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BEE COLONIES COMFORT IN DIFFERENT TYPES OF HIVES

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Abstract

In order to test various hive systems in growing and exploitation of bee colonies, and in order to estimate comparative advantages and disadvantages, assessment of biological bee comfort, as well as economic efficiency of their exploitation in small and medium beekeeping farms, was carried out an experiment on comparative study of maintaining bee colonies in different types of hives: horizontal and vertical, both with Dadant frames. Two similar batches of bee colonies were created. The first batch of 20 colonies was put in horizontal hives and second batch with 25 colonies– in vertical hives. The main sources of honey in the area were: Acacia, Linden tree and spontaneous flora. In beekeeping season of 2011 have been studied main biological and morpho productive characters of bee colonies, such as: colony strengthens, resistance to overwinter and diseases, queens prolificacy, brood viability, total quantity of honey collected in nest after harvest. Appreciation of morpho productive characters was done according to our methodology developed by the new zootechnic regulation according to bee colonies valuation, growing and certification of genitor beekeeping materials, approved by decision of Government of Republic of Moldova no. 306 of 28.04.2011. It was found that the types of hives, where were housed the experimental bees, all other equal conditions of maintenance and exploitation, have not had any impact on the biological process of bees overwinter. This is confirmed by the fact that the average strengthens of bee colonies in both experimental groups, being equal at the beginning of experiment (1,78 kg in the autumn of 2010, in entry of overwinter) remained same in spring of 2011 (1,49 kg out of the winter). Therefore, overwinter resistance of bee colonies in both groups was also identical, averaging 83.1%. At the same time, the hive types, tested in experiment, had a significant influence on reproduction process and development of bee colonies in high beekeeping season. Thus, the queens prolificacy from 2nd batch with bee colonies located in vertical hives during the season, was higher compared to the Ist batch, accommodated in vertical hives, with 60 eggs/24 hours, or with 3.5% (B > 0.95). A better prolificacy activity of queens in vertical hives can be explained, in our view, by the fact that they have a better comfort of laying, compared with those from horizontal hives. We found that in horizontal hives, queens prefer for laying the area near bee entrance and it is explained by the fact that this place is better aired and ensure the brood with sufficient oxygen. In vertical hives queens laying is more uniform and it is spread on more honeycombs. This is due to a better and uniform ventilation in entire hive, which gives enough oxygen to brood. All this, has led to an active laying of queens from vertical hives, also to a bigger amount of capped brood and as a result, essential increase of bee colony strengthens. At the beginning of first harvest (locust tree), bee colonies placed in vertical hives reclaimed at a bigger rate than those placed in horizontal hives. Regarding bee colonies strengthens, those from 2nd batch exceeded significant, at this stage, those from 1st batch, with 0.33 kg or 9,4% (B > 0,99). Bee colonies from vertical hives entered overwinter significantly more powerful than bees from horizontal hives, which creates premises for a stronger development and better productivity in the next beekeeping season. Due to a quicker development, bee colonies kept in vertical hives accumulated, during active season, a bigger quantity of honey in the nest. Thus, the total quantity of honey accumulated in nest, bee families maintained in vertical hives have significantly exceeded those from horizontal hives with 7.5 kg, or 19,1% (B > 0.999). Economic effect obtained at exploitation of vertical hives only from honey production is 375 MD lei, or 23.8 euro per bee colony. Based on obtained results were made following conclusions. 1. Vertical hives compared to horizontal hives, offer to bee colony more comfortable biological conditions. 2. Maintenance of bee colonies in vertical hives ensures an increase of queens laying -3.5% and of average annual strengthens of the bee colony – with 6.0%. 3. Use of vertical hives contributes to increasing of honey production with 19.1%. 4. Bee colonies exploitation in vertical hives ensures economic efficiency at least 23.8 euro per bee colony.

Key words**:** *Apis mellifera Carpatica*, effect economic, hives, horizontal, testing, vertical

INTRODUCTION

Beekeeping from Republic of Moldova is practiced, most by amateur beekeepers, and a smaller number of professional beekeepers. On the whole, in our country, there are about 120 thousand *Apis mellifera Carpatica* bee colonies and over 4,5 thousand beekeepers. Technology

of bee colonies growing and exploitation is, predominantly, extensive and sedentary. Only a small part of professional beekeepers practice beekeeping at pasture. Bee colonies transportation to pasture shall be carried out, as a rule, with trucks, trailers and less with special pavilions. Most of loading-unloading of bee hives with colonies is carried out manually and less with special means. In this context, the type of hives and their weight has a fairly large technological importance.

In many beekeeping households, so far, there is no unified technology of bee colonies growing and exploitation. In beekeeping practice are used different types of hives, both horizontal and vertical, with different types of frames. The advantages and disadvantages of these types of hives and frames are generally known from literature of specialty [1, 3, 5, 6, 7].

According to Silaev's report, from 2007 (5), Russia, home of bees, has an important place in production of beekeeping products. Evolution of bees' houses has passed a long way, from tree hollow, up to contemporary beehive with removable frames. In Russia, more used are vertical hives with 12 frames and two stores, the hives with two bodies with 10 frames and one or two stores, and horizontal hives with 20 and more frames. At the choice of hive type is necessary that its construction would correspond to some requirements, such as: good overwinter of bees, quick increase of bees power in spring, facility and efficiency of anti swarming procedures, high productivity of work to tend bee colonies and honey extraction, comfortable transportation to pasture, easy construction and its low cost.

According to D. Istratie's research, from 2010 [1], Romania had been highlighted, comparing, the economic efficiency of bee colonies maintenance in two systems of horizontal hives LAYENS and DADANT, with the purpose to find solutions which can limit the negative influence of climatic factors on damage to bee biology and beekeeping production.

Special researches on testing various hive systems in bee colonies growing and exploitation on territory of Republic of Moldova have not been done yet.

Based on this, we proposed to test different systems of hives in bee colonies growing and exploitation, in order to estimate advantages and disadvantages, biologic comfort of the bees, as well as economic efficiency of their exploitation, in small and middle beekeeping households.

MATERIAL AND METHOD

Researches have been done on bee colonies of *Apis mellifera Carpatica* race, in 2011. For the experiment, in fall of 2010 were formed two similar batches of bee colonies. Bees from first batch, in number of 20 colonies, were introduced for overwinter into horizontal hives with 20 Dadant frames. Bee colonies from second batch, with a bee population of 25 colonies, were introduced into vertical hives with body of 10 Dadant frames and stores with ½ Dadant frames. The thickness of the wood walls at both types of hives was 22 mm. Vertical hives had detachable bottoms of metal mesh. The hives were placed at stationary apiary of Zoology Institute from Science Academy of Moldova, which is located in a forest glade of forest sector nb. 21 of Canton no. 4, fold forest Ghidighici, Straseni. As honey sources in this area, serve Acacia, Linden tree and spontaneous flora. Bee hives with colonies from both batches were placed under same conditions, at a distance of 2 m one from another, with bee entrance faced to south. In winter of 2010-2011, the minimum air temperature, in the area, was 0 C.

Beekeeping season of 2011 have been studied the main bee colonies biological and morphoproductive characters such as: bee colonies power, resistance to overwinter, queens prolificacy, brood's viability, resistance to diseases, the total quantity of honey collected in nest after harvest. Morpho productive characters assessment was done according to methodology developed by us in the new zoo technical regulation regarding bee colonies valuation, growing and certification of beekeeping genitor material, approved by decision of Government of Republic of Moldova no. 306 of 28.04.2011 [2].

The power of bee colonies has been approved by bee amount existing in the nest at that moment. Assessment was done three times a year: spring examination (02 April), end of

spring (31 May) and autumn examination (29 September). After these three appreciations was determined average power of each bee colony. Bee quantity (kg) was determined by multiplying the number of intervals between frames, occupied uniformly by bees, with coefficient of 0,25 for Dadant standard frame.

Bee colonies resistance to overwinter was assessed after the amount of surviving bees over winter, using information from autumn examination of 2010 and from spring of 2011. The bees' resistance to overwinter was determined by the correlation of bee quantity after winter with bee quantity before winter, expressed as a percentage.

Queens prolificacy (eggs/24 hours) was determined at the end of the spring examination (May 31) by dividing capped brood cell number from the nest to 12 (cycle of capped brood development, days), thus resulting the egg number laid in 24 hours. The cells number with capped brood from the nest was determined by measuring with Netz frame of squares number (5 x 5 cm) filled with capped brood and multiplying it by 100, revealing the total number of cells with capped brood.

Assessment of bee colonies brood viability was done twice - on 15th and 30th of June 2011, by marking with matches, in the corners, a part of honeycomb densely egg laid, with 400 cells (10 x 10 cm). After 4 days, were counted cells with larvae and total number of cells on marked surface, which represents the brood viability, expressed as a percentage. The final brood viability was determined by calculating the average of the two assessments.

Resistance to diseases was determined through following the hygienic behaviour of bee colonies, using standard test, whereby brood from a compact surface was euthanized in order to establish the speed and accuracy with which the bees identify and remove the dead brood. The evaluation was done twice (on 19th May and 02nd June, 2011) on each bee colony. The brood was euthanized at capped stage (Stern) by pricking with a fine needle through cell caps from a part of honeycomb in the nest, on a square surface of 5 x 5 cm (100 cells) marked in corners with matches. After 24 hours, since the introduction into the nest of the comb with euthanized brood, was determined the number of cells in which the brood has been removed. The correlation of cells number with removed brood and with initially euthanized brood from the marked surface of the comb, made up the resistance to diseases, expressed as a percentage. Average of the values between the two evaluations made the final resistance to diseases.

Total quantity of honey collected in the nest was determined at each bee colony, by adding the quantity of honey-wares, extracted during harvest season, with quantity of honey collected in the nest, and left after autumn examination, as food for bees for overwinter period. The quantity of honey-wares was determined for each bee colony apart, at each extracting, by weighing the combs with honey before and after extraction (accurate to 0,1 kg), weight difference being the amount of extracted honey-wares. The quantity of honey left in nest as bee food was determined at autumn examination, by weighing combs with honey and their reduction (from the total weight thereof) of summary weight of standard frames with combs without (for frame-type Dadant-0.6 kg).

Experimentally obtained information was processed according to variation biometric statistics, after the methods of Plohinschii N. A. 1969 [4].

RESULTS AND DISCUSSIONS

The results of researches, presented in the table, show that the types of hives, where were kept the bees during our experiment, all other equal conditions of maintenance and exploitation, have not had any impact on the biological process of overwinter of the bees. This is confirmed by the fact that the average power of bee colonies from both experimental batches, was equal at the beginning of the experiment (the fall of 2010, before overwinter) remained same in the spring of 2011 (after overwinter). Therefore, the resistance to overwinter of bee colonies from both batches was also identical, averaging 83,1%.

At the same time, the types of hives tested in our experiment had a significant influence on reproduction process and bee colonies development during beekeeping season.

Table 1. Testing results of different types of hives for maintenance and exploitation of *Apis mellifera Carpatica* bee colonies

Name of morpho productive characters	Horizontal hives n = 20 $M_1 \pm m_1$	Vertical hives n = 25 $M_2 \pm m_2$	$M_2–M_1$	td
Bee colonies power in autumn, 2010, kg	1,78 ± 0,07	1,78 ± 0,05	0,00	0,00
Bee colonies power after overwinter, 2011, kg	1,49 ± 0,07	1,49 ± 0,06	0,00	0,00
Overwinter resistance 2010-2011, %	83,1 ± 1,8	83,1 ± 1,5	0,0	0,00
Queens prolificacy, eggs/24 hours	1702 ± 25	1762 ± 15	+60*	2,07*
Bee colonies power at first harvest, kg	3,50 ± 0,09	3,83 ± 0,04	+0,33**	3,36**
Bee colonies power in autumn, 2011, kg	2,01 ± 0,02	2,08 ± 0,02	+0,07*	2,50*
Bee colonies average annual power, kg	2,33 ± 0,05	2,47 ± 0,03	+0,14*	2,41*
Brood viability, %	89,0 ± 0,5	89,6 ± 0,4	+0,6	0,94
Resistance to diseases, %	85,3 ± 1,2	87,3 ± 0,9	+2,0	1,33
Total quantity of honey, kg	39,2 ± 1,0	46,7 ± 0,9	+7,5***	5,33***

Remark: * - B > 0,95; ** - B > 0,99; *** - B > 0,999

Thus, the queens prolificacy from bee colonies placed in vertical hives, during beekeeping season, was higher, compared to bee colonies placed in horizontal hives, with 60 eggs/24 hours, or 3,5% (B > 0,95). A better prolificacy activity of the queen from vertical hives is explained, in our view, by the fact that they have a better comfort for laying, compared with those from horizontal hives. We found that in horizontal hives, queens prefer to lay on the place near bee entrance, what is explained by the fact that this place is better ventilated and ensures the brood with sufficient oxygen. In vertical hives Queens are laying more uniform and it is spread on many combs. This is due to better and uniform ventilation in entire hive, which favours necessary provision of the brood with oxygen. All this has led to the queens active laying in vertical hives, and a bigger number of capped brood and as a result, essential increase of bee colonies power.

At the beginning of first harvest (locust), bee colonies placed in vertical hives recovered much quicker than the bees from horizontal hives. After their power, bee colonies from second batch, were much stronger, at this stage, as those from first batch, with 0,33 kg or 9,4% (B>0,99).

Dynamics of bee colonies development can be demonstrated most clearly by illustrating of their power diagram at different periods of time. It was found that the power of bee colonies placed in horizontal hives increased, in active season, from 1,49 ± 0,07 kg - after overwinter, up to 3,5 ± 0,09 kg – at first harvest, reaching up to 2,01 ± 0,02 kg – in fall, at beginning of overwinter. The bee colonies power kept in vertical hives increased, in this period, from 1,49 ± 0,06 kg - out of the overwinter, up to 3,83 ± 0,04 kg - at first harvest, reaching up to 2,08 ± 0,02 kg – in fall, at beginning of overwinter. Therefore, bee colonies kept in vertical hives entered into overwinter, significantly more powerful, than bees from horizontal hives, which creates premises for a stronger development and higher productivity in the next beekeeping season.

In bee colonies placed in vertical hives can be noticed a weak increasing of their resistance to diseases, compared with bees from horizontal hives. However, the difference after this biological characteristic, between the two batches of bee colonies is not significant.

Due to more accelerated development rhythm, bee colonies kept in vertical hives have collected during the active season, a bigger quantity of honey in the nest.

Thus, after the total quantity of honey collected in the nest, bee colonies placed in vertical hives have significantly exceeded the bee colonies from horizontal hives with 7.5 kg, or 19.1% (B>0.999). This difference is certain according to the highest level of resolution after Student [4]. The economic effect obtained at the exploitation of vertical hives, makes in honey production 375 MD lei, or 23.8 per bee colony. Taking into account the fact that, simultaneously with honey production, from bee colonies are acquired other bee products (beeswax, propolis, etc), quite important too, so economic efficiency of vertical hives, instead of horizontal ones, can grow up to 25-30 Euros per bee colony.

CONCLUSIONS

1. Vertical hives offer to bee colonies more comfortable biological conditions, compared to horizontal hives.
2. Maintenance of bee colonies in vertical hives guarantees an increase of queens prolificacy - with 3.5% and colonies average annual power - with 6.0%, compared with horizontal hives.
3. Use of vertical hives for maintaining bee colonies contributes to increase honey production with 19.1% compared to horizontal hives.
4. Bee colonies exploitation in vertical hives ensures an economic efficiency at least of 23.8 per bee colony, compared with horizontal hives.

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