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TESTING OF THE BEE QUEENS BY THE QUALITIES OF DESCENDANTS

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Abstract

The aim of the research was the identification genotypic methods for estimating the value of bee queen improving, by their testing after qualities of descendant. The researches was conducted on the Apis mellifera Carpathian bee families, have been grown at the experimental apiary of the Institute of Zoology of the Academy of Sciences. The apiary is located at stationary in a clearing at the edge of the forest. The main melliferous sources in this area are white acacia, linden and wild flora, inclusive yellow melilot. In these experiments were genotypic tested five bee queens after qualities of descendant. For this, have been formed 5 similar batches of bee families (each10 families in every batch), in which, at one time was changed old queens and implanted queens young - daughters of one of the queens - mothers supposed testing. The value of improvement queens-mothers was assessed by comparison averages method morph- productive characters of daughters bee families with the average for the entire apiary, calculating the absolute and relative difference of the averages for each character (feature) in part. At the daughter's families were studied following morphs – productive characters: queen prolificacy, family power, resistance to disease, brood viability and honey production. The research results have shown that according of testing 5 queens after qualities descendants, through the method of comparing with average apiary, have been identified 2 queens which improve honey production. After other morph- productive characters studied, the tested queens have a neutral improvement value. At least in the studied population, it was not identified universal - ameliorative queen of all morph - productive characters. Research result have shown, that phenotypic performance of previously selected queens after their qualities and their families-parents, does not guarantee the improvement value without testing them after qualities of descendant.

Key words*: testing, genotypic, queens, qualities, descendants.*

INTRODUCTION

In beekeeping, queens role in the genetic improvement of bee populations is enormous. This is due to their reproductive biological peculiarities, expressed by extraordinarily high prolificacy and relatively short duration of successive generations (Ruttner,

1980; Siceanu, 2012; Totzek, 2013; Билаш, 1991; Гайдар, 2003; Контев, 1989; Кривцов, 1987). The queen carryng of the entire diploid set of chromosomes, transmitted by heredity in descendents its genetic qualities and morpho- productive abilities. At the apiaries of material genitor multiplication, from a queen of breeding family, in a beekeeping season can be taken thousands of eggs or larvae a day for directed growth of daughter queens with relatively predicted breeding value. Therefore, genotypic qualities of queens from maternal breeding families depends of value phenotypic daughter – queens, both those selected for renewal of queen effective to own apiary and creating new elite bloodlines, and those widely disseminated in third apiaries for implantation in bee families and genetic improvement of populations. Thus, the breeding queens have a significant impact on the development levels of bee families morph - productive characters from the entire population of the apiary, line, ecotype, race as a whole. Therefore, selecting the most valuable breeding queens and their intensive use for sampling and multiplication of genitor beekeeping material has a particularly high importance.

In zootechnics, in general, it is known, that with phenotypic selection method of reproduction after their performance and of ascendants, safer is method of their genotypic selection after qualities of descendants.

In beekeeping, the methods of genotypic selection of reproducers have their own specific after descendants' qualities. Their appreciation after descendants' qualities is carried out, through the maternal line.

According to the research by Билаш (Билаш, 1991), it must to perform testing remarkable queens after qualities of descendants, from each of them must be assessed each 30 families - daughters. The daughters - queens' performance can be compared both with their contemporaries and average indicators apiary. The main morph-productive character, after which is estimated performance of families - daughters is honey production.

The researcher Totzek, 2013, in instructions drawn up by them, for testing queens descendants after qualities in Pskov Region (Russia), recommends formation of similar lots of families - daughters by at least 8 families from each queen being tested.

After communications of Кривцов, 1987, in Austria, the system of selection and reproduction in apiculture is conducted by the Austrian Beekeepers Union. Under its guidance, annual are involved in testing of bee queens after qualities of descendants about 1500 - 2000 families - daughters. The remarkable queens with breeding mother families are transmitted for testing at the particular apiaries, which assesses their genotypic qualities after manifestation morpho –

productive characters of 5-15 families - daughters.

According to the information of Вайс, 1982 (cited by Кривцов, 1987), in the Germany bee queens are evaluated at the three test points, after qualities of descendants. In each of these points are tested simultaneously, 10 remarkable queens-mother at the effective of 10 families -daughters from each queen – mother.

In Romania, according to Dragan, 1984, (quoted by Кривцов, 1987), annual, at the district testing apiaries is identify queens - recordist after honey production, profilacity, gentleness, behavior on the combs, tendency swarming etc. This activity is conducted by Research Institute for Apiculture. The queens highlighted by the characters complex are transmitted at the elite apiaries for their using in the improvement of new lines and crossbreeds.

US beekeeping program selection according to business firms' Dadant & Sons "and" Baton Rouge "(cited by Кривцов, 1987) provides production and conservation of inbred queens lines for their use in cross interline producing. The remarkable breeding queens from cross are distributed for testing by the beekeepers participating at the Complex Program of Selection and Amelioration in Beekeeping. The most valuable queens becomes sources for obtaining queens daughters and drones for the reproduction of the subsequent generation. This material of breeding is returned to companies to achieve commercial cross - breeds.This cooperation is based on close contacts of company with selector - beekeepers.

Generalizing these limited data, we conclude that the growth problems of reproductive - queen, selection and assessment of their value of breeding is a current problem, studied and solved in different countries at different levels.

In the Republic of Moldova, in the former Soviet system, driven growth of the apiaries of breeding queens fell apart at the end of the twentieth century. Currently, there are only two breeding apiaries where grow the queens on the basis of selection. The rest, to all other apiaries, the queens are grow by reproduction methods and clandestine, in the rarest cases, based on the phenotypic selection, but in most cases without any selection. At present, there are only two apiaries of breeding where grow queens based on the selection.

In this context, the aim of this paper was to highlight and mediate of genotypic methods for estimating the value of improving of bee queen by their testing after qualities of descendants.

MATERIALS AND METHODS

The research was conducted on the *Apis mellifera carpathian* bee families, increased at the experimental apiary of the Zoological Institute of the Academy of Sciences of Moldova. The apiary

is located at the stationary in a clearing of the forest, near its edge. The main melliferous sources in this area are white acacia, linden and wild flora, including yellow melilot.

In special experiments were conducted research for genotypic testing of 5th bee queens after qualities of descendants. For each queen being tested, were formed similar batches of bee families (10 families in each batch), where, in early June, the same day (02 June 2014), in each family of bees, was changed the old queen and implanted by a young queen, the daughter of one of the 5 queens of families breeding batch, donor of genitor material. The next day, too, were exchanged with young queens and other queens from families when left outside of the apiary experimental batch. Next, the bee families of queens-daughters from all experimental batches were maintained under the same conditions as entire apiary.

The amount of improvement queens-mothers was assessed by method of comparison the averages morph-productive characters of bee families - daughters with the average for the entire apiary (Iliev, 1992), calculating the absolute and relative difference of the averages for each character (qualities) in part. At the daughters families were studied following morph – productive characters: queen prolificacy, family power, resistance to disease, brood viability and honey production. Determining the level of morph-productive characters development by bee families was carried, according to the methodology developed by us (Cebotari, 2010) for Norma Livestock, regarding breeding of bee families, the growth and certification of genitor beekeeping material, approved by Government Decision no. 306 of 28.04.2011 (OJ no. 78-81 of 13.05.2011, art. 366) (Livestock standard, 2011).

The data obtained in experience were statistically processed using computer software "STATISTICA - 6" and evaluated their certainty, according to variation biometric statistics, by methods of Плохинский, 1969.

RESULTS AND DISCUSSIONS

The research results showed that after the value of morph - productive characters –descendants - families (families-daughter), most queens, included in the test were attributed at the *Neutral* category of improvement. However, the daughter's families of some queens were ascertained and some peculiarities of morph - productive characters development (Table 1).

We want to mention, that the level of development of morph - productive characters at the families - daughter was on the whole, quite high, which corresponds to the requirements, submitted to bee populations from breeding apiaries.

Thus, **prolificacy queen**-daughters of mothers tested, varied within 1693 - 1796 eggs / 24 hours. The

highest prolificacy (1796 ± 47 eggs) was registered at the queens daughters of Queen 49R.

The lowest prolificacy showed queens daughters of Queen 22R, is why, it has been attributed to the category of *Reductive-relative* of this important character. The qualifier "relatively" was related, because the negative deference of the average level of development of this character in queen's daughter, compared with the average of the apiary did not have a significant threshold of certainty, according to the probability theory of forecasts without error after Student (Плохинский, 1969).

After value of prolificacy improvement, the other queens-mothers supposed tested, and therefore the daughter queens, had at first glance, slightly higher level, compared to the average of the apiary, were assigned to the *Neutral* category, because the significant differences at this character, has not been established.

Table 1. The test results of bee queen after qualities of descendants (daughters)

Nr. d/o batch	Nr. registration queen	Families-daughters, N	Average of character, M ± m	Difference from the average of apiary, d	t_d	Category of ameliorative
Qeen prolificacy, eegs/24 hours						
1	19R	10	1794 ± 40	+60	1.40	Neutral
2	34R	10	1776 ± 44	+42	0.90	Neutral
3	49R	10	1796 ± 47	+62	1.26	Neutral
4	21R	10	1783 ± 38	+46	1.13	Neutral
5	22R	10	1693 ± 30	-41	1.22	Reductive-relative
Average of apiary		80	1734 ± 15	x	x	x
Family power, kg						
1	19R	10	3.21 ± 0.04	+0.04	0.89	Neutral
2	34R	10	3.20 ± 0.03	+0.03	0.75	Neutral
3	49R	10	3.17 ± 0.04	0.00	0.00	Neutral
4	21R	10	3.18 ± 0.04	+0.01	0.25	Neutral
5	22R	10	3.12 ± 0.06	-0.05	0.83	Reductive-relative
Average of apiary		80	3.17 ± 0.02	x	x	x
Diseas resistance, %						
1	19R	10	91.8 ± 0.5	+0.2	0.37	Neutral
2	34R	10	92.0 ± 0.4	+0.4	0.89	Neutral
3	49R	10	91.8 ± 0.4	+0.2	0.44	Neutral
4	21R	10	92.0 ± 0.3	+0.4	1.11	Neutral
5	22R	10	92.1 ± 0.2	+0.5	1.79	Ameliorative-relative
Average of apiary		80	91.6 ± 0.2	x	x	x
Broods viability, %						

1	19R	10	93.2 ± 0.5	+0.9	1.70	Ameliorative-relative
2	34R	10	92.9 ± 0.5	+0.6	1.13	Neutral
3	49R	10	92.8 ± 0.5	+0.5	0.92	Neutral
4	21R	10	92.6 ± 0.5	+0.3	0.57	Neutral
5	22R	10	92.4 ± 0.5	+0.1	0.19	Neutral
Average of apiary		80	92.3 ± 0.2	x	x	x
Honey production, kg						
1	19R	10	53.97 ± 2.70	+3.79	1.35	Neutral
2	34R	10	55.58 ± 2.47	+5.40	2.09	Ameliorative-ordinary
3	49R	10	56.02 ± 2.57	+5.84	2.18	Ameliorative-ordinary
4	21R	10	54.10 ± 2.42	+3.92	1.55	Neutral
5	22R	10	52.19 ± 1.80	+2.01	1.03	Neutral
Average of apiary		80	50.18 ± 0.76	x	x	x

Given the fact, that the queen prolificacy decisively determine the amount of copped brood, it has a decisive impact on the development of family power. Through these connections, the development of power daughters - families of tested queens had a similar picture at the prolificacy.

After improvement of the power value families, most queens included in the test were assigned to the N*eutra*l category, because significant differences, at this character, compared to the average of apiary, have not been established. However, the highest power level was recorded at the families – daughter of the queen 19R and constituted 3.21 ± 0.04 kg. The lowest power was recorded in families - daughter of the queen 22R and constituted 3.12 ± 0.06 kg. After the development level of the families - daughter power, this queen was attributed to the *Reductive - relative* category, because gives up, and therefore insignificant, the level of development of this character on average on the apiary.

Resistance to diseases of bee families both from the experimental batches, as well the entire apiary, was at a fairly high level, and ranged within average from 91.6 to 92.1%.The highest level of disease resistance was recorded in families - daughters of the queen no. 22R. Resistance to diseases families daughter of the queen has had a clear tendency to be higher, compared to the average on the apiary, 0.5 or 0.5% absolute units (td=1.79; P<0.1). After improvement value of this character, queen no. 22R was assigned to the category improvement-relative of disease resistance character. Families - daughters of the other queen tested showed a level of development close to the average level of the apiary, so with some improving trends. After the improvement value of this

character, the other 4 bee queen tested after qualities of descendants were assigned to the *Neutrals* category, since the differences between the level of development of this character at the families – daughters and entire of the apiary were not significant. More obvious, the level of development morph-productive characters of families - daughters, compared with the average of the apiary, can be viewed in the histogram (Figure 1).

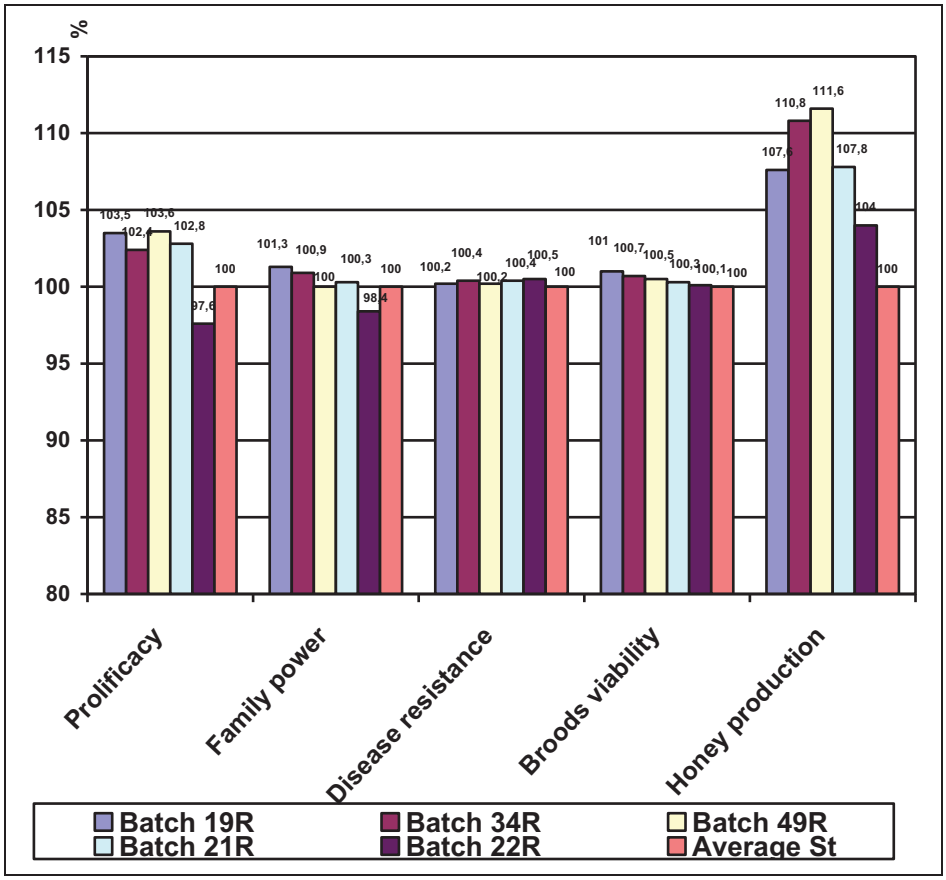

Figure 1. The level of morph – productive characters development of families - daughters, compared with the average on the apiary.

From the histogram can be seen, that all morph - productive characters studied, families - daughters have exceeded tended of apiary level, but clearly these trends were recorded at the prolificacy and honey production. Thus, at the prolificacy, families - daughter of tested queens, except families - daughters of the queen 22R, were on the average level of the apiary. It was observed, that between queens prolificacy and honey production there is a positive correlation. Such correlation registered and anonymous author "Al-Bee", 2013, from web (Al-Bee,

2013). Other researchers, Bar-Cohen et. al., 1978, showed positive correlations between quantity of capped brood and honey production capacity (rxy = 0.27 ± 0.08). **Broods viability** of families - daughter from all experimental batches, as well around the entire apiary, also, was at a rather high level, and ranged on average from 92.3 to 93.2%. The most brood viability was recorded in families - daughters of the queen 19R. Broods viability from these families, has had a clear overcome tendency to the apiary average level of 0.9 or 1.0% absolute units (td = 1.70; P<0.1). After improvement value of this character, queen no. 19R was assigned to the category Improvement - relative. The other tested queen, were assigned to the category of *Neutrals* after qualities of descendant, because the level brood viability of their families - daughters, although have a slight tendency to increase, did not differ significantly compared to average on the apiary.

Honey production, is one of the most important selection characters of bee families, was quite high both in families -daughters of tested queens, and the average for the entire apiary, framing within the averages limits of 50.18 and 56.02 kg. We should mention, that due to progressive targeted selection of bee families, by this character, throughout a long period, has been obtained the increasing effect of its level. More than that, the bee queens were selected mainly by the production of honey, became, in some cases, ameliorative after this character. The highest honey production was recorded at the families - daughters of the queen no. 49R and was 56.02 ± 2.57 kg. After the production of honey, families - daughters of the queen significantly exceeded the average level on the apiary 5.84 kg or 11.6% (td = 2.18; P<0.05), which corresponds to thirst threshold of certainty, according to the probability theory of forecasts contest without error after Student. After ameliorative value of this important morph – productive character, the queen no. 49R has been assigned to the category *Ameliorative - ordinary*. The second level of honey production has been recorded in families - daughters of the queen no. 34R, in average 55.58 ± 2.47 kg. After the production of honey, families - daughters of the queen significantly exceeded the average level on the apiary with 5.40 kg or 10.8% (td = 2.09; P<0.05). After ameliorative value of the families - daughters of this morph – productive character, the queen no. 34R has been assigned, also, to the Ameliorative – *ordinary* category. We should mention that after the improvement value of the other morph – productive characters investigated, both these ameliorative queens were assigned to the category *Neutrals*. Therefore, we can conclude, that selecting these queens for breeding and multiplication of genitor material, we have a significant increase of honey production in bee family's population and, at least,

will not affect their other morph - productive characters.

After improvement value of honey production level families - daughters, the other three queens taken in testing were assigned only to the *Neutral* category. This situation demonstrates, that, in this condition while the queens intended for testing, after qualities of descendants were previously selected by the development of their phenotypic characters and parents families, their genotypic value was no to all true. In our research, from 5 selected queens as performance after their phenotypic qualities and families-parents, just 2 queens, certified their ameliorative value after honey production (40%). In addition, we found that, at least, in our research we have not been identified the queens universal - ameliorative of all morph - productive selected characters.

CONCLUSIONS

In genotypic testing result of 5 bee queens by qualities of descendant, through the method of comparing with the average on the apiary, have been identified two queen-*Ameliorative - ordinary* of honey production.

The phenotypic performance of pre-selected queens after their morph – productive qualities and of families - parent do not guarantee improvement genotypic value without them testing after descendant qualities.

At least, in the studied population, have been not identified universal - ameliorative queens of all morph - productive characters.

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