STIMULATIVE FEEDING OF BEES AS ONE FACTOR IN PREPARING COLONIES FOR EARLY NECTAR FLOWS

Piotr Skubida, Piotr Semkiw, Krystyna Pohorecka

Research Institute of Pomology and Floriculture, Division of Apiculture,
Kazimierska 2, 24 – 100 Puławy. Poland
E – mail: piotr.skubda@man.pulawy.pl

Received 06 April 2008; accepted 07 May 2008

Summary

The research was conducted from 2001 to 2003. The aim was to determine the usefulness of accelerating spring development of colonies, by applying stimulative feeding. The following products were used for feeding: in group II – honey-and-sugar candy, in III – honey-and-sugar candy with the addition of pollen, in IV – sugar syrup. Group I were the control, unstimulated colonies. The tendency for better spring development was observed in the groups of colonies fed with honey-and-sugar candy and candy with the addition of pollen. Later , this group also had greater honey yields. The application of sugar syrup as food stimulating the development of bee colonies, particularly in higher doses, was ineffective.

Keywords: stimulative feeding, colony development, honey yield, honey-and-sugar candy, sugar syrup, pollend.

INTRODUCTION

Recent years have seen a trend toward shifting the nectar flows towards the beginning of spring. In the majority of apiaries in Poland, the first nectar in beehives is already found in the first part of May. Also, about 42% of the annual gross increase falls in this month (Bieńkowska 2004). Early occurrence of nectar flow is the reason why it is recommended to strengthen the bee colonies for this flow. With this aim in mind, beekeepers try to stimulate the development of colonies by using various methods. In order to reach the increase in the strength of bee colonies, stimulative feeding is usually applied. It most often consists of sugar syrup, honey-and-sugar candy and pollen or its substitutes.

Proper timing of winter colony feeding (ending at the beginning of August) provides a basis for good colony development in spring (Skubida 1998).

Nabors (2000) fed package bees which were a prepared mixture of yeast, soya and sugar (500 g), establishing a higher amount of brood and productivity in colonies. In previous research, packages contained sugar syrup 2:1 in order to accelerate the reconstruction of comb foundation. Pollen substitutes did not induce the a swarm impulse. Similar dependencies were demonstrated by Chambers (1990), who used a composition containing soya, brewer's yeast, powdered milk, and honey or sugar syrup for stimulative feeding. Candy prepared in such a way was placed on upper frame bars. The same location was applied by Horr in his research (2000), when serving colonies with honey and pollen or pollen candy. The weight of the served packages ranged from 0.32 kg to 0.45 kg per colony. The author claims that pollen is an essential protein component of the bee diet, particularly for good development of uncapped brood. As an alternative solution, Horr recommends the application of combs with bee bread from the previous year. He also claims that

stimulative feeding in spring should be started when the colony has little food at its disposal. Sugar syrup, in 1:1 or 2:1 concentration, in the amount of 0.25 l per colony, could be used for this purpose.

Goodwin (1997) attributes great importance to feeding bee colonies with sugar syrup. It results in faster development of colonies. It also plays an important role in the intensification of their pollinating activity and higher pollen yield.

Król (1993) added 200 mg of vitamin B_1 to sugar syrup (1:1 concentration), applied in the dose of 0.5 l daily, for the last 10 days of April and of August. This resulted in a 40% increase in the amount of brood in May, June and July, 40% growth of rape honey production and 30% growth of buckwheat honey production. Zmarlicki and Marcinkowski (1979) applied various methods of stimulating feeding in spring. The first group of colonies was fed with a sugar syrup concentration of 1:1, in a single dose of 0.5 l every 4-5 days. The second was fed with honey-and-sugar candy. The third was fed with sugar-yeast candy. In the fourth group the stimulation of colonies was obtained by uncapping combs with reserves. These authors assessed that the highest development in honey production from early nectar flow, was obtained after the application of sugar syrup feeding. This amounted to 200% in comparison with the control group. However, in this group of colonies, bees most often developed a swarming impulse. This indicates that those colonies reached their biological maturity earlier. In other groups, this development ranged from 14 to 43%. Racys (2000) also looked for factors that would positively influence the acceleration of spring development of colonies. He pointed out, first of all, to the high maintenance of the colonies in autumn of the previous year, which was to influence their favourable wintering. Among various analysed methods of stimulation, he examined the effect of additional feeding of colonies. These additional feedings were: with candy containing 50% of honey and 50% of pollen: with syrup containing mineral and protein additives (50% sugar, 40% water and 10% milk), and: with sugar syrup containing an addition of vitamin C. The research by Racys (2000) found that those colonies that were fed in early spring with sugar syrup had good, spring development.

Interesting results were also obtained by Skowronek (1979). Skowronek applied various methods of feeding for stimulating the production of wax. He revealed a good effect of protein supply on the growth of production. Pollen showed a favourable effect on wax-making bees.

The aim of the current research was to establish how carbohydrate feeding, with or without added pollen, supplied to bee colonies in early spring, affect their development and resulting yield.

METHODS

The research was conducted in an apiary located in Sadłowice. The apiary belongs to the Department of Apiary Technologies, Apiculture Division of the Research Institute of Pomology and Floriculture in Puławy, Poland. The research was conducted from 2001–2003. Experimental colonies in Dadant beehives, were divided into four groups of seven colonies each. All groups were assigned colonies of similar strength.

1. Control group – not fed
2. Colonies fed with honey-and-sugar candy
3. Colonies fed with honey-and-sugar candy with the addition of pollen
4. Colonies fed with sugar syrup

In 2001 and 2003, feeding started in March and in 2002 – in April, after the first bee flight. Feeding ended after about a month. Sugar syrup was prepared in the concentration of 1:1 and was supplied to each colony on a one-time basis. It was

supplied in a 1.5 l dose repeated every seven days. Sugar syrup was supplied in side feeders. Honey-and-sugar candy was prepared hot, according to a recipe provided by Guderska (1983): 2 kg of sugar and 600 g of honey for 1 litre of boiling water, were brought to the proper temperature (118°C), and then the mass was mixed until it thickened. Honey-and-sugar candy was supplied to colonies in the form of packets – portions, containing 30 dag of candy, and honey-and-sugar candy with the addition of pollen containing 25 dag of candy and 5 dag of dried and ground pollen pellets carefully mixed with it. Both forms of candy were packed in a plastic film with holes and placed on an upper ceiling of the brood nest. One or two bars between the frames were removed. Feeding was repeated only after the colony used up the candy. Overall, in individual groups, colonies received 1.2 kg of candy and 6 l of sugar syrup (about 4 kg of sugar).

During the first spring inspection, an assessment was carried out in each colony. This assessment was of the remaining winter reserves and included the measurement of the brood area. Additional measurements of brood area were carried out in order to determine the dynamics of its growth. They took place as follows: in 2001 – on 3.04, 26.04 and 21.05, in 2002 – on 12.04, 30.04 and 20.05, and in 2003 – on 25.03, 22.04 and 13.05.

Additionally, during the apiary season, overall yield of honey was determined for each experimental group. The number of reconstructed foundation combs was also determined. Results were statistically analysed using variation analysis. An assessment of the statistical significance of differences was carried out applying Duncan's test. The calculation was carried out at the significance level of $p = 0.05$. A statistical program, developed in the Laboratory of Experimental Methods and Statistics, at The Research Institute of Pomology and Floriculture in Skierniewice, Poland was used with this aim in view.

ACKNOWLEDGEMENTS

Although most of the material has been collected by one of the authors (BW), we would like to express our sincere thanks to all the collectors for making some specimens of bees available to our studies. Our special thanks go to Dr Anna Klasa and Dr Lech Buchholz (both ONP, Ojców), as well as to Dr Robert Rozwałka (Marie Curie University, Lublin).

RESULTS

Winter food reserves. In each year of the research, after the end of wintering period and during the first inspection of colonies, an assessment was carried out. This was an assessment of the carbohydrate reserves remaining in combs after the winter period. The average amount for all groups of colonies was the same. It amounted to 3.0 kg / colony.

Spring development of colonies. In 2001 and 2003, bee colonies began brood development at a very low level. In 2002, during the first measurement, the brood area was definitely higher (Table 1). Taking into consideration the third measurement of brood, which was carried out in May, a significant increase of its area was noticeable. This proves the intensive development of colonies. In the 2001 measurements, the significantly highest brood area was observed in the group of colonies fed with honey-and-sugar candy, and in the group fed with, honey-and-sugar candy with the addition of pollen. A significantly lower, although similar area, was observed in the group fed with syrup as well as in the control group. The third measurement of brood in 2002 did not reveal any significant differences in brood area between groups. The third

measurement of brood area carried out in May 2003 found a statistically significant advantage of group III, fed with candy enriched with pollen. Colonies from group II, fed with candy without pollen, showed the weakest development.

As can be seen from the charts (Fig. 1, 2, 3) none of the groups revealed a significantly faster development. In 2002, the development was faster than in the two previous years, since its maximum was reached (in all groups) already in the second measurement. It was maintained in the third measurement at the level similar to the one previously reached. In 2002 colonies did indeed grow earlier, but this was not dependent on the method of feeding. Possible causes include:

Table 1

Average brood area in spring (dm^2).

Groups	2001			2002			2003		
	Measurement date			Measurement date			Measurement date		
	3.04	26.04	21.05	12.04	30.04	20.05	25.03	22.04	13.05
Group I control	6.47a	17.45a	31.28a	26.36a	52.96a	52.35a	6.04a	15.84a	43.52a
Group II fed with candy	6.72a	19.90b	42.13b	21.72a	54.32a	48.76a	5.72a	14.72a	41.86a
Group III fed with candy and pollen	6.74a	18.08b	34.04a	21.51a	52.83a	50.45a	5.92a	16.62a	47.17b
Group IV fed with syrup	7.50a	14.86a	33.50a	19.48a	52.96a	47.56a	6.43a	17.83a	44.23a

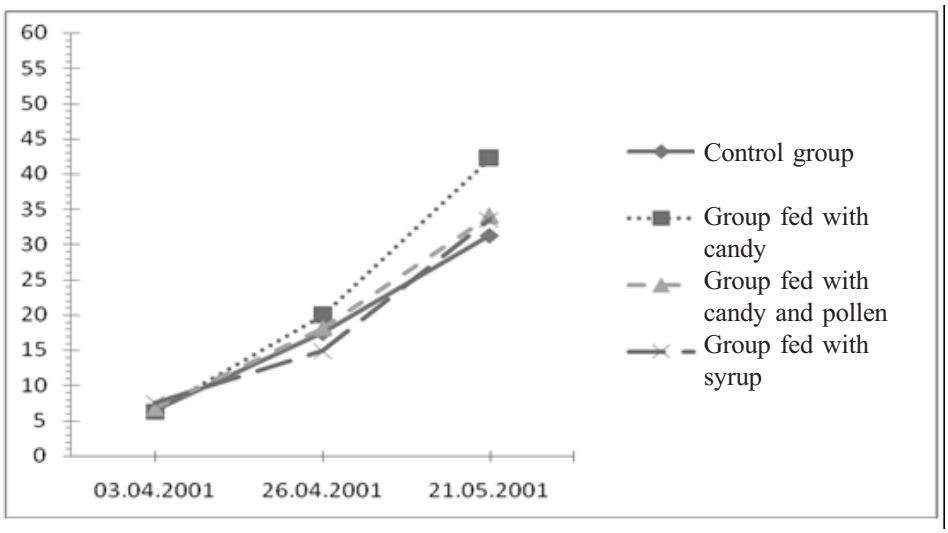

Fig. 1. Average brood area in the spring of 2001 (dm^2).

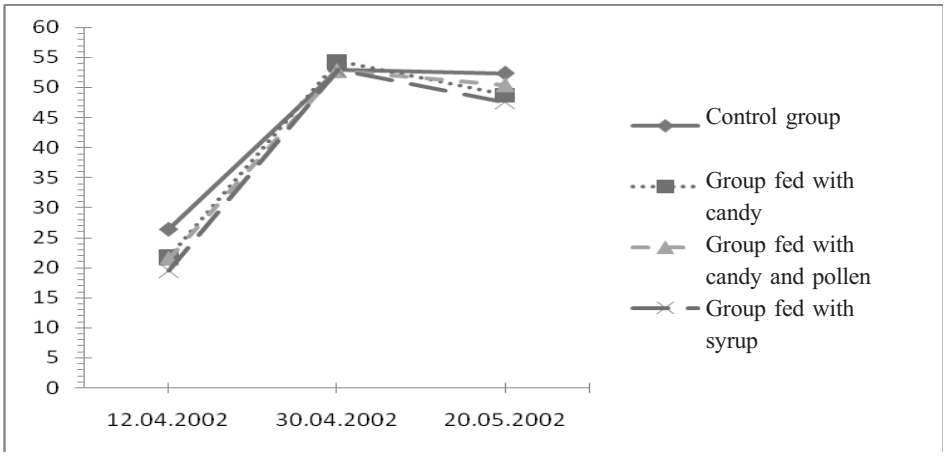

Fig. 2. Average brood area in the spring of 2002 (dm^2).

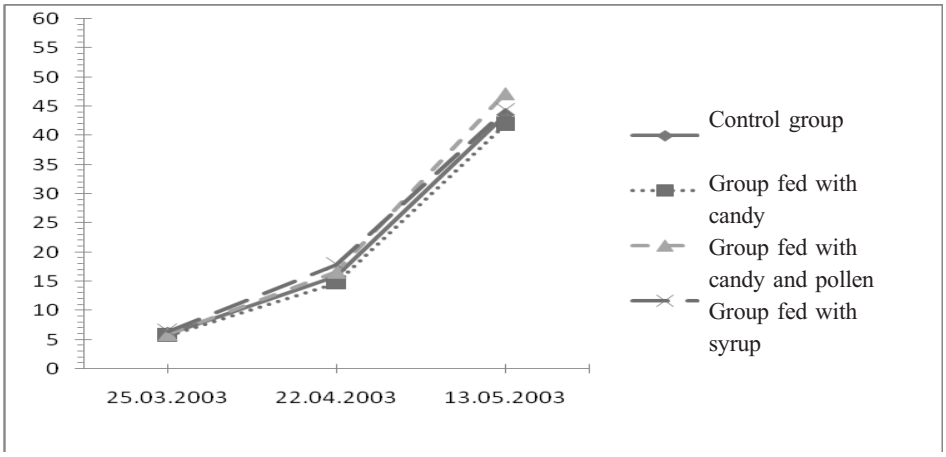

Fig. 3. Average brood area in the spring of 2003 (dm^2).

Table 2

Average dynamics of the brood area increase (in dm^2).

Groups	2001		2002		2003	
	1-2 meas.	1-3 meas.	1-2 meas.	1-3 meas.	1-2 meas.	1-3 meas.
Control group	10.98b	24.81a	26.60a	25.99a	9.80a	37.48a
Group fed with candy	13.18c	35.41b	32.60b	27.04a	8.55a	36.14a
Group fed with candy and pollen	11.34b	27.30a	31.32b	28.94b	10.70a	41.25b
Group fed with syrup	7.36a	26.00a	33.48b	24.99a	11.40a	37.80a

Different letters in columns indicate significant differences at $p \leq 0.05$.

Table 3

Average honey yield in the season from one colony (in kg).

Groups	2001	2002	2003
Control group I	7.92b	18.98a	10.30a
Group fed with candy II	7.58b	24.04b	13.20b
Group fed with candy and pollen III	3.83a	25.42b	11.20a

Different letters in columns indicate significant differences at $p \leq 0.05$.

Table 4

Average number of sheets of reconstructed foundation per colony.

Groups	2001	2002	2003
Control group I	1.80a	4.33b	3.00a
Group fed with candy II	2.00a	4.80b	3.33b
Group fed with candy and pollen III	1.70a	3.33a	2.93a
Group fed with syrup IV	1.50a	2.83a	2.83a

Different letters in columns indicate significant differences at $p \leq 0.05$.

1) stronger colonies and greater amounts of brood, already at the first measurement

2) better weather for the development of colonies, i.e. more favourable conditions for pollen collecting and brooding

3) better nectar flow (winter rape and acacia - developing after it)

Dynamics of brood area increase. The difference in the brood area between the last and the first measurements is the best indicator of the bee colony development. In 2001, the highest dynamics of development was revealed by colonies from the group fed with honey-and-sugar candy (Table 2). In 2002 and 2003, the colonies which developed the fastest originated from the group fed with candy and pollen. The established differences in the dynamics of brood increase between the first and the third measurement were statistically significant in comparison to the other groups.

The dynamics of the brood area increase from the first to the second measurement in groups was about 2.5 to 4.5 times higher in 2002 than in 2001. It was 2.7 to 3.8 times higher than in 2003.

Honey yield during the apiary season. In 2001, compared to subsequent years of research, experimental groups III and IV achieved significantly lower honey yield than group I (control group) and II (fed with candy without pollen). In 2002, honey yield from all experimental groups (i.e. supplied with food) was significantly higher than that from colonies originating from the control group. In 2003, a significantly higher average honey yield was observed in the group of colonies fed with candy (group II). The other groups did not significantly differ (Table 3).

Reconstruction of comb foundation during the season. In 2001, colonies of all groups did not reconstruct much of their comb foundation. The method of feeding did not bring about any significant differences between the groups. In 2002, significantly more sheets of foundation were reconstructed by bees from the group fed with candy (II) and from the control group (I), while in 2003 only from groups fed with candy. As regards the production

of foundation, 2002 proved to be the best. This correlated with honey production and the dynamics of colony development (Table 4).

DISCUSSION

Stimulating spring feeding was applied regardless of the presence or the lack of carbohydrate reserve. This is contrary to Horr (2000), who claims that this form of feeding should be applied when the colony has too little food at its disposal. The average value of reserves provided in the results was below the essential standard. This average value of reserves refers to that which should be found in a beehive to ensure the proper functioning of the colony. It is typically determined as 3.5-5 kg. It is worth reflecting on the purposefulness of supplying colonies with sugar syrup in spring in one litre doses or higher. Horr (2000) proposes single doses of 0.25 l per colony, while Zmarlicki and Marcinkowski (1979) recommend 0.5 l. Additionally, attaching side feeders to beehives leads to excessive cooling of the brood nest. This interferes with the temperature regime of the colony development. Supplying the candy on the upper board of the beehive is the best solution for maintaining an optimal microclimate in the colony. This method was also used by Chambers (1990).

Hartwig (1967) carried out histochemical tests of the midgut of worker-bees fed with substitutes of pollen (baker's yeast and soya flour) in comparison to feeding with a mixture of honey and pollen (1 g of pollen and 10 g honey). The research results suggest that the differences in protein food did not influence the changes in the occurrence of RNA, phospholipids and some hydrolytic enzymes in the cells of midgut epithelium of worker-bees. The only objection, concerned the use of providing soya flour, which was found to cause a high mortality rate of experimental bees. For this reason Hartwig restricted research only to the application of pure pollen with honey-and-sugar candy.

Average dynamics of the increase in the brood area were compared. It can be noted for individual years that the development of colony strength is not precisely reflected in their honey yield. This is revealed in all the years of the research, see Table 2 and 3. On the other hand, according to Gerula (2004), stronger colonies at the beginning of May and less brood was found before main lime nectar flow resulted in higher production of honey in 2003 (year of great honey yield). However, in the current research, the year 2002 proved most melliferous. A similar development of brood was observed at that time, by Gerula (2004); in 2003 conditions to rear brood were better than in 2002.

The results of the research by Zmarlicki and Marcinkowski (1979) – who obtained a statistically higher honey yield from the group of colonies fed with syrup – were not confirmed. Also, in this research it was not found, that the application of any of the carbohydrate or carbohydrate-protein food, had any influence on increasing the occurrence of swarm impulse in groups.

CONCLUSIONS

1. Bee colonies fed with honey-and-sugar candy and honey-and-sugar candy with the addition of pollen, reveal a tendency for better spring development.

2. Average honey yields are not related to the dynamics of colony development after the application of stimulating food. Colonies fed with both forms of candy show an increased tendency to produce higher honey yields.

3. Spring stimulative feeding with sugar syrup supplied in large doses in site feeders, which would result in cooling the brood nest, is not recommended.

REFERENCES

Bieńkowska M. (2004) – Nationwide structure of honey flows in Poland in the years 1995-2003. *J. apic Sci*. 48 (2): 111 – 122.

Chambers S. (1990) – Feeding pollen to honeybees for colony development. *Bee World.* 71 (1): 35 – 47.

Gerula D. (2004) – Effects of adjusting the colony structure of caucasian (Apis mellifera caucasica Gorb.) and carniolan (Apis mellifera carnica Pollm.) bees under different flow conditions. *J. apic Sci.* 48 (2): 83 -95.

Goodwin M. (1997) – Feeding sugar syrup to honey bee colonies to improve pollination: a review. *Bee World*. 78 (2): 56 – 62.

Guderska J. (1983) – Odżywianie się i dokarmianie pszczół. [In:] Hodowla pszczół. *PWRiL*: 175 – 176.

Hartwig A. (1967) – Badania histochemiczne jelita środkowego pszczół robotnic odżywianych namiastkami pyłku kwiatowego. *Pszczeln. Zesz. Nauk.* 11 (1 -3): 69 – 77.

Horr B. (2000) – Spring stimulative feeding. *Am. Bee J.* 140 (3): 199 -201.

Król A. (1993) – Wpływ witaminy B_1 podawanej w pokarmie na kondycję pszczół i rozwój rodzin. *Pszczeln. Zesz. Nauk.* 37 (3): 11 -21.

Nabors R. (2000) – The effects of spring feeding pollen substitute to colonies of Apis mellifera. *Am. Bee J.* 140 (4): 322 – 323.

Racys J. (2000) – An investigation into the maximum utilization of spring honey – flow. *Pszczeln. Zesz. Nauk.* 44 (2): 95 – 101.

Skowronek W. (1979) – Wpływ podkarmiania węglowodanowego i białkowego na produkcję wosku i i rozwój rodzin pszczelich. *Pszczeln. Zesz. Nauk.* 23: 29 - 42.

Skubida P. (1998) – Wpływ zróżnicowanego sposobu przygotowania zapasów zimowych na rozwój i produkcyjność rodzin. *Pszczeln. Zesz. Nauk.* 42 (1): 95 - 117.

Zmarlicki C., Marcinkowski J. (1979) – Wpływ wiosennego podkarmiania pobudzającego pszczół na przyspieszenie rozwoju rodzin i produkcję miodu. *Pszczeln. Zesz. Nauk*. 23: 43 – 52.

PODKARMIANIE POBUDZAJĄCE JAKO JEDEN Z CZYNNIKÓW PRZYGOTOWANIA RODZIN NA WCZESNE POŻYTKI

Skubida P., Semkiw P., Pohorecka K.

Streszczenie

W latach 2001-2003 prowadzono badania mające na celu stwierdzenie celowości przyśpieszania wiosennego rozwoju rodzin przy zastosowaniu podkarmiania stymulującego rozwój. Jako pokarmy zostały użyte: w grupie II – ciasto miodowo-cukrowe, w III – ciasto miodowo-cukrowe z dodatkiem pyłku, w IV – syrop cukrowy. Grupę I stanowiły rodziny kontrolne, nie stymulowane. Tendencję do lepszego rozwoju wiosennego, a w okresie późniejszym do większych zbiorów miodu zaobserwowano w grupach rodzin podkarmianych ciastem miodowo-cukrowym i ciastem z dodatkiem pyłku. Stwierdzono brak celowości stosowania wczesną wiosną syropu cukrowego jako pokarmu stymulującego rozwój rodzin pszczelich, szczególnie w większych dawkach.

Słowa kluczowe: podkarmianie stymulujące, rozwój rodzin, zbiory miodu, ciasto miodowo – cukrowe, syrop cukrowy, pyłek.