Danish Research Service for Plant and Soil Science
Administration
Department of Bee Diseases
Skovbrynet 18
DK-2800 Lyngby, Denmark

Report no. 2003

Use of »trapping comb« to decrease the population of *Varroa jacobsoni* in honeybee *(Apis mellifera)* colonies in cold climate

Brug af fangsttavler for at reducere populationen af Varroa jacobsoni *i bifamilier* (Apis mellifera) *i koldt klima*

INGEMAR FRIES[1] and HENRIK HANSEN

Summary

In two experiments, the influence from the trapping comb technique on the natural downfall of *Varroa jacobsoni* from infested honeybee colonies in a Nordic climate was investigated. In one experiment, a 9-days interval between each comb shift was used (N=17), while a 7-days interval was used in the second experiment (N=17). In both experiments three trapping combs were used. The results indicate that the trapping comb technique might be sufficient to continuously keep the *Varroa* population at a low level in a Nordic climate, contrary to findings in middle-Europe. To substantiate these results, several years of investigation with the same colonies, using only the trapping comb technique for *Varroa* control, is necessary.

Key words: *Varroa jacobsoni, Apis mellifera,* honeybees, trapping comb, Nordic climate.

Resumé

Der er foretaget dronninge-indespærring på fangsttavler i bifamilier inficeret med *Varroa jacobsoni* i to forsøg i nordisk klima. I det ene forsøg blev der anvendt 9-dages interval mellem hvert tavleskift (N=17), mens der i det andet forsøg blev anvendt 7-dages interval (N=17). I begge forsøg blev der brugt tre fangstavler. Resultaterne viser, at dronninge-indespærring kan være tilstrækkelig til fortsat at holde varroapopulationen nede på et lavt niveau i nordisk klima i modsætning til mellemeuropæisk klima. For endelig at dokumentere dette, er det nødvendigt kun at anvende dronninge-indespærring til varroakontrol i de samme familier i flere år.

Nøgleord: *Varroa jacobsoni, Apis mellifera,* honningbier, fangsttavler, dronninge-indespærring, nordisk klima.

[1]) Swedish University of Agricultural Sciences, Bee Division, Box 7024, S-750 07 Uppsala, Sweden

Introduction

Varroa jacobsoni is a parasitic mite that attacks and feeds on both adult honeybees *(Apis mellifera)* and honeybee brood. The entire reproductive cycle and the brood development of the parasite occurs within the sealed brood cells of the honeybee (8). The *Varroa* mite causes death of honeybee colonies in most areas in which it is found and the *Varroa* mite is a major obstacle to world beekeeping at present. The most common way of control is the use of acaricides inside the beehive.

It has been shown that the removal of sealed brood from honeybee colonies reduces the mite population significantly (11, 12). *Maul* (4) developed a trapping comb system where the queen was allowed to use only one frame that was successively changed three times with an interval of nine days. It has been shown that this system is capable of removing more than 90% of the mites from honeybee colonies (3, 6). However, studies over three years indicate that the use of the trapping comb system alone is insufficient to keep the population of *Varroa jacobsoni* from growing from one year to the next, in middle Europe (5). In a colder climate, the length of the brood rearing period is reduced and the time for mite reproduction before and/or after the trapping period is thereby shortened. Disadvantages connected with the comb trapping system could be the time necessary to complete the treatment and the fact that a skilled beekeeper is needed.

The purpose of this study was to examine the possibilities of the trapping comp system developed by *Maul* (4), in a Nordic climate.

Materials and methods

Two apiaries, A and B, on the island of Gotland in Sweden, with 17 colonies each were used. The natural downfall of mites was followed in both apiaries from mid-May to mid-November with varying intervals between each counting. In apiary A, a net bottom was used allowing practically all mites falling from the bees to be counted. In apiary B, a plastic screen to collect mites, covering 53% of the bottom was placed in the center of the bottom board. This collects approximately 81.6±2.2% (x±S.E.M, N=143) of the mite downfall (*Fries,* unpublished). In both apiaries, the Swedish standard frame, 366×222 mm was used.

The first trapping comb was introduced on 20 June in apiary B and on 21 June in apiary A. The trapping device was a cage built from plastic queen excluders. In apiary A, the method of *Maul*

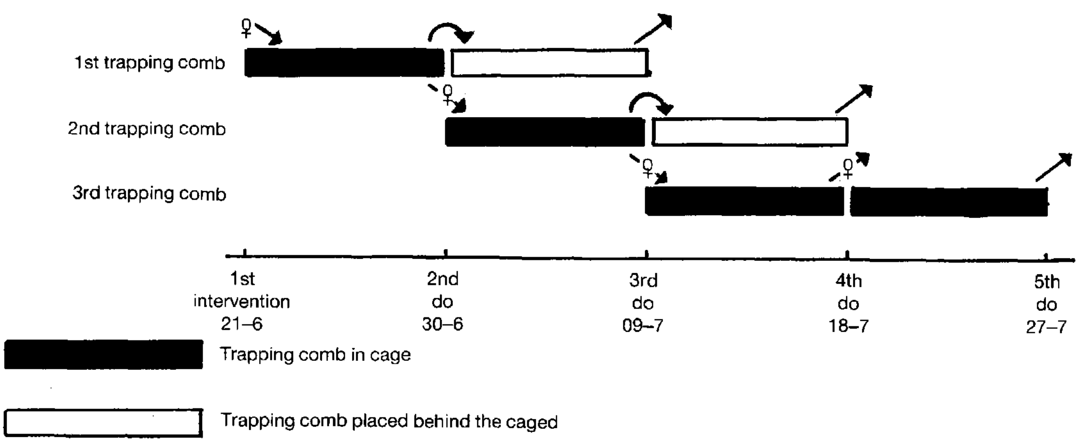

Fig. 1. Apiary A. Nine days between comb shifts. In the first intervention, the queen is put on the trapping comb in the cage. In the second intervention all queen cells are removed. The first trapping comb is placed in the colony and the queen transferred to a new trapping comb. In the third intervention the first trapping comb is removed from the colony. The second trapping comb is placed in the colony and the queen is transferred to the third trapping comb. In the fourth intervention the second trapping comb is removed. The queen is released from the cage where the third trapping comb remains. In the fifth intervention both the cage and the third trapping comb are removed.

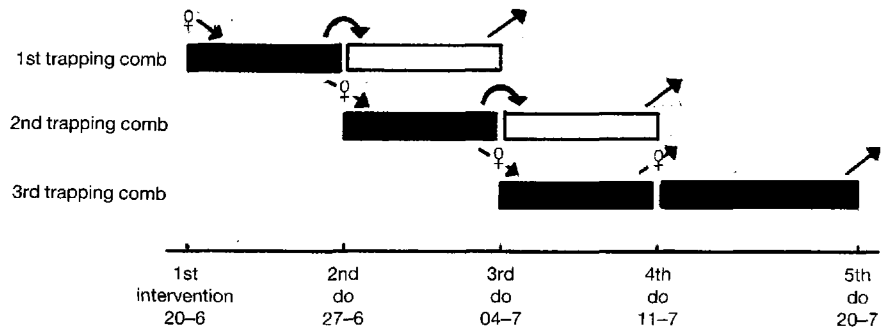

Fig. 2. Apiary B. Seven days between comb shifts, but with the third trapping comb in the cage 9 days after the queen was released. Further explanation in Fig. 1.

(4) with nine days between each comb shift was used (Fig. 1). In apiary B, the intervals between each comb shift were seven days but with the third comb remaining in the cage without the queen until practically all brood was sealed nine days after the queen was released from the cage (Fig. 2). All combs that were removed from the colonies were marked with the colony number and placed in a deep freezer. Later the combs were uncapped and the mites washed out with a hand shower over a net screen and subsequently counted. Due to technical failure, combs from one colony in apiary A and combs from two colonies in apiary B were not investigated.

In apiary B, five colonies were managed to ensure that no sealed brood was present when the third trapping comb was removed. At this time, these colonies were treated with two applications of 50 ml Perizin solution (Bayer-Leverkusen) at two-days intervals and the mite downfall was counted two days after each treatment. The efficiency of the trapping comb system using a 7-days interval between each comb shift was calculated from the number of removed mites in the sealed brood in percentage of the total mite population. The total mite population was estimated from the equation total mite population = # mites in removed combs + Perizin downfall / 0.95. The factor 0.95 is used since two treatments of Perizin is expected to remove approximately 95% of the mites from a broodless colony (9). After evaluation of the Perizin treatment, these colonies were not included in further calculations.

The amount of brood removed by each comb was estimated in % of the total comb area and the figures transformed to cm^2.

Results

The trapping combs were successfully removed in all colonies in both apiaries except for one colony in apiary B and two colonies in apiary A. In apiary B, one colony produced no brood in the third trapping comb while no brood was produced in the third comb in two colonies in apiary A. The average amount of brood removed with each comb and the average percentage of mites in each comb can be seen from Table 1. Table 2 shows the number of mites removed with each comb and the results of the Perizin treatment of five colonies in apiary B.

In Fig. 3 and 4, the average daily mite downfall

Table 1. Amount of sealed brood (cm^2) and relative number (%) of mites (x ± S.E.M.) removed by each trapping comb for apiary A and B. The total amount of sealed brood (cm^2) and total number of mites removed (x ± S.E.M.) are also shown.

Apiary	Interval	N	Comb 1		Comb 2		Comb 3		Total	
			Brood	Mites%	Brood	Mites%	Brood	Mites%	Brood	Mites#
B	7 days	16	607.3±21.8	30.6±3.2	484.5±43.2	48.3±3.5	473.6±53.1	21.2±2.6	1565.3±79.5	1078.7±229.2
A	9 days	15	628.6±21.1	26.9±5.0	561.5±47.2	49.2±2.3	535.0±68.8	23.9±4.3	1725.1±121.9	560.8±200.6

Table 2. Number of mites removed with each trapping comb, number of mites in downfall after Perizin treatments and efficiency of brood removal in % of total mite population. Total mite population, cf. text.

Colony #	Comb 1	Comb 2	Comb 3	Total	2 × Perizin	Efficiency %
84	1147	1719	429	3295	48	98.6
87	769	1599	395	2763	305	90.4
91	966	706	470	2142	607	77.9
92	336	208	34	578	9	98.5
94	42	153	43	238	4	98.3
					x ± S.E.M.	92.7±4.0

in apiary A and B, respectively, is shown. Although, at slightly different levels, both apiaries show roughly the same pattern; a successive increase in the downfall level as summer proceeds, with a dramatic reduction when no sealed brood hatches in the colonies because of the brood removal. A slightly rising, but still very low, level of downfall is retained until the end of the season. In both apiaries, the variation in downfall between the colonies is lower at the end of the season compared to the early season when registration began.

The time required to complete the trapping comb method was estimated to 45–60 minutes / colony

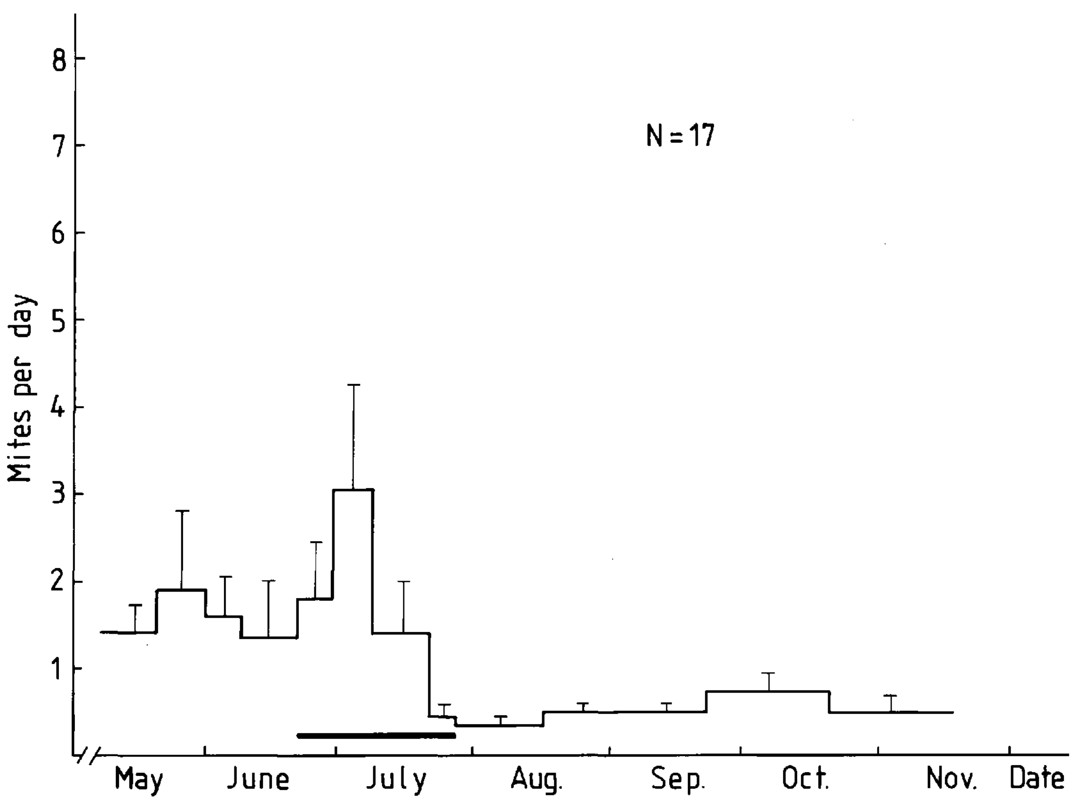

Fig. 3. Average ($\bar{X}$ ± S.E.M.) mite downfall in apiary A, nine days between comb shifts. Thick horizontal line represents time of treatment.

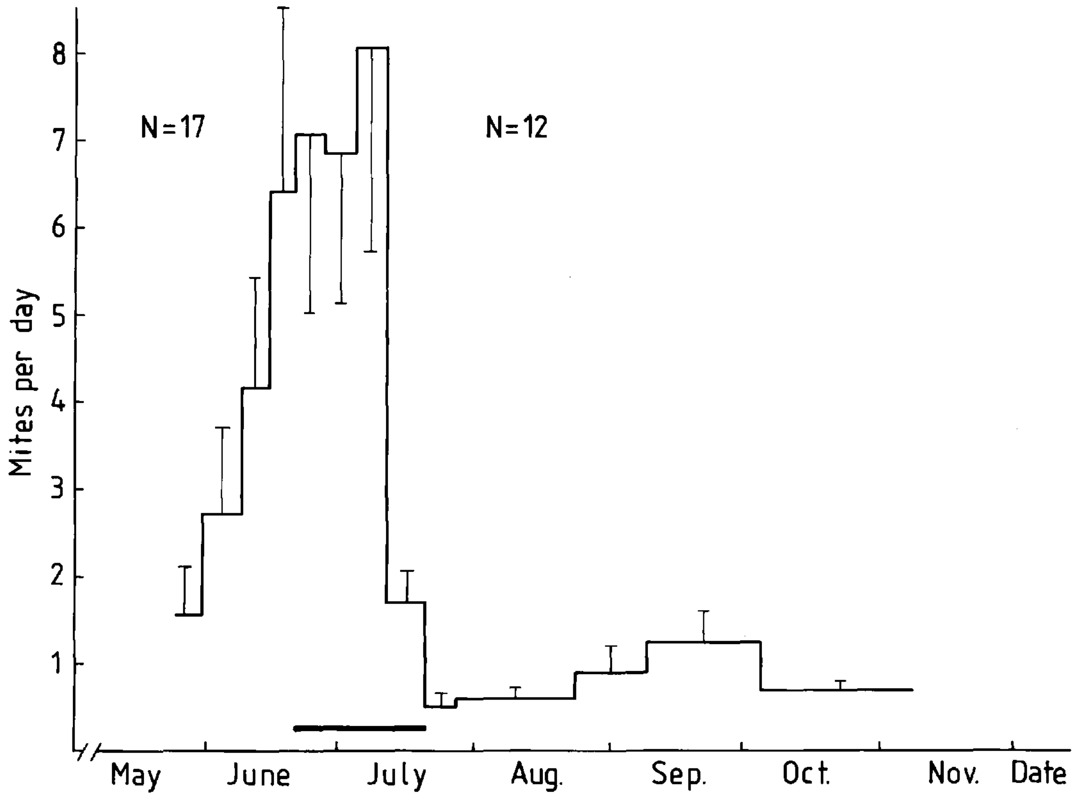

Fig. 4. Average (X̄ ± S.E.M.) mite downfall in apiary B, seven days between comb shifts. Thick horizontal line represents time of treatment.

Discussion

The presented results support the hypothesis that the trapping comb system could be sufficient in a Nordic climate to keep honeybee colonies infested by *V. jacobsoni* below the infestation level where severe damages occur. This is contrary to the results presented by *Maul et al.* (5), where the mite population in the southern parts of FRG, judged from the mite downfall, is allowed to increase substantially after the trapping comb period. There is an increase in the mite downfall towards the late season in the present study as well (Fig. 3, 4) but the increase is much smaller than earlier presented by *Maul et al.* (5). This difference could possibly be referred to differences in the length of the brood rearing period due to climatic conditions. To fully substantiate the above hypothesis, it is necessary to continue the present experiment with the same colonies for several years.

Somewhat dependant on the age of the queen, honeybee colonies on Gotland normally reduce their brood rearing in August, most colonies become broodless during September and only few colonies with young queens will have small patches of sealed brood in October. The short period of brood-rearing after completion of the trapping period, probably explains the low increase in the mite downfall. The efficiency of the trapping comb method might also improve in a cold climate, if the mites in such a climate spend less time on the adult bees before entering a brood cell for reproduction as suggested by *Woyke* (14).

The use of 7-days interval between each comb shift, using three combs as in the nine days interval alternative, was tested in an effort to decrease the total time during which the queens' production is removed. As can be seen from Table 2, more than 90% of the mites were removed from the Perizin treated colonies in the 7-days interval alternative in this study. This should be compared to the results presented by *Klepsch* and *Maul* (3) and *Maul* and *Klepsch* (6) where 93.6% and

88.9%, respectively, of the mites were removed in the 9-days interval alternative. No significant differences were seen in this study between the treatments in apiary A and B. On average, from the both treatments, it seems as if the first trapping comb catches around 30%, the second around 50% and the third around 20% of the total amount of mites removed (cf. Table 1).

To remove brood from honeybee colonies for the time necessary to practice the trapping comb system does not decrease the honey yield in Sweden provided no late honeyflow occurs (1). The method does not alter over-wintering success in FRG (6) and it does not seem likely that the wintering capacity of honeybee colonies will decrease from the trapping comb system in a Nordic climate, provided that the queen is released around mid-July. However, this aspect needs further studies.

The time required for the five operations necessary in the trapping comb system as applied in this study (Fig. 1, 2) is less than one hour per colony. No control colonies were used in this study but comparisons show that less than 30 minutes extra labour / colony is used when the trapping comb system is compared to conventional management methods during the summer (7, 13). The extra time needed should be weighed against the time and the cost involved in chemical treatments as well as the risk of contamination of the honey when pesticides are used.

With the trapping comb system, it is possible to substantially reduce the *Varroa* mite population in honeybee colonies without the use of any chemical treatments. Perhaps the method is sufficient to keep the mite population continuously low in a Nordic climate. To make the method more attractive to the beekeepers, methods to kill mites in the sealed trapping combs should be developed. Suitable methods could be heat treatment as suggested by *Rosenkranz* (10) or formic acid treatment as suggested by *Kimmich* (2). This could enable beekeepers to use the brood produced in the trapping combs in the colonies after treatment.

Acknowledgements

The authors are grateful to Dr. *Volprecht Maul* for helpful suggestions on the experimental work and for comments to the results, to *Gustav Boberg* and *Åke Lyberg* for providing the honeybee colonies and skillfull technical assistance and to *Annette Ellegaard Sørensen* for skillfull technical assistance. The assistance of *Christian Schousboe* in percentage calculations is fully appreciated. The study was made possible through financial support from The Farmers Foundation for Research and Development and The Danish National Association of Beekeepers.

References

1. *Fries, I.* 1988. Erfarenheter med varroakvalster från Gotland 1987. Bitidningen 87, 53-55.
2. *Kimmich, K.* 1987. Die varroazide Wirkung der Ameisensäure in die verdeckelte Bienenbrut. Diplomarbeit, Univ. Hohenheim, FRG.
3. *Klepsch, A. & Maul, V.* 1983. Neue Versuche zur Wirksamkeit des Bannwabenverfahrens. Proc. 29th Int. Cong. Apic., Apimondia, Budapest 1983, Apimondia Publ. House, Bucharest, 258-265 (German ed.).
4. *Maul, V.* 1983. Empfehlungen zur Methodik der Varroa-Elimination mittels Bannwaben aus Arbeiterbrut. Allg. Dtsch. Imkerztg. 17, 179-184.
5. *Maul, V., Klepsch, A. & Assmann-Wehrmüller, U.* 1988. Das Bannwabenverfahren als Element imkerlicher Betriebsweise bei starkem Befall mit *Varroa jacobsoni* Oud. Apidologie 19, 139-154.
6. *Maul, V. & Klepsch, A.* 1986. Biologische Bekämpfung der Varroatose. Hess. Landesanst. Leistungsprüf. Tierz. Neu-Ulrichstein Jahresb. 1985, 72-76.
7. *Maul, V. & Klepsch, A.* 1987. Biologische Bekämpfung der Varroatose. Hess. Landesanst. Leistungsprüf. Tierz. Neu-Ulrichstein Jahresb. 1986, 90-95.
8. *Ritter, W.* 1980. Varroatosis – a new disease of the honeybee *Apis mellifera*. Bee Wld. 62, 141-153.
9. *Ritter, W.* 1986. Varroatosis in the Honey Bee, *Apis mellifera*, and its control with Perizin. Vet. Med. Rev. # 1, 3-16.
10. *Rosenkranz, P.* 1987. Thermobehandlung, verdeckelter Arbeiterinnen-Brutwaben als Möglichkeit der Varroatose-Kontrolle. Apidologie 18, 385-388.
11. *Ruttner, F. & Koeniger, N.* 1979. Experiments to eliminate *Varroa* mites by biological methods. Proc. 27th Int. Cong. Apic., Apimondia, Athens 1979, Apimondia Publ. House, Bucharest, 366-368.
12. *Ruttner, F. & Koeniger, N.* 1980. Eine biologische Methode zur Eliminierung der Varroa-Milben aus Bienenvölkern. Allg. Dtsch. Imkerztg. 15, 11-12.
13. *Staemmler, G.* 1987. Das Bannwabenverfahren unter schleswig-holsteinischen Klimabedingungen. Die Neue Bienenzucht. 14, 94-98.
14. *Woyke, J.* 1987. Comparative population dynamics of *Tropilaelaps clareae* and *Varroa jacobsoni* mites on honeybees. J. apic. Res. 26, 196-202.

Manuscript received 9 June 1989.