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USE OF PEPPERMENT OIL AS ACARICID AGAINST THE PARASITIC MITE, *Varroa jacobsoni* Ouds INFESTING HONEY BEE COLONIES IN MANSOURA, EGYPT.

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ABSTRACT

Twelve 9-frame colonies 1st hybrid (Carniolan x local Egyptian race) were chosen to study the effect of different concentrations (0.5, 1.0 and 1.5%) of pepperment oil.

The reduction in Varroa population living on worker bees increased significantly by increasing concentration. The third application was more effective on infested brood cells than the first and second application. The effect of pepperment oil gradually reduced numbers of infested brood cells and was more significant after two applications. Mite mortality was significantly related with repetition of treatments and concentration used.

INTRODUCTION

Varroa mite is considered one of the most harmful of honey bee colonies all over the world. The ectoparasitic mite *Varroa jacobsoni* Ouds. spread epidemically destroying thousands of bee colonies in Egypt and reducing the honey production to minimum levels(El-Shemy *et al*., 1995 and Fathy & Fouly, 1997).

Every year in Switzerland, more than 90% of the colonies are treated with strips that contain the pyrethroids fluvalinate or flumethrin. Extended use of pyrethroids, however, results in residues accumulation in the wax and thus, the quality of bee products is jeopardised (Bogdanov *et al.,* 1990 and Wallinar, 1995). On the other hand, it was also found that strains of mites resistant to Apistan in northern Italy (Milani, 1994).

Therefore, it is necessary to find out new ways for varroa control, where the substances used should be available in nature, safe to consumers of bee products and the residues of those products produced should not also accumulate in bee wax. Numerous natural plant products, such as essential oils and their mixtures have been extensively used by many scientists to control varroa mites (Colin, 1990; Steen, 1992; Moosbeckhofer, 1993; Imdorf *et al*., 1995 and Fathy & Fouly, 1997).

Researches on natural or non-chemical products for controlling pests become very important in order to minimize the chemical pesticides which may be harmful to both human and environment.

Therefore, the present study dealt with the application of essential oil of pepperment (*Mentha piperita*) as a commercial product for controlling Varroa mites.

MATERIALS AND METHODS

The present studies are carried out at the Apiary of the Faculty of Agriculture, Mansoura University, Egypt during autumn 1999.

Twenty 9-frame honey bee colonies 1st hybrid (Carniolan x local Egyptian race), infested with the same infestation level with Varroa mites, were chosen. Bee colonies were divided into 4 groups, 5 colonies each (replicates). Where the first three groups were fed 500 ml sugar solution (1:1 w/v), three times at seven days intervals and mixed with commercial pepperment oils in three concentration 0.5, 1 and 1.5%. The fourth group was provided with only sugar syrup and used as control.

To determine the mortality percentages of Varroa mites, the bottom of each hive was covered with a sheet of strong white paper and coated with Vaseline just before each application. These sheets were removed 24 hours after feeding with pepperment oil where dead mites, that fell down on the hive floor, were visually counted. At the same time, another sheet was replaced the former one and removed six days later just before the next application. The same technique was repeated for the second and third application. Data was corrected using Henderson and Tilton formula (1955).

To determine number of Varroa mites parasitizing worker bees, a frame was removed from the center of each colony and the workers were swept with a brush into a beaker containing water and soap as a washing-up liquid (Ritter, 1981 and Stort *et al*., 1981). The beaker was then shacked for about 30 minutes and the workers were collected after that by a wire net. Varroa individuals, which fell off from worker bees, were found at the bottom of the container. All worker bees and mites were counted for each sample where the number of mites / 100 worker bees was calculated for each treatment where this ratio could be used as an index for the infestation level.

Concerning numbers of infested brood cells, samples of 100 cells from two sealed worker brood combs were randomly opened at random, using a sharp needle where number of infested and healthy cells were counted.

All recorded data of each application was recorded before treatment and one also and seven days after feeding and statistically analyzed using the analysis of variance technique for the completely randomized design reported by Snedecor and Cochran (1969).

RESULTS AND DISCUSSION

1. Varroa mites infesting worker bees:

Data in Table 1 showed that varroa mites parasitizing worker bees were significantly affected by application with commercial pepperment (*Mentha piperita*) oil and this effect was positively correlated with repetition of feeding especially after two treatments. The first application with the tested concentrations 0.5, 1.0 and 1.5% didn't cause any significant reduction in Varroa population 24 hours after treatment. The second application obviously reduced mite numbers from 47.80, 45.60 and 43.40 to 45.80, 29.20 and 16.60 individuals/100 worker bees / hive using 0.5, 1.0 and 1.5% of pepperment oil, respectively.

These numbers reached their lowest level of occurrence after the third application and all data were significant as shown in Table 1. These results proved that the reduction percentages in Varroa population living on worker bees highly increased by prodding bee colonies with concentrations of 1.0 and 1.5% of pepperment oil.

Also, reduction percentages in Varroa population increased linearly with increase in concentration and time after each treatment. In bee colonies treated with 1.0 of pepperment oil, Varroa population was reduced by 43.58, 66.00 and 81.59% seven days after each of the tested treatments, respectively (Fig. 1). These values significantly increased to 61.78, 84.37 and 93.38% when colonies were treated with 1.5%, respectively. From the previous results, it can be concluded that the reduction in Varroa population living on worker bee increased significantly by increasing concentration especially after the second and third applications. Similar results were obtained by Steen (1992) who found a great mortality (74-90%) in varroa populations treated with oil mixtures containing thymol, menthol and camphor. Also, Wachendörfer *et al*. (1985) found that a great reduction in Varroa population treated with formic acid for 2-4 times.

2. Numbers of infested brood cells:

Different concentrations of pepperment oil used in this experiment didn't affect the number of infested brood cells, third application caused an average reduction of 53.89 , 70.73% and 58.56 , 78.61% after feeding with 1.0 and 1.5% after 1 and 7 days from treatment, respectively (Fig. 1). These values were significantly higher than 25.78 and 52.16% for those treated with 0.5%.

From the previous results, it can be concluded that there was a large number of brood cells, which were already sealed, containing reproduced Varroa mites during the periods of first and second applications. Therefore, it is recommended to repeat treatments with pepperment oil for several times. These findings agree with those obtained by Klepsch *et al*. (1983). Moreover, Ritter (1986) stated that two applications with perizin were sufficient for reaching an efficiency of more than 90% in Varroa infection. It was also found that reduction in number of infesting cells (Fig. 1), specially after two applications. Concentrations of 0.5, 1.0 and 1.5% caused an average of 11.88, 33.68 and 38.52% reduction in Varroa population one day after the second application, respectively. After seven days from feeding, the same concentrations increased these values to 18.83, 45.17 and 48.26%, respectively (Fig. 1). These values increased in the third application to 25.78, 53.89 and 58.56% after one day and 52.16, 70.73 and 78.61% after 7 days from feeding with the same concentrations, respectively (Fig. 1).

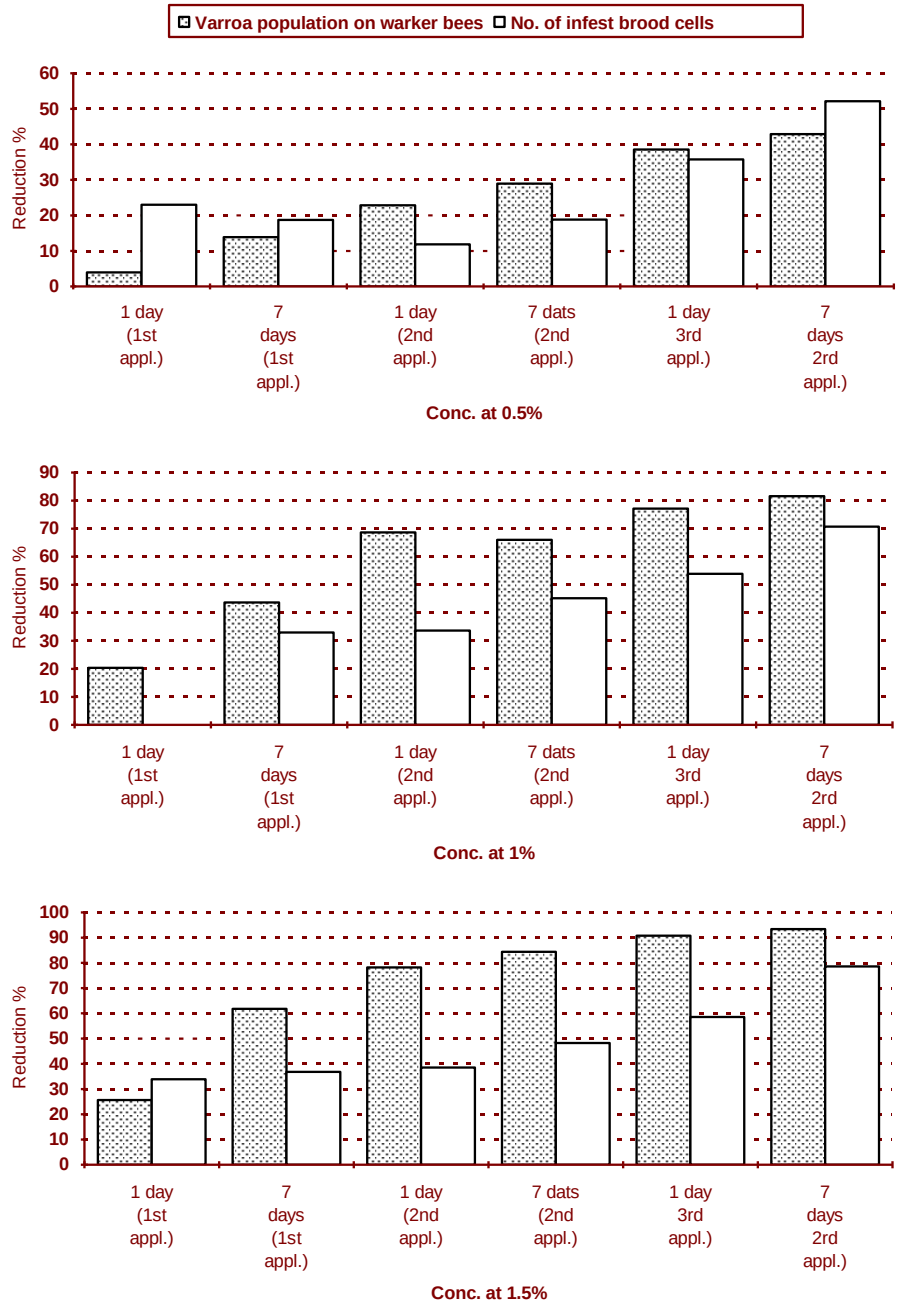

Fig. 1. Reduction percentages in varroa population on worker bees and infected brood cells after treatment concentration of pepperment oil

3. Mortality of Varroa mites fall onto the hive floor:

It is known that many old mites die naturally after energizing from cells with young bees (Ritter, 1981). Subsequent applications with 0.5% of pepperment oil to the same colony yielded an average of mortality 70.63, 79.68, 78.46% and 78.95, 71.18, 62.94% after one and seven days from the first, second and third applications, respectively (Fig. 2). The higher concentration caused higher mortality in Varroa mites population reached where mortality averaged 89.44, 95.26, 93.65% and 93.96, 83.54, 74.17% mortality was obtained when bee colonies were fed with sugar syrup mixed with 1.0% of pepperment oil after three applications, respectively. These values significantly increased when the hives were treated with 1.5% of pepperment oil as shown in Fig. 2. The previous results indicated that mite mortality was significantly related to repetition of treatment and concentration used.

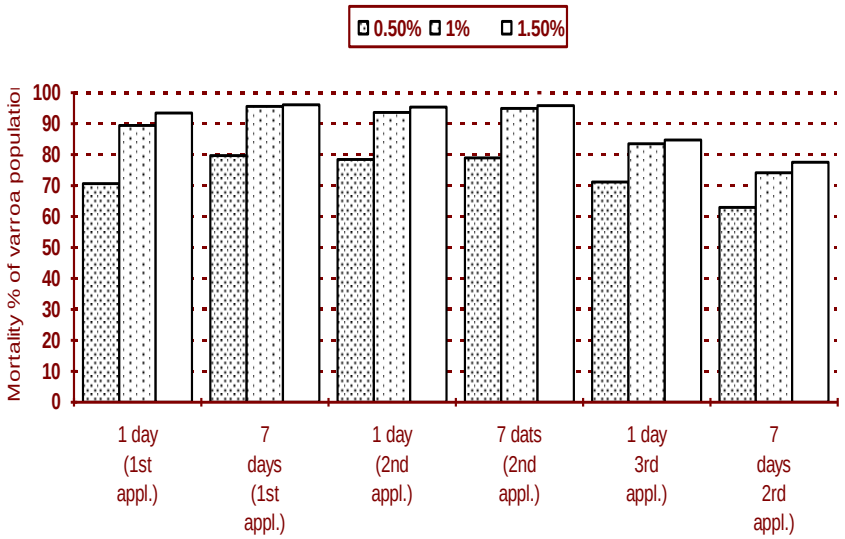

Fig. 2. Mortality percentages of varroa mites fall onto the hive floor after treatment concentration of pepperment oil

As a result, a considerable therapeutical improvement has been achieved in varroasis control by using natural substances such as pepperment oil. On the other hand, no harmful effects were noticed neither to queens nor to the broods in the treated colonies and bee mortality was extremely low and it can concluded that the levels of infestation can be kept well below the threshold of damage without contamination of honey. To increase the efficiency, treatments are usually repeated several times. Although, the effect of an essential oil or other natural products and acaricides as well, even if repeated, can't eliminate Varroa invasion or even reduce its population to a tolerable in colonies containing capped brood cells,

especially in countries like Egypt, where sealed brood cells are present almost all year around. Moreover, the side effect of such substances on different biological and physiological aspects in the social life of honey bee should be also taken in consideration in further research.

Generally, the control of Varroa mite by using natural products such as pepperment oil is more recommendable than the use of other chemical acaricides in order to avoid harmful effects.

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إستخدام زيت النعناع الفلفلى كمبيد أكاروس ضد طفيل الفاروا

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أجريت التجربة لدراسة تأثير زيت النعناع الفلفلى كمادة طبيعية على الفاروا التى تصيب طوائف نحل العسل بجمهورية مصر العربية وذلك بتركيزات 0.5 ، 1.0 ، 1.5% من خلال محاليل التغذية0 أظهرت النتائج مايلى:-

* حدث إنخفاض فى تعداد الفاروا المتعلقة بشغالات نحل العسل حيث تزداد الفروق المعنوية بزيادة التركيز0
* كانت المعاملة الثالثة أكثر تأثيراً على عدد عيون الحضنة المصابة عن المعاملة الأولى والثانية0
* أعطى زيت النعناع الفلفلى إنخفاضاً تدريجياً فى عدد عيون الحضنة المصابة بتكرار المعاملة0 وكان التأثير واضحاً بعد المعاملتين الأولى والثانية0
* النسب المئوية للموت للفاروا المتساقطة على قاعدة الخلية تزداد بتكرار المعاملات وبزيادة التركيزات المختلفة0

Table 1. Average numbers of Varroa mites living on worker bee and number of infested brood cells before and after treatment with different concentration of pepperment oil.

Treatment	Before treatment		First application				Second application				Third application			
			After 1 day		After 7 days		After 1 day		After 7 days		After 1 day		After 7 days	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
Syrup 0.5%	50.20 ±3.51	63.00 ±3.21	47.80 ±3.00	58.80 ±2.65	46.00 ±2.42	56.40 ±1.56	45.80 ±3.24	57.60 ±2.30	44.60 ±2.34	52.80 ±1.96	42.80 ±2.33	49.20 ±4.10	43.20 ±3.06	44.40 ±2.09
Syrup 1.0%	56.40 ±4.72	68.40 ±3.65	45.60 ±3.61	58.20 ±3.21	35.60 ±3.09	53.60 ±2.82	29.20 ±1.51	51.20 ±2.82	26.00 ±2.56	41.60 ±2.71	20.40 ±2.24	38.00 ±1.83	17.80 ±3.51	34.40 ±2.65
Syrup 1.5%	58.00 ±3.21	58.80 ±4.22	43.40 ±2.78	48.20 ±3.62	25.40 ±2.00	47.00 ±3.33	16.60 ±3.63	43.60 ±2.41	13.80 ±2.28	40.00 ±2.21	11.00 ±1.54	34.20 ±2.23	8.80 ±1.88	28.20 ±1.92
Control	51.40 ±3.21	71.40 ±3.62	51.20 ±2.41	72.60 ±3.00	56.40 ±3.21	69.00 ±3.61	61.00 ±2.42	64.20 ±3.11	65.00 ±2.42	66.60 ±2.98	73.00 ±3.14	69.00 ±3.44	78.20 ±2.65	76.40 ±2.35
F value			NS	NS	**	NS	**	NS	**	NS	**	**	**	**
L.S.D. at 5%			NS	NS	5.17	NS	7.88	NS	6.19	NS	5.27	8.43	5.50	9.31

A: Number of Varroa mites / 100 worker bees.
B: Number of infested brood cells / 100 cells / hive.