Scientific Papers. Series D. Animal Science. Vol. LVIII, 2015
ISSN 2285-5750; ISSN CD-ROM 2285-5769; ISSN Online 2393-2260; ISSN-L 2285-5750

STUDY ON THE MAINTENANCE OF BEE FAMILIES INTO VERTICAL HIVES ON DADANT AND LAYENS FRAMES

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Abstract

The paper presents the study done on the frame model technology and its effects on productivity. The productivity of a bee family is correlated with the hive's productive capacity, the micro-climate conditions and the volume available for the optimal growth of the bee family. For finding solutions that limit the negative influence that a certain hive model has on a bee family, the paper aims to compare the two main frame technologies used in apiculture. The study was made using numerically equal bee families, kept in the same conditions and under the same preventive treatments, with the purpose of determining their productive capacity and development patterns.

Key words*: bees, frame, hive, Dadant, Layens.*

INTRODUCTION

From the ancient times because of the favorable podeclimatic conditions of our country, there has been a big concern about beekeeping. Thus, the first document appears in the writings of the Greek historian Herodot (484 – 425 b.C.) which says that "in the south of Danubis the earth is inhabited by bees".

The type of bee exploited at present is a cross between the local bee (*Apis mellifica carpatica*) with qeens of Italian species (*Apis mellifica lingustica*), Carniolan bee (*Apis mellifica carnica*) and other hybrid species from Banat and Wallachian plain (Bura et al., 2005). Besides improving the quality of the biological material always existed a concern for discovering new effective methods of raising bees. The production capacity of the bee families is correlated with several factors: the productive potential of the queens, resistance to diseases and pests, the characteristics of the hive, the hive ability, the mining technology applied, the apiary honey production (Nicolaescu, 1928; Antonescu, 1966; Bura, 1996). Depending on the goal you are pursuing every beekeeper along the time created many models of hives . Between all the systematic hives created, only two models have managed to establish itself until today: Dadant and Layens (Hristea, 1976).

The aim of the paper is to highlight the effectiveness of the technology maintenance compared bee hives in two models, to find solutions that can limit the negative influence of climatic factors on the bee and beekeeping production.

MATERIAL AND METHODS

To highlight the influence that both models have on the biology of the bee hives and beekeeping production , researches have been conducted in own apiary on a number of six hives, three vertical Dadant model and three Layens vertical model in September 2012 - September 2013. For results to be closer to reality the bee families that were populated hives were brought to the same initial weight (2.5 kg) weight ensure normal development in the two models of hives during winter. Bees were applied to the same treatments performed in the same period and were stimulated with the same amount of food.

BIOLOGICAL MATERIAL

Knowing the major influence on the development of quality queen bee family were used queens obtained by double tapping, having the same age, from the same bee family.

Power bee family was determined by weighing at certain period of time: in preparation for the winter period" at the end of winter, early harvest of rape, early summer".

Determine the amount of sapling and honey was made by measuring the area occupied by

them from time to time so: 1 dm^2 comb on one side contains 175 g or 400 cells empower honey bee working.

AUXILIARY MATERIALS

The lot of hives subject experiment consists of six hives (three of each type), with the following characteristics:

A. Dadant hive was invented by Ch. Dadant, American beekeeper with French nationality, who invented and related wax leaf frame. Innovation in beekeeping was brought by frame which is very well suited to spin. In the first phase was invented longue 18 frames then create a frame due to the need for storing smaller harvest hive appeared vertical (systematic hive) with three models of frames: Frame ½ , ¾ frame and frame 1/1 (Antonescu, 1979; Manualul Apicultorului, 1986).

The hive dimensions are:

- Nest body - 446 mm x 370 mm x 306 mm (internal dimensions);
- Store harvest - 446 mm x 370 mm mm x 153 (internal rates);
- The bottom of the hive - 586 mm x 410 mm
- Plateau - 466 mm x 390 mm (made up of several parts);
- Cover - 486 mm x 390 mm x 150 mm (internal dimensions).

The hive is made of fir plank thickness of 2 cm and can be used as appropriate with one or two stores harvest. Stores crop used in this study are those of ½. The frames are made of linden and 414 mm x 272 mm have internal dimensions with an area of 11.26 dm^2, with frames for harvest shop with a height reduced by half. Hive has a volume of 0.050 m^3 (body nest), an area of 112.6 dm^2, 10 frames per nest and 56.3 dm^2 surface combs shop harvest.

B. Layens hive was designed and built by M. de Layens and it has been adapted by the model of Voirnot abbot's hive , improving conditions for wintering and work easier for beginners in beekeeping. At first horizontal version was built with 16 frames after that, because naturally bee hive inside vertical movement was built and vertical version with new frames.

In this study it was used a modified version of the hive Layens using ten frames as well (instead of the new hive has Layens as original).

Layens hive has the following dimensions:

- Body 342 mm x 370 mm hive x 404 mm (internal dimensions);
- Store the harvest 342 mm x 370 mm x 404 mm (internal dimensions);
- Hive bottom 482 mm x 390 mm;
- Plateau 362 mm x 343 mm (made up of several parts);
- Cover 382 mm x 150 mm x 373 mm (internal dimensions).

The hive is made of fire wood 2 cm thick. The frames are made of linden and 310 mm x 370 mm (Gustav, 1972), have internal dimensions, with an area of 11.47 dm^2. Hive has a volume of 0.051 m^3 and 114.7 dm^2 the frames nest.

PROCEDURE

Working technology used was as follows:

- The work done over the year in the two hive systems were identical pointing out by determining the parameters proposed for the experiment;
- In preparation for wintering hives has been performed and equalize weight of the bee families(LOUVEUX., 1987), by adding bees using classical methods (uniform smell by adding flavoring tea made with water and sugar 1: 1);
- Protecting the nest was made according to each model technology hive (aperture adding insulation);
- Expanding the nest was made progressively as the technology for each hive model;
- Stimulating feeding winter cakes were made from powdered sugar and honey (25% and 75% powdered sugar honey) and in early spring with powdered sugar cakes, honey and inactivated yeast (25% honey, 62.5% powdered sugar and inactivated yeast 12.5%);
- Against Varroa treatments were performed with varachet, as planned: two in October (at a distance of seven days) and two spring after picking acacia (Istratie, 2010);
- The experiment was conducted over a period of one year (September 2012 - September 2013).

RESULTS AND DISCUSSIONS

To highlight the quantitative evolution of the population of bees in winter, comparative research conducted on two models of hives that were conducted over the period September 2012 to early March 2013 and are presented in Table 3. The amount of bee used in the experiment was 2.5 kg bee \ family. Because

variability in mortality of bees in winter is high even when using the same model of the hive, in Table 3 we worked with the average amount of bee hive within each model for the deviation to be as small as possible.

Table 1. Quantity evolution of bee families kept in Dadant hives in the winter: September 2012- March 2013

Month	Hive no 1			Hive no 2			Hive no 3			Mortality rate	
	Bee weight kg	Mortality		Bee weight kg	Mortality		Bee weight kg	Mortality		Kg	%
		Kg	%		Kg	%		Kg	%		
Sept.	2.5	0	0	2.5	0	0	2.5	0	0	0	0
March	2	0.500	20	2.15	0.35	14	1.95	0.55	22	0.46	18.4

Table 2. Quantity evolution of bee families kept in Laynes hives in the winter: September 2012- March 2013

Month	Hive no 1			Hive no 2			Hive no 3			Mortality rate	
	Bee weight kg	Mortality		Bee weight kg	Mortality		Bee weight kg	Mortality		Kg	%
		Kg	%		Kg	%		Kg	%		
Sept.	2.5	0	0	2.5	0	0	2.5	0	0	0	0
March	2.3	0.20	8	2.35	0.15	6	2.30	0.20	8	0.19	7.6

Table 3. Comparison of quantitative average evolution of bee families, maintained in two models of hives during the winter in September 2012 - March 2013

Month	Dadant hive			Layens hive		
	Bee weight kg	Mortality		Bee weight kg	Mortality	
		Kg	%		Kg	%
September	2.5	0	0	2.5	0	0
March	2.04	0.46	18.4	2.32	0.18	7.2

If we follow the quantity evolution of the bee families, we notice that the Dadant hive model has suffered the biggest loss in the winter (18.4 % average) and the Layens (7.2% average), while the thus the fewest losses (Figure 1).

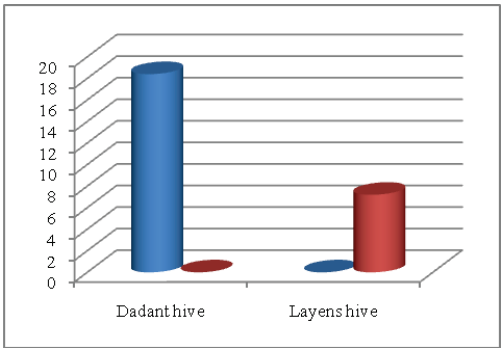

Figure 1. Mortality of bee families maintained in both models of hives during the winter: September 2013- March 2013 (%)

This is possible because, Dadant hives (even if the family was isolated with a diaphragm in a total of seven frames) is hardly heated enclosure frames having the largest share of horizontal skein may not fully occupy space in the hive and thus in the remaining unoccupied, the low temperature condensation occurs.

The space inside of the Layens hive during the winter (seven frames isolated diaphragms) is almost equal to the Dadant hive (0.0357 m3) because of the largest space that is occupied by the vertical frames, the family occupies the entire premises and so the conditions of wintering are close to the natural ones, so the bee family has the optimal conditions for wintering.

A basic indicator in the growth and development of bee families is the presence of the brood. The main factors that influence this indicator are:

- Outdoor temperature;
- Queen quality;
- The quality of the hive model used;
- The power of bee family;
- Reserves of food from nature and from inside the hive.

To pursue further development of bee families was done to measure surface brood combs at

different dates at a period of about 21 days, period corresponding to a working bee development cycle from egg stage to adult.
To understand better the dynamics of development of bee family in one year research was split into three periods: the development during spring, summer development during and development during the autumn.
Development during spring begins with the first background check and ends at the first big harvest of the year. The data obtained are presented in Table 4.

Table 4. The growth dinamics of bee families in the two hive models in spring: March 2013 – May 2013

Hive model	Bee weight (Kg)	March 7 (dm^2)	March 28 (dm^2)	April 18 (dm^2)	May 9 (dm^2)	Brood (dm^2)	Brood (cell no.)
Dadant 1	2	8	13.80	21	50	92.80	37120
Dadant 2	2.15	8.50	14	21.50	50	94	37600
Dadant 3	1.950	8	13.50	21	48	90.50	36200
Dadant average	2.03	8.16	13.76	21.16	49.3	92.43	36972
Layens 1	2.30	12.30	18	29	67.10	126.40	50560
Layens 2	2.35	12.50	19	30	68	129.50	51800
Layens 3	2.30	12	17.50	28.50	67	125	50000
Layens average	2.31	12.26	18.16	29.16	67.36	126.96	50784

The hive used has a large influence on egg-laying queen as shown in Table 4 the bees maintained in the Layens are with 37.35 % higher than those maintained in Dadant hive, the development period of the year before the first big harvest (Figure 2, Figure 3).

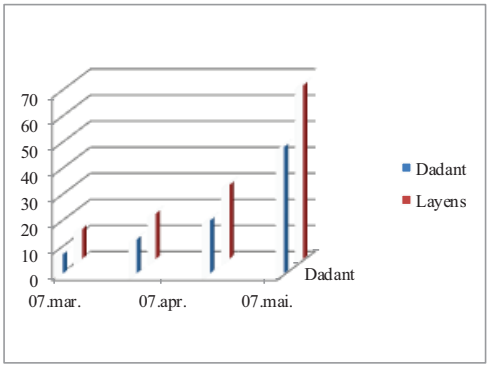

Figure 2. The dynamic development of bee families in the two hive models during spring March 2013 - May 2013 (dm^2 brood cells)

This difference is even greater in early March when the bees in hives Layens had maintained with 50.24 % higher than the Dadant hives.
The fact that the height of the frame is longer than the length makes the volume of the family nest of bees to occupy full frames, bee family development occurs vertically and temperature inside the hive is much easier to control.

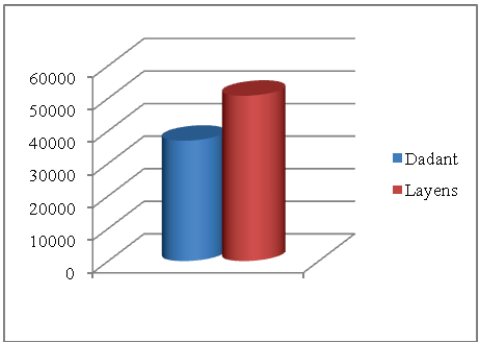

Figure 3. The dynamic development of bee families, expressed as average in the two hive models during the spring, March 2013 - May 2013 (brood cells no.)

For the second phase of development of the bee family research started after completion of the first harvest and was completed with the completion of the last great harvest of the year (sunflower harvesting). The data obtained are presented in Table 5.
The analysis of the obtained data we can see that during this period in the Dadant hive, the lay-eggs queen decreases by 41% while the hives Layens decreases only 34.13% (Figure 4).
We can conclude saying that summer frame Layens is superior to the summer frame Dadant for the growth of the bee families inside the hive, the heat is concentrated at the top (which has a height of 404 mm) and this makes the bees work less for conditioning the

nest. It should be noted that during this period Dadant hives had attached one harvest shop.
For the third growth period for the bee family researches begun after the last great harvest of the year and were completed late in September before performing treatments to destroy the Varroa Destructor parasite. The data obtained are presented in Table 6.

Table 5. The dynamic development of bee families in the two hive models in summer May 2013 - July 2013

Hive model	Bee weight (Kg)	May 30 (dm^2)	June 20 (dm^2)	July 10 (dm^2)	July 30 (dm^2)	Brood (dm^2)	Brood (cell no.)
Dadant 1	3.39	74	78	62	42	256	102 400
Dadant 2	3.60	76	81	65	45	267	106 800
Dadant 3	3.30	72	77	62	44	255	102 000
Dadant hive average	3.43	74	78.66	63	43.66	259,33	103 732
Layens 1	4.56	90	100	82	62	334	133 600
Layens 2	4.68	95	98	80	60	333	133 200
Layens 3	4.52	89.8	94	78	59	320.8	128 320
Layens hive average	4.58	91.60	97.33	80	60.33	329.26	131 704

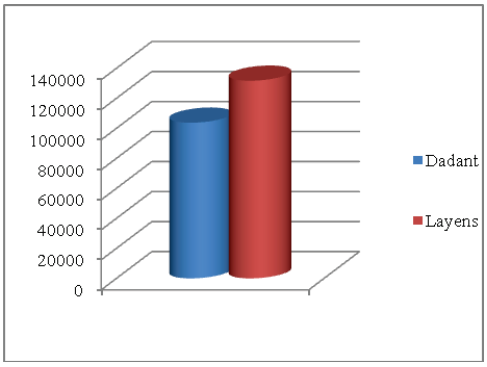

Figure 4. Bee family growth dimanics in both hive models between May 2013 – July 2013 (dm^2 brood cells)

Making a review of the data obtained we can observed that during this period the Dadant hives , queen drops 66.22 % as hives Layens decreases 65.04 %. It can be concluded as the autumn Layens frame is superior to Dadant frame for the growth of bee families.
If we analyze the amount of brood is submitted after the date of August 20, 2013 we notice that Layens hives it is 17.996 and in Dadant hives the average is 9464. Considering that the queen bees and brood submitted by the end of October - early November we conclude that Layens hives for winter will be enough but Dadant hives will need to make unification of hives to pass safely over the winter.

Analyzing the dynamics of bee family in terms of the amount deposit of brood (Figure 5) we can see that Layens is superior to the Dadant hive throughout the year.

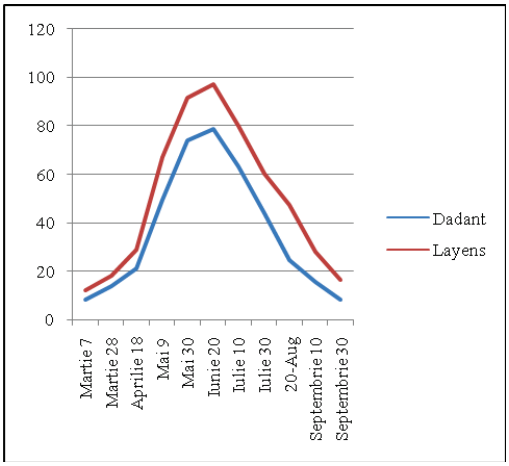

Figure 5. Bee family growth dynamics in both hive models during all the year 2013

The floral honey results from the processing of floral nectar honey bee brought by it in the hive (Iordache et al., 2008). The quantity of honey needed by the bee colonies during a year is very difficult to quantify, it varies depending on several factors: the strength of the bee family, the amount of eggs and brood in the hive, microclimate conditions that

ensure their hive model, outdoor temperature and humidity (Marghitas, 2005).

To draw a conclusion about the potential production per hive model, we analyzed the parameter "quantity of extracted honey" and quantity of bee families that conducted us to this parameter. Rapeseed harvest began in May 9 data and lasted until 20 May 2013. The data obtained are presented in Table 7.

Table 6. Bee family growth dynamics in both hive models during the autumn period August 2013 – September 2013

Hive model	Bee weight (Kg)	August 20 (dm^2)	September 10 (dm^2)	September 30 (dm^2)	Brood (dm^2)	Brood (cell no.)	Bee weight (Kg)
Dadant 1	2.7	27	16	9	52	20800	2.7
Dadant 2	2.5	24	15	8	47	18800	2.5
Dadant 3	2.4	23	15	8	46	18400	2.4
Dadant hive average	2.53	24.66	15.33	8.33	48.33	19333	2.53
Layens 1	3.2	47	29	16	92	36 800	3.2
Layens 2	3.3	48	28	17	93	37 200	3.3
Layens 3	3.2	48	28	17	93	37 200	3.2
Layens hive average	3.23	47.66	28.33	16.66	92.66	37066.66	3.23

Table 7. Honey production and bee weight evolution in both of hive models during the rapeseed harvest 9th May 2013 to 20th May 2013

Hive model	Weight of bee family		Differences between the weight of the bees		The honey production	
	Before harvest (kg) 9.05.2013	After harvest (kg) 20.05.2013	(kg)	(%)	(kg)	(kg honey/kg bee)
Dadant 1	3.39	3	0.39	11.5	7	2.06
Dadant 2	3.60	3.1	0.5	13.88	7.5	2.08
Dadant 3	3.30	3	0.3	9.09	7	2.12
Average	3.43	3.03	0.4	11.66	7.16	2.08
Layens 1	4.56	3.8	0.76	16.66	10.5	2.3
Layens 2	4.68	3.7	0.98	20.94	12	2.56
Layens 3	4.52	3.8	0.72	15.92	11	2.43
Average	4.58	3.76	0.82	17.9	11.16	2.43

According to Table 7 at the rapeseed harvest the quantity of harvested honey is 55.86 % higher in Layens hives to Dandant hives but also the bee loss is 6.24 % higher (Figure 6).

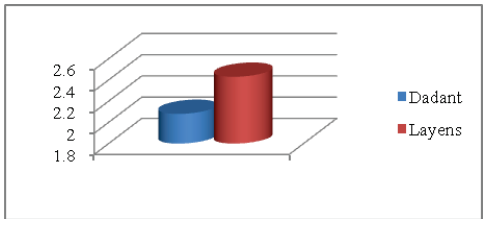

Figure 6. The efficiency of transforming the nectar in honey bee at bee families maintained in Dadant and Layens hives (kg honey / bee kg) at rape harvest

We conclude that stronger families during spring collect more honey bee but also the bee loss family is higher. The honey production is higher at bee families from Layens hives that collect 2.43 kg / kg to bee families from Dadant hives that collect with 2.08 kg / kg bee.

Looking at table 8 we can make some observations. The honey production is 32.81% higher at Laynes hives than Dadant hives after sunflower harvest, but also the bee loss in higher with 1.41% at Laynes hives. The honey production is 6.07% honey kg/ bee kg higher at Laynes hives than Dadant hives with 5.42 honey kg/bee kg (Figure 7).

Table 8. Honey production and bee weight evolution in both hive models during sunflower harvest 24th June 2013 to 30th July 2013

Hive model	Weight of the bee family		Difference between bee weight		Honey production	
	Before harvest (kg) 24.06.2013	After harvest (kg) 30.07.2013	(kg)	(%)	(kg)	(kg honey/kg bee)
Dadant 1	4.1	2.7	1.4	34.1	22	5.36
Dadant 2	3.9	2.5	1.4	35.89	21	5.38
Dadant 3	3.9	2.4	1.5	38.46	21	5.38
Average	3.93	2.53	1.43	36.38	21.33	5.42
Layens 1	4.8	3.2	1.6	33.33	28	5.83
Layens 2	4.9	3.2	1.7	34.69	29	5.91
Layens 3	4.8	3.2	1.6	33.33	28	5.83
Average	4.66	3.23	1.63	34.97	28.33	6.07

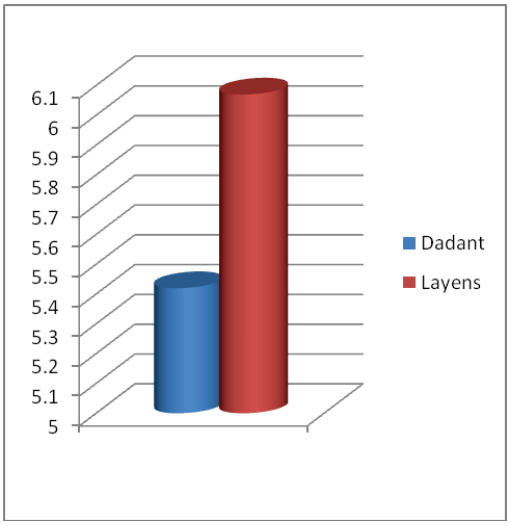

Figure 7. The efficiency of transforming the nectar in honey bee at the bee families maintained in Dadant and Layens hives (kg honey / bee kg) at sunflower harvest

CONCLUSIONS

After analyzing the evolution of bee families and quantity of honey collected we can conclude:

- The study undertaken aimed at comparing the behavior of bee colonies increased in two types of hives (Dedant and Layens), widespread in beekeeping practice. The study case was carried out in the south of the country, in the author's own apiary.
- Have been targeted a number of technical and biological parameters (power bee family, the ability to produce juvenile, survival during winter, the amount of honey harvested etc.).
- In winter, bees from Layens hives losses are lower than the 11.2% Dadant hives. Inside Layens hives, the bee fully occupy the space, wintering mat is formed in the middle frame and the bee will only move vertically constantly having food over the ball of winter. This system helps to decrease the mortality during the winter.
- During the winter, bee losses in Layens hives are lower than the losses in Dadant hives with 11,2%.Inside Layens hives, the bee fully occupy the space, wintering mat is formed in the middle frame and the bee will only move vertically constantly having food over the ball of winter. This system helps to decrease the mortality during the winter.
- During the spring, the bee families of Layens hives have showed a stronger growth, in March the bee queens layed with 50,24% more eggs than the bees from Dadant hives. The lack of vertical currents in Layens hives, have determined the temperature maintenance and the bee queens lays more eggs.
- The bees growth in summer from Layens hives is 6.87% higher than Dadant hives of bees. In the summer, the queen of the hive Layens, sustained over a longer time lay ceiling , with less need for conditioning bee hive.
- During the autumn, bees in Layens hives is higher by 3.88% from Dadant hives of bees lay eggs and brood amount obtained, allow us to get through the winter without unify hives. Also with plentiful bee, bees growth will cover a longer period in the late autumn, which will ensure less waste bee in the spring and will influence the growth of earlier brood start.

- The quantity of honey obtained and extracted from rapessed harvest is higher in Layens hives than Dadant hives, with 55.16%. With a stronger development in the early part of the spring, the Layens hives have a larger amount of bee for the first harvest of the year.Honey extracted from sunflower harvest is higher in Layens hives than Dadant hives with 32.81%.

- The research carried out in the mentioned conditions (plains) shows the superiority of the Layens hives to Dadant hives.

ACKNOWLEDGEMENTS

This research work was a part from PhD thesis elaboration "The characterization of the main types of honey in the Rucar-Bran mountain area" and was carried out with the support of Faculty of Animal Science, University of Agronomic Science and Veterinary Medicine of Bucharest.

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