



CONTROLLING VARROA MITE, *Varroa destructor*, IN HONEY BEE, *Apis mellifera*, COLONIES BY CERTAIN EXTRACTS OF MEDICINAL PLANTS IN NORTH SINAI

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ABSTRACT

The present work was carried out to control Varroa mite, *Varroa destructor*, in three different local districts (Bir El-Abd, El-Arish, and El Sheikh Zuwayd) in North Sinai Governorate, Egypt, during the period between 2018 and 2020. Alternative control methods, *i.e.* using some botanical extracts from certain wild plants *i.e.* Chamomile, (*Matricaria chamomilla*) Sage, (*Salvia officinalis*) and Thyme, (*Thymus vulgaris*). Infestations in brood and on adult honeybees as well as fallen mites were determined. Obtained results showed that, the non-treated colonies had the highest mean percentage of infested drone brood cells, worker brood cells and adult worker bees. Effect of thyme extract compared to sage, or chamomile was particularly remarkable in El-Arish district. Also, the highest number of Varroa mite fallen on the hive bottom board was recorded after the 10th week of treatment. Thyme extract showed the highest effect on the tested mite compared to other extracts.

INTRODUCTION

The ectoparasitic, Varroa mite is considered one of the most destructive pests of honeybees and beekeeping industry all over the world. The infestation of the mite *Varroa destructor* (Anderson and Trueman, 2000). Formerly *Varroa jacobsoni* (Oud.) to Egyptian apiaries is thought to be found in 1987. Epidemic spread of the mite resulted in destroying thousands of bee colonies and reducing colony production to nearly zero in most apiaries (Yousif-Khalil, 1992; Zhang, 2000; Cargel and Rinderer, 2009).

Varroa weakens the immune system of bees and makes them more susceptible to viral and bacterial infections (Yang and Cox-Foster, 2005). The presence of this parasite in the adult bee life alters its behavior to the detriment of its regular duties (Faucon, 2003). Parasitism causes

deformities of young bees, and heavy infestation may cause death before emergence of pupae and the birth of mutilated bees (Boecking and Genersch, 2008). Also, Varroa decreases body weight by about 30% and shortens life expectancy (Bowen-Walker and Gunn, 2001; Murilhas, 2002).

Varroa mite is a highly damaging parasite, if left untreated, nearly 100% of colonies die within two to five years in temperate regions (Saeid, 2012). Several ways for spreading of Varroa mite include robbing behavior and colony drifting and infested swarms (Rademacher, 1991).

Control Varroa mite using some botanical extracts from Certain wild plants, *i.e.* Chamomile, (*Matricaria chamomilla*) Sage, (*Salvia officinalis*) and Thyme, (*Thymus vulgaris*).

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MATERIALS AND METHODS

Locations of the Experiments

The current experiments were conducted at three locations (Bir El-Abd, El-Arish, and El-Sheikh Zuwayed) represent the beekeeping areas within North Sinai Governorate, Egypt. Certain relevant meteorological parameters (obtained from Center Agency for Public Mobilization and Statistics, April, 2020) are shown in Table 1.

Preparation of Plants and Extracts

Certain natural wild plants, widely distributed in north Sinai, were used to control Varroa mite in the experimental apiaries, *i.e.* at Bir El-Abd, El-Arish, and El-Sheikh Zuwayed. Extracts of Chamomile, (*Matricaria chamomilla*) Sage, (*Salvia officinalis*) and Thyme, (*Thymus vulgaris*) were evaluated for their efficiency against the varroa mite.

Extraction applied on the whole plants' organs, that was obtained *via* the percolation method using ethanol 80% and hydroalcohol extracts (4:1 V/V) and followed by evaporation process to form a thickened extract which used as a final extract (Azwanida, 2015).

Honey Bee Colonies

Twelve honey bee (*Apis mellifera*) colonies, hybrid Carniolan Honey Bee, in Langstroth hive, of the same relatively strength (10 combs covered with adult bees from both sides for each colony) were selected and divided into three groups (4 colonies per group).

Any extract of each tested plant was applied through spray of water solution (20 mg extract/L) in the presence of an emulsifier (triton×100) for homogenization. 0.5 liter/colony/week for 12 weeks applied at 7:00 am.

Evaluation of the tested extracts for mite control

Percentage of mites on adult bees as well as in the sealed worker and drone brood

cells was recorded just before treatment and every week after spraying the colony with the prepared extract solution.

The percentage of Varroa mites fallen on the hive ground was recorded by putting a thin wooden plate, covered with thin layer of Vaseline.

At the same time, Varroa mites on adult bee, and area of sealed brood cells were recorded just before treatments and 10 weeks after treatments.

To assess reduction in Varroa mite, infestation before and after treatments were calculated according to the formulation of **Hendirson and Tilton (1955)**:

Infestation in untreated before treatment:

Reduction (%) = $1 - \frac{[\text{Infestation in untreated before treatment} \div \text{Infestation in untreated after treatment} \times \text{Infestation after treatment} \div \text{Infestation before treatment}]}{\times 100}$

Statistical Analysis

All experiments in the present work were completely randomized design. Data were analyzed using SAS program (**SAS Institute, 1989**). The general linear model's procedure to test for differences (alpha = 0.05) and the LSD mean separation tests were used.

RESULTS AND DISCUSSION

Potential Efficacy of Botanical Extracts as Varroa Control Agents

Reduction of mite infestation in drone brood

Concerning the reduction of Varroa mite infestation in drone brood cells, data before and after treating colonies with plant extracts at three apiaries, Bir El-Abd, El-Arish, and El-Sheikh Zuwayed, during the tested period, *i.e.*, July to Sep of 2020, are shown in Table 2.

The non-treated colonies gave the highest mean percentage of infested brood drone cells which ranged from 56.25%, and 66.25% at non-treated weeks (1, and 2) respectively.

Table 1. Annual rates of certain climatic data of tested districts in 2020

District	Climatic zone	Average annual temp. (°C)		Average annual relative humidity (%)	Rainfall (mm)
		Min.	Max.		
Bir El-Abd	Semi-Arid	18.2	31.7	82.8	4.9
El- Arish	Semi-Arid	17.6	31.3	82.4	5.4
El- Sheikh Zuwayed	Semi-Arid	16.5	30.1	80.1	6.9

Table 2. Percentage of infested brood drone cells in colonies treated with different extract plant solutions at Bir El-Abd, El-Arish, and El- Sheikh Zuwayed during 2020 (Mean of infested cells per 100 cells)

Location (L)	Extract P (E)	Weeks of control (W)												Mean
		W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	
L1	E1	57.50	66.25	62.50	58.75	58.75	52.50	47.50	46.25	42.50	37.50	38.75	42.50	50.94
	E2	55.00	62.50	62.50	60.00	62.50	56.25	52.50	48.75	48.75	45.00	45.00	50.00	53.75
	E3	53.75	62.50	61.25	62.50	62.50	56.25	56.25	52.50	52.50	51.25	48.75	55.00	55.63
	Mean	55.42	63.75	62.09	59.17	58.75	55.00	52.09	49.17	47.92	44.59	44.17	49.17	53.44
L2	E1	45.00	55.00	52.50	51.25	50.00	46.25	40.00	36.25	32.50	27.50	28.75	30.00	41.25
	E2	46.25	57.50	57.50	55.00	51.25	48.75	45.00	41.25	37.50	38.76	41.25	40.00	46.67
	E3	53.75	56.25	55.00	53.75	51.25	50.00	51.25	50.00	48.75	47.50	45.00	43.75	50.52
	Mean	48.34	56.25	55.00	53.34	50.84	48.34	45.42	42.50	39.59	37.92	38.34	37.92	46.15
L3	E1	68.75	81.25	81.25	80.00	75.00	68.75	67.50	55.00	53.75	48.75	51.25	55.00	65.52
	E2	60.00	76.25	73.75	66.25	63.75	62.50	57.50	57.50	52.50	52.50	52.50	57.50	61.04
	E3	66.25	78.72	77.50	75.00	75.00	72.50	73.75	71.25	68.75	68.75	67.50	73.75	72.19
	Mean	65.00	78.75	77.50	73.75	71.25	67.92	66.29	61.25	58.34	59.67	57.09	61.25	66.25
	G. Mean	56.25	66.25	64.86	62.09	60.28	57.09	54.59	50.97	48.61	46.39	46.53	49.45	
		Mean of extract plant (E)												
	E1	57.09	67.50	65.42	63.34	61.25	55.84	51.67	54.84	42.92	37.92	39.59	42.50	52.71
	E2	53.75	65.42	64.59	60.42	57.92	55.84	51.67	49.17	46.25	45.42	46.25	49.17	53.82
	E3	57.92	65.84	64.59	62.50	61.67	59.59	60.42	57.92	56.67	55.84	53.75	56.67	59.45
	LSD 0.05	L=2.25	E=2.25	W=4.2	LE=3.9	LW=NS	EW=NS	LEW=NS						
	F. Value	L=114	E=14.8	W=15.4	LE=3.4	LW=0.16	EW=1.5	LEW=0.13						

L₁= Bir El-Abd L₂= El-Arish L₃= El-Sheikh Zuwayed E₁= thyme extract E₂= sage extract E₃= chamomile extract

Application of control program which started from the 3rd week under any extract plant solution caused decreases in level of Varroa infection which ranged from 1.55% after the third week by L₃E₃W₃ 77.50% which is a rather moderate decrease due to spraying with chamomile, to as high as 50% by L₂E₁W₁₀ (27.50%) indicating a considerable increase due to thyme spray in

El-Arish after the end of the tenth week of control, which indicates an increase in the effect of extracts solution on reducing of Varroa infection, as it decreased infection by (15.19%), (30.57%) and (43.82%) under influence of chamomile (55.84%), sage (54.42%), and thyme (37.92%), respectively compared with the non-treated colonies.

Main effects

The main effects of L, E and W showed decreases in means percentage of infested brood drone cells by applying program of control in any location with spraying the extract solutions.

Application of alternative control under the three apiaries conditions decreased reduction in infestation by averages of (30.34%) in El-Arish (L₂) (46.15%) and (19.34%) in Bir El-Abd (L₁) (53.44%) comparing with El-Sheikh Zuwayed (L₃) (66.25%). Application of alternative control with using thyme extract (E₁) (52.71%) gave increases averaging (2.11%) and (12.79%) comparing with sage (E₂) (53.82%), chamomile (E₃) (59.45%). Superiority the 10th week (46.39%) over all the weeks of control by reduction average (28.48%) comparing with the 3rd week (64.86%).

Interaction effects

LE: The greater effect of thyme extract over sage, and chamomile was particularly marked where in El-Arish was present; and the higher reduction of infestation after end of the 10th week over all weeks of control was particularly evident where gave high significant effect.

LW, and EW: There were no interaction effects indicating that the effect of any is independent of the effect of the other.

Assessment in this respect, **Abd El-Wahab and Ebada (2006)** used different concentrations (25, 50 and 100%) of *Citrus aurantium* L. (Sour Orange), *Cymbopogon flexuosus* (Lemon grass) and Citronella volatile oils and Mavrik against Varroa mites in honey bee colonies. The percentage of infestation by Varroa mites on worker brood and adult workers, number of dead Varroa fallen on the sheet and amount of brood rearing were determined in the tested colonies. The highest concentrations (100%) of tested volatile oils were highly effective in controlling *Varroa mites*. The mean percentage of *Varroa mites* on the

worker brood and adult workers reduced to 100% after the fourth week of treatment with *Citrus aurantium* L. (Sour Orange), *Cymbopogon flexuosus* (Lemon grass) and after the third week of treatment with Citronella oils. Mavrik strips caused highest reduction of Varroa in the worker brood cells. The highest concentrations of tested volatile oils caused highly amount of sealed worker brood particularly in Citronella oil as well as in Mavrik strips.

Reduction of Mite Infestation in Worker Brood

Concerning the reduction of Varroa mite infestation, in brood worker cells treated with different extract plant solutions at three apiaries, the results in Table 3 point to the number of infested brood worker cells in Bir El-Abd, El-Arish, and El-Sheikh Zuwayed cities during the period from July to September in 2020.

The non-treated colonies gave the highest mean percentage of infested brood worker cells which ranged from 40.28%, and 44.59% at weeks 1, and 2 respectively. Application of control program under any extract plant solution caused decreases in level of Varroa infection which ranged from 2.70% after the third week by L₁E₃W₃ (45%) which is a rather moderate decrease due to spraying with chamomile, to as high as 48.39 % by L₂E₁W₁₀ (20%) indicating a considerable increase due to thyme spray in El-Arish after the end of the tenth week of control, which indicates an increase in the effect of extracts solution on reducing of Varroa infection, as it decreased Infection by (17.28%), (29.25%) and (47.66%) under influence of chamomile (37.92%), sage (31.25%), and thyme (23.34%), respectively comparing with the non-treated colonies.

Main effects

The main effects of L, E and W showed decreases in means percentage of infested brood worker cells by applying program of control in any location with spraying the extract solutions. Application of alternative

Table 3. Percentage of infested brood worker cells in colonies treated with different extract plant solutions at Bir El-Abd, El-Arish, and El- Sheikh Zuwayed located during 2020 (Mean of infested cells per 100 cells)

Location (L)	Extract P (E)	Weeks of control (W)												Mean
		W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	
L1	E1	36.25	45.00	45.00	40.00	36.26	38.75	32.50	28.75	32.50	25.00	28.75	31.25	34.17
	E2	38.75	45.00	45.00	34.75	42.50	40.00	40.00	35.00	35.00	31.25	35.00	36.25	38.96
	E3	38.75	46.25	45.00	34.75	41.25	42.50	40.00	37.50	37.50	36.25	40.00	40.00	40.93
	Mean	37.92	45.42	45.00	42.50	40.00	38.75	37.50	33.75	33.34	30.84	34.56	35.84	37.95
L2	E1	37.50	38.75	37.50	35.00	32.50	26.25	23.50	21.25	18.75	20.00	21.25	22.50	27.92
	E2	37.50	38.75	37.50	37.50	35.00	33.75	33.75	33.75	31.25	31.25	33.75	35.00	34.90
	E3	36.25	40.00	40.00	38.75	37.50	36.25	35.00	35.00	35.00	36.25	36.25	41.25	37.29
	Mean	37.09	39.17	38.34	37.09	35.00	32.09	30.84	30.00	28.34	29.17	30.42	32.92	33.37
L3	E1	45.00	50.00	48.75	48.75	47.50	43.75	41.25	36.25	32.50	25.00	25.00	30.00	39.69
	E2	45.00	48.75	47.50	45.00	43.75	41.25	37.50	37.50	37.50	31.25	33.75	36.25	40.42
	E3	47.50	48.75	48.75	48.75	36.25	36.25	43.75	43.75	45.00	41.25	43.75	46.25	45.40
	Mean	45.84	49.17	48.34	47.50	46.25	44.17	40.84	39.17	38.34	32.50	35.00	37.50	42.05
G. Mean		40.28	44.59	43.89	42.36	40.42	38.37	36.39	34.31	33.34	30.84	33.34	35.42	
Mean of extract plant (E)														
	E1	39.59	44.59	43.75	41.25	38.75	34.59	32.50	28.75	26.25	23.34	25.84		33.93
	E2	40.42	44.17	43.34	42.09	40.42	38.34	37.09	35.42	34.59	31.25	34.17		38.09
	E3	40.84	45.84	44.59	43.75	42.09	42.09	39.59	38.75	34.17	37.92	40.00		41.36
	LSD 0.05	L=3.85		E=3.85		W=3.05		LE=NS		LW=NS		EW=5.35		LEW=NS
	F. Value	L=7.01		E=5.15		W=12.28		LE=0.35		LW=0.56		EW=1.67		LEW=0.20

L₁= Bir El-Abd L₂= El-Arish L₃= El-Sheikh Zuwayed

control under the three apiaries conditions decreased reduction in infestation by averages of (20.64%) in El-Arish (L₂) (33.37%) and (9.75%) in Bir El-Abd (L₁) (37.95%) comparing with El-Sheikh Zuwayed (L₃) (42.05%). Application of alternative control with using thyme extract (E₁) (33.93%) gave increases averaging (12.26%) and (21.90%) comparing with sage (E₂) (38.09%), chamomile (E₃) (41.36%). Superiority the 10th week (30.84%) over all the weeks of control by reduction average (29.73%) comparing with the 3rd week (43.89%).

Interaction effects

LE, and LW: There were no interaction effects indicating that the effect of any is independent of the effect of the other.

E₁= thyme extract E₂= sage extract E₃= chamomile extract

EW: The greater effect of thyme extract over sage, and chamomile was particularly

marked where in El-Arish was present; and the higher reduction of infestation after end of the 10th week over all weeks of control was particularly evident where gave high significant effect.

Assessment in this respect, **Al-Abbadi and Nazer (2003)** studied the effect of several volatile plant oils, plant materials and fluvalinate (Apistan) strips on the control of the mite, *V. destructor* infesting honey bee (*A. mellifera*) colonies. The volatile oils were: Clove, Lavender, Peppermint, Sage and Thyme. The plant materials were Cumin 'fruits, Eucalyptus leaves and worm wood flowers. For each tested material, 3 treatment periods were carried out. Each period lasted for 24 days followed by 8 days of no treatment, within each treatment period, and average of 3-6 treatment were applied. Dead mites were counted one hour before and after each treatment. An increase in dead mites was recorded during the 3 treatment periods

indicating that the worm wood flowers, peppermint oil and clove oil treatments were effective in the control of *V. destructor*, though not significantly different than the control. The overall increase in the dead mites was 3.92, 3.62 and 3.34 fold, respectively.

Reduction of Mite Infestation on Adult Bees

Concerning the reduction of Varroa mite infestation, on adult worker bees treated with different extract plant solutions at three apiaries, the results in Table 4 are bees in Bir El-Abd, El-Arish, and El-Sheikh Zuwayed during the period from July to September in 2020.

The non-treated colonies gave the highest mean percentage of infested on adult worker bees which ranged from 27.06%, and 31.39% at weeks 1, and 2 respectively. Application of control program under any extract plant solution caused decreases in level of Varroa infection which ranged from (1.70%) after the third week by L₁E₃W₃ (29%) which is a rather moderate decrease due to spraying with chamomile, to as high as 42.86% by L₂E₁W₁₀ (14%) indicating a considerable increase due to thyme spray in El-Arish after the end of the 10th week of control, which indicates an increase in the effect of extracts solution on reducing of Varroa infection, as it decreased infection by (16.21%), (25%) and (34.42%) under influence of chamomile (26.67%), sage (23.50%), and thyme (20.33%), respectively comparing with the non-treated colonies.

Main effects

The main effects of L, E and W showed decreases in means percentage of infested on adult worker bees by applying program of control in any location with spraying the extract solutions. Application of alternative control under the three apiaries conditions decreased reduction in infestation by averages of 45.34% in El-Arish (L₂) (20.17%) and 33.01% in Bir El-Abd (L₁) (24.72%) comparing with El-Sheikh Zuwayed (L₃) (36.90%). Application of

alternative control with using thyme extract (E₁) (25.71%) gave increases averaging (5.17%) and (12.80%) comparing with sage (E₂) (27.04%), chamomile (E₃) (29%). Superiority the 10th (23.50%) week over all the weeks of control by reduction average (24.34%) comparing with the 3rd week (31.06%).

Interaction effects

LE, LW and EW: There were no interaction effects indicating that the effect of any is independent of the effect of the other.

Assessment in this respect, **Abu-Lila and Amany (2006)** evaluated some non-traditional methods for controlling *V. destructor* as ectoparasite mite in honeybee colonies. She recorded the infestation levels of *Varroa mite* in brood cells and on adult bees in colonies treated with botanical aqueous extracts of Thyme, Ginger and worm wood plants and in colonies treated with crude oils of marjoram, clove, cedar wood and mint plants. Then, the results were compared with those obtained from untreated colonies and those given from colonies treated with Mavrik as a traditional acaricide recommended for controlling Varroa mite. The results obtained showed that the average reductions of brood infestation with Varroa mite reached 81.29, 75.01 and 87.60 % after using thyme, ginger and worm wood, respectively as plant extracts for 28 days in infested hives. While the reduction rates were 81.27, 70.90, 66.80 and 73.80 % after using marjoram, clove, cedar wood and mint oils, respectively. Reduction reached 81.29 % after using the acaricide Mavrik.

Varroa Fallen on the Hive Bottom Board

Concerning the reduction in number of Varroa mite which, fallen on the bottom board treated with different extract plant solutions at three apiaries, the results in Table 5 point to the number of *Varroa destructor* fallen on the bottom board in Bir

Table 4. Percentage of infested of adult workers in colonies treated with different extract plant solutions at Bir El-Abd, El-Arish, and El- Sheikh Zuwayed located during 2020 (Mean numbers of mites on 100 adult bees).

Location (L)	Extract P (E)	Weeks of control (W)												Mean	
		W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12		
L1	E1	28.50	29.50	29.00	29.00	27.50	25.00	25.00	22.50	20.00	17.00	18.00	19.00	24.08	
	E2	24.00	31.50	31.00	29.50	28.00	25.50	24.00	23.50	21.50	20.50	21.00	18.50	24.88	
	E3	26.00	29.50	29.00	28.00	26.00	25.00	24.50	22.50	23.00	22.50	22.50	24.00	25.21	
	Mean	26.17	30.17	29.67	28.83	27.17	20.17	24.17	22.83	21.50	20.00	20.50	20.50	24.72	
L2	E1	23.50	24.50	24.00	23.00	22.00	18.50	18.00	16.00	16.00	14.00	13.50	14.50	18.96	
	E2	19.50	23.00	22.50	22.00	22.00	19.50	19.00	18.50	18.00	17.00	18.00	19.00	19.83	
	E3	22.50	24.50	24.50	23.50	23.00	21.50	20.50	20.00	20.00	19.00	20.00	21.50	21.71	
	Mean	21.83	24.00	23.67	22.83	22.33	19.83	19.17	18.17	18.00	16.67	17.17	18.33	20.17	
L3	E1	31.50	39.00	38.50	37.50	37.50	36.00	35.00	32.50	32.00	30.00	30.00	31.00	34.21	
	E2	32.50	39.50	39.50	38.50	38.50	36.50	35.50	35.50	38.50	33.00	35.50	36.00	36.42	
	E3	35.50	41.50	41.50	42.00	42.50	41.50	41.00	40.00	39.50	38.50	38.50	39.00	40.08	
	Mean	33.17	40.00	39.83	39.33	39.50	38.00	37.17	36.00	36.00	33.83	34.67	35.33	36.90	
G. Mean		27.06	31.39	31.06	30.33	29.67	27.67	26.83	25.67	25.17	23.50	24.11	24.72		
Mean of extract plant (E)															
	E1	27.83	31.00	30.50	29.83	29.00	26.50	25.67	23.67	22.67	20.33	20.50	21.50	25.71	
	E2	25.33	31.33	31.00	30.00	29.50	27.17	26.17	25.83	25.33	23.50	24.83	24.50	27.04	
	E3	28.00	31.83	31.67	31.17	30.50	29.33	28.67	27.50	27.50	26.67	27.00	28.17	29.00	
	LSD 0.05	L=1.4		E=1.4		W=2.26		LE=NS		LW=NS		EW=NS		LEW=NS	
	F. Value	L=213		E=7.61		W=8.24		LE=1.46		LW=0.63		EW=0.59		LEW=0.10	

L₁= Bir El-Abd L₂= El-Arish L₃= El-Sheikh Zuwayed E1= thyme extract E2= sage extract E3= chamomile extract**Table 5. Percentage of *V. destructor* fallen on the bottom board after treating the colonies treated with different extract plant solutions at Bir El-Abd, El-Arish, and El-Sheikh Zuwayed located during 2020 (Mean numbers/colony)**

Location (L)	Extract P (E)	Weeks of control (W)												Mean	
		W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12		
L1	E1	10.25	11.50	11.50	13.00	14.25	18.50	21.25	24.25	25.25	28.25	28.75	29.75	19.71	
	E2	9.25	11.50	11.75	13.25	15.25	17.25	20.50	23.25	25.00	25.75	27.00	28.50	19.02	
	E3	11.25	11.25	12.50	14.00	14.50	15.75	16.50	17.00	18.25	20.25	20.00	21.25	16.04	
	Mean	10.25	11.42	11.92	13.42	14.67	17.17	19.42	21.50	22.83	24.75	25.25	26.50	18.26	
L2	E1	9.75	10.75	11.50	12.75	15.00	18.00	19.75	22.50	26.50	28.50	29.25	30.50	19.56	
	E2	9.50	11.50	10.75	12.50	14.75	18.00	20.50	21.50	23.00	25.25	26.50	28.75	18.54	
	E3	8.50	9.25	9.75	9.75	10.25	13.00	14.50	15.00	17.25	18.50	18.75	19.75	13.69	
	Mean	9.25	10.50	10.67	11.67	13.33	16.33	18.25	19.67	22.25	24.08	24.83	26.33	17.26	
L3	E1	15.25	17.00	18.00	20.50	21.25	23.00	27.25	30.75	34.25	37.00	37.00	37.75	26.63	
	E2	18.75	19.00	19.75	22.00	23.50	25.75	26.25	28.00	31.25	33.25	34.00	34.50	26.33	
	E3	13.50	13.75	13.50	16.00	16.75	15.75	17.25	19.75	21.75	22.75	24.00	26.00	18.40	
	Mean	15.83	16.58	17.08	19.50	20.50	21.67	23.58	26.17	29.08	31.00	31.67	32.75	23.79	
G. Mean		11.78	12.83	13.22	14.86	16.17	18.39	20.42	22.44	24.72	26.61	27.25	28.53		
Mean of extract plant (E)															
	E1	11.75	13.08	13.67	15.42	16.83	20.00	22.75	25.83	28.67	31.25	31.67	32.67	21.97	
	E2	12.50	14.00	14.08	15.92	17.83	20.33	22.42	24.25	26.42	28.08	29.17	30.58	21.30	
	E3	11.08	11.42	11.92	13.25	13.83	14.83	16.08	17.25	19.08	20.50	20.92	22.33	16.04	
	LSD 0.05	L=1.21		E=1.21		W=1.19		LE= NS		LW=NS		EW=2.06		LEW=NS	
	F. Value	L=46.5		E=39.6		W=144		LE=2.43		LW=0.30		EW=5.35		LEW=0.31	

L₁= Bir El-Abd L₂= El-Arish L₃= El-Sheikh Zuwayed E1= thyme extract E2= sage extract E3= chamomile extract

El-Abd, El-Arish, and El-Sheikh Zuwayed cities during the period from July to September in 2020.

The non-treated colonies gave the lowest mean number of *Varroa destructor* fallen on the bottom board which ranged from 11.78%, and 12.83% mite at weeks 1, and 2 respectively. Application of control program under any extract plant solution caused increases in numbers of Varroa mite which ranged from (11.11%) after the third week by L₁E₃W₃(12.50%) which is a rather moderate increase due to spraying with chamomile, to as high as (165.12%) by L₂E₁W₁₀ (28.50%) indicating a considerable increase due to thyme spray in El-Arish after the end of the 10th week of control, which indicates an increase in the effect of extract solutions on increasing numbers of Varroa mite, as it increased numbers by (79.51%), (100.57%) and (138.91%) under influence of chamomile (20.50%), sage (28.08%), and thyme (31.25%), respectively comparing with the non-treated colonies.

Main effects

The main effects of L, E and W showed increases in numbers of *Varroa destructor* fallen on the bottom board by applying program of control in any location with spraying the extract solutions. Application of alternative control under the three apiaries conditions decreased the numbers of Varroa mite fallen on the bottom board by averages of (37.83%) in El-Sheikh Zuwayed (L₃) (23.79%) and (5.79%) in Bir El-Abd (L₁) (18.26%) comparing with El-Arish (L₂) (17.26%). Application of alternative control with using thyme extract (E₁) (31.25%) gave increases averaging (3.15%) and (36.97%) comparing with sage (E₂) (28.08%), chamomile (E₃) (20.50%). Superiority the 10th week (26.61%) over all the weeks of control by increasing average (101.29%) comparing with the 3rd week (13.22%).

Interaction effects

LE, and LW: There were no interaction effects indicating that the effect of any is independent of the effect of the other.

EW: The greater effect of thyme extract over sage, and chamomile was particularly marked where in El-Sheikh Zuwayed was present; and the higher number of Varroa mite fallen on the bottom board after end of the 10th week over all weeks of control was particularly evident where gave high significant effect.

Assessment in this respect, **Melathopoulos *et al.* (2000)** found that spraying Neem oil on bees was more effective for controlling *V. jacobsoni* than feeding oil in a sucrose based matrix (patty) feeding Neem-Aza in syrup or spraying Canola oil. Only Neem oil provided *V. jacobsoni* control comparable to the known Varroa acid, Formic acid, but it was not as effective as the synthetic product Apistan (tau-Fluvalinate). On the other hand,- Neem oil spray treatments had no effect on adult honey bee population, but treatments reduced the amount of sealed brood in colonies by 50% and caused queen loss at higher doses.

El-Bassiouny *et al.* (2004) suggested that Varroa infestation levels up to 0.12 mites/bee (12% infestation) would keep wintering colony and forward for performance the following spring. **Branco *et al.* (2006)** stated that estimation of *V. destructor* population size in honeybee colonies was an important tool to implement integrated control practices. Three sampling methods were studied simultaneously to estimate the size of mite population: killing the mites with an acaridae. **Mahmoud (2005)** used Thymol, mixtures of Thymol and Santonica, Eucalyptus, Peppermint, Formic acid, Lactic acid, Apistan and Mavrik for controlling Varroa mite infestation in honey bee colonies in Egypt. She found that the reduction of the Varroa infestation reached,

Apistan (77.1%), mixture of Thymol and Santonica (62.9%), Mavrik (54.5%), Formic acid (47.0%), Eucalyptus (38.5%), Lactic acid (33.0%) and Peppermint (28%).

Abu-Lila, and Amany (2006) showed that the average reductions of brood infestation with *Varroa* mite reached 81.29, 75.01 and 87.60 % after using thyme, ginger and worm wood, respectively as plant extracts for 28 days in infested hives. While the reduction rates were 81.27, 70.90, 66.80 and 73.80 % after using marjoram, clove, cedar wood and mint oils, respectively. Reduction reached 81.29 % after using the acaricide Mavrik.

Conclusion

The greater effect of thyme extract over sage, and chamomile was particularly marked where in El-Arish was present; and the higher reduction of infestation after end of the 10th week over all weeks of control was particularly evident where gave high significant effect.

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المخلص العربي

مكافحة طفيل الفاروا في خلايا نحل العسل باستخدام بعض المستخلصات النباتية في شمال سيناء

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أجريت تجربة عملية لدراسة تأثير ثلاث مستخلصات نباتية برية على حلم الفاروا المدمر كأحد التحديات الرئيسية لتربية النحل تحت تأثير الظروف المناخية لثلاث مناطق مختلفة بكل من بئر العبد، العريش، الشيخ زايد، بمحافظة شمال سيناء - مصر. مع تطبيق واحدة من طرق مكافحة البديلة باستخدام محاليل بعض المستخلصات النباتية الطبيعية والمتوفرة بمنطقة الدراسة وهي لنباتات: البابونج والمريمية والزعتر بإضافة 20 مجم/لتر ماء، وذلك لتقييم كفاءة هذه المستخلصات لمكافحة الزيادة في انتشار الفاروا على الخلايا في عيون الحضنة المغطاة (ذكور وشغالات) وعلى الشغالات البالغة، فضلاً عن أعداد الفاروا المتساقطة على اللوح السفلي بأرضية الخلية. أظهرت النتائج أن معاملات الكنترول (غير معاملة بمستخلصات النباتية) سجلت أعلى نسبة إصابة في حضنه الذكور، وحضنة الشغالات والشغالات البالغة كما وجد أن التأثير العالي كان لمستخلص الزعتر مقارنة بالمريمية والبابونج، حيث كان ملاحظاً بشكل خاص في منطقتي العريش وبئر العبد مقارنة بمنطقة الشيخ زايد. كما أن الانخفاض العالي في الإصابة لوحظ بعد نهاية الأسبوع العاشر من تطبيق المعاملة، حيث أعطت نتائج أعلى تأثير معنوي مقارنة بالأسبوعين؛ الأول والثاني.

الكلمات الإسترشادية: أكاروس الفاروا، نحل العسل، مكافحة البديلة، المستخلصات النباتية.

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