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PRODUCTION CHARACTERISTICS OF DISTINGUISHED HONEY BEE LINES FROM DIFFERENT PARTS OF SERBIA

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Abstract: For apicultural practice the productive traits of bee colonies are of great significance, since it is related to different geographical bee breeds. For the purpose of preservation of existing populations and natural diversity of honey bee and for the purpose of their further selection, researches upon the productive features of certain individual populations of choice at the territory of Republic of Serbia. During three years of research productive traits of six selected lines of honey bee from three different localities in Serbia (East, West and South Serbia) were studied. Through the survey of productive traits we have come to conclusion that there are significant variations among separate lines, which can be used to improve bee breeding program of the domestic honey bee and pick up the best lines for next generations.

Key words: honey bee, bee lines, production characteristics, selection

Introduction

Many species of farm animals have been raised and improved for thousand years. However, in beekeeping some bee subspecies have separated under the influence of environment and geographical spreading and they possess a far greater variability in relation to the species of other domestic animals. In order to achieve ever better production results in zootehnics the right choice of the parents of future generations is extremely important *Latinović et al. (2004)*. Quantitative traits, included into selection, are defined in a breeding programme, but their monitoring and improving in beekeeping is being impeded by the action of a number of paragenetic factors which are in this branch more present than in the other livestock breeding branches *(Mladenović et al., 2002a; Nedić et al., 2005; Nedić 2009)*. Phenotypic expression of economically important traits depends on a greater number of genes, each of them having its own smaller or greater individual contribution. A very important trait for a production practice is a bee capacity to collect nectar, which is influenced genetically and used in a linear beekeeping. Thus *Neumann and Moritz (2000)* established a statistically significant difference in the yield of nectar between various honey bee lines examined in the same raising conditions. However, this trait often depends on weather conditions, plant coverage, strength of society, and also on the fertility of queen bee *Oldroyd (1987)*, race belonging *Oldroyd and Goodman (1990)* and brood surface *Georgijev et al.(2003)*. *Georgijev and Plavša (2005)* established a positive correlation between the quantity of bees and broods in a society on the productivity per years of research (r = +0.36 and r = +0.57), and also that the increase in the number of larvae and free space in bee society increase the number of pollen bees (*Dreller and Page, 1999*). In order that a bee society should have a normal spring development it is extremely important to have a sufficient number of broods of all ages in the flowering time of fruit trees *Jevtić (2007)*. The quantity of broods in society is influenced by the quantity and kind of winter supply of food *Mladenović et al. (2002a,b)*, stimulating apitechnical measures *Mladenović (2003)* and the origin of bees *Nedić et al. (2006)*. *Mladenović et al. (2004)* established a highly positive correlation (r = +0,81) between an overall area of brood and number of pollen bees.

The aim of this research was to study the most important productive traits of chosen lines of a subspecies *Apis mellifera carnica* Poll. in our country and to give recommendations for breeding-selection work for spreading the best lines in practice.

Materials and Methods

The bee lines of the *Apis mellifera carnica* race from different geographical localities in the Republic of Serbia were included in the research. The research was carried out on the beehive of the Agricultural Faculty in Belgrade, to which the bee societies from three localities: surroundings of Kraljevo (1 and 2), Vranje (3 and 4) and Knjaževac (5 and 6) were delivered. Two lines of bees (L) with 5 bee societies in each line from each region were brought onto the beehive. The 6 lines in total were monitored. Bee societies were put into standard Langstrot-Rut beehives and at the start of the trial their equalizing per strength was performed. Following productive traits were examined: the surfaces of bees, brood, honey and pollen. The evaluation was performed in two spring examinations (I and II) before the beginning of black locust pasture and in the autumn examination in the first decade of September. The reading was conducted on the individual frame in 1/10 frame, by the method prescribed in the the Regulations on how to research the breeding livestock traits *(Službeni glasnik, 1996)*. The data were analyzed by a standard factorial variance analysis investigating the traits in different bee lines (L) in the same rearing conditions during the period from 2004-2006.

Results and Discussion

One of the major aims in beekeeping is a numerous bee society both in spring and during honey collecting, and also to secure a sufficient number of worker bees for winter period for getting through the winter. For this reason the quantity of bees per society is a very important economic trait in a bee.

The greatest surface of brood in all three examinations was confirmed in the line 2 (1.89, 5.26 and 3.21 frame), while the smallest one was confirmed in the line 3 (1.14, 2.86 and 2.28 frame). The greatest difference between the II and I spring examination was observed in the line 2 (3.35 frame), what seems to confirm the thesis that the Kranjska bee race, after its hibernation in a weaker society, develops rapidly up to the time of a black locust pasture (Table 1). In autumn examination an average surface of bees was the greatest in the line 2 (3.21 frame), and the smallest in the line 3 (2.28 frame). As regards the years of research the greatest average surface of bees in spring examination was in 2004 (1.73 and 4.13 frame), while in the autumn examinations it was the greatest in 2006, being 3.23 frame on average. In all seasons of examination an abrupt development in the number of bees in spring, followed by stabilization, was present, while in the course of autumn the decrease in number was observed. The results of these studies agree completely with so far established dynamics on the strength of honey bee society for the *A. m. carnica* race in Europe, *Ruttner (1975)*, as well as with the studies on the surface of bees by *Georgijev and Plavša (2005)*. However, *Jevtić (2004),* in the societies spring examination, confirmed 5.11 bee frame on average. Our results show that the surface of bees in the I and II spring examination was highly significantly ($P<0.01$) dependent on the line origin, while the effect of the year was highly significant ($P<0.01$) on the studied trait in the I spring and autumn examinations (Table 2).

The greatest average surface of brood in the I spring examination was observed in the line 2 (1.61 frame), and in the II examination in the lines 5 and 2 (5.15 and 5.06 frame). In autumn examination the surface of brood varied from 1.74 frame in the line 2 to 2.04 frame in the line 3. Tabular results show that the surface of brood, between the I and II spring examination increased greatly in the line 5 (by 3.91 frame), then in the line 1 (by 3.55 frame) and line 2 (by 3.44 frame), indicating a very high potential for a spring development in the trial bee lines. The bee lines developed very rapidly during the period between two spring examinations what *Poklukar (2001)* suggested as a race characteristics for *A. m. carnica*. Similar results were obtained by *Georgijev (2006)* regarding the development of the brood of the bees from Timočka Krajina (1.60, 3.68 and 1.43

frame per society) where this trait was influenced significantly (P<0.05) by the origin of the bees.

Table 1. Descriptive statistics for the examined productive traits of honeybee lines

Factor		I Spring exam				Factor		II Spring exam				Factor		Autumn exam			
L*	Year	n	$\overline{x}$	SD	SD err.	L	Year	n	$\overline{x}$	SD	SD err.	L	Year	n	$\overline{x}$	SD	SD err.
Honeybee surface																	
1		13	1.32	0.63	0.17	1		12	3.84	0.92	0.27	1		12	3.12	1.06	0,11
2		14	1.89	0.49	0.13	2		14	5.24	1.70	0.45	2		14	3.21	0.97	0,26
3		14	1.14	0.57	0.15	3		12	2.86	1.02	0.29	3		11	2.28	0.73	0,22
4		12	1.63	0.67	0.19	4		11	3.78	0.84	0.25	4		11	2.85	1.05	0,32
5		13	1.49	0.47	0.13	5		13	4.19	1.40	0.39	5		13	2.79	0.52	0,15
6		14	1.33	0.64	0.17	6		13	4.00	1.38	0.38	6		12	2.66	0.91	0,26
	2004	30	1.73	0.41	0.08		2004	30	4.13	1.19	0.22		2004	30	3.02	0.93	0,17
	2005	27	1.06	0.52	0.10		2005	24	3.97	1.94	0.40		2005	23	2.25	0.64	0,13
	2006	23	1.58	0.71	0.15		2006	21	3.94	1.04	0.23		2006	20	3.23	0.85	0,19
Avr.		80	1,46	0.61	0.07			75	4.02	1.42	0.16			73	2.84	0.91	0.11
Brood surface																	
1		13	1.15	0.64	0.18	1		12	4.70	1.48	0.43	1		12	2.00	0.69	0,20
2		14	1.61	0.34	0.09	2		14	5.06	1.55	0.41	2		14	1.74	0.77	0,21
3		14	0.77	0.40	0.11	3		12	3.53	1.51	0.44	3		11	2.04	0.93	0,28
4		12	1.15	0.59	0.17	4		11	4.23	0.93	0.28	4		11	1.86	0.77	0,23
5		13	1.25	0.52	0.15	5		13	5.15	1.24	0.34	5		13	1.78	0.64	0,18
6		14	1.17	0.51	0.14	6		13	4.52	1.38	0.38	6		12	1.79	0.62	0,18
	2004	30	1.45	0.54	0.10		2004	30	4.60	1.14	0.21		2004	30	2.30	0.67	0,12
	2005	27	1.00	0.53	0.10		2005	24	3.96	1.74	0.36		2005	23	1.44	0.62	0,13
	2006	23	1.05	0.46	0.10		2006	21	5.17	1.19	0.26		2006	20	1.69	0.55	0,12
Avr.		80	1.19	0.55	0.06			75	4.56	1.44	0.17			73	1.86	0.72	0.09
Honey surface																	
1		13	2.71	1.73	0.48	1		12	3.58	1.65	0.48	1		12	4.93	2.26	0,65
2		14	2.45	1.37	0.37	2		14	3.39	1.11	0.30	2		14	5.19	2.04	0,54
3		14	1.91	1.31	0.35	3		12	2.74	1.72	0.50	3		11	4.16	2.35	0,71
4		12	1.93	0.69	0.20	4		11	2.59	1.15	0.35	4		11	4.03	1.31	0,40
5		13	2.29	1.12	0.31	5		13	2.31	0.98	0.27	5		13	4.52	1.60	0,44
6		14	2.06	0.55	0.15	6		13	2.17	1.21	0.34	6		12	3.78	1.31	0,38
	2004	30	1.51	0.53	0.10		2004	30	3.19	0.80	0.15		2004	30	5.30	2.08	0,38
	2005	27	3.10	1.36	0.26		2005	24	3.00	1.84	0.38		2005	23	3.74	1.03	0,21
	2006	23	2.13	0.97	0.20		2006	21	2.01	1.17	0.26		2006	20	4.06	1.86	0,42
Avr.		80	2.23	1.20	0.13			75	2.80	1.39	0.16			73	4.47	1.87	0.22
Pollen surface																	
1		13	0.29	0.21	0.06	1		12	0.18	0.17	0.05	1		12	0.23	0.28	0,08
2		14	0.54	0.42	0.11	2		14	0.42	0.38	0.10	2		14	0.23	0.17	0,05
3		14	0.36	0.30	0.08	3		12	0.23	0.31	0.09	3		11	0.22	0.16	0,05
4		12	0.32	0.21	0.06	4		11	0.14	0.10	0.03	4		11	0.24	0.26	0,08
5		13	0.42	0.31	0.09	5		13	0.29	0.22	0.06	5		13	0.21	0.17	0,05
6		14	0.34	0.30	0.08	6		13	0.22	0.20	0.06	6		12	0.12	0.13	0,04
	2004	30	0.30	0.14	0.03		2004	30	0.21	0.19	0.03		2004	30	0.22	0.21	0,04
	2005	27	0.28	0.27	0.05		2005	24	0.27	0.32	0.07		2005	23	0.16	0.19	0,04
	2006	23	0.60	0.38	0.08		2006	21	0.29	0.29	0.06		2006	20	0.25	0.19	0,04
Avr.		80	0.38	0.30	0.03			75	0.25	0.26	0.03			73	0.21	0.20	0.02

L – linija/line;

A highly significant influence ($P<0.01$) on the surface of brood in spring examination was observed both in the origin of line and year of research. In the II spring examination the year effect on the brood surface was statistically significant ($P<0.05$), while in the analysis of data regarding the autumn examination the influence of the year on the studied trait was highly significant ($P<0.01$). Bees collect nectar and pollen powder if there is a melliferous pasture in the nature and if climate conditions allow them to fly out of the beehive, but for a successful development of society in early spring the good winter stores from previous season are also necessary.

The third studied trait, a surface of honey, in the first two spring examinations, was the greatest in the line 1 (2.71 and 3.58 frame), and the smallest in the lines 3 (1.91 frame) and 6 (2.17 frame). In all three examinations the line 1 had the greatest average surface of honey (3.74 frame), while the smallest one was observed in the line 6 (2.672 frame).

A quantity of honey from the first to the second spring examination was increased by 0.58 frame on average, while observed individually, the greatest difference in the honey quantity (by 0.94 frame) was realized in line 2. This line displayed a very rapid spring development of brood and this potential resulted in increased collecting activity of worker bees. In the I spring examination the effect of the year on the surface of honey was highly significant ($P<0.01$), while a significant effect ($P<0.05$) on the surface of honey was caused by the interactive effect (line x year). In the II examination the honeybee line significantly influenced ($P<0.05$) the surface of honey, while the effect of year was highly significant ($P<0.01$). In autumn examination the year effect on the surface of honey was highly significant ($P<0.01$).

In the nutrition of bees the need for proteins is essential, along with an appropriate quality and quantity of pollen in bee society. Pollen is a primary source of proteins and it is collected by the bees in the morning hours mostly when a relative humidity of the air is higher, making the adhesion of pollen grains easier. The greatest average surface of pollen in the I and II spring examination was observed in the line 2 (0.54 and 0.42 frame), and the smallest in the line 4 (0.14 frame), that is, in the line 1 (0.29 frame). In autumn examination the surface of pollen was equalized and it ranged around the general average of 0.21 frame, with the exception of the line 6 of 0.12 frame. In trial years the greatest surface of pollen in the I spring examination was observed in 2006 (0.60 frame) caused by an intensive development of pollen yielding plants. In the II spring examination the surface of pollen was equalized per years and ranged from 0.21 frame in 2004 to 0.29 frame in 2006, while in the autumn period an average supplies of pollen ranged from 0.16 frame in 2005 to 0.25 frame in 2006.

Table 2. Results of analysis of variance (2 way – ANOVA) for examined traits

Factors	I Spring exam		II Spring exam		Autumn exam	
	$F_{exp.}$	p	$F_{exp.}$	p	$F_{exp.}$	p
	Honeybee surface					
Line	3.900	0.004**	4.403	0.002**	2.120	0.077
Year	13.100	0.000**	0.345	0.710	10.668	0.000**
Line x Year	0.700	0.753	0.958	0.489	1.479	0.172
Error						
	Brood surface					
Line	4.284	0.002**	2.287	0.058	0.349	0.881
Year	7.730	0.001**	4.317	0.018*	11.451	0.000**
Line x Year	0.662	0.755	0.302	0.978	0.449	0.915
Error						
	Honey surface					
Line	1.730	0.141	2.958	0.019*	1.171	0.335
Year	22.391	0.000**	5.271	0.008**	6.289	0.003**
Line x Year	2.023	0.046*	0.824	0.607	1.039	0.424
Error						
	Pollen surface					
Line	1.631	0.165	1.529	0.195	0.502	0.774
Year	11.012	0.000**	0.498	0.611	1.150	0.324
Line x Year	0.794	0.635	0.587	0.818	0.504	0.880
Error						

* - P < 0,05; ** - < 0,01

Jevtić (2007) in different bee ecotypes, established the average surface of bees pollen in spring examination in parental societies per years to be 0.28 and 0.66 frame, while in the autumn examination it was on average 0.47 and 0.26 frame of pollen.

In the first spring inspection, the effect of the year in which the trait was studied was highly significant (P<0.01) on the pollen surface. In the II spring and autumn inspection no statistically significant (P>0.05) influence regarding the factor of the line and year on this trait was established.

Conclusion

On the basis of the research results on productive traits: surface of bees, surface of brood, surface of honey and surface of pollen, in the six lines of honey bee *Apis mellifera carnica* Poll. on the territory of Serbia the following can be concluded:

The studied bee lines have displayed characteristic productive traits for the bees of the subspecies *Apis mellifera carnica* Poll., and among them excelled the bees of the line 2 having the best results for the surface of bees (1.89, 5.24 and 3.21 frame, respectively per inspections), while the bees of the line 5 realized the greatest development of brood between the two spring inspections (3.91 frame), followed by the bees of the lines 1 and 2. The bees belonging to the lines 1 and 2 had the best results in the surface of honey in the first two spring inspections, while the bees belonging to the line 5 had the best results for the autumn period. As regards the supplies of pollen in the first two spring inspections the bees from the lines 2 and 5 had the best results what gives them a solid ground for a good society development in a spring period.

A present variability provides enough room for further improvement of analyzed traits in a desired direction and possibility to separate outstanding lines, by whose further improvement a long-term increase of the effects of applied selection in studied raised bee populations, by choosing the best mothers of queen bees will be achieved.

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Proizvodne osobine izabranih linija pčela sa teritorije Srbije

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Rezime

U trogodišnjem ispitivanju, istraživane su najvažnije produktivne osobine izabranih linija medonosne pčele sa teritorije Republike Srbije. Najveća površina pčela utvrđena je u liniji 2 (u prvom i drugom prolećnom pregledu je iznosila: 1,89 i 5,24 rama, dok je u jesenjem bila 3,21 rama). Najveća površina legla u oba prolećna pregleda bila je najveća u liniji 2 i 5 (1,61 : 1,25, odnosno 5,06 : 5,15 rama), dok su u jesenjem pregledu sve linije imale približno istu površinu legla. U liniji 1 i 2 utvrđena je najveća prosečna površina meda i iznosila je 3,74, odnosno 3,68 rama. Površina polena u prolećnim pregledima bila je najveća u liniji 2 (0,54 i 0,42 rama).

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