

## FIELD EVALUATION OF SOME PLANT EXTRACTS FOR THE CONTROL OF VARROASIS

Elbassiouny, A.M.; M.A.EL-Banby ; A.A.Gomaa and M.A.M.Ali  
Plant Protection Dept., Fac. of Agric., Ain Shams Univ., Shoubra  
EL-Kheima, Cairo, Egypt.

### ABSTRACT

Six plant extracts, namely zingiber (ginger) roots, leaves of marjoram, seeds of santonica, clove, caraway and fenugreek were evaluated against varroa mite during September-October,1995, at the apiary of the faculty of Agriculture, Ain Shams University, Cairo, Egypt. The obtained results revealed that santonica, clove and fenugreek were the most effective compounds for reducing varroa mite population. Colonies treated with the other plant extracts( zingiber, marjoram and caraway) also had significantly fewer mites than untreated colonies. There was no indication that any of the tested compounds had adverse effects on honey bee colonies.

**Keywords:** Honey Bee – *Apis mellifera* - Varroa mite - Botanical watery extracts.

### INTRODUCTION

The most significant event affecting apiculture in the last decade is the wide spread of the ectoparasite bee mite, *Varroa jacobsoni* Oud. With regret, human negligence assisted in the spread of this parasite. The end result has been a loss of beekeepers, fewer bee hives and an increase in cost of leasing hives for honey production and crop pollination (Cobey and Lawrence,1988; Arnold,1990 and Hunt,1998). The main method of protection against varroa mite is the use of acaricides (Loglio and Plebani,1992 and Eischen,1998 ). Resistance issues to miticides used to control varroa mite (Baxter *et al*,1998) support the need to develop alternative strategies for controlling this mite (Clark,1990; Rickli *et al.*,1991; Riffle *et al.*,1991 and Sanford,1996).

The present study was therefore carried out to evaluate the toxicity of some plant extracts to the Varroa mite, as well as their effect on the host (honey bee).

### MATERIALS AND METHODS

The present work was conducted during September-October, 1995, at the apiary of the faculty of Agriculture, Ain Shams University, Cairo, Egypt. Twenty-eight colonies, headed by Carniolan honey bee queens, were divided into seven experimental groups, each group consisting of four colonies. Each colony comprised five frames covered with bees and three frames of brood.

#### Plant Extracts

Plant extracts from, zingiber (ginger) roots, leaves of marjoram, seeds of santonica, clove, caraway and fenugreek were used for this study. One kilogram of each tested material was used, they were heated in an equal volume of distilled water and placed inside dark glasses overnight. An amount of 100 ml from each extract were evenly sprayed by means of a hand sprayer

on the frames covered with bees and the hive cavity. Each plant extract was applied four times at four-day intervals.

#### **Determination of the Infestation Level of Varroa Mite**

The infestation level of varroa mites was estimated in both adult bees and brood before and after the treatment of each application. The infestation level of adult honey bees was estimated according to the method described by Shimanuki and Knox (2000). The infestation level of varroa mite in brood was estimated by opening 20 sealed worker brood cells using forceps and counting adult varroa mite.

#### **Varroa Mite Recovered on Sticky Boards**

Immediately before each application and forty-eight hours after, sticky boards were inserted on the bottom board of each colony. The boards were then removed after 48 and 96 hours and number of varroa mite were counted.

#### **Estimation of the Bee Mortality**

Bees mortality was estimated 48 and 96 hours after each application by counting the dead bees in 55 x 46 cm rimmed boards placed in front of the hive entrances.

## **RESULTS AND DISCUSSION**

#### **Mean Number of Mite per Adult bee before and after Treatment.**

Table (1) shows that there were no significant differences between mean number of mites per adult bee before treatments in all the treatment groups. Mean number of mites were 0.214, 0.193, 0.229, 0.275, 0.172, 0.219 and 0.191 per bee in colonies treated with zingiber, santonica, marjoram, clove, caraway, fenugreek and untreated colonies, respectively. After the first application mean number mites per bee decreased in all the treatments except those treated with santonica (0.236) to 0.153, 0.175, 0.164, 0.171, 0.168 and 0.216 for colonies treated with zingiber, marjoram, clove, caraway, fenugreek and untreated colonies, respectively. However, these differences were statistically non significant. After the second application, the number of mites per bee were 0.157, 0.177, 0.232, 0.184, 0.200, 0.134 and 0.200 in colonies treated with zingiber, santonica, marjoram, clove, caraway, fenugreek and untreated colonies, respectively. Analysis of variance found significant decrease in the mean number of mites per bee in colonies treated with fenugreek when compared with untreated colonies. Otherwise, no significant difference was evident in colonies treated with the other compounds and untreated colonies. The number of mites per bee after the third application decreased significantly in colonies treated with santonica and marjoram, with mean mites per bee dropping to 0.069 and 0.077, respectively, compared to untreated colonies (0.153). Meanwhile, no significant difference was found in colonies treated with either santonica or marjoram. The results also indicate that the infestation levels in colonies treated with zingiber, clove, caraway and fenugreek decreased, but this decrease was not significant when compared

with untreated colonies (0.153) which exhibited 0.149, 0.167, 0.159, and 0.117 mite per bee, respectively. After the fourth applications, the mean number of mites per bee decreased significantly in all the treatments as compared with untreated colonies. It reached 0.107, 0.720, 0.077, 0.077, 0.071, 0.112 and 0.218 for colonies treated with zingiber, santonica, marjoram, clove, caraway, fenugreek and untreated colonies, respectively.

**Table (1) : Mean number of mites per adult bee after treatments with certain botanical watery extracts during September-October 1995 at Ain Shams University (mean  $\pm$  s.e.).**

Botanical extract	Mean mites per bee				
	Before application	After 1 <sup>st</sup> application	After 2 <sup>nd</sup> application	After 3 <sup>rd</sup> application	After 4 <sup>th</sup> application
Zingiber	0.214 $\pm$ 0.025	0.153 $\pm$ 0.042	0.157 $\pm$ 0.026 ab	0.149 $\pm$ 0.019 bc	0.107 $\pm$ 0.019 a
Santonica	0.193 $\pm$ 0.046	0.236 $\pm$ 0.042	0.177 $\pm$ 0.018 ab	0.069 $\pm$ 0.009 a	0.072 $\pm$ 0.010 a
Marjoram	0.229 $\pm$ 0.068	0.175 $\pm$ 0.033	0.232 $\pm$ 0.015 c	0.077 $\pm$ 0.013 a	0.077 $\pm$ 0.010 a
Clove	0.275 $\pm$ 0.098	0.164 $\pm$ 0.023	0.184 $\pm$ 0.030 ab	0.167 $\pm$ 0.004 c	0.077 $\pm$ 0.012 a
Caraway	0.172 $\pm$ 0.047	0.171 $\pm$ 0.022	0.200 $\pm$ 0.013 bc	0.159 $\pm$ 0.017 bc	0.071 $\pm$ 0.009 a
Fenugreek	0.219 $\pm$ 0.041	0.168 $\pm$ 0.016	0.134 $\pm$ 0.015 a	0.117 $\pm$ 0.012 b	0.112 $\pm$ 0.014 a
Untreated	0.191 $\pm$ 0.049	0.216 $\pm$ 0.025	0.200 $\pm$ 0.025 bc	0.153 $\pm$ 0.008 bc	0.218 $\pm$ 0.029 b
F value	0.33	0.98	2.21**	10.16**	10.72*
L.S.D.			0.051	0.042	0.050

#### **Number of Mites per Brood Cell Before and After Treatment**

Results presented in Table (2) shows that there was no significant difference between the infestation level in brood nest in all the groups before treatment. Mean number of mites per brood cell were 0.250, 0.325, 0.275, 0.250, 0.200, 0.150 and 0.175 in colonies treated with zingiber, santonica, marjoram, clove, caraway, fenugreek and untreated colonies, respectively. After the first application, the mean number of mites per brood cell were 0.100, 0.150, 0.075, 0.150, 0.122, 0.050 and 0.100 in colonies treated with zingiber, santonica, marjoram, clove, caraway, fenugreek and untreated colonies, respectively. Analysis of variance indicated that these decrease were non significant for all treatments. Following the second application mean number of mites per brood cell did not decrease significantly in colonies treated with santonica (0.050), clove (0.050) and fenugreek (0.050). Meanwhile, a slight increase in the number of mites per brood cell occurred in colonies treated with marjoram (0.200), zingiber (0.125), caraway (0.175) and untreated colonies (0.175). After the third application the mean number of mites per brood cell decreased when compared with untreated colonies. It reached 0.10, 0.05, 0.02, 0.05, 0.02, 0.05 and 0.15 mites in colonies treated with zingiber, santonica, marjoram, clove, caraway, fenugreek and untreated colonies, respectively. In spite of there was no significant difference for the mean number of mites per brood cell among colonies treated with zingiber, santonica, marjoram, clove, caraway and fenugreek, but there was a significant difference between them and untreated colonies. After the fourth application, except for treatment with caraway the mean number of mites per brood cell decreased significantly for all the colonies treated with other tested plant extracts as compared with untreated colonies. Their numbers were 0.050, 0.050, 0.075, 0.050, 0.100, 0.050 and 0.175 mite per brood in colonies treated with zingiber, santonica, marjoram, clove, caraway, fenugreek and untreated colonies, respectively.

**Table (2) :Mean number of mites per brood cell on brood after treatments With certain botanical watery extracts during September-October 1995 at Ain Shams University(mean± s.e.).**

Botanical extract	Mean mites per bee				
	Before application	After 1 <sup>st</sup> application	After 2 <sup>nd</sup> application	After 3 <sup>rd</sup> application	After 4 <sup>th</sup> application
Zingiber	0.250 ± 0.064	0.100 ± 0.071	0.125 ± 0.048 ab	0.100 ± 0.055 ab	0.050 ± 0.029 a
Santonica	0.325 ± 0.125	0.150 ± 0.050	0.050 ± 0.029 a	0.050 ± 0.050 a	0.050 ± 0.029 a
Marjoram	0.275 ± 0.063	0.075 ± 0.048	0.200 ± 0.091 b	0.025 ± 0.025 a	0.075 ± 0.048 a
Clove	0.250 ± 0.097	0.150 ± 0.064	0.050 ± 0.029 a	0.050 ± 0.029 a	0.050 ± 0.029 a
Caraway	0.200 ± 0.071	0.122 ± 0.063	0.175 ± 0.063 ab	0.025 ± 0.025 a	0.100 ± 0.048ab
Fenugreek	0.150 ± 0.096	0.050 ± 0.050	0.050 ± 0.029 a	0.050 ± 0.029 a	0.050 ± 0.029 a
Untreated	0.175 ± 0.063	0.100 ± 0.058	0.175 ± 0.025 ab	0.150 ± 0.023 b	0.175 ± 0.025 b
F value	0.51	0.98	1.79*	2.30*	1.92*
L.S.D.			0.075	0.080	0.077

**Mortality of Varroa mite**

The results in Table (3) show that the highest mean number of adult varroa, recovered on sticky boards, occurred after the first application of santonica (425.25) followed by clove (120.50), fenugreek (81.25), caraway (78.50), marjoram (66.75), then zingiber (54.00), and the lowest mean number was in untreated colonies (50.25). A significant difference was found in the mean number of varroa mite on sticky boards between colonies treated with santonica and the other groups. However, no significant difference was evident among colonies treated with zingiber and marjoram and untreated colonies.

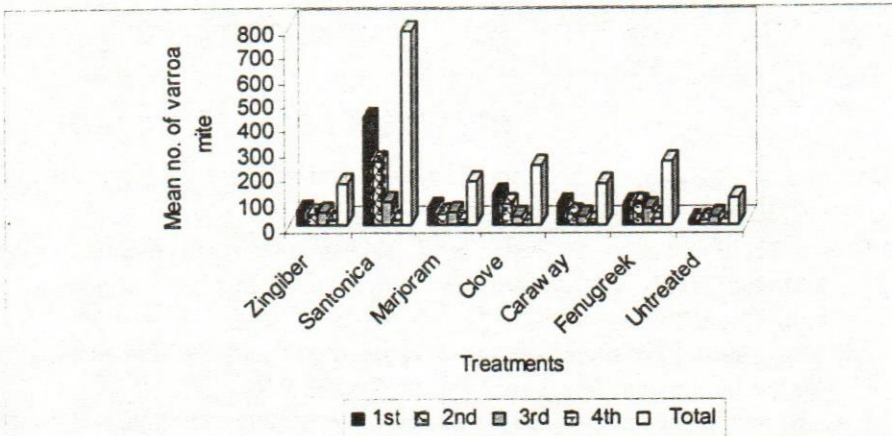
After the second application, the number of adult varroa mite on sticky boards increased significantly in all the treatment groups when compared with untreated colonies. These mean numbers were 42.00, 250.75, 45.00, 80.50, 44.00, 80.00 and 19.00 mites, in colonies treated with zingiber, santonica, marjoram, clove, caraway, fenugreek and untreated colonies, respectively. Colonies treated with santonica had significantly more varroa mite i.e. 250.75 mite per sticky board when compared with other treatments or untreated colonies. There was no significant difference in the number of collected mites in colonies treated with the other tested plant extracts.

**Table (3) : Mean number of adult varroa mites recovered on sticky boards after treatments with certain botanical watery extracts during September- October 1995 at Ain Shams University (mean ± s.e.).**

Botanical extract	Mean no. of varroa mites on sticky boards				
	After 1 <sup>st</sup> application	After 2 <sup>nd</sup> application	After 3 <sup>rd</sup> application	After 4 <sup>th</sup> application	Total
Zingiber	54.00 ± 5.01 d	42.00 ± 3.76 c	50.52 ± 9.65 c	19.75 ± 2.38 b	166.00 ± 7.67 c
Santonica	425.25± 46.45a	250.75± 32.72 a	87.52 ± 10.41 a	20.75 ± 5.39 b	784.00 ± 90.41a
Marjoram	66.75 ± 4.64 cd	45.00 ± 3.76 c	49.00 ± 2.01 c	10.50 ± 2.26 c	171.25 ± 11.67c
Clove	120.50± 6.52 b	80.50 ± 14.79 b	31.50 ± 1.76 d	4.25 ± 0.88 dc	236.75 ± 25.82b
Caraway	78.50 ± 11.79c	44.00 ± 5.01 c	31.25 ± 4.64 d	7.25 ± 1.88 cd	161.00 ± 14.85c
Fenugreek	81.25 ± 1.63 c	80.00 ± 13.79 b	65.00 ± 17.80 b	25.00 ± 3.01 a	251.25 ± 13.13b
Untreated	20.25 ± 3.39 d	19.00 ± 0.75 d	36.00 ± 7.27 d	2.00 ± 0.50 e	106.50 ± 10.60d
F value	278.27**	114.47**	36.23**	50.74**	448.13**
L.S.D.	20.50	22.00	12.00	4.00	50.00

The same trend was observed after the third application. The mean numbers of adult varroa mites recovered on sticky boards were 50.52, 87.25, 49.00, 31.50, 31.25, 65.00 and 36.00 in colonies treated with zingiber, santonica, marjoram, clove, caraway, fenugreek and untreated colonies, respectively. The highest number was found in santonica treatment. However, after the fourth application the highest mean number of varroa mite recovered on sticky boards was observed with the treatments of fenugreek (25.00), followed by santonica (20.75) then zingiber (19.75). Colonies treated with clove or caraway had significantly fewer varroa mite when compared with other treatments, i.e. 4.25 and 7.25 mite per board, respectively which was still higher than those collected in untreated colonies i.e. 2.00 mite per board.

Finally, the total mean number of varroa mite recovered on sticky boards after four applications were 166.00, 784.00, 171.25, 236.75, 161.00, 251.25 and 106.50 in colonies treated with zingiber, santonica, marjoram, clove, caraway, fenugreek and untreated colonies, respectively (Figure, 1). However, colonies treated with santonica had significantly more varroa mite on sticky boards than the other treatments or untreated colonies. Also, there was no significant difference between means of colonies treated with clove and fenugreek. There were no significant differences between means of colonies treated with zingiber, marjoram and caraway, but there were significant differences between all the treatments and untreated colonies.



**Fig. (1): Mean numbers of varroa mite recovered on sticky boards during four applications of certain potential watery extracts.**

### **Mortality of Bees**

Treated with the different tested plant extracts did not significantly cause a higher rate of mortality to the bee colony than the normal rate (Table 4). Total mean number of dead bees after treating the colonies four times were 9.75, 8.50, 7.25, 7.50, 9.25, 10.50 and 11.00 in colonies treated with zingiber, santonica, marjoram, clove, caraway, fenugreek and untreated colonies, respectively.

The fore-mentioned study examined plant extracts (that are generally consumed by humans) as miticides therefore little concern about residues in honey bee products. Related compounds are used to manage orthropod pests (Schulz,1993, Sammataro *et al*,1998 and Imdorf *et al*, 1999).

All treatments decreased the number of mites per bee either on adult or on brood after four applications. However, of the tested plants santonica extract proved to be the most effective compound followed by zingiber, marjoram, clove, fenugreek and caraway for reducing varroa mite population in the field trial. There was no indication that any of the compounds had adverse effects on the colonies in this study.

**Table (4) : Mean number of dead bees after treatments with certain botanical watery extracts during September-October 1995 at Ain Shams University (mean ± s.e.).**

Botanical extract	Mean no. of dead bee				
	After 1 <sup>st</sup> application	After 2 <sup>nd</sup> application	After 3 <sup>rd</sup> application	After 4 <sup>th</sup> application	Total
Zingiber	2.75 ± 0.38 ab	2.25 ± 0.38	2.75 ± 0.13	2.00 ± 0.50	9.75 ± 0.19
Santonica	3.50 ± 0.25 ab	1.25 ± 0.38	2.25 ± 0.13	1.50 ± 0.00	8.50 ± 0.51
Marjoram	2.00 ± 0.50 ab	2.25 ± 0.38	1.75 ± 0.38	1.25 ± 0.13	7.25 ± 0.21
Clove	1.50 ± 0.00 b	2.50 ± 0.25	2.00 ± 0.00	1.50 ± 0.25	7.50 ± 0.24
Caraway	3.00 ± 0.25 ab	1.75 ± 0.13	1.75 ± 0.13	2.75 ± 0.38	9.25 ± 0.33
Fenugreek	3.75 ± 0.88 a	1.75 ± 0.13	2.50 ± 0.75	2.50 ± 0.00	10.50 ± 0.41
Untreated	2.75 ± 0.38 ab	2.75 ± 0.38	3.00 ± 0.50	2.50 ± 0.25	11.00 ± 0.10
F value	1.09*	0.43	0.50	0.63	1.19
L.S.D.	1.75				

## REFERENCES

- Arnold, G. (1990) Current and recent research on varroa in Europe. *Am. Bee J.*,130 (4): 257-261.
- Baxter J .R.; F. Eischen, J. Pettis, W T. WUson and H, Shimanuki: (1998) Detection of fluvalinate-resistant varroa mites in U.S. honeybee.*Am. Bee J.*,138: 291.
- Clark, K J. (1990). Field trials comparing vegetable oil and menthol as a control for tracheal mites. *Am. Bee J.*130(12). 799-800.
- Cobey, S. and T. Lawrence (1988). Varroa mite: potential methods of control *Am. BeeJ.*,128 (2): 112-117.
- Eischen, F. A (1998) Varroa;s response to fluvalinate in the western U.S. *Am. Bee. J.*,38(6):439 - 440.
- Hunt, G. J. ( 1998). The war against Varroa: how are we doing?. *A.m. Bee J.*,138 (5). 372-374.
- Imdorf, A.; S. Bogdanove; K. I. Ochoa and N. W. Calderone (1999). Use of essential oils for the control of Varroa jacobsoni Oud. In honey bee colonies. *Apidologie*,30: 209-228.
- Loglio, G. and G. Plebani (1992). Valutazione deli. effecadia dell,Apistan. *Apicoltura Modemo*,83: 95-98.

- Rickli, M.; A. Imdorf and V. Kilchenmann (1991). Treatment of Varroa disease using compounds of essential oils. *Apidologie*,22(4):417-421.
- Riffle, M.S.; G.R. Waller; D.S. Murray and R.P. Sgaramello (1991). Composition of essential oil from *Proboscidea louisianica* (Martyniaceae). *Proceeding of the Oklahoma Academy of Science* 71:35-42.
- Sammataro, D.; H. G. Degrandi; G. Needham and G. Warell (1998) Some volatile oils as potential control agents for varroa mites (Acari:Varroidae) in honey bee colonies. *Am. Bee J.*,138(9): 681-685 .
- Sanford, M. T. (1996) APIS. Apiculture Information and Issues- University of Florida, USA
- Schulz, S, (1993) Treatment of varroasis with essential oils depending on the Apilife/VAR dosage. *Apidologie*,24(5): 497-499.
- Shimanuki, H. and D. A. Knox (2000), Diagnosis of honey bee diseases, United States Department of Agriculture, Agriculture Research Service. Agriculture Handbook Number 690 .

### تقييم فعالية بعض المستخلصات النباتية لمكافحة طفيل الفاروا

عادل محمد البسيوني ، محمد على البنبى ، احمد على جمعة ، محمود عبد السميع محمد على  
قسم وقاية النبات - كلية الزراعة - جامعة عين شمس - شبرا الخيمة - القاهرة - مصر

اجريت هذه الدراسة بمنح كلية الزراعة جامعة عين شمس لتقييم فعالية المستخلصات المائية لكل من الزنجبيل و الشيح البلدى و البردقوش و القرنفل و الكراوية و الحلبة ضد طفيل الفاروا في طوائف نحل العسل التجريبية . اظهرت النتائج المتحصل عليها ان لمستخلصات الشيح البلدى و القرنفل و الحلبة تأثير ابادى للفاروا بينما اعطت مستخلصات كل من الزنجبيل و البردقوش و الكراوية نتائج متوسطة في مكافحة هذا الطفيل . كما لم يثبت وجود اى تأثير سلبى لهذه المستخلصات على نحل العسل المعامل ، حيث لم تتأثر افراد هذه الطوائف ولم يثبت اى تأثير سام لهذه المركبات على النحل.