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===== **TOULOUSE - AUZEVILLE** =====

TRIAL REPORT

ON THE

HAPPYKEEPER BOTTOM BOARD

January to October 2005

Please note : The original report has been written in French.
Although made at the best, translation has not been made
by professional translators. Some errors can therefore occur.

BROUARD Isabelle

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1. Preamble

The HAPPYKEEPER company, represented by Mr. LE PABIC, requested the beekeeping operation of Lycée Agricole de Toulouse-Auzeville to carry out an experiment. The protocol has been proposed by the Happykeeper company. The experiment was partly funded by Région Ile de France.

2. Introduction

Beekeepers using the Happykeeper tubes bottom boards say they are satisfied but their findings are not sufficient to validate the true benefit of the board to the colony. Some hives have been fitted with tubes bottom boards so that we could make the comparison with hives fitted with mesh bottom boards in order to verify what the beekeepers said :

- bottom board permanently clean;
- considerable fall of Varroa mites;
- earlier development of the colony.

3. Equipment and method

3.1 Study site

Studied hives are led as fixed production hives to the suburb of Toulouse.

3.2 Equipment

Study will be carried out on 21 Dadant-Blatt 10 frame hives, 10 being fitted with tubes bottom boards and the other eleven with mesh bottom boards whose screen surface correspond to the inner surface of the hive body.

Hives fitted with tubes bottom boards are randomly mixed with those fitted with mesh bottom boards. Both are positioned in the periphery of the production apiary.

Used equipment, hive bodies, supers and frames are identical on all the hives.

3.2.1 Tubes bottom board description

Indicated dimensions are those of Dadant-Blatt 10 frame hives which will be used for the trials. The tubes bottom board consists of a 50 mm tall wooden frame whose open surface is 450 mm by 480 mm, as inner surface of the hive body. The ten tubes are 450 mm in length, 34 mm in diameter and 3,5 mm apart, each one located underneath a brood frame, occur in this open surface. The tubes are held together by three struts which slip into grooves cut along the frame sides.

3.2.2 Full screen bottom boards description

These full screen bottom boards consist of a wooden frame 450 mm by 526 mm, a central batten 55 mm wide and a 3 mm mesh stainless steel screen cut into 2 parts by the batten, each being 205 mm long.

3.2.3 Bees colonies

Bee colonies breed are Buckfast. Queens are sisters and naturally mated.

Last anti-Varroa treatment was made in August 2004. No anti-Varroa treatment will be applied during the experiment duration.

3.3 Protocol

3.3.1 Varroa mite fall counts

Counts begin immediately after fitting the boards, that is to say from the 14th of January 2005 until mid-October 2005.

Varroa mite fall counts are scheduled as follows :

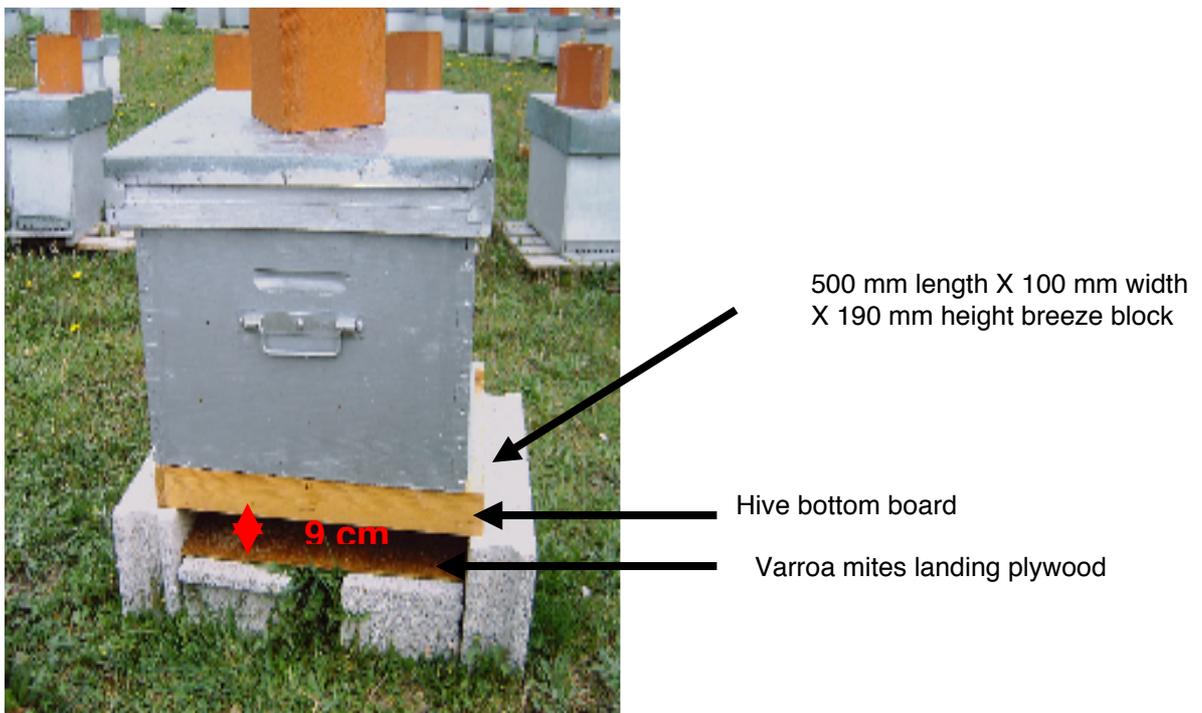
- once a week for 4 weeks;
- then once a month until October 2005;

Landing surface of Varroa mites is 9 cm under the boards and does not interfere with ventilation, thanks to breeze blocks which support the boards frames, as it can be seen on picture n° 1.

It is made of 5 mm thick water-resistant plywood whose dimensions (450 mm X 470 mm) correspond to Varroa mite fall surfaces for both types of board.

To make things easier, each plywood is greased with margarine after each count.
Each Varroa mite caught on the plywood is taken with tweezers and put in a water filled container.

Picture n° 1



3.3.2 Board cleanliness

The Following points will be specifically reported :

- Deposits of non evacuated waste mixed with condensed water or none;
- Deposits of propolis on solid surfaces (tubes bottom board only);
- Presence of mold;
- Evaluation of board surface obstructed by waste, wax or propolis;
- In conclusion : necessary to clean the board or not.

Being given the dates of the beginning of the experiment, these observations are made in spring and at the end of summer.

Each board observation will be photographed.

3.3.3 Infestation measurement

Because it is convenient, the infestation measurement method used is the one described in the book "Varroa et varroatose" whose author is P. Robeaux.

This method consists of taking a few hundred bees (between 200 and 500) from several brood frames, in order to get a homogeneous sample, and to sink them in 70% alcohol, in a jar using a funnel.

Bees die in a few seconds and the jar is then agitated to separate the Varroa mites from the bees.

The Jars' contents are poured into a white container while insuring that no mites stay stuck to the wall of the jar and mites and bees numbers are counted. Calculated percentages determine the infestation rate.

$$\frac{\text{Number of mites} \times 100}{\text{Number of bees}} = \text{infestation rate}$$

According to Ritter and his coworkers (1983) :

- below 5%, no treatment is needed;
- between 5 and 10%, serious attack, the colony may be weakened at the end of wintering;
- between 10 and 20%, obvious disorders;
- > 20%, collapse of the colony within coming days or weeks;
- > 30%, colony may be considered as lost.

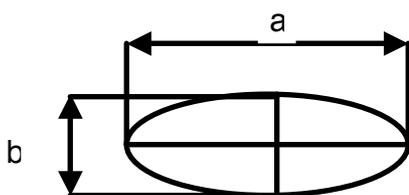
This measurement will be done in March, May and at the end of summer, to evaluate development and to assess the colonies condition after wintering.

3.3.4 Colonies strength evaluation

These evaluations must provide for comparison of development of different colonies according to the type of board.

The Following points shall be reported during the visit :

- brood surface : selection of the formula according to brood shape
 - ellipse formula



$$\text{Surface} = \frac{\pi}{4} \times a \times b$$

- rectangle formula if shape is the one of a rectangle
- state of brood (solid, pocked with holes, stages, etc.)
- number of frames occupied by bees,
- dates of supers installation

Frequency of observations : they will be carried out at the beginning of spring, several times during the season and at the end of summer.

3.3.5 Honey consumption during winter

Winter honey consumption evaluation is made by weighing the hives at the beginning of the experiment and during the spring visit, with adapted scales.

3.3.6 Honey production

Honey harvest evaluation is made by weighing the supers previously tared.

4. Results

4.1 Hives behaviour

4.1.1 Hives mortality

21 sistered hives have been set up for experimentation on the 14th of January 2005. An autumn visit was made : colonies occupied at least 2 brood frames and provisions were sufficient. Being given the winter starting date, no starting visit was made. Then, out of 11 hives fitted with mesh boards, 9 remain at the end of October and 8 out of 10 hives fitted with the Happykeeper boards.

Table 1

Hive N°	Januar. 2005	Feb. 2005	March 2005	April 2005	May 2005	June 2005	July 2005	Aug. 2005	Sept. 2005	Oct. 2005	
mesh boards	1										
	4				supercedure						
	5										
	8										
	9				low population						
	12										
	13										
	15										
	18										
	19			bourdonneus							
	21										
Happy keeper boards	2										
	3										
	6				supercedure						
	7									?	
	10										
	11		bourdonneuse								
	14	Low population although on two brood frames in October 2004									
	16										
	17										
20											



Dead hive

4.1.2 Honey consumption during winter

Table 2

Hive N°		Weight on 15/01/05 in Kg	Weight on 24/03/05 in Kg	Consumption in Kg	%
mesh boards	1	28,0	23,9	-4,1	-15
	4	24,7	23,0	-1,7	-7
	5	30,0	25,8	-4,2	-14
	8	30,0	23,8	-6,2	-21
	9	32,5	28,0	-4,5	-14
	12	29,0	24,0	-5,0	-17
	13	25,0	21,7	-3,3	-13
	15	30,5	26,0	-4,5	-15
	18	31,0	25,0	-6,0	-19
	19	30,0	25,0	-5,0	-17
	21	28,5	25,0	-3,5	-12
			mean	- 4,4	-15
Happykeeper boards	2	20,0	16,0	-4,0	-20
	3	32,0	25,8	-6,2	-19
	6	27,0	21,8	-5,2	-19
	7	31,0	25,8	-5,2	-17
	10	30,0	25,7	-4,3	-14
	11	32,0	24,0	-8,0	-25
	16	30,5	26,0	-4,5	-15
	17	30,5	25,7	-4,8	-16
	20	25,5	20,0	-5,5	-22
				mean	- 5,3

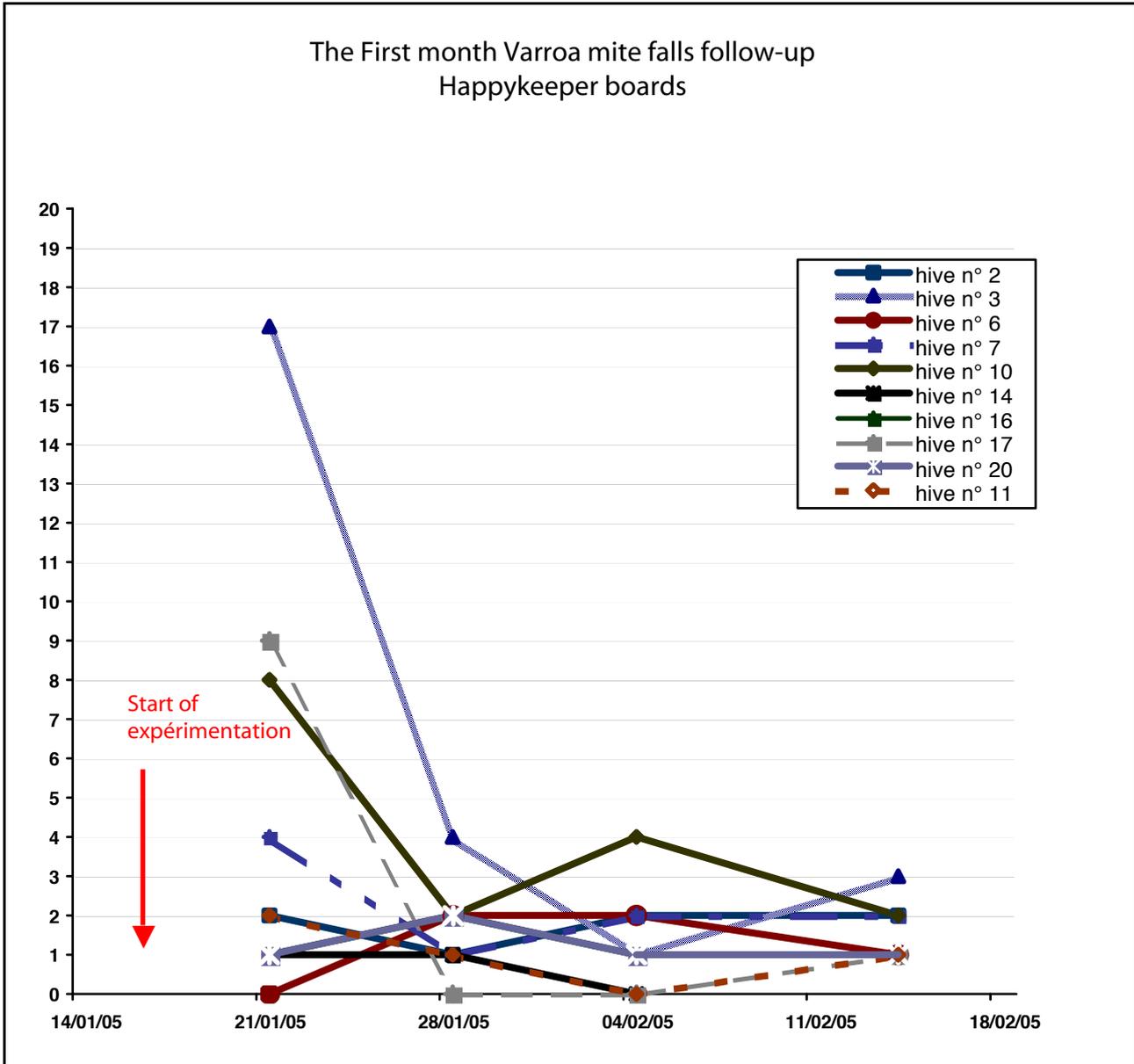
It can be observed that all colonies consume honey between the 15th of February and the 24th of March, between 7% and 19% for hives fitted with mesh boards (15% on average), and between 14% and 22% (18% on average) for hives fitted with Happykeeper boards.

4.2 Varroa infestation

4.2.1 Varroa mite falls follow-up

4.2.2.1 During the first month of the experiment

diagram n° 1

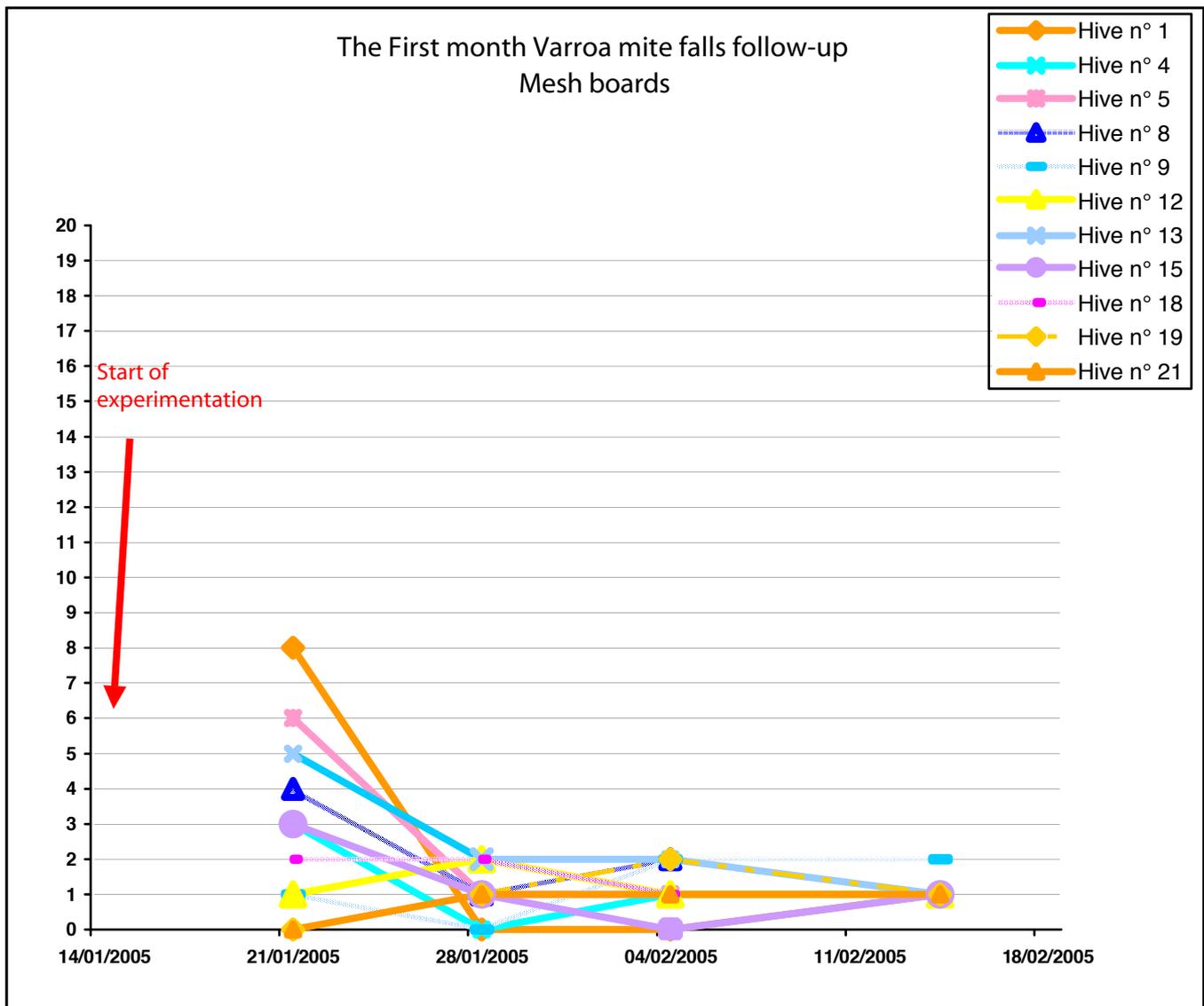


It can be observed that mite falls are larger during the first week, especially for hives n° 3, 10 & 17.

The following weekly falls are much smaller and are between 0 and 4.

It can be seen that hive n° 14 is included until 01/28/05, being counted as alive, no check being possible at that time.

Diagram n° 2

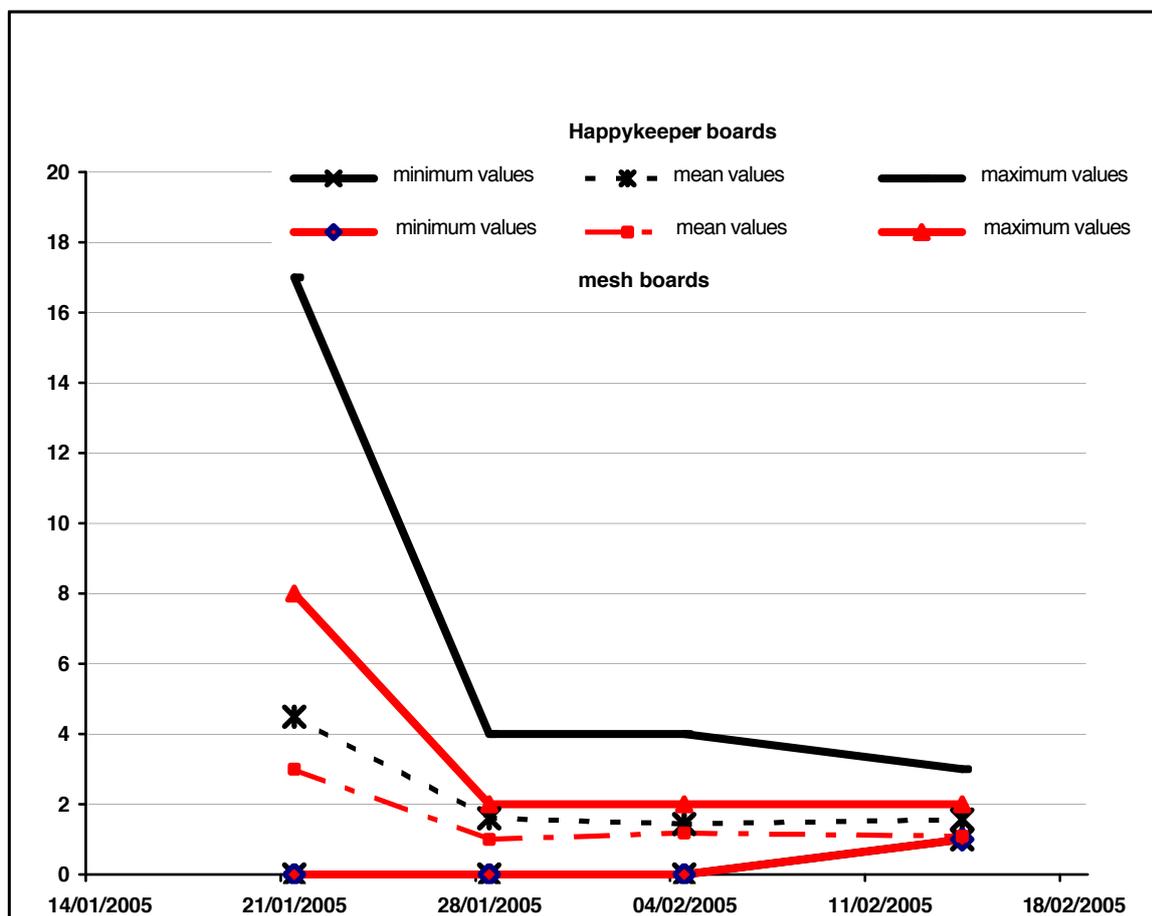


For hives fitted with mesh boards, a larger number of falls can be observed during the first week than are observed later, with the exception of hives n° 12 and 19.

Varroa mite falls during the following 3 weeks are counted between 0 and 2 falls per week.

According to diagrams 1 and 2, Varroa mite numbers collected on the plywood during the first week and during the first month, have the same size as hives fitted with Happykeeper boards and hives equipped with fully meshed boards.

Diagram n°3



According to the above diagram, it is observed that mean values obtained from hives fitted with Happykeeper boards are slightly higher than those obtained from hives fitted with mesh boards.

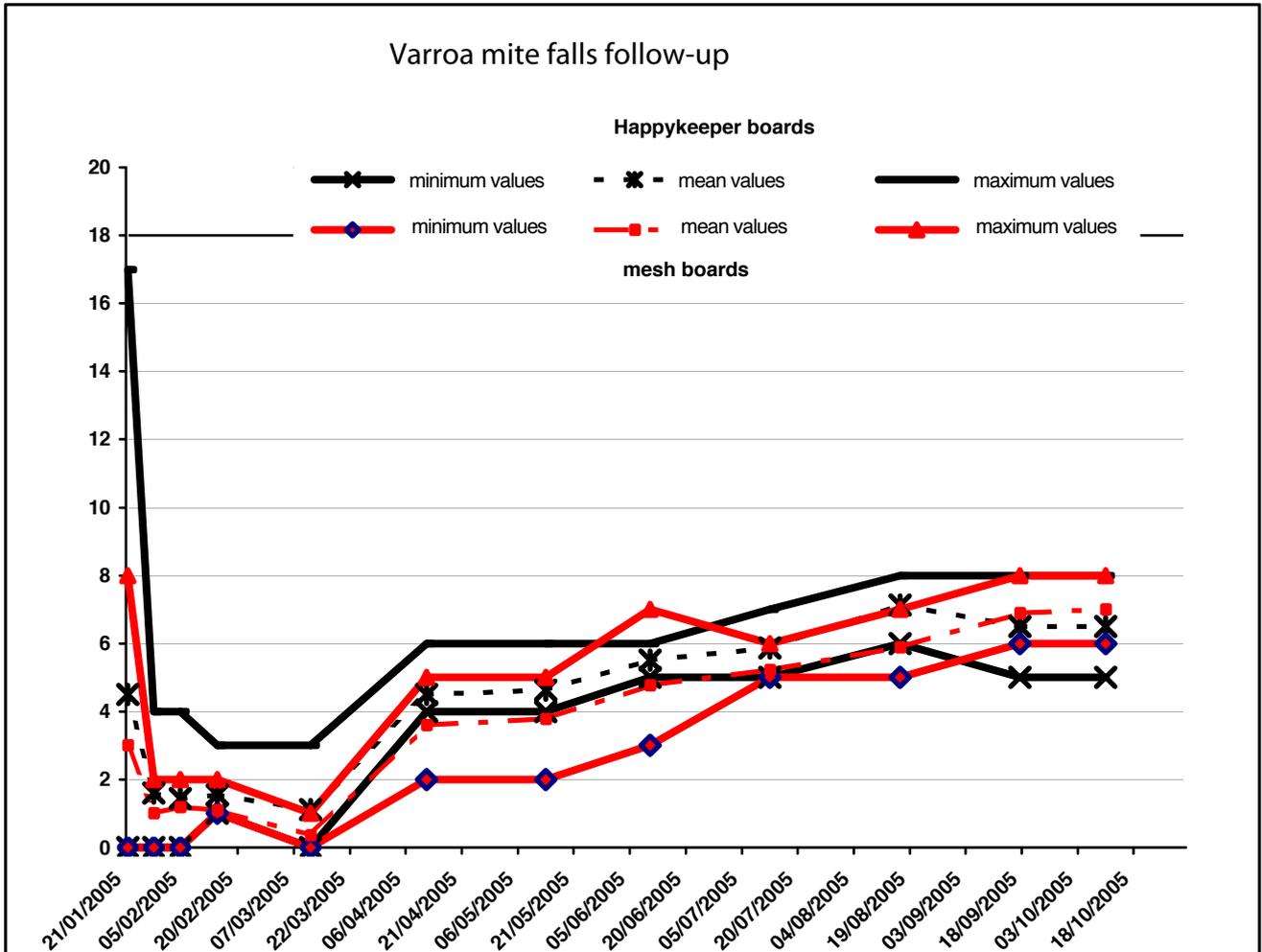
In the same way, maximal values are higher with Happykeeper boards.

Maximum values obtained from hives fitted with mesh boards are slightly higher than mean values obtained from hives fitted with Happykeeper boards.

As for minimum values, they are the same for both hive batches.

4.2.2.2 During the beekeeping season

Diagram n° 4



It can be observed that Varroa mite falls are higher during the first week than for any other count (cf. diagrams 1, 2 & 3).

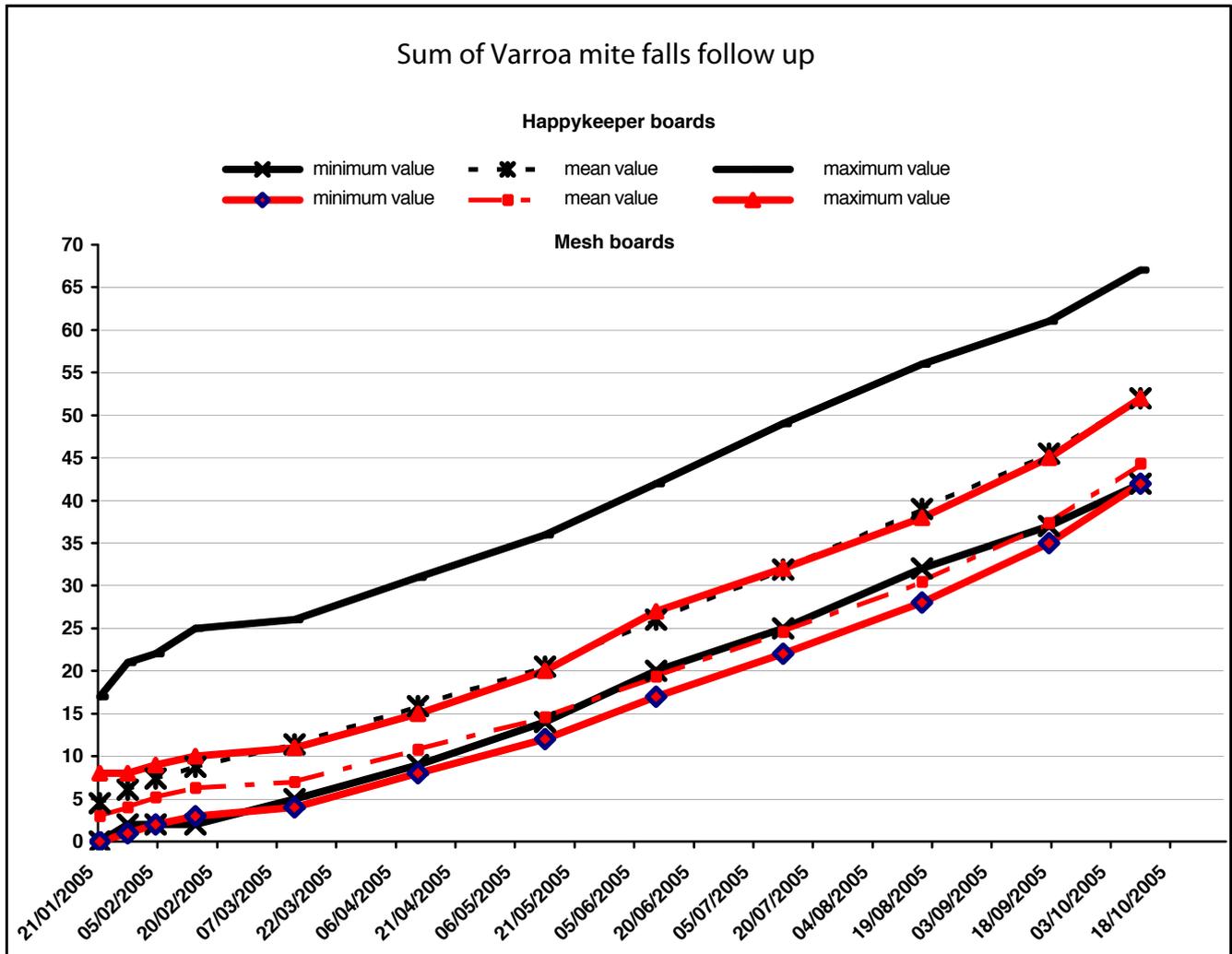
Varroa mite falls increase over time for all hives, except on the 11th of March when all counts are smaller (reason ? handling artifact ?).

Maximum values for hives fitted with Happykeeper boards are higher than maximum values for hives fitted with mesh boards.

Mean values for hives fitted with Happykeeper boards are slightly higher than mean values for hives fitted with mesh boards.

Minimum values for hives fitted with Happykeeper boards are nearly the same as mean values for hives fitted with mesh boards.

Diagram n° 5



When we sum Varroa mite falls, we can see that :

- curves are nearly right, and slopes are similar
- maximum values for hives fitted with Happykeeper boards are far higher than those for hives fitted with mesh boards.
- Except during the first month, mean values for hives fitted with Happykeeper boards are nearly the same as maximum values for hives fitted with mesh boards.

4.2.3 Infestation rate measurement

Diagram n° 6

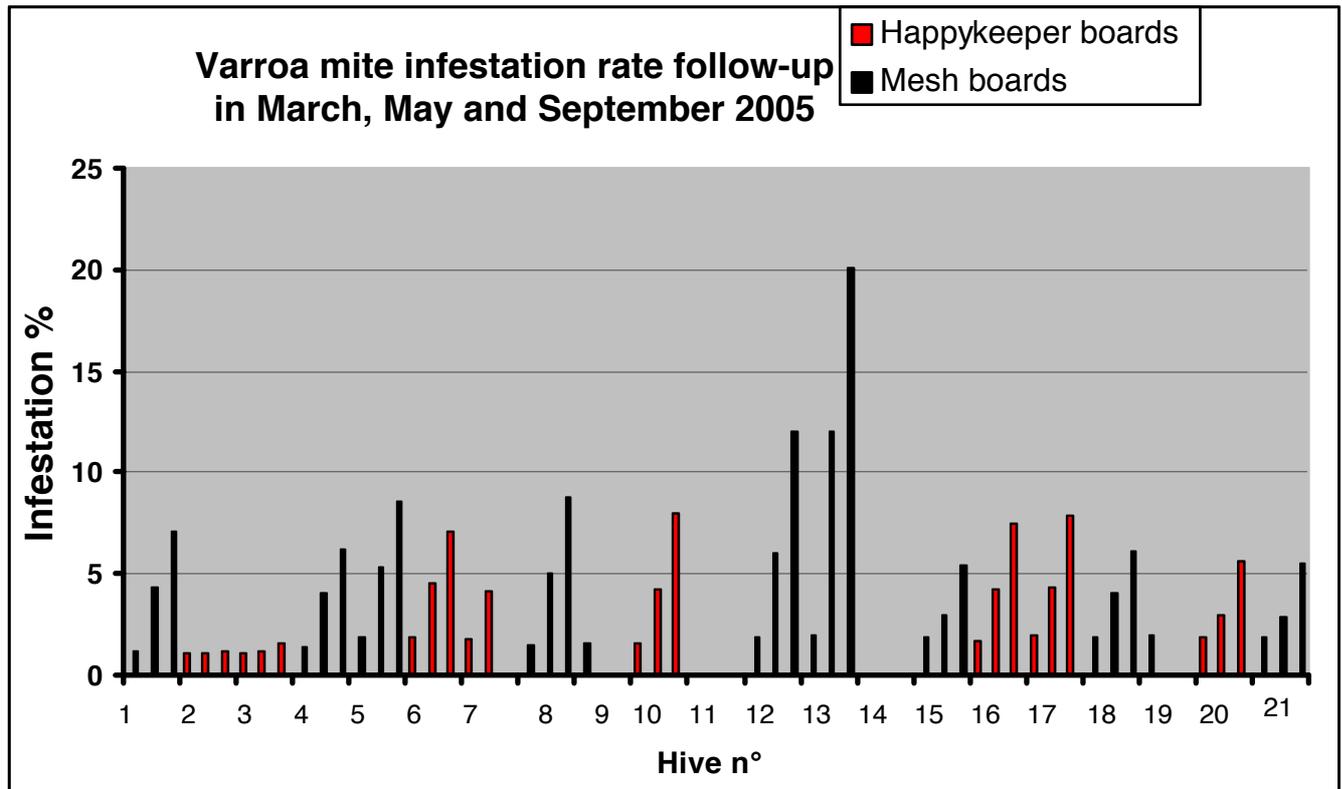


Table 3

batch	March	May	March to May evolution %	September	May to September evolution %	Value %
Happykeeper board	1,6	3,3	+ 103	5,5	+67	mean
	1,1	1,1		1,1	+3	minimum
	2,0	4,5	+125	8,0	+77	maximum
mesh board	1,7	4,7	+167	8,9	+91	mean
	1,2	2,9	+142	5,4	+88	minimum
	2,0	12,0	+500	20,1	+67	maximum

It can be observed :

- Infestation rate is similar in all hives in March (from 1.1 to 2%);
- Infestation rate increases during the season;
- A higher infestation rate for hives fitted with mesh boards on and after the May report : 3 of these hives out of 10 (n° 5,12 & 13) show a rate higher than 5%. All hives fitted with Happykeeper boards show a rate lower than 5%;
- All hives fitted with mesh boards rates exceed 5% threshold in September; rates of two hives (n° 12 & 13) exceed 10%, critical threshold for colony survival without treatment;
- Two hives fitted with Happykeeper boards (n° 6 & 10) September rates are situated between 7.10 and 7.20;
- Two hives fitted with Happykeeper boards (n° 2 & 3) seem to be very slightly infested : rates under 1.6%

4.4 Colonies strength evaluation

Diagram n° 7

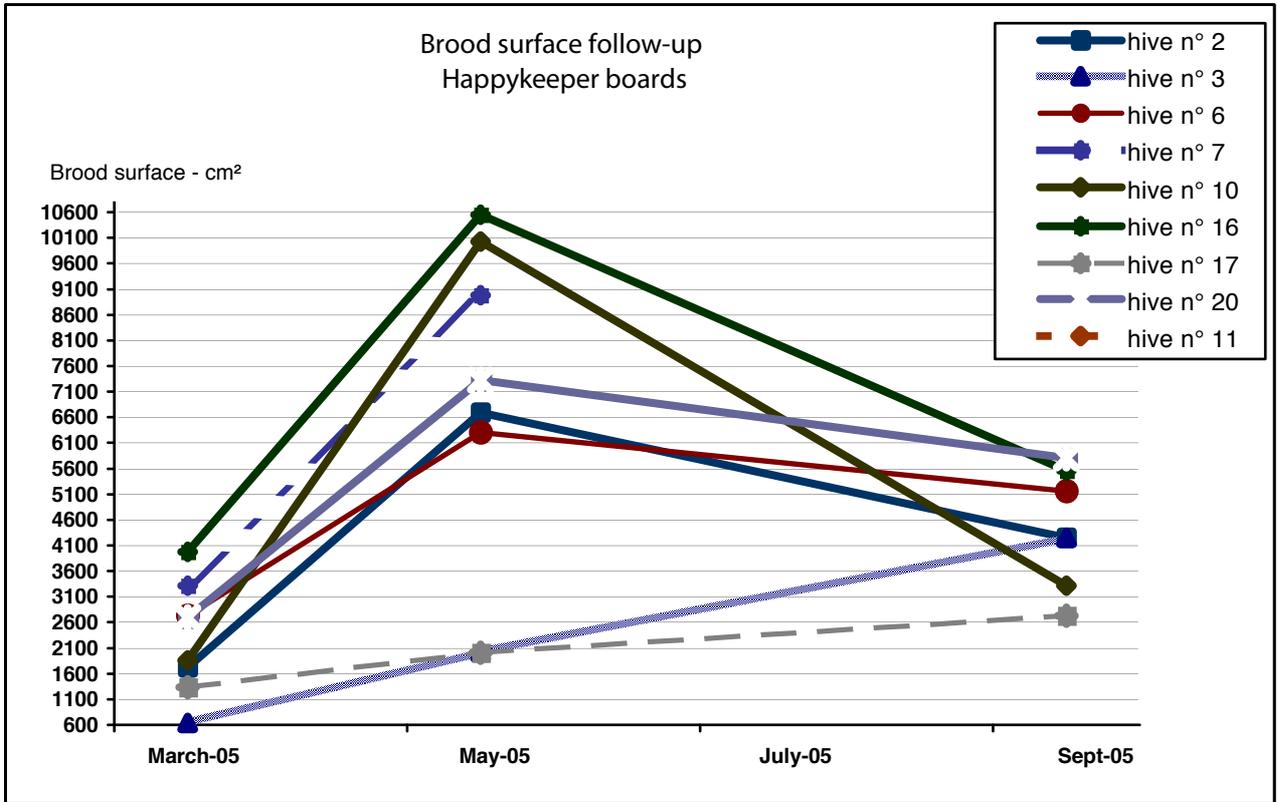
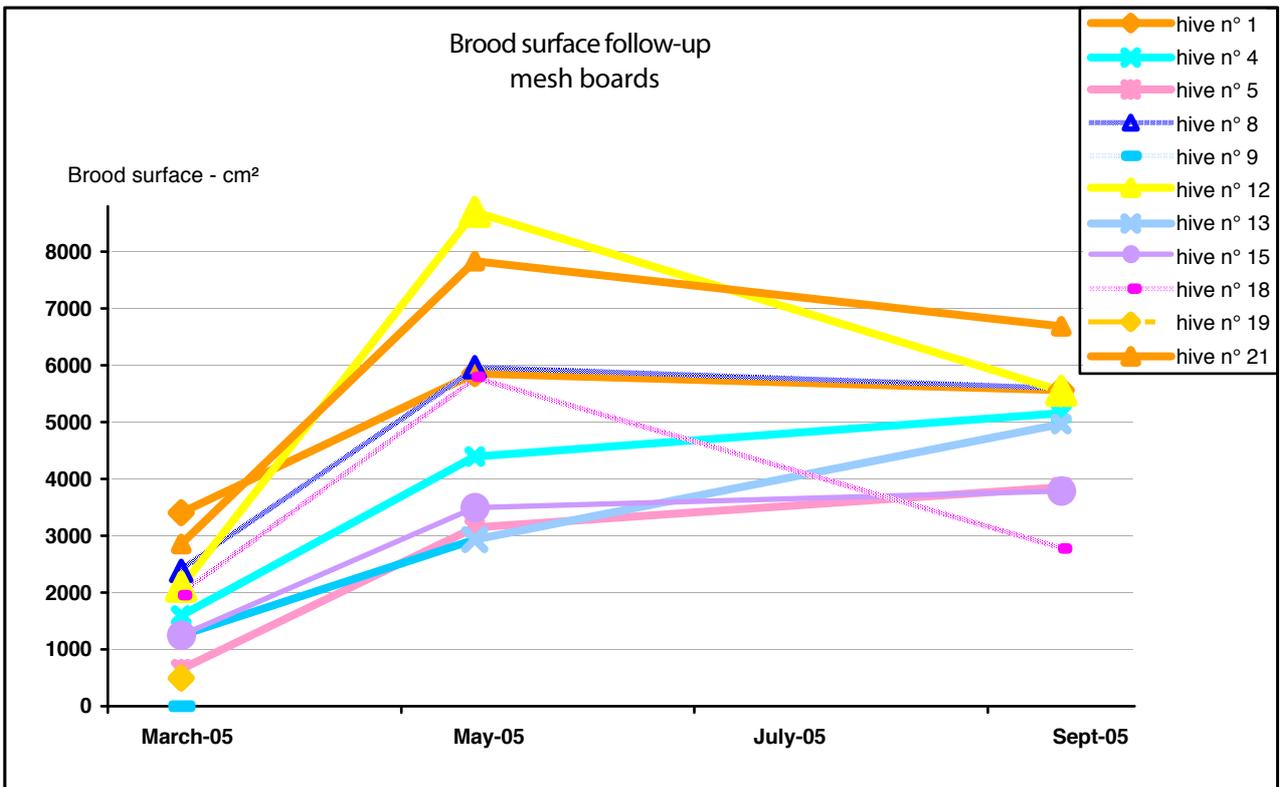


Diagram n° 8



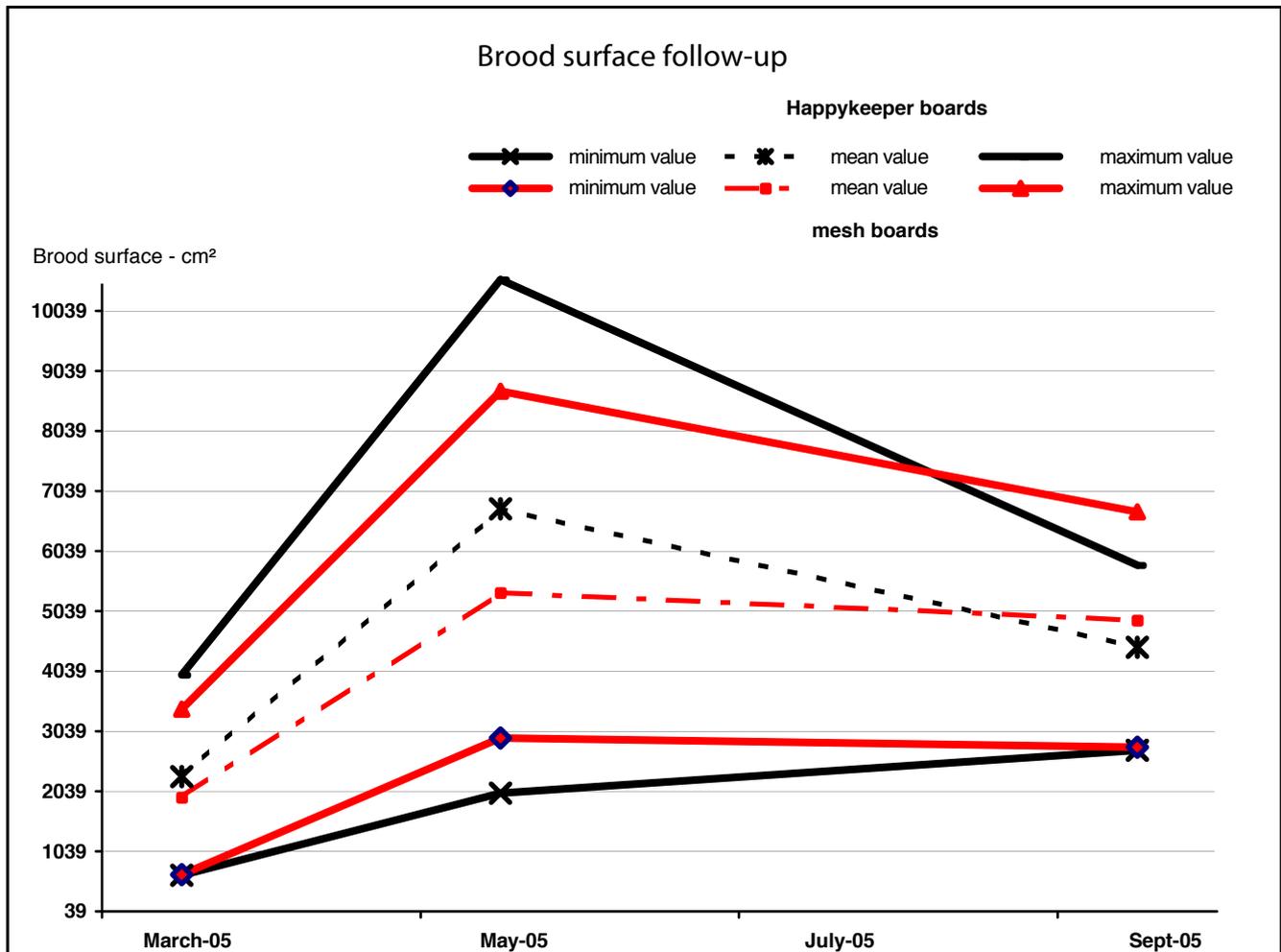
"Brood surface follow-up" readings of brood surface were taken in March, May and September 2005; maximum values in May on the diagram do not mean that colonies reached their maximum population at that time nor at the same time. It is only possible to conclude that the maximums were reached between May and September.

It can be observed on these two diagrams that brood surface increases from March to the end of May and reaches its minimum in September.

Only hives fitted with Happykeeper boards n° 3 and 17 show a small brood surface in March and a linear development until September.

Brood surface growth between March and May seem higher for hives 5 & 12 and 2 & 10 (between 290 and 440%) than on other hives.

Diagram n° 9



It must be noted that colonies which died at the beginning of the season do not appear on this diagram.

Maximum and mean values for hives fitted with Happykeeper boards are higher than those found for hives fitted with fully meshed boards.

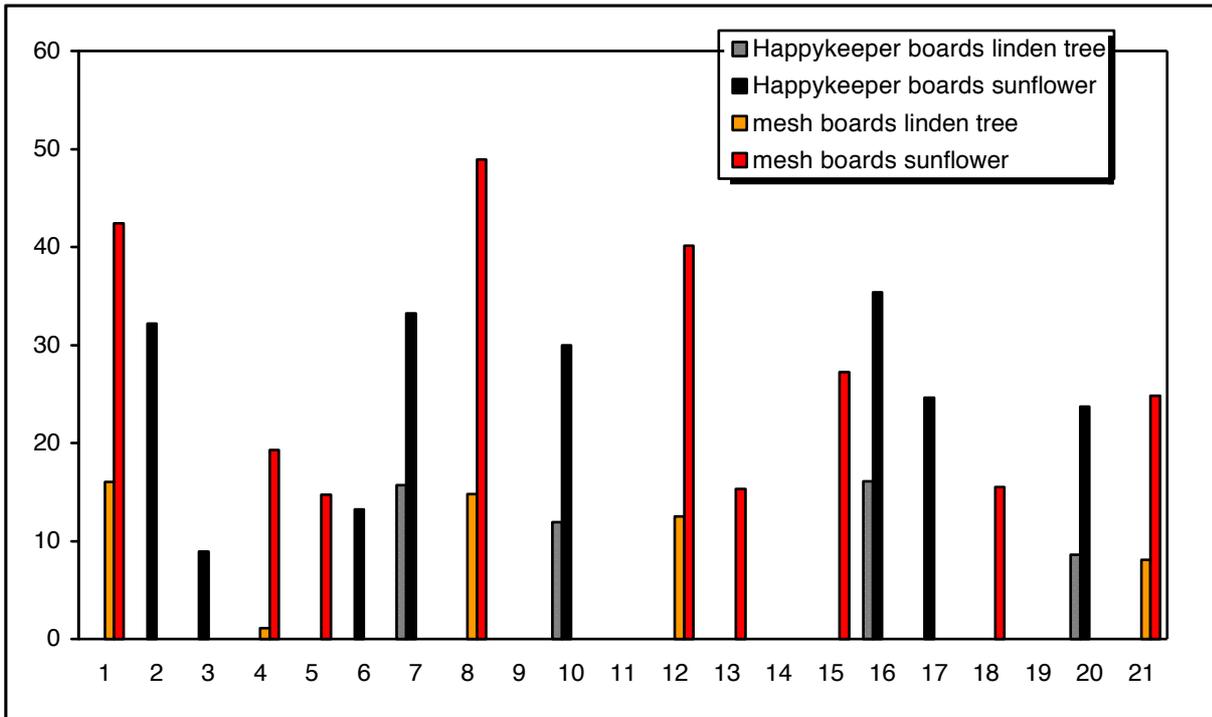
On the contrary, minimum values for hives fitted with mesh boards are higher than those found for hives fitted with Happykeeper boards.

Brood surface reading dates do not provide for comparing the moment when the two batches reach their maximum development.

It can be observed however, that the two curves of each kind cross each other. Brood surfaces become the same between May and September.

4.5 Honey production

Diagram n° 10



The hives did not receive any compensatory feeding, eventually allowing them to harvest acacia honey on this site.

Most hives made two honey harvests : linden tree and sunflower; except hives n° 2, 3, 5, 6, 13, 15 & 18 which harvested only linden tree honey.

Table 4

	Happykeeper boards		mesh boards	
	linden tree	sunflower	linden tree	sunflower
Mean value	6,5	25,1	5,8	25,6
Kg/hive	31,7		31,4	

No difference can be found between linden tree and sunflower honey production between the two batches of boards.

4.7 Board cleanliness

The two board types were examined during beekeeping season : at the end of winter and at the end of summer.

Table 5

Hive n°		Dead bees found on the boards		
		March 2005		September 2005
		Weight in g	Number of bees	
Mesh boards	1	35		0
	4	6		1
	5	24		1 nymph
	8	80		4
	9	30		
	12	211		3
	13		5	10
	15	29		0
	18		25	3
	19	34		
Happykeeper boards	2		20	0
	3		3	2
	6		28	10
	7		29	
	10		6	3
	11		12	
	16		13	2
	17		5	0
20		6	1	

It is important to notice that a great amount of dead bees had been found on mesh boards at the end of winter.

In September, the number of dead bees is lower than in March with nearly identical figures for both batches of boards.

Boards look cleaner in September : less dead bees but more propolis.

According to September 2005 observations, it may be distinguished :

- among dead bees, some withered wing bees, sign of Varroa infestation on both batches of hives.
- in Happykeeper hives :
 - propolis between tubes and wooden frame
 - propolis spots on the tubes walls
 - wax cap waste on the tubes walls

Concerning descriptive examination of the boards, here are two examples of observations of two hives having different kinds of boards, at two dates. See also pictures of other boards.



Hive n° 1, mesh board.
End of March 2005

- many dead bees,
- a few nymph bees
- cap wax
- very little propolis (except between board and body)

Clean board



Hive n° 3, Happykeeper board.
End of March 2005

- few dead bees,
- some propolis spots on tubes
- a few caps and some wax waste
- openings between the tubes are not obstructed

Clean board



Hive n° 1, mesh board.
September 2005

- 3 dead bees with withered wings,
- propolis spots on wooden frame and central batten.

Clean board



**Hive n° 3, Happykeeper board.
September 2005**

- 2 dead bees between the tubes,
- propolis spots on tubes
- wax waste at rear of board, 3 cm long.

Clean board

Only Happykeeper board of hive n° 17 is comparatively dirty in September :



**Hive n° 17, Happykeeper board.
September 2005**

- pieces of wax and propolis spots covering tubes walls,
- propolis between tubes and wooden frame,
- propolis between tubes,
- no dead bee.

board significantly dirty

5. Discussion

Collected data during this experiment has not been statistically analyzed. They only show tendencies.

5.1 - Varroa infestation

According to diagrams n° 1, 2 & 3, Varroa mite falls are higher during the week following the boards fitting, on either kind of board.

Monthly counts of Varroa mite falls do not change much during the season (diagram n° 4), although infestation rates increase (diagram n° 6). Logically, Varroa mite fall counts should have increased more strongly.

Varroa mite falls follow up does not look to be itself reliable enough, to appreciate the boards efficiency : being given the small number of mite falls counted, tests have been made on a few hives over a 4 week period : weekly counts have been compared to monthly counts (that is to say the sum of counts during these four weeks). Added counts are higher than monthly counts used for the experiment. Varroa mite fall counts are therefore certainly underestimated.

During the season, Happykeeper hives show Varroa mite falls higher than hives on mesh boards. In parallel, infestation measurements done in May and at the end of summer seem to show that the Happykeeper batch is less infested than the mesh board batch. (Cf. diagram n° 6)

Is there a relationship between Varroa mite falls and infestation rate ?

It seems evident that, the more a hive is infested, the more mites can be found on the plywood. Besides, bees can have a stronger delousing behavior and be less infested. And queens are sisters whose selection criteria are not specifically oriented towards Varroa resistance.

Is it the board type which generates a lower Varroa mite infestation rate in hives fitted with Happykeeper boards ?

- Infestation rates in March are nearly the same on all hives (these are not the initial rates which should have been measured just after fitting the boards); then a higher growth can be observed on the "mesh" batch than on the "Happykeeper" batch (see table n° 3) :
 - +170% / +258% mean values for the Happykeeper board / mesh board from March to September ,
 - +202% / +557% maximum values for the Happykeeper board / mesh board from March to September
 - +3% / +230% minimum values for the Happykeeper board / mesh board from March to September
- Initial and more frequent infestation measurements, with control measures, (this test looks rather sensitive because results depend on the way samples are taken), correlating with brood surface, should have perhaps provided for a better analysis of the batch, important growth differences can be found : from +3 to +202% for "Happykeeper" hives; from +230 to 557% for hives with mesh boards.

important growth differences can be found : from +3 to +202% for "Happykeeper" hives; from +230 to 557% for hives with mesh boards.

Why do "mesh" hives 12 and 21 having the same initial infestation rates, show very different infestation rates in September ? (12% for hive 12; 5.5% for hive 21); although their brood surface evolution curves are very similar; It is the same for "Happykeeper" hives 6 (7.1% in September) and 20 (5.5%).

- To check Happykeeper boards efficiency, we could switch boards on both batches, especially as for hives fitted with fully meshed boards showing an infestation rate above 10% (hives n° 12 & 13).

5.2 Colonies development

For hives fitted with mesh boards, a high quantity of dead bees were found on the mesh boards at the end of winter (table 5) can explain a smaller brood surface, compared to "Happykeeper" hives (diagrams 7, 8 & 9).

It is important to point out that the common practice is to close mesh boards during winter to avoid a high honey consumption and a large number of dead bees.

On the other hand, we could have assumed, being given the Happykeeper board conception and what beekeepers stated, that colonies wintering with this board consumed less honey. Table 2 does not allow us to see a difference between the two hive batches (mean value : 15 for the "mesh" batch, 18 for the "Happykeeper" batch, during winter). Being given that weighing started only in January, data could have been more significant over a longer period ?

Brood surface is greater with the "Happykeeper" batch (diagram n° 9). On the other hand, we do not know when each batch reached its maximum brood development. Is there a time difference between developments of these two batches ?

Hives fitted with mesh boards show a smaller brood surface in May, although linden and sunflower honey production are nearly the same (diagram 10, table 4) by both hive batches. To be more precise, it must be stated that these experimental hives, with small colonies in winter, did not receive any feeding which could have supported an earlier honey harvest from acacia.

A hive productivity (comparison between sister queens) is highly correlated to their brood surface and sanitary state. We can assume that hives fitted with mesh boards (a bit more infested in May, table 3), have recovered their developmental delay with the "Happykeeper" batch, between brood surface reading (on the 10th of May) and linden flowering (from the 10th to the 23rd of June). However, are these 4 to 6 weeks sufficient to proliferate the "mesh" batch a workers population equivalent to the one of the "Happykeeper" batch ? Brood surface measurements in June would certainly have provided for the evaluation.

Sanitary state of the colonies is deteriorated in the end of summer, mainly for hives fitted with fully meshed boards. In some of these hives, withered winged bees and tubular brood virus symptoms can be observed; a consequence of weakening from strong Varroa infestation.

In March, boards are clean although many dead bees can be seen on mesh boards. In September, tubes walls and openings of only one Happykeeper board are covered with propolis.

6. Conclusion

The experiment compares the behavior of hives fitted with tubes Happykeeper boards and that of hives fitted with fully meshed boards, from January to October 2005; in order to verify what some beekeepers stated.

These hives with sister queens, led as a fix apiary, without supplemental feeding and without anti-Varroa treatment during the experimentation.

Hives fitted with mesh bottom boards do not have a closing system to prevent ventilation during winter, a precaution normally taken in general use.

Collected data has not been statistically analyzed, they show tendencies which need to be studied further.

The trial permitted the observation of :

- Hives fitted with Happykeeper boards seem to be less infested with Varroa mites than hives fitted with mesh boards. Some of these latter have infestation rates $> 5\%$ (with 2 of them $> 10\%$) and serious symptoms regarding colonies survival during 2005-2006 winter.
- Colonies on Happykeeper boards have less dead bees at the end of winter on the board; This could partly explain greater brood surface in spring (until May measurement).
- Hives fitted with Happykeeper boards produce as much linden and sunflower honey as hives on fully meshed boards.
- Cleanliness of boards is equal for both hives batches.

This trial has demonstrated the failing of Varroa mite counts on plywood 9 cm below the boards. Experiment conditions do not provide for the checking of low honey consumption in hives wintering with a Happykeeper board; nor to prove if the board type has an influence on the time when hives reach their maximum development.

To check Happykeeper bottom boards efficiency against Varroa infestation, it would be interesting to switch the boards of the two batches for next season.