in pcs.)	Material collected for nuclei (frames with brood in pcs.)
Site 1			
1	6	0	3
2	3	0	1
3	3	0	3
4	5	0	3
5	5	0	1
Sum	22	0	11
Site 2			
1	0	500	3
2	0	500	2
3	0	500	4
4	0	500	1
5	0	500	6
Sum	0	2 500	16
Site 3			
1	0	500	1
2	0	500	1
3	0	500	2
4	0	500	1
5	0	500	1
Sum	0	2 500	6

In the case of colonies from site 1, queen rearing was conducted from one-day old worker larvae which were transferred into queen-cell cups. In one series, 30 larvae were introduced into colonies. In the case of colonies from sites 2 and 3, young bees were collected (500 individuals from one beehive) which were intended to be used in mating hives. Bee queens were not reared on these sites. Frames with sealed brood were removed from all colonies which were then used to establish nuclei. They were collected from colonies which were strong at this particular moment in time.

The obtained research results were subjected to the ANOVA and Tukey's test ($\alpha = 0.05$). The *Minitab* statistical package was used for analyses.

Results

Queen bees in all bee colonies from each site derived from the Carniolan breed: sites 1 and 2 – line *PWJOT* and on site 3 – line *Wielka*.

The mean number of frames totally covered by bees during the entire honey season, i.e. from March, 28th to August, 24th as well as during the season peak, i.e. at the end of May or beginning of June, did not differ significantly in individual sites, $P = 0.451$, $df = 12$ (Table 2).

Table 2. Colony strength – number of frames completely covered by bees on a selected day in the peak of the season (at the end of May or beginning of June 2006) and during the entire experimental period (March 28th to August 24th 2006)

Tabela 2. Siła rodzin – liczba ramek obsiadanych przez pszczoły „na czarno” w wybranym dniu w szczycie sezonu (na przełomie maja i czerwca 2006 r.) oraz w całym okresie doświadczenia (28 III-24 VII 2006)

Number of hive	Breed of queen	Number of frames on a selected day in the peak of season (pcs./hive)	Mean number of frames in a colony during the entire experimental period (pcs./day/hive)
Site 1			
1	PWJOT 29/05	24.5	16.33
2	PWJOT 25/05	17.0	13.43
3	PWJOT 90/05	19.0	16.42
4	PWJOT 44/05	20.0	16.43
5	PWJOT 18/05	25.5	15.63
Mean ±SD		21.2 ±3.65 a*	15.65 ±1.28 a*
Site 2			
1	PWJOT 01/05	20.0	16.75
2	PWJOT 09/05	16.0	13.83
3	PWJOT 02/05	24.5	20.00
4	PWJOT 06/05	15.5	13.83
5	PWJOT 49/05	18.0	16.17
Mean ±SD		18.8 ±3.65 a*	16.12 ±2.55 a*
Site 3			
1	Wielka 73/05	20.0	17.00
2	Wielka 01/05	20.0	15.75
3	Wielka 03/05	14.0	10.40
4	Wielka 04/05	20.0	15.33
5	Wielka 05/05	19.0	13.25
Mean ±SD		18.6 ±2.61 a*	14.35 ±2.59 a*

*Mean values in a given column followed by the same letter do not differ statistically significantly (Tukey's test, $\alpha = 0.05$).

The mean honey yield per one bee colony ranged from 21.64 kg to 25.29 kg and did not differ significantly between individual sites, $P = 0.590$, $df = 12$. In addition, the performed analyses failed to show significant differences in honey production taking into account the strength of individual colonies, $P = 0.312$, $df = 12$ (Table 3).

Table 3. Honey production in the rearing colonies
Tabela 3. Produkcja miodu w rodzinach wychowujących

Number of hive	1st honey harvest (kg)	2nd honey harvest (kg)	Honey yield jointly from 1st and 2nd honey harvest (kg)	Amount of honey converted per 1 frame covered by bees (kg/frame)
Site 1				
1	23.900	–	23.900	1.464
2	–	22.955	22.955	1.709
3	27.608	–	27.608	1.681
4	19.613	4.255	23.868	1.453
5	12.445	15.693	28.138	1.800
Mean \pm SD			25.29 \pm 2.39 a*	1.621 \pm 0.155 a*
Site 2				
1	22.296	12.485	34.781	2.076
2	–	16.450	16.450	1.189
3	23.438	–	23.438	1.172
4	–	11.730	11.730	0.848
5	21.813	–	21.813	1.349
Mean \pm SD			21.64 \pm 8.68 a*	1.327 \pm 0.457 a*
Site 3				
1	9.603	16.308	25.911	1.524
2	9.145	12.970	22.115	1.404
3	10.513	3.320	13.833	1.330
4	12.983	11.970	24.953	1.628
5	12.290	11.988	24.278	1.832
Mean \pm SD			22.22 \pm 4.89 a*	1.544 \pm 0.197 a*

*Mean values in a given column followed by the same letter do not differ statistically significantly (Tukey's test, $\alpha = 0.05$).

Discussion

There is no doubt that the production results of bee colonies, in particular the honey yields, are affected by the accessibility to plant communities which ensure abundant supplies of nectar. That is why the choice of an appropriate location for the apiary is a very important factor (WENNING 1999) and rational utilization of nectar can increase honey yields by at least 50% (GROMISZ et AL. 1978).

In the case of the presented study, bee colonies were placed in separate sites, but the performed assessment of the bee forage failed to show significant differences in the honey resources between the experimental apiaries; in the case of sites 1 and 3 – these resources amounted to 11 364 kg, while in site 2 – to 11 130 kg. It can be said that the environmental conditions, in other words, the abundance of the nectar source base, were high since the mean beehive yield (more than 20 kg) was close to the countrywide average (GERULA et AL. 2007). The nectar source base in the presented study was not found to have any influence on the possible variations in the honey yields of the bee colonies between the three examined sites.

In addition, honey yields of bee colonies are further affected by their strength, i.e. by the number of bees found in the hive during the period of the nectar flow as indicated by FARRAR (1973) and, later on, in experiments carried out by HARBO (1986), GENC and AKSOY (1993), DELAPLANE (1997) or GONTARZ and SOCHA (2001).

In the investigations presented in this study, bee colonies selected for the experiments were characterized by similar strength, and with the passage of time this strength was regulated by the removal from honey supers of frames with brood which were used to establish nuclei. The performed statistical analysis failed to show statistically significant differences between the mean number of frames completely covered by bees between the three compared sites both during the peak of the season, i.e. at the end of May and beginning of June, as well as in the course of the entire experiment. Therefore, it can be assumed that the mean colony strength was identical in all the three examined apiaries.

In view of the above-presented results, it can be presumed that the honey production in the performed investigations may have been affected by the origin, i.e. the breeding line, of queens and the breeding works – among others – the rearing of queens (the rearing of several series of 30 queen-cell cups with young larvae in the rearing family) as well as by the rearing of young bees used to settle mating hives. However, the performed statistical analysis did not corroborate this hypothesis as it failed to show statistically significant differences in mean honey yields per colony between the three sites.

Conclusions

On the basis of the results obtained from the performed investigations, the following conclusions can be drawn:

- Colonies rearing queens as well as colonies rearing bees for the settlement of mating hives are characterized by similar honey yields.
- It was found that in a queen-rearing apiary it is possible to obtain honey yields per colony which are similar to the mean honey yields recorded countrywide.

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PRODUKCJA MIODU W PASIECE HODOWLANEJ

Streszczenie. Celem pracy było określenie wydajności miodowej rodzin wychowujących z pasieki nastawionej na produkcję matek pszczelich. Porównano ilość miodu uzyskaną od rodzin wychowujących matki z 1-dniowych larw roboczych z ilością miodu otrzymaną od rodzin, którym odbierano młode pszczoły do zasiedlania ulików weselnych. Dodatkowo ze wszystkich rodzin pobierano ramki z czerwiem do tworzenia odkładów. W doświadczeniu nie wykazano różnic pod

względem wydajności miodowej pomiędzy rodzinami doświadczalnymi z różnych grup. Stwierdzono ponadto, że mimo stosowania zabiegów hodowlanych, przeciętna wydajność miodowa z pnia była stosunkowo wysoka i nie odbiegała od średniej krajowej wydajności.

Słowa kluczowe: pszczoła miodna, produkcja miodu, wychów matek, siła rodziny

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