IMPACT OF DROUGHT OVER MORPH-PRODUCTIVE FEATURES OF *APIS MELLIFERA CARPATICA* BEE COLONIES

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Abstract

The research purpose was to establish the damage (variance) degree of the morph-productive characters value and also of other biological features of bee colonies, depending on weather conditions. Research have been done on Apis mellifera Carpatica bee colonies, grown up at the experimental apiary of the Institute of Zoology of Science Academy from Moldova. At the bee colonies were evaluated a series of morph- productive characters, such as prolificacy of the queen, colony strength, overwinter resistance, brood viability, disease resistance and production of honey, also a number of exterior morphological traits of the bees, such as tegument colour, specific (type) of covering cells with honey, bee behaviour by opening the nest and examining the honeycomb, tube length, cubital index and discoid dislocation of the bifurcation point of the lower rib from radial cell with distal rib of cubital cell of the right anterior wing. Research have shown that adverse weather conditions (drought) of 2012 had a negative impact, mainly on the morph-productive characters such as queen's prolificacy, family strength, brood viability, disease resistance and honey production. Thus, the power of bee colonies in 2012 was 0.6 kg of bee, or 20.2% lower (P <0.001) compared with 2011. This power decrease of bee colonies was due to the reduction of both, reproductive indices, such as the queens' prolificacy, brood viability, resistance to diseases and also honey productivity. Average queens' prolificacy in 2012 was 1740 ± 16 eggs/24 hours, which is 66 eggs, or 3.7% lower than in 2011 (P <0.01), which was stagnant reflected over the quantity of covered brood of which results the amount of working bees – the family power. Average viability of the brood in 2012 was significantly lower with 2.5 percentage points, or with 2.8% (P <0.001) compared with the brood grown up in 2011. Resistance to disease (determined by hygienic test)of bee colonies in 2012 was significantly lower with 2.0 percentage points, or 2.2% (P <0.001) compared with 2011, which increased the number of morbidity and mortality cases of the bees. On the background of the damage of the bee colonies general condition, the honey production collected in the nest by bee families in 2012 was only 23.9 ± 1.2 kg, which is 20.9 kg or 46.7% significantly lower (P <0.001) compared with 2011. However, there have been no significant changes in the behaviour of bees by the nest opening and by examining the comb, and the cubital index and discoid dislocation of the bifurcation point of the lower rib from radial cell with distal rib of cubital cell of the right anterior wing of the bees.

Key words: Impact, drought, morph-productive, features, bee

INTRODUCTION

On the background of global warming, the 2012 year, for Republic of Moldova, was a year with contradictory weather conditions. Winter was very frosty, with pretty low temperatures (up to -25 and -30°C in some areas). At the same time, the amount of precipitation and soil moisture reserves in the early spring (March) were pretty good. From May to August, climatic conditions were overly warm and dry. Day temperatures reached, in some areas, extremely high values, registering a record of +42,7°C. From April till September, significant precipitation, basically, have not been. Climatic conditions in this period have been appreciated by the specialists in the field, in accordance with the rules in force, with the designation of natural disasters. These have caused serious environmental consequences, particularly to

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The manuscript was received: 15.02.2013
Accepted for publication: 26.07.2013

flora, both cultivated and the spontaneous (natural).

Natural disasters have had a negative indirect impact on the beekeeping. It consists of the affecting melliferous processes, especially, the nectarifer one, at plants that ensure the existence of Apis mellifera honey bees. At the same time, we agree exactly with those researchers [1], which considers that, the influence of climatic factors on melliferous resources, remains "a great unknown".

Under these conditions, the bees have had difficulties at collecting food for every day, such as nectar and pollen. Bees' effort of searching for melliferous resources, as well of transportation-storage of food in the nest, increased significantly. The bees' usage degree, working under these conditions, also increased. Thus, bee colonies have been affected in general, because the consequences of the drought were reflected, through working bees, also over other members of the colony: the queen, drones, brood, as well as on some important functions of the colony as a whole.

Multiple investigations in the field [2, 3, 5, 6, 8] have shown that weather factors have direct connections with the melliferous production, which, in turn, influences directly on the morph productive indices of Apis mellifera bee colonies [12]. At the same time, the impact of adverse weather conditions, particularly of natural calamities, over variability of morph productive features is not sufficiently studied.

In this context, the awareness of damage (variability) degree of morph productive characters value, as well as other biological qualities of bee colonies, depending on the climatic conditions of the year, represents an actual scientific problem.

MATERIAL AND METHOD

Research has been done on *Apis mellifera carpatica* bee colonies, grown at experimental apiary of Zoology Institute of Science Academy from Moldova. The apiary is placed at the stationary in a forest glade, near the edge. Bee colonies transportation to pastoral has never been done. The main melliferous sources in this area are white acacia, linden and spontaneous flora of various herbs, including yellow melilot.

It was proposed the aim, in order to elucidate the impact degree of drought of 2012 on the variability of morph productive and external morphological indices of bee colonies and morphological outdoor. To this end, at bee colonies have been assessed, a series of morph productive characters, such as: queen's prolificacy, bee colony strength, overwinter resistance, brood viability, resistance to disease and honey production, as well as a number of morphological external features of the bees, such as: the tegument colour, specificity (type)of honey covering, bee behaviour by opening the nest and by examining the comb, proboscis length, cubital index and discoid dislocation of lower rib from radial cell with the distal rib of cubital cell of the anterior right wing. The data obtained as a result of the assessment in 2012 (an extremely dry year) were compared with data from 2011 (normal year from the point of view of weather conditions).

The value of bee colonies morph productive characters, as well as morphological external traits of the bees, was performed, according to the methodology developed by us [4] in zoo technic norm relating to bee colonies assessment, growth and certification of beekeeping genitor material, approved by Government decision No. 306 of 28.04.2011 (M.O. No. 78-81 of 13.05.2011, art. 366) [7].

The data obtained as a result of the research were processed statistically using computer software "STATISTICS-6" and appreciated their certainty, according to variational biometric statistics, after the methods of Плохинский Н. А. 1969 [11].

RESULTS AND DISCUSSIONS

Research has shown that unfavourable climatic conditions (drought) of 2012 have had a negative impact, mainly, on morph productive characters, such as: queens prolificacy, bee colony strength, brood viability, resistance to disease and honey production (table).

Table Morph productive features of *Apis mellifera Carpatica* bee colonies at experimental apiary of Zoology Institute

Nr	Morph productive features	2011		2012		d	t_d
		N	$M_1 \pm m_1$	N	$M_2 \pm m_2$	M_2-M_1	
1	Tegument's colour, %:						
	dark brown	13	26 ± 6,3	29	58 ± 7,0	+32***	3,4
	medium brown	28	56 ± 7,1	11	22 ± 5,9	-34***	3,7
	light brown	9	18 ± 5,5	10	20 ± 5,7	+2	0,3
2	Honey covering specificity, %:						
	dry	6	12 ± 4,6	17	34 ± 6,7	+22**	2,7
	mixed	43	86 ± 4,9	30	60 ± 7,0	-26**	3,0
	wet	1	2 ± 2,0	3	6 ± 3,4	+4	1,0
3	Behaviour, %:						
	By opening the nest: gentle	46	92 ± 3,9	48	96 ± 2,8	+4	0,8
	aggressive	4	8 ± 3,9	2	4 ± 2,8	-4	0,8
	by examining the comb: not leaving	48	96 ± 2,8	47	94 ± 3,4	-2	0,5
	leaving	2	4 ± 2,8	3	6 ± 3,4	+2	0,5
4	Proboscis length, mm	50	6,59 ± 0,01	50	6,53 ±0,02	-0,06**	2,7
5	Cubital index, %	50	45,6 ± 0,5	50	44,8 ± 0,5	-1,2	1,7
6	Positive discoid dislocation,%	50	80,2 ± 2,0	50	77,7 ± 4,2	-2,5	0,5
7	Bee colony strength, kg	50	2,97 ± 0,02	50	2,37 ±0,02	-0,60***	15,0
8	Queens prolificacy, eggs/24 hours	50	1806 ± 13	50	1740 ± 16	-66**	3,2
9	Overwinter resistance, %	50	82,5 ± 0,9	50	86,2 ± 0,7	+3,7**	3,2
10	Brood's viability, %	50	91,1 ± 0,3	50	88,6 ± 0,4	-2,5***	5,0
11	Resistance to disease, %	50	89,4 ± 0,3	50	87,4 ± 0,3	-2,0***	4,8
12	Honey production, kg	50	44,8 ± 0,9	50	23,9 ± 1,2	-20,9***	13,9

*Remark: ** B≥0,99; *** B≥0,999*

The biggest changes have had bee colonies' strength and their honey production.

Thus, the colonies' strength, in 2012, was 0,6 kg of bee, or 20,2% less (with the highest threshold of certainty of forecasts without error after Stiudent, P < 0,001), compared to the year 2011. The data show that this strength reduction of bee families was caused by decreasing, both of reproductive indices, such as queens prolificacy, as well as brood viability and bee colonies resistance to disease.

Overall on studied bee colonies population, the average queens' prolificacy, in 2012, was 1740 ± 16 eggs/24 hours, what is with 66 eggs, or 3,7% lower than in 2011 (P < 0,01). It demonstrates that the unfavourable weather conditions, negatively influencing nectareous and polenifer processes at melliferous plants, works indirectly through the quantity and food quality, as well as through vital activity of working bees, on the physiological functions of queens gametogenesis, which has been stagnant reflected over the quantity of covered brood, which shows the amount of working bees - the colony strength.

Research has shown that, the drought is affecting not only the quantity, but also the quality of brood grown in the colony, which is much lower in the year with natural disasters. Brood grown in the dry year was more vulnerable to survive than in other years. Thus, the average brood's viability in 2012, was significantly lower by 2,5 percentage units, or by 2,8% (P<0.001), compared with brood grown in 2011.

Research data show that natural disasters caused by drought affects stagnant general physiological state of bee colony, which is expressed by decreasing of immune functions activity and its defence from different factors. Thus, resistance to disease (determined by hygienic test) of bee colonies in 2012 was much lower, with 2,0 percentage, or 2,2% (P < 0,001), compared to 2011. This has increased the number of morbidity cases and bees' mortality.

On the background of disorder of bee colonies general condition, resulted with negative impact on the physiological functions of bees' vital activity, had suffered mostly the main productive character – honey

production. Research results clearly demonstrates that honey production accumulated in the nest by bee colonies in 2012 – the dry year, extremely unfavourable for beekeeping, was only 23,9 ± 1,2 kg, which is with 20,9 kg, or 46,7% lower (with the highest threshold of certainty of forecasts without error after Stiudent, $P < 0,001$), compared to 2011. Because of the low honey production, none of bee colonies could be assigned, in accordance with provisions of zoo technic norm regarding bee colonies evaluation, growth and certification of beekeeping genitor material, at least at first class of evaluation. Most bee colonies do not have even the minimum of food reserves for their own needs. Under these conditions, many of bee-keepers were prompted to interfere with additional food, supporting unexpected expenses.

In 2012, the only one of main morph productive characters was not affected - overwinter resistance. Given that, this character is determined at the bee colony strength by beginning of overwinter (autumn 2011) and bee colony strength by finishing the overwinter (early spring 2012), and climatic conditions during these periods were normal, the value of this character, not only has not decreased, but, on the contrary, even increased. Thus, the overwinter resistance bee families in the period of 2011-2012 was higher, compared to the related period of the years 2010 – 2011 by 3,7 percentage units, or 4,5% ($P < 0,01$).

At the same time, some of the morphological external features, in particular, race particularities, have changed at investigated bee colonies, despite the fact that some of these qualities, how is the tegument's colour, are not wholly determined by climatic conditions. We consider that the changes observed at some external features of the bees, such as increasing of bee colonies share with typical coloured individuals (dark brown) and colonies with type of prevalent dry covering, found in 2012 compared with 2011, represent, rather, the impact of the selection made in this bee colony population.

Were not observed significant changes in bees' behaviour, so by opening the nest, as well as by examining the comb, in 2012 compared with 2011. In both years, by opening the nest, bees had, predominantly gentle behaviour, and by examining the comb – a calm behaviour without leaving the comb. Also, there are no significant differences, in these years, about cubital index and discoid dislocation of lower rib from radial cell with the distal rib of cubital cell of the anterior right wing.

Of bees external characters, just the proboscis length has had a decrease in 2012 compared to 2011 – with 0,06 mm or 1,0% ($P < 0,01$). Despite the fact that some researchers [9, 10] bring confirmation that additional food contributes to increase the proboscis length, however, remains to be elucidated, further, how this difference of proboscis length in our research is due to environmental conditions, because the available bibliographic information to us, about the investigations in this respect, are not enough.

CONCLUSIONS

1. It is clearly established that climatic conditions of drought have a negative impact on morph productive characters of *Apis mellifera Carpatica* bee colonies, such as: queen's prolificacy, brood's viability, colony strength, resistance to disease, honey production.

2. The largest decrease in the value of morph productive characters is the colony strength (up to 20,2%, $P < 0,001$) and honey production (up to 46,7%, $P < 0,001$).

3. The value of external morphological traits of the bees, with the exception of proboscis length, does not change significantly, depending on the climatic conditions of the year.

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