

EVALUATION OF THE EFFICIENCY OF SOME ESSENTIAL OILS AND CHEMICAL ACARICIDES FOR *VARROA* CONTROL

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ABSTRACT

This research was carried out during the period between mid August to mid April in the years 2004 -2005 and repeated for the same months in the years 2005-2006 and on this basis we divided these periods into 5 subperiods according to honey harvest seasons and climatic variations which are closely related. Different methods (Feeding, Evaporation and Spraying of Thymol oil *Thymus vulgaris* and mixed feeding of Eucalyptus: Thymol: Peppermint (1:2:1) and Chemical acaricides (Oxalic acid, Formic acid, Apistan and Bayvarol) were used against *Varroa* the external parasitic mite on honey bee colonies. The reduction percentage of *Varroa* mites in sealed brood and adult worker after 28 days post treatment ranged from 59.97% - 83.5% with the use of oxalic acid, 89.96% - 96.21% with formic acid, while it was 90.09% -100% with apistan and 79.88% - 100% with bayvarol. However the reduction percentage of *Varroa* mites with essential oils was between 59% - 84.78% with Thymol feeding, 63.37% - 90.09% with mixed feeding, 81.38% -100% with thymol evaporation (20%) and 77.13% - 100% with Thymol spraying (1%).

INTRODUCTION

Varroa are small external about one millimeters parasitic mites that infest sealed brood and adult of honey bees. The original natural host of this mite is the Indian honey bee *Apis cerana*, and it's jump to *Apis mellifera* has put the mite on a host with little natural defences against it. The mite *Varroa destructor* was first detected in Egypt in 1987 In alAreesh region and likely arrived across the border with Palastine.

The varroa mites became the focus of much interest among honeybee researchers in many countries after the varroa problem became apparent and had a great impact on productivity of honeybee colonies. Infested colonies will die within 1 to 2 years if the beekeeper does not take necessary actions against *Varroa* mites.

Non-Chemical Methods (Cultural methods) for *Varroa* mite control include using drone comb or bottom screens to trap

Varroa mites. As the mites have a preference for laying their eggs in drone cells, drone foundation can be placed into colonies to encourage the mites into them. Once the comb is sealed it can be removed from the hive and destroyed along with all the mites it contains. Care must be taken to get the timing correct for this method or the mite population might increase faster than normal.

Chemical Methods as synthetic miticides remain attractive because they are never lethal to bees. If the mites are vulnerable, Apistan can kill 85 percent of them (if properly used and the mites are not resistant). Formic acid might kill 70 to 90 percent, but if it's too cold the acid are less effective, and if it's too hot it disperse too quickly. Many "natural" miticides, like Thymol or essential oils or Formic acid, require such high doses that they can kill the bees as well as the mites. Some of the essential oils have little safety margin between killing mites and

killing bees. But, careful application of multiple miticides can avoid the evolution of resistant mites. It just takes the kind of attention and time that sideliners and hobbyists might not have. The promoters of multiple miticides

in small dosages and the promoters of high-dose synthetics have squared off. The present study aimed to evaluate the efficiency of some essential oils and chemical acaricides for varroa control.

MATERIALS AND METHODS

Chemicals acaricides

1. **Formic acid (85% conc.)** Stripes paper of 7x15x0.5 cm were saturated with Formic acid (2ml /cover of the comb) and placed on top of the bee combs per colony.
2. **Oxalic acid dehydrate (oxalic acid 99.5%)** 50 gm of the oxalic acid salt was dissolved in one litre of the water spraying applied per one time weekly for one month.
3. **Apistan (fluvalinate 10%)**. One stripe of the Apistan strip (24x3x1cm) was used one time/colony /month.
4. **Bayvarol (0.9 flumethrin active ingredient)**. Two Bayvarol stripes were used as one time/colony/month.

Essential oils concentrations:-

10 gm of the Thymol oil, 5ml Eucalyptus and 5ml Peppermint oils were mixed with a concentration 2:1:1.

- 1) 1.5 ml of each prepared stock of the mixture oils was added to one liter of the sugar solution (1v sugar: 1v water). The honey bee colonies were fed weekly for one month with the previous prepared solutions.
- 2) A Cake of 100 pollen supplement consisted of 2 part wheat germ mixed with 1 part honey (w/w) and 6 ml of each of the previously prepared mixture of my standard oils; so we have 4 different cake blends; then we applied 25 gm of each blend on the top of the combs to feed each colony weekly throughout the month starting at 15 of December to 13of January during 2004-2005 and 2005-2006 Seasons.

- 3) 20 ml or (gm) of each of our standard crude oils + 80 ml of the olive oil (20%). Two cotton strips of 20 cm length were saturated with 10 ml of essential oil, and placed between brood bee combs per each tested colony. Every oil strips were replaced weekly for one month.
- 4) 1.0 ml of the crude oil added to 99.0 ml water with a final concentration 1.0%. The spraying treatment was used with a rate of 1 ml of the suspension /covered bee comb/colony; one time a week during one month.

Throughout the study three colonies were used for every experiment and the bottom board of the colony was covered with a plastic sheet coated with raw Vaseline to capture the fallen varroa mites to be counted. Also, three colonies were taken as control by feeding them with frank sugar solution without any additives and as a control for spraying method pure water was sprayed to show how this would affect the rate of fallen varroa to compare with our results in colonies treated by our standard methods of feeding and spraying respectively. The experiment was processed at 17 of August to 15 of September; 15 of October to 15 of November; 15 of December to 13 of January; 15 of February to 15 of March and 15 of April to 15 of May for the seasons 2004 _ 2005 and 2005 _ 2006. Twenty seven honeybee colonies we used for this study. Three colonies we used for each concentration of tested essential oil and chemical acaricides.

RESULTS AND DISCUSSION

From the results it can be concluded that there were no significant differences in the *Varroa* reduction percentage between chemical compounds and essential oil controls used in this experiments as shown in Table (1). In spite of the residues that remain in honeybee products when using chemical acaricides, it is rather wise to compare between

the side effects of the materials used for the experiment, the natural (essential) oils and the chemical acaricides. The chemical acaricides surely have greater residue side effects; however they possess a higher efficacy when used for short time and at minimal effective concentrations. Several materials was used to control the mites have been investigated

including biotechnical, genetic and chemical controls. Chemical treatments are absolutely necessary to keep colonies alive. Essential oil treatment using evaporation technique was successfully applied method used with all year seasons.

The optimum admixture concentration of essential oils used as feeding syrup to get the maximum lethal effect on varroa population dynamic was shown and adopted to be 1:2:1 per Eucalyptus, Thymol and Peppermint.

The Thymol oil recorded maximum varroa population reduction approaching 93% with both two experimental years 2004 & 2005. The spraying method was used in the late spring and early autumn, because the temperature was suitable, however it was difficultly applied.

The therapeutic activity of the tested chemical compounds towards varroa mite could be arranged in descending order as follows, Apistan > Bayvarol > Formic acid > Oxalic acid. The Apistan, Bayvarol, Formic acid and Oxalic acid caused higher reduction percentage in the varroa population approaching (95.34%, 93.05%, 89.96% & 75.48%), respectively in worker brood.

These results are in agreement of Fathy and Fouly (1993) had shown similar results; however they used camphor oil at different concentrations to control varroa mites. El-Shemy *et al.* (2001) tested the efficacy of different natural oil, clove oil to found that mite reduction ranged from 45.75% to 92.2%.

Calderone and Nasr (1999) mentioned that Apistan was more effective (98%) against *Varroa* mite than Formic acid (56%). Fries, (1991), Elzen *et al.* (2002) and Sherif (1998) found that the number of dead varroa mites. When used Apistan and Bayvarol comparison with those control especially after 2nd and 3rd days. Herbert *et al.* (1988) and Abd El-Fattah *et al.* (1991) reported that the mites were killed within the first 24 hours following treatment with Apistan. Herbert *et al.* (1989) found that the majority of dead mites were recorded within 5 days with a peak on the first day of treatment with Apistan. Allam (1994) reported that varroa mites were killed within

the first four days of application with Apistan. Mutinelli *et al.* (1997) used oxalic acid solution (5%) to controlling varroa mites. Amrine and Noel (2006) and Amrine *et al.* (2007), Abd El-Raheem (1999) used several chemical acaricides against varroa invasion. Khattab, (2001) stated that thymol, Eucalyptus, Menthol and Clove oils consider a highly effective acaricides against varroa mites. Essential oils were safe to human and bees, residues in honey are low even after long term treatments (Imdorf *et al.*, 1999). In addition the efficiency of the acaricides depend on temperature and seasons of the year (Cox *et al.*, 1989). The organic compounds such as organic acid and volatile oils are inexpensive alternatives of synthetic acaricides for the control of parasitic mites in honey bee (Imdorf *et al.*, 1999). Schenk *et al.* (2001) reported that neem oil at 75% concentration caused approximately 100% mortality in bee mites. Also mineral oils serve as vehicles for more effective miticidal therapeutic oils. A 6% blend of eucalyptus and winter green oils had a positive effect on mite drops (Grant, and Giliard Jackson, 2004). Fathy and Fouly (1993) reported that the treatment with camphor to increase the efficacy of varroa control. El-Shemy (1997) used six dose of the same essential oils to control the mite. All the tested oils gave a good effect on this parasitic mite. Mutinelli *et al.* (1993) found that the Apilife-VAR killed (78.7%) mites per colony. Rezk & Gadelhak (1997) reported that the best effect was exerted by the application of eucalyptus and matricary. The effects of both mint and clove oil-extracts were significantly lower. Also, Hu-Fuliang *et al.* (2005) used Thymol and Thymol blended with other essential oils or essential oil components offer a promising exception. Mite mortality is over 90% when these formulations are used. Bacandritsos *et al.* (2004) found that the highest efficacy (89.71%-90.20%) in hives treated with the mixture essential oils. Rickli *et al.* (1991), Gal *et al.* (1992), Steen (1992), Colin *et al.* (1994), Allam *et al.* (2003), Baggio *et al.* (2004), Abd El-Wahab *et al.* (2006), Greatti *et al.* (2006) and Abdol-Ahad *et al.* (2008) used several form essential oils against varroa invasion.

Thymol is a volatile monoterpenoid found among many species of plants, and is toxic to varroa at doses safe to their honey bee hosts

Table (1): Comparison between effects of some essential oils and chemical acaricides on Varroa reduction percentage in honeybee colonies during 2004&2005-2006.

Season	Treatments Periods	Formic acid		Oxalic acid		Apistan		Bayvarol		Thymol Feeding		Mixed. (C) feeding		Thymol (20%) Evaporation		Thymol (1%) spraying	
		WB	AW	WB	AW	WB	AW	WB	AW	WB	AW	WB	AW	WB	AW	WB	AW
2004	Aug. - Sep.	-	-	60.06	83.50	90.09	90.09	79.88	83.50	82.36	79.88	88.92	90.09	100	100	93.80	100
	Oct. - Nov.	93.92	91.26	-	-	97.01	90.91	94.09	86.96	84.78	83.06	92.56	77.47	96.22	95.34	-	-
	Dec. - Jan.	90.72	96.21	-	-	92.51	96.21	85.37	94.12	-	-	68.12	81.20	94.45	97.63	-	-
	Feb. - Mar.	95.10	96.04	-	-	95.00	96.36	90.08	84.93	80.23	76.54	71.74	78.26	91.19	81.38	-	-
	April- May	-	-	59.97	72.50	94.93	92.92	89.87	87.43	68.40	68.67	72.98	68.67	100	100	81.05	90.15
2005	Aug. - Sep.	-	-	71.52	74.09	93.30	93.13	87.09	88.87	73.46	77.67	81.24	77.67	100	89.00	93.81	89.00
	Oct. - Nov.	89.96	94.71	-	-	95.34	97.10	93.05	94.32	78.87	80.81	85.53	85.63	93.30	95.15	-	-
	Dec. - Jan.	93.02	97.17	-	-	95.22	100	95.22	100	-	-	65.37	65.20	93.51	97.35	-	-
	Feb. - Mar.	91.32	92.50	-	-	95.54	96.08	95.54	95.95	77.75	75.08	74.54	71.90	91.92	80.89	-	-
	April- May	-	-	75.48	78.53	91.83	91.69	88.02	85.60	59.00	75.82	79.58	67.84	89.71	93.02	77.13	85.82

WB= worker brood

AW= adult worker

Mixed. (C) Feeding = Mixed of Eucalyptus: Thymol : Peppermint (1:2:1).

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تقييم فعالية بعض الزيوت العطرية والمبيدات الكيميائية الأكاروسية في مكافحة طفيل الفاروا

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في هذا البحث تم تقييم فعالية بعض الزيوت العطرية والمبيدات الكيميائية الأكاروسية في مكافحة طفيل الفاروا أجريت هذه التجربة في منطقة سدس الأمراء، لمدة عامين متتاليين ما بين ٢٠٠٤-٢٠٠٥ و٢٠٠٦ وكانت نتائج الدراسة كالتالي:

أ- طريقة التغذية:

استخدمت زيوت الكافور والثيمول والنعناع مفردة أو مخلوطة بنسب وهي (١:٢:١) وتم أخذ ١.٥ مل من الزيوت/لتر تغذية سكرية الغير مخلوطة أو المخلوطة بنسب مختلفة وتم إضافتها إلى التغذية السكرية وغذيت الطوائف أسبوعياً لمدة شهر كامل في جميع فترات السننتين وفي فترة ديسمبر ويناير أضيفت الزيوت المخلوطة إلى بدائل حبوب اللقاح وغذيت هذه الطوائف أسبوعياً بمقدار ٢٥ جم/طائفة وكانت النتائج المتحصل عليها كالتالي: سجل الثيمول أعلى نسبة خفض للفاروا على كل من الحضنة

والشغالات البالغة على الإطلاق بعد ٢٨ يوم من المعاملة حيث بلغت ٨٠,٢٣٪، ٧٧,٧٥٪ على التوالي بينما كانت أقل نسبة للخفض سجلت في فترة ابريل - مايو فبلغت ٤٠,٦٢٪، ٤٦,٢٤٪ على الحضنة في عامى أنداسة على الترتيب. بينما أعطت الزيوت المخلوطة مع مكملات حبوب اللقاح نسب خفض للفاروا أقل من نظيرتها المضافة إلى المحاليل السكرية.

ب- طريقة البحر:

وفي هذه الطريقة تم تشبييع الشرائط القطنية بزيت الليمون بتركيز ٢٠٪، واستخدمت هذه الطريقة في جميع فترات السنة ولمدة عامين متتاليين وكانت انتاج المتحصل عليها كالتالى:
أعطى التركيز (٢٠٪) للليمون بعد ٢٨ يوم من المعاملة أعلى نسبة خفض للفاروا على كل من الحضنة والشغالات البالغة في معظم فترات عامى الدارسة فوصل إلى أكثر من ٩٠٪.

ج- طريقة الرش:

استخدم زيت الليمون بالرش بتركيز ١% و أعطى نسبة خفض للفاروا على حضنة الشغالات المخلوطة والشغالات البالغة بعد ٢٨ يوم من المعاملة وصلت الى ٩٣٪ في عامى الدارسة. أما استخدام المواد الكيميائية العلاجية فقد أظهر معدلا عاليا في السيطرة على طفيل الفاروا خاصة مع اليبستان يليه البيفرول ثم حامض الفورميك ثم حامض الأوكساليك، حيث وصلت نسبة الخفض على حضنة الشغالات إلى ٩٥,٣٤٪، ٩٣,٠٥٪، ٨٩,٩٦، ٧٥,٤٨٪ على التوالي. وقد أوصت الدارسة بمايلى:-

- ١- ينصح باستخدام الزيوت العطرية مع المحاليل السكرية وكذلك مع بدائل حبوب اللقاح لما لها من تأثير مباشر على الفاروا وتأثير سلبي بسيط على الطوائف التي تستعيد نشاطها بعد انتهاء الاستخدام.
- ٢- ينصح باستخدام طريقة تبخر الزيت مثل الليمون في نهاية الخريف وبداية الشتاء، حيث يكون نشاط النحل في تربية الحضنة قليل ومعظم أفراد الطفيل تتواجد على النحل البالغ وبالتالي تعطى المكافحة نتائج ايجابية في خفض تعداد الطفيل.
- ٣- تعتبر الزيوت العطرية وخاصة الليمون بالتغذية أو البحر (بتركيز ٢٠٪) من أفضل الطرق في خفض تعداد الفاروا وهي وسيلة آمنة ومتوفرة ورخيصة الثمن.