

## Evaluation of some natural components for controlling Varroa mites in honey bee colonies

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### ABSTRACT

This study was carried out to assess the efficacy of some volatile oils and Varroazal<sup>®</sup> for controlling Varroa mites (*Varroa destructor*) in honey bee colonies (*Apis mellifera* L.) during the period from 1<sup>st</sup> of July till the end of October 2015 and 2016 in Qalubia governorate, Egypt. Randomized complete block design was applied at this study. The apiary was divided into 7 treatments (3 colonies / group). The treatments were the use of oils of clove, peppermint, thymol, camphor, Varroazal<sup>®</sup>, mavric and control (without treatment). Mean No. of fallen varroa mites before treatment ranged between 5-15 mite/colony during the two experimental months 2015 and 2016. Data indicated that the most effective treatments were mavric and Varroazal<sup>®</sup>, while the lowest effective one was the treatment of camphor oil, during the seasons of study.

**Key words:** *Apis mellifera* L., *Varroa destructor*, volatile oils, control.

### Introduction

The varroa mite (*Varroa destructor*, Varroidae, Mesostigmata, Arachnida) is an ectoparasitic mite on honey bee brood and adults. It considered one of the most serious pests in honey bee colonies (Sammataro *et al.*, 2000; Anderson and Truman, 2000). It causes huge losses to honey bees (*Apis mellifera* L., Apidae, Hymenoptera) and great economic loss to the world-wide beekeeping industry (Rashid *et al.*, 2012). Varroa mites need to be controlled because untreated colonies collapsed within a few years due to the damage to both brood and adult bees (Elzen *et al.*, 2000b). Several substances were used for controlling varroa mites among of them the acaricides which used successfully to suppress its population in honey bee colonies (Mobus and Bruyn, 1993; Gregorc and Planinc, 2001). A wide array of chemicals (fluvalinate, amitraz, coumaphos and others) were successfully used for controlling varroa in honey bee colonies by killing more than 99% of varroa population in infested colonies (Ferrer-Dufol *et al.*, 1991). Regular treatments of honey bee colonies with acaricides allows productivity to be maintained, but it was very harmful to human by its residue in wax, honey and all honey bee products (Wallner, 1999). Using acaricides also increase the varroa resistance to these chemical substances (Thompson *et al.*, 2002). This study was carried out to evaluate the use of some volatile oils separately and combined as Varroazal<sup>®</sup> compared to mavric (fluvalinate) in controlling varroa mites in honey bee colonies.

### Material and Methods

This experiment was carried out during the experimental period (from the 1<sup>st</sup> of July to the end of October) at 2015 and 2016 years in the experimental apiary of the Faculty of Agric., Benha Univ., Kalyubia, Egypt.

### Number of experimental colonies

Twenty-one of Carniolan honey bee colonies (*Apis mellifera* L., Apidae, Hymenoptera) in equal strength (10 honey bee combs covered with bees and a queen in the same age) housed in Langstroth hives were chosen and used for experimental treatments. Each treatment consisted of 3 colonies as replicates.

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## Treatments

Seven treatments applied to twenty-one honey bee colonies as follows:

- T1:** Three honey bee colonies were applied weekly with clove oil 100% (2 ml/colony).
- T2:** Three honey bee colonies were applied weekly with peppermint oil 98.5% (2 ml/colony).
- T3:** Three honey bee colonies were treated weekly with thymol 99% (2 g /colony).
- T4:** Three honey bee colonies were treated weekly with camphor 100% (2 g /colony).
- T5:** Three honey bee colonies were applied weekly with Varroazal<sup>®</sup> (10 g /colony).
- T6:** Three honey bee colonies were treated every 13 days with mavric 20%.
- T7:** Three honey bee colonies were not treated as a control.

## Application methods

### A) Volatile oils

Two ml of each experimental volatile oils (clove, peppermint, thymol and camphor) was mixed with 10% white soft paraffin and put on the top of honey bee combs as a topical application. These applications were repeated every week by the same doses with removing the old one as described by Ismail *et al* (2006).

### B) Mavrik acaricide

Mavrik acaricide 20% (20 ml/l water) was used by impregnating stripe of carton (2 x 20 cm) for 24 hr. in mavrik and held in one comb between the brood nest of each tested colony every 13 days according the method by Abd El-Wahab and Ebada (2006).

### C) Varroazal<sup>®</sup>

The treatment with Varroazal<sup>®</sup> was applied by dusting honey bee adults with about 10 g/colony every week as described by El-Hady *et al* (2015).

### D) Sugar solution

Every experimental colonies were received sugar solution (50%). Every colony was received about 1litter every week.

## Efficacy of treated materials

Effectiveness percentages of the tested materials were determined according to the formula adopted by Liorente J. Matinez, (1989) as follow:

$$\text{Efficacy (\%)} = \frac{\text{Final of fallen mites in the treatment} - \text{final of fallen mites in control}}{\text{Final of fallen mites in the treatment}} \times 100$$

### Statistical analysis

Date were analyzed by the computer program using ANOVA Tests with LSD at 5% level according to Little and Hills (1978).

## Results and Discussion

Date in Tables (1 and 2) showed that July month was the first one from the side of occurrence of the total mean number of fallen varroa mites followed by August, September and finally October which come as the lowest month within the months of experiments in the two years of study (2015 and 2016).

With respect to the comparison between the efficacy of all treatments in 2015, data in Table (1) showed that all treatments, were more effective than control. The chemical formulation mavric and Varroazal® come in the first category in controlling varroa mites and this appears in efficacy of 70.4 and 67.8%. Thymol and clove occupied the second category recording 64.9 and 62.3%, respectively while the peppermint and camphor oils were the lowest effective in controlling varroa mite with efficacy percent 58.5 and 56.2 %.

With regard the second season 2016, data in Table (2) showed the same trend with increase in the efficacy percent. When mavric and Varroazal® gave high efficacy 80.1 and 78.4 % achieving the first category. Also, thymol and clove gave 76.3 and 74.8 % and camphor oil was the lowest effective one.

**Table 1.** Efficacy of some components on controlling varroa mites during the summer and autumn months 2015.

Date Treatment	Pre-treat.	July			Mean	August		Mean	September			Mean	October			Mean	Total mean	Efficacy
		1/7	13/7	26/7		9/8	22/8		4/9	17/9	30/9		1/10	13/10	26/10			
Clove	15	85	90	50	75 <sup>d</sup>	50	96	73 <sup>d</sup>	58	80	75	71 <sup>d</sup>	70	75	65	70 <sup>d</sup>	72.2 <sup>d</sup>	62.3 <sup>d</sup>
Peppermint	13	72	76	68	70 <sup>c</sup>	61	75	68 <sup>c</sup>	65	60	70	65 <sup>c</sup>	55	60	65	60 <sup>c</sup>	65.7 <sup>c</sup>	58.5 <sup>c</sup>
Thymol	11	80	78	85	81 <sup>c</sup>	66	90	78 <sup>c</sup>	74	66	91	77 <sup>c</sup>	85	55	85	75 <sup>c</sup>	77.7 <sup>c</sup>	64.9 <sup>c</sup>
Camphor	12	65	56	74	65 <sup>f</sup>	55	71	63 <sup>f</sup>	65	58	60	61 <sup>f</sup>	55	60	65	60 <sup>e</sup>	62.2 <sup>f</sup>	56.2 <sup>f</sup>
Varroazal®	16	90	99	81	90 <sup>b</sup>	82	90	86 <sup>b</sup>	75	95	79	83 <sup>b</sup>	65	98	77	80 <sup>b</sup>	84.7 <sup>b</sup>	67.8 <sup>b</sup>
Mavric	15	94	93	98	95 <sup>a</sup>	99	85	92 <sup>a</sup>	88	99	86	91 <sup>a</sup>	99	81	90	90 <sup>a</sup>	92.0 <sup>a</sup>	70.4 <sup>a</sup>
Control	5	40	25	40	35 <sup>e</sup>	31	29	30 <sup>e</sup>	25	23	20	26 <sup>e</sup>	20	18	16	18 <sup>f</sup>	27.2 <sup>e</sup>	
Total mean					73.0 <sup>a</sup>			70.0 <sup>b</sup>				67.7 <sup>c</sup>				64.7 <sup>d</sup>		
MSE					0.57			0.61				0.57				0.54	0.22	0.05

<sup>a,b,c</sup> Means with different superscript in the same column are significantly different at (P<0.05).

**Table 2:** Efficacy of some components on controlling varroa mites during the summer and autumn months 2016.

Date Treatment	Pre-treat.	July			Mean	August		Mean	September			Mean	October			Mean	Total mean	Efficacy
		1/7	13/7	26/7		9/8	22/8		4/9	17/9	30/9		1/10	13/10	26/10			
Clove	11	65	66	91	74 <sup>d</sup>	90	56	73 <sup>d</sup>	54	99	60	71 <sup>d</sup>	55	90	62	69 <sup>d</sup>	71.7 <sup>d</sup>	74.8 <sup>d</sup>
Peppermint	12	70	72	65	69 <sup>e</sup>	80	54	67 <sup>e</sup>	65	67	60	64 <sup>e</sup>	50	77	53	60 <sup>e</sup>	65.0 <sup>e</sup>	72.3 <sup>e</sup>
Thymol	15	85	80	75	80 <sup>c</sup>	80	72	76 <sup>c</sup>	78	77	70	75 <sup>c</sup>	70	78	71	73 <sup>c</sup>	76.0 <sup>c</sup>	76.3 <sup>c</sup>
Camphor	8	68	62	62	64 <sup>f</sup>	60	62	61 <sup>f</sup>	55	73	52	60 <sup>f</sup>	65	52	60	59 <sup>e</sup>	61.0 <sup>f</sup>	70.4 <sup>f</sup>
Varroazal®	10	80	95	89	88 <sup>b</sup>	90	80	85 <sup>b</sup>	82	81	80	81 <sup>b</sup>	68	97	75	80 <sup>b</sup>	83.5 <sup>b</sup>	78.4 <sup>b</sup>
Mavric	6	89	99	88	92 <sup>a</sup>	92	90	91 <sup>a</sup>	90	92	88	90 <sup>a</sup>	82	99	83	88 <sup>a</sup>	90.2 <sup>a</sup>	80.1 <sup>a</sup>
Control	5	35	23	32	30 <sup>e</sup>	18	22	20 <sup>e</sup>	13	11	12	12 <sup>e</sup>	11	9	10	10 <sup>f</sup>	18.0 <sup>e</sup>	
Total mean					71.0 <sup>a</sup>			67.5 <sup>b</sup>				64.7 <sup>c</sup>				62.7 <sup>d</sup>		
MSE					0.58			0.57				0.55				0.57	0.43	0.05

<sup>a,b,c</sup> Means with different superscript in the same column are significantly different at (P<0.05).

These data were harmony with Imdorf and Bogdanov (1999) who indicated that thymol and thymol blended with essential oils or essential oil components offer a promising exception in varroa mite control and mite mortality obtained with these formulations exceeds 90% and often approaches 100%. Same trend of results was confirmed by Skert, *et al*, (2011) found that four consecutive amitraz fumigations gave 93.82% reduction on average in final mite number and this ensure normal colony development. Also, these data are agreed with the finding by Hamaad *et al*. (2008) who found that the thymol oils spray resulted 65.9% of varroa mite mortality and it has potential for varroa mite control under Egyptian conditions. Additionally, Whittington *et al* (2000) tested the obtained oils neem, thymol and canola to control Varroa mites in honey bee colonies and found that thymol oil spray (3.6 g/vermiculite block /colony) killed 68±6% of varroa mite. Fouly and Al-Dehrai (2009) stated that clove oil gave 62% efficacy in controlling varroa mites. El-Hady *et al* (2015) reported that controlling varroa mite with some essential oils ranged between 80.95% (cinnamon oil 30%) to 86.99 (thymol 30%) in winter and from 67.46% (thymol 30%) to 82.16% (cinnamon 30%). If we take in consideration the natural origin and safety which may be achieved and the low difference between chemical formulation and natural products it could be conclude that natural products have promising future in the scale of varroa mites control but this need to increase of study to study to show the

pollution which may be happen to honey bee products and also study mammalian toxicity of this natural products.

## Conclusion

Varroa mite is considered one of the most important honey bee pests so it must be controlled. Experiments were carried out to evaluate some natural components in controlling this mite. Data indicated that the most effective treatments were mavric and Varroazal®, while the lowest effective one was the treatment of camphor oil. This action is just the beginning for making integrated pest management program for controlling varroa mite.

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