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EFFECTS OF A VITAMIN-MINERAL PREPARATION ON DEVELOPMENT AND PRODUCTIVITY OF BEE COLONIES

M. MLADENOVIĆ*, V. MLAĐAN** and NADA DUGALIĆ-VRNDIĆ**

*Faculty of Agriculture, 11080 Beograd-Zemun, Nemanjina 6 **Scientific Institute for Veterinary Medicine of Serbia, 11000 Beograd, Vojvode Toze 14

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In spring and autumn we monitored the influence of additional feeding on brood, honey and pollen in honey bee colonies a vitamin-mineral preparation (Forssatom), brewers yeast and sugar syrup, in comparison with a control group.

The greatest brood surface in the spring was recorded for the group additionally fed syrup with the vitamin-mineral preparation. It was 6,8% greater when compared to the control unsupplemented group. The greatest brood surface in the autumn was observed in the group additionally fed with yeast and it was 25,4% greater than in the control group.

In the spring the greatest honey surface was recorded in the group additionally fed on syrup with yeast (37,8% higher than the control). In the autumn the highest values were reached in the group additionally fed on the vitamin-mineral preparation, namely, 181,7% higher than in the control hives.

Pollen surface in the spring was smaller in all the supplemented groups as compared to the control, whereas the highest values in the autumn were recorded in the group additionally fed on sugar syrup alone, namely 30% greater than the control.

The correlation between brood and honey surface was very close for all the investigated groups, with the exception of the control group where it was only close. The correlation between brood and pollen surface was close in all the tested groups, and that between honey and pollen surface intermediate except for the group additionally fed on sugar syrup where it was weak. The regression coefficient was used to determine the area of pollen and honey required to increase brood surface, and vice versa.

Key words: honey bee, food, yeast, vitamin-mineral preparation

INTRODUCTION

The aim of modern technology in apiculture is to obtain highly- productive bee colonies. To achieve this goal, in addition to the health of bee colonies, investigations are performed in the sphere of bee breeding for the purpose of increasing the gathering activity of flying worker bees (Milne, 1980a), as well as honey yields in relation to the weight of worker bee larvae (Milne, 1980b).

One of the most efficient means of creating strong bee colonies is stimulative nutrition on solid and liquid feed in the spring and in the autumn. Certain active matters are usually added for the purpose of ensuring disease control in bees and broods (Menapace and Hale, 1981) and protection of the bee colony from the influence of certain pesticides (Stoner et al. 1982).

The most frequently used supplement (Haydak, 1970) consists of soybean meal, dried brewers yeast and skimmed milk powder. Adding egg yolk powder and commercial casein (the main milk protein) enables the nutritive value of the pollen substitute to be similar to fresh pollen collected and brought into the hive by the bees. However, when it is possible to choose, the bees prefer pollen to the pollen substitute. Attempts to increase pollen substitute attractiveness with the addition of different essential oils and sugar were successful particularly when anise oil, phenylic oil or dark rum were added to the sugar-honey dough (Robinson, 1966).

Favourable effects on brood emergence, as well as honey yield increases (Abdellatif et al. 1971) were achieved by feeding bees on dry medical yeast enriched with vitamins as the pollen substitute. Haydak (1970) recommended a mixture of soybean meal, dried brewers yeast and skimmed milk powder as a pollen substitute. The nutritive value of the mixture was increased by adding dried egg yolk. Konstantinović and his associates (1987) established the positive effects of Bevipleks, lemon juice and brewers yeast on brood development and honey and pollen yields, whereas Mladenović and Živić (1996) concluded that no inactivation of brewers or baker's yeast at high temperatures is necessary, since the activity of Saccharomyces cerevisiae has no influence in terms of shortening the life of bees. Moreover, on the contrary, bees fed on yeasts treated at 37 and 42^{0}C lived longer than those given yeasts inactivated at 70^{0}C and 110^{0}C.

In our investigations we used the vitamin-mineral preparation "Forssatom" and brewers yeast with the aim of establishing the influence on queen bee activity from values of brood surface in the spring and autumn and on the influence of worker bee activity from honey and pollen surface areas.

MATERIAL AND METHODS

Our investigations were performed in the apiary of the Faculty of Agriculture of Belgrade in 1994-1995 with the domestic Apis mellifera carnica honey bee breed. The apiary was a stationary type with Langstroth-Root hives. Four hive groups with three bee colonies per group were formed. The first group

was fed on sugar syrup in a 1:1 ratio, the second on sugar syrup with the addition of Forssatom (10 drops per liter of syrup), the third on brewers yeast with addition of 40 g of sugar syrup per liter, whereas the fourth group received no supplement and was used as the control. Bee colonies in the first three groups received the supplement consisting of 0.5 l of sugar syrup every second day. The trial lasted two years. The bees were monitored for a period of 30 days each spring and autumn. Before and after feeding, the colonies were examined in detail by measuring brood, honey and pollen surfaces as percentage areas of honey combs on both sides of the frames.

The results obtained were statistically processed correlations were established; dependence intensities between investigated parameters were determined using regression coefficients and all the data thus obtained are presented in appropriate tables.

RESULTS

Table 1. Effects of stimulative feeding on brood, honey and pollen surfaces in 1994/95 (dm^2)

Treatment	Period	Syrup		Forssatom		Yeast		Control	
		surface	%	surface	%	surface	%	surface	%
Brood	spring	20.7	81.4	27.2	106.8	26.4	103.5	25.4	100
	autumn	10.8	84.0	15.0	116.5	16.2	125.4	12.9	100
Honey	spring	38.7	105.8	38.9	106.3	50.5	137.8	36.6	100
	autumn	22.8	219.2	29.3	281.7	15.8	151.9	10.4	100
Pollen	spring	5.1	68.7	5.7	76.8	4.9	65.4	7.5	100
	autumn	1.6	130.0	1.3	108.8	1.5	122.5	1.2	100

From the results presented in Table 1 it appeared that the differences recorded between the initial and the final measurement following feeding of bee colonies in the spring and in the autumn for 30 days during two years vary from group to group.

The differences recorded between spring and autumn measurements in the control group were marked as 100%. When the group given sugar syrup is compared with the control, it may be concluded that greater honey quantities were obtained within both seasons namely 5,8 % in the spring and 119,2% in the autumn but there was 18,6% less brood in the spring, and 16% less in the autumn. Pollen quantities 30% were greater in the autumn and 31,3% smaller in the spring.

Compared to the control the group given Forssatom had a 6,8% greater brood surface in the spring and it was also 16,5% greater in the autumn. The honey surface was 6,3% greater in the spring and 181,7% greater in the autumn. The pollen surface was 8,8% greater in the autumn, but 23,2% smaller in the spring.

A greater brood surface was also recorded in the group given yeast compared to the control, namely, 3,5% in the spring and 25,4% in the autumn. Honey quantities in the spring were 37,8% greater and in the autumn 51,9% greater, while pollen quantities were 22,5% greater in the autumn but 24,6% smaller in the spring.

If only the spring results pertaining to broods are analyzed, it is clearly evident that the greatest brood surface increase was obtained in the group fed with Forssatom (6,8%), followed by that given yeast (3,5%), whereas feeding with syrup had a negative, non-stimulative effect on brood surface which decreased by 18,6% as compared to the control. The greatest increase in the autumn was recorded in the group fed with yeast (25,4% followed by Forssatom (16,5%), whereas feeding only with syrup displayed no stimulative effect and led to a brood surface reduction of 16,00%.

Concerning honey surface it is evident that in it was increased the spring (5,8-37,8%) and in the autumn (51,9-181,7%) when compared to the control whereas pollen surface increased in all three groups in the autumn (ranging from 8,8 to 30,0%), but was smaller than the control in the spring (ranging from 23,2 to 34,6%).

Table 2. Correlation coefficients between brood, honey and pollen surface depending on the type of feeding (dm^2)

Variant	Brood-honey	Brood-pollen	Honey-pollen	$\bar{X}$
Syrup	0.86	0.61	0.39	0.62
Forssatom	0.85	0.64	0.42	0.64
Yeast	0.81	0.63	0.49	0.64
Control	0.69	0.61	0.46	0.59
$\bar{X}$	0.80	0.62	0.44	0.62

From the data presented in Table 2 it is possible to assess the variablility of correlations between brood properties and honey, brood and pollen, and honey and pollen, i. e. based on correlation interdependencies regarding other characteristics of the investigated phenomena. Correlation intensity was established according to Roemer- Orphalov's table, and, based on the general average, it may be concluded that there was a close correlation (0,62) between the investigated parameters.

Regardless of the supplement it may be concluded that there was a very close correlation between brood and honey (0,80), a close correlation between brood and pollen (0,62), and an intemediate correlation between honey and pollen (0,44). When assessing all the investigated groups, it may be concluded that there was a close correlation among the tested parameters (0,62, 0,64, 0,64), and an intermediate correlation for the control group (0,59). The closest correlations between brood and honey were found in the groups given sugar syrup (0,86) and Forssatom (0,85), between brood and pollen in the group given Forssatom (0,64), and between honey and pollen in the group supplemented with yeast (0,49).

Table 3. Regression coefficients between brood, honey and pollen surfaces with respect to different feeding regimes (dm^2)

Treatment	Correlation	Syrup	Forssatom	Yeast	Control	$\bar{X}$
Brood-honey	brood	1.19	1.68	1.80	1.16	1.46
	honey	0.73	0.61	0.51	0.73	0.64
Brood-pollen	brood	1.37	1.23	1.30	3.31	1.80
	pollen	0.24	0.26	0.26	0.10	0.22
Honey-pollen	honey	1.60	1.79	2.17	3.65	2.30
	pollen	0.17	0.18	0.13	0.07	0.14

From the data presented in Table 3 it is possible to establish the intensity with which an investigated parameter influences the changes of another parammeter, i. e. which brood increase is obtained per dm^2 of introduced nectar or how much honey is obtained per dm^2 increase of brood surface, etc.

It was concluded that a mean honey increase of 0,64 dm^2 and a mean pollen increase of 0,22 dm^2 was obtained per each dm^2 of brood; a brood increase of 1,46 dm^2 and a pollen increase of 0,14 dm^2 is obtained per each dm^2 of honey; and a brood surface increase of 1,8 dm^2 and honey increase of 2,3 dm^2 is obtained per each dm^2 of pollen.

In the control group this dependence was greater than for all the supplemented groups. Thus, for instance, to obtain a brood surface increase of 1 dm^2 in the group given syrup, honey surface must be increased by 0,73 dm^2 and pollen surface by 0,24 dm^2; to obtain a honey surface increase of 1 dm^2 brood surface must be increased by 1,19 dm^2 and pollen surface by 0,17 dm^2, and finally, to ensure a pollen surface increase of 1 dm^2 brood surface must be increased by 1,37 dm^2 and honey surface by 1,6 dm^2. In the group given Forssatom each brood increase of 1 dm^2, required a honey surface increase of 0.61 dm^2 and a pollen surface increase ad 0.26 dm^2 whereas to obtain a 1 dm^2 honey surface increase, a brood surface increase of 1,68 dm^2 and pollen surface increase of 0,18 dm^2 must be ensured, while a 1,23 dm^2 greater brood and 1,79 dm^2 greater honey surface is necessary to achieve 1 dm^2 of pollen surface increase. In the group supplemeneted yeast an increase of honey surface of 0,51 dm^2 and pollen surface of 0,26 dm^2 is required for each 1 dm^2 of brood surface increase, for each 1 dm^2 of honey surface increase an increase of brood surface of 1,8 dm^2 and pollen surface of 0,13 dm^2 is necessary, and finally for each 1 dm^2 of pollen surface increase an increase of brood surface of 1,30 dm^2 and honey surface of 2,17 dm^2 must be ensured.

DISCUSSION

The results presented in this paper show to what extent the administration of sugar syrup alone or with Forssatom or yeast may influence brood, honey and pollen surface areas.

Sugar syrup with the addition of a vitamin-mineral preparation stimulated greater brood and honey surface formation as compared to the control, and this influence was more pronounced in the autumn than in the spring which confirmed the investigations of Konstantinović and coworkers (1987). Moreover, pollen surface in the spring was reduced probably due to increased brood nutrition, so this period is recommended for feeding with protein supplements too (Alves et al. 1995).

Yeast had a stimulative effect both on brood and on honey surface increase in the autumn and in the spring as compared to the control, although the amount of yeast may have been insufficient because pollen surface in the spring had decreased by 34,6%. Therefore, the amounts of yeast in the supplement should be increased or soybean meal or certain aminoacids used instead (Liu Fu-hai et al. 1993).

Syrup supplementation alone ensured no brood surface increase in the spring or in the autumn as compared to the control probably because, with the exception of sugar, this supplement contained no additional substances indispensable for brood development.

The administration of Forssatom in the spring was important for the purpose of brood surface increase in comparison to the group given syrup alone and the group given the yeast supplement. On the contrary, in the autumn the greatest brood surface increase was recorded in the group in which yeast supplementation was used. We suggest that such results were obtained because natural protein sources were more available in the spring. Therefore the vitamin-mineral complex contained in Forssatomm was more important than the artificially introduced protein supplement.

Honey surface was very closely correlated with brood surface in all supplemented groups as compared to the control. Therefore it may be concluded that honey surface increase represents one of the elements influencing brood surface increase.

In all supplemented groups pollen surface in the spring was smaller but in the autumn greater that in the control.

More rapid development of bee colonies and increased brood nutrition in the spring require larger amounts of pollen, whereas in the stage of preparation for overwintering, pollen and particularly honey surfaces are increased jointly to ensure complete nutrition for the winter.

Based on the results obtained we may conclude that the vitamin mineral preparation approaches conditions of natural beekeeping in the spring, displaying a more stimulative effect than brewers yeast and sugar syrup on the development of bee colonies whereas the use of brewers yeast in the autumn strengthens bee colonies for overwintering.

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EFEKAT VITAMINSKO-MINERALNOG PREPARATA NA RAZVOJ I PROIZVODNJU PČELINJIH DRUŠTAVA

M. MLADENOVIĆ, V. MLAĐAN, I N.DUGALIĆ-VRNDIĆ

SADRŽAJ

U proleće i jesen vršeno je prihranjivanje pčelinjih društava sa vitaminsko-mineralnim preparatom (Forssatom), pivskim kvascem i šećernim sirupom, uz prisutnu kontrolnu grupu i praćen uticaj prihranjivanja na leglo, med i polen.

Pomoću izračunatih procentualnih razlika ispitivanih varijanti ustanovljeno je da je površina legla u proleće najveća u grupi prihranjivanoj sa vitaminsko-mineralnim preparatom i da je veća u odnosu na kontrolu za 6,8%, dok je u jesen najveća površina sa leglom bila u grupi prihranjivanoj sa kvascem i bila je veća za 25,4% u odnosu na kontrolu.

Površina meda u proleće bila je najveća u grupi prihranjivanoj sa kvascem (37,8% veća od kontrole), a u jesen je grupa prihranjivana sa vitaminsko-mineralnim preparatom imala najveću površinu i to za 181,7% veću od kontrolne grupe.

Površina polena u prolećnom ispitivanju bila je manja u svim ispitivanim varijantama u odnosu na kontrolu, dok je u jesenjem prihranjivanju najveću površinu imala grupa prihranjivana sa šećernim sirupom i to za 30% veću od kontrolne grupe.

Korelaciona veza između površine legla i meda je u svim ispitivanim grupama vrlo jaka, izuzev u kontrolnoj gde je jaka. Korelaciona veza između površine legla i polena u svim ispitivanim varijantama je jaka, a između površine meda i polena srednja, izuzev grupe prihranjivane sa šećernim sirupom gde je slaba. Koeficijentom regresije smo utvrdili koliko je potrebno dm^2 polena i meda da bi se povećala površina legla i obrnuto.