

MORPHOPRODUCTIVE PERFORMANCE OF BEE COLONIES IN BREEDING APIARIES

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Abstract

In climatic conditions of 2010, were evaluated morphoproductive capacities of Carpathian Apis mellifera bee families from two breeding apiaries, in which technologic level of and genetic improvement was different: in the first apiary - was moderate, in the second - higher. It was found that the average values of the morphoproductive characters of bee families, were framed within the race standard (excepting the production of honey from the first apiary), constituted respectively: proboscis length - 6.47 and 6.48 mm, cubital index - 41.1 and 42.2%, positive discoid displacement - 70.7 and 69.4%, neutral - 28.4 and 30.4%, overwintering - 80.1 and 85.6%, colony strength - 2.83 and 3.05 kg, queens prolificacy - 1689 and 1783 eggs, brood viability - 85.1 and 97.1%, resistance to disease - 76.8 and 95.8%, production of honey - 38.80 and 52.9 kg, elite class record - 0 and 43.7%, elite - 2.5 and 31.3%, Class I - 10.0 and 12.5%, Class II - 21.3 and 12.5% Class III - 43.7 and 0% without classes - 22.5 and 0%. At each apiary, were selected nuclei with advanced bee families for breeding, with following morphoproductive characters values, respectively: proboscis length - 6.52 and 6.59 mm, cubital index - 41.7 and 43.4%, positive discoid displacement - 85.8 and 77.7%, neutral - 14.2 and 24.6%, overwintering - 86.9 and 91.2%, colony strength - 3.03 and 3.27 kg, queens prolificacy - 1893 and 1849 egg, brood viability - 90.7 and 98.0%, resistance to disease - 87.5 and 97.1%, production of honey - 48.25 and 57.4 kg, elite class record - 0 to 100% elite - 25 and 0%, Class I - 75.0 and 0%. The differential of selection constitute: after external morphometric characters - 0.8-23.6% - and after morphoproductive characters - 1.4 - 24.4%. The selection intensity of family bees in breed nucleus constituted, respectively 10.0% - at first apiary and 43.7 at second apiary.

Key words: selection, morphoproductive characters, bee families, breeding nucleus, differential, intensity of selection

INTRODUCTION

In Republic Moldova there are about 120 thousands bee colonies, from which annually are received about 2,0 to 2,2 thousand tons of honey and big quantities of other bee products. Bees are pollinating about 350 thousands ha of land with agricultural crops, from which is obtained additionally 20-30% of annual crop worthing over 700 million lei. Analysis of recent years situation in the country, demonstrates that, the productive potential of beekeeping branch, is estimated under its possible level. Thus, from a bee family is obtained per year only 16 to 18 kg of honey, comparing to 30-50 kg - minimal potential of

the race. This is explained by the fact that in technologies of growth and reproduction of bee families are not applied the science achievements, currently are used, queens of dubious origin and value, produced by unlicensed beekeepers, without taking in consideration major morphoproductive values, such as: race purity, winter and disease resistance, brood viability, queens prolificacy, honey productivity. In technology of queens growth are missing methods, ruled mating processes and monitoring of their origin, of genotypic selection of bee populations, such as: appreciation of genetic value of bee families and determining the bonitation class after a complex of morphoproductive characters, progressive selection after the independent limits of many characters, genetic consolidation of bee population through

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directed queen mating of the queens by applying the method of instrumental seeding. In choosing bee families for collection of genitor material, is not taken into account the difference and effect of selection. Due to the above-mentioned blemish of genetic improvement of bee families effective, the country has a serious shortage of genitor material bee breeding (especially queens) with high genetic value. Being a need of queen of 60 thousands per year, there are produced, officially, at breeding apiaries only 1,0 to 2,0 thousand breeding queens but their genetic and morph-productive quality is not very good. To elucidate and eliminate these flaws were undertaken evaluation researches of morphoproductive characteristics of bee families and creating performing lots of families for breeding genitor material.

MATERIAL AND METHODS

Experimental works were done on bee colonies of *Apis mellifera Carpatica* race. In 2010 bee season, were evaluated morphoproductive characters of bee colonies and selected breeder stock with high performance to assure production of queen bees at the apiary „Ion Sprinceană Skit” from Hîrtopul Mic, county Criuleni, where the technological practice for production and selection of queen bees is poorer, and at the experimental apiary of Zoology Institute from Moldavian Science Academy, where technological practice of production and selection is more advanced. Therefore, bee colonies was identified, which had high honey storage instinct and morphoproductive characters in accordance with the standard of this race, which were used for rearing queen bees. In order to amplify the differential, intensity and selection effect of respective bee population, the breeders stock was selected from the total of bee colonies from apiaries. Selection was conducted after the individual performance of bee colonies. Selection intensity of bee colonies from breeders stock is: „Ion Sprinceană Skit” apiary-10% and Institute of Zoology apiary-43.7%.

On the basis of morphoproductive and biological indicators was selected breeder stock

of mother and father bee colonies. Selection of this stock was done considering the method of independent limits of the principal characters morphoproductive of the most performing bee colonies of who indicators, at least, was in concordance with the minimal standard characteristic to Carpathian race, and they are:

- body color- brown;
- proboscis length - 6,4 mm;
- cubital index- 40%;
- positive discoid dislocation - 70% and neutral- 30%;
- overwintering - 75%;
- colony strength – 2.33 kg;
- queen prolificacy - 1600 eggs;
- brood viability - 80%;
- diseases resistance - 60%;
- honey production - 45 kg;

Determination of the appreciation of morphoproductive characters of bee colonies was done by the methodology from Norms regarding the honeybee colonies evaluation, breeding and certification of genetic material in beekeeping approved by Minister of Agriculture and Food Industry. In order to obtain high quality genetic material at the experimental apiaries was applied instrumental insemination method of queen bees which gave us the possibility to control the mating of the queen bees with the drones from selected colonies. Instrumental insemination was done using Latshaw apparatus under the SM-2T triocular microscope.

RESULTS AND DISCUSSIONS

Researchers have shown that the number of apiaries have evaluated different potential genetic-production, which depends on the selection made recent years in these bee colonies (table).

Climatic conditions of 2010, being unfavorable for beekeeping, especially during the harvest from acacia, influenced stagnant on basic morphoproductive indices of bee families. For this reason, in most apiaries, the amount of principal productive index of bee colonies - honey production has not reached the breed standard requirements.

Table 1 The evaluation results of the morphoproductive bee families of the investigated apiaries

Nr.	Morphoproductive and biological characteristics	Total on apiary			Race standard	Breeding nucleus			Selection difference		td
		n	M ± m	Cv %		n	M ± m	Cv%	Units	%	
<i>Apiary „Ion Sprinceană Skit”</i>											
1	Proboscis length, mm	62	6.47 ± 0.01	1.34	6.4	8	6.52 ± 0.03	1.4	0.05	0.8	1.7
2	Cubital index, %	62	41.1 ± 0.4	8.6	40	8	41.7 ± 0.7	4.6	0.6	1.5	0.7
3	Positive discoid dislocation, %	62	70.7 ± 2.6	29.3	70	8	85.8 ± 3.1	10.1	15.1	21.3	3.8
	neutral, %	62	28.4 ± 2.6	72.1	30	8	14.2 ± 3.1	61.3	14.2	50.0	3.6
4	Overwintering, %	80	80.1 ± 1.5	17.6	75	8	86.9 ± 2.1	6.7	6.8	8.5	2.6
5	Colony strength, kg	80	2.83 ± 0.02	5.8	2.33	8	3.03 ± 0.04	3.6	0.2	7.1	5.0
6	Queens prolificacy, eggs/24 hours	80	1689 ± 13	6.9	1600	8	1893 ± 47	6.9	204	12.1	4.2
7	Brood viability, %	80	85.1 ± 0.3	3.6	80	8	90.7 ± 1.2	3.7	5.6	6.6	4.5
8	Disease resistance, %	80	76.8 ± 0.7	7.8	60	8	87.5 ± 1.5	4.9	10.7	13.9	6.5
9	Honey productivity, kg	80	38.80 ± 0.54	12.5	45	8	48.25 ± 0.66	3.8	9.45	24.4	11.
10	Bonitation class, % :										
	Elite-record	-	-	-	-	-	-	-	-	-	-
	Elite	2	2.5 ± 1.7	-	-	2	25.0 ± 16.3	-	22.5	100	1.4
	Class I	8	10.0 ± 3.4	-	100	6	75.0 ± 16.3	-	65.0	750	3.9
	Class II	17	21.3 ± 4.6	-	-	-	-	-	-	-	-
	Class III	35	43.7 ± 5.6	-	-	-	-	-	-	-	-
	Out of the class	18	22.5 ± 4.7	-	-	-	-	-	-	-	-
<i>Experimental apiary of Zoology Institute from Moldavian Science Academy</i>											
1	Proboscis length, mm	16	6.48 ± 0.02	1.5	6.4	7	6.59 ± 0.03	1.4	0.11	1.7	3.1
2	Cubital index, %	16	42.2 ± 0.6	6.9	40	7	43.4 ± 0.6	3.9	1.2	2.8	1.4
3	Positive discoid dislocation, %	16	69.4 ± 2.8	16.3	70	7	77.7 ± 3.2	11.1	8.3	12.0	2.0
	neutral, %	16	30.4 ± 2.8	36.5	30	7	24.6 ± 3.6	41.8	5.8	23.6	1.3
4	Overwintering, %	16	85.6 ± 1.8	18.0	75	7	91.2 ± 2.2	6.5	5.6	6.5	2.6
5	Colony strength, kg	16	3.05 ± 0.07	9.2	2.33	7	3.27 ± 0.07	5.8	0.22	7.2	2.2
6	Queens prolificacy, eggs/24 hours	16	1783 ± 34	7.6	1600	7	1849 ± 61	8.8	66	3.7	0.9
7	Brood viability, %	16	97.1 ± 0.3	1.1	80	7	98.0 ± 0.4	1.0	0.9	0.9	1.8
8	Disease resistance, %	16	95.8 ± 0.5	2.3	60	7	97.1 ± 0.9	2.6	1.3	1.4	1.3
9	Honey productivity, kg	16	52.9 ± 1.3	9.6	45	7	57.4 ± 0.8	3.8	4.5	8.5	2.9
10	Bonitation class, % :	7	43.7 ± 12.8	-	-	7	100 ± 0.0	-	56.3	2.3 _x	4.4
	Elite	5	31.3 ± 12.0	-	-	-	-	-	-	-	-
	Class I	2	12.5 ± 8.5	-	100	-	-	-	-	-	-
	Class II	2	12.5 ± 8.5	-	-	-	-	-	-	-	-
	Class III	-	-	-	-	-	-	-	-	-	-

At the apiary “Ion Sprinceana Skit” of the 80 families assessed, only 10 families, or 12.5%, reached, after honey production, the breed standard. Therefore, the evaluation marks, none of the families of bees could not be attributed to the upper zootechnical class elite- record. The elite upper class were assigned only two families of bees, or 2.5% of the overall population, and first grade were awarded only eight families of bees, or

10.0% of the overall population. Most families of bees, the results of quality assessment, were assigned to Class II and III, respectively, 17 and 35 families, or 21.3% and 43.7%. More than a fifth of bee families (18 families, or 22.5%) did not correspond to any of the zootechnical classes of quality assessment (being outside the classes).

By other morphoproductive characters, bee colonies from the apiary "Ion Sprinceana Skit"

match or exceed the minimum requirements of the breed standard. Thus, families of bees from the average actually exceed the breed standard: after proboscis length – 0.07 mm, or 1.1%, after cubital index - by 1.1 percentage points, or 2.7%, after discoid positive displacement – 0.7 percentage points, or 1.0%, after overwintering - by 5.1 percentage points, or 6.8%, after the colony strength – 0.5 kg, or 21.5%, as queens prolificacy 89 eggs, or 5.6%, after the viability of juveniles - by 5.1 percentage points, or 6.4%, and as resistance to disease - by 16.8 percentage points, or with 28.0%. After the average of honey bee colonies that actually gives the breed standard of 6.2 kg or 13.8%.

Because of the low value of the character of honey, choice of core breeding in this apiary was quite difficult. To reproduce genitor material from this apiary, in the **breeding nucleus**, only 8 families of bees were selected the best of the existing herd, which corresponds for purpose of selection and the breed standard *Apis mellifera* Carpathian. These bee families exceed the average herd from apiary (selection differential) by all characters morphoproductive evaluated. Selection differential between the core and the entire breeding population of bee in the apiary, are: proboscis length – 0.05 mm, or 1.8% ($P < 0.1$), cubital index – 0.6 units percentage points, or 1.5% ($P > 0.1$), the positive discoid displacement – 15.1 percentage points, or 21.3% ($P < 0.001$), the overwintering – 6.83 percentage points, or 8.5% ($P < 0.01$), the colony strength – 0.2 kg, or 7.1% ($P < 0.001$), queens prolificacy - 204 eggs, or 12.1% ($P < 0.001$), brood viability – 5.6 percentage points, or 6.6% ($P < 0.001$), disease resistance – 10.7 percentage points, or 13.9% ($P < 0.001$), honey production – 9.45 kg, or 7.2% ($P < 0.001$), the proportion of bee-class elite – 22.5 percentage points, or 10 times ($P < 0.001$) and the proportion of bee Class I - 65 percentage points, or 6.3 times ($P < 0.001$). This differential value of morphoproductive character of bee breeding in the nucleus, compared with the total number

Results evaluation of morphoproductive characteristics of bee colonies from investigated apiaries existing in the apiary will ensure the selection effect at future generations of this population of bee colonies.

At the *experimental apiary of the Institute of Zoology*, despite the weather, because the highest level of technology selection, growth and care, morphoproductive performance level of bee colonies was much higher.

Thus, evaluation marks, after autumn review, most of the 16 bee families were assigned to the upper classes of evaluation: elite record - 7 families, or 43.7% and the elite - 5 families, or 31.3%. Of the total number of families, only two were of class I and two of class II, which are 12.5% of each. Families with lower value of quality assessment of class II in the apiary, there were not. We note that families of bees from the hives of Institute not only match in the overwhelming majority breed standard, but also far exceed these requirements. On average of the apiary, bee families go beyond of the standard of race *Carpathian Apis mellifera*: after proboscis length - 0.08 mm, or 1.3%, after cubital index - by 2.2 percentage points, or 5.5%; after positive discoid dislocation- 0.6 percentage points, or 0.8%, after colony strength,- with 1.17 kg, or 30.9%, after queens prolificacy - with 183 eggs, or 11.4% after brood viability - by 17.1 percentage points, or 21.3%, as disease resistance - by 35.8 percentage points, or 59.7% after an average production of honey - with 7.9 kilograms, or 17.5%.

From the number of 16 families of bees, the most valuable - 7 families were selected for breeding core, which was produced a batch of queen-daughter, who after instrumental sowing clusters were implanted in young, new-formed swarms.

Families of bees of the breeding nucleus are all (100%) of the upper class of evaluation - the *elite record*. These families of bees, by value of all morphoproductive characters, above much the breed standard and the apiary average, which is quite high. *Selection differential* between the core and the entire breeding population of families of bees from the apiary of Institute, are: the proboscis length – 0.11 mm, or 1.7% ($P < 0.01$), cubital index – 1.2 percentage points, or 2.8% ($P > 0.1$), the discoid positive displacement – 8.3 percentage points, or 12.0% ($P < 0.05$) in overwintering – 5.6 percentage points, or 6.5% ($P < 0.05$) in colony strength – 0.22 kg, or 7.2% ($P < 0.05$) queens prolificacy -

66 eggs, or 3.7% ($P>0.1$), brood viability – 0.9 percentage points, or 0.9% ($P<0.1$), resistance to disease - 1.3 percentage points, or 1.4% ($P>0.1$), honey production – 4.5 kg, or 8.5% ($P<0.001$) and the proportion of bee elite class record – 56.3 percentage points, or 2.3 times ($P<0.001$). This differential of value of morphoproductive character of bee breeding in the nucleus, compared with the total number existing in the apiary, will ensure the selection effect in subsequent generations of bee population.

Of the lot of bee breeding, created this year, will be continued an enlarged reproduction of beekeeping genitor material next year.

CONCLUSIONS

1. In climatic conditions of the same year, the morphoproductive performance of bees from breeding apiaries varies in dependence of selection technology level, growth and their genetic improvement.

2. After the value of morphoproductive characters (except for honey production), bees from the apiary „Ion Sprinceană Skit” correspond with requirements of the race standard Carpathian *Apis mellifera*. After an average of honey production, bee families from this apiary yield comparing with race standard with 6.2 kg or 13.8%.

3. At the apiary „Ion Sprinceană Skit” was created a nucleus of 8 performing bee families, festinated to reproduction of beekeeping genitor material, which exceed the breed standard: after the value of morphometric characters - with 4,3 to 22.6% and after the value of morphoproductive character - with 7.2 to 45.8%. The differential of selection constitute: after external morphometric characters from – 0.8 - 21.0% after morphoproductive characters – 6.6-24.4%. The intensity of selection constitutes 10%.

4. After morphoproductive value of characters, bee population from apiary of Institute of Zoology not only corresponds, but exceeds far requirements of race standard Carpathian *Apis mellifera*, after morphometric characters - with 0.8-5.5% and after the value of morphoproductive characters – cu 11.4–59.7%.

5. At the apiary of Zoology Institute was created a nucleus of 7 performing bee families, festinated for reproduction of

beekeeping genitor material, which far exceed the race standard: after the value of morphometric characters - with 3.0 to 11.0% and after value of morphoproductive characters - with 15.6–61.8%. The differential of selection constitute: after external morphometric characters from – 1.7-23.6% - after morphoproductive characters – 1.4-7.2%. The intensity of selection constitute 43.7%.

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