

RESULTS AND DISCUSSION

RESULTS AND DISCUSSIONS

Part (1): Population dynamics and seasonal fluctuations of Varroa mites

The population of the ecto-parasitic mite, *Varroa destructor*, infesting honeybee colonies was studied in three regions of Beni-Sweif Governorate during 22/12/2003 to 22/12/2004. The Varroa population dynamics inside sealed worker and drone brood as well as adult worker honeybees were determined. The fallen dead Varroa mites were also estimated on the board sheet of the hives.

A. Beni-Sweif City region

1- Varroa infestation (%) in sealed worker brood

It could be found that Varroa infestation levels in worker brood cells were reversely proportional to temperature and relative humidity . results were as follows:

Mean infestation were 16% in autumn (at 21.5°C and 50.5 RH); 17.2% in winter (at 17.35°C and 51.31 RH); 8.86% in spring season (at 28.94 °C and 40.93 RH), However in summer season infestation was 3.1% with temperature 28.14 °C and RH 49.86 respectively. This was shown to be reversely proportional to worker brood area as in Table (1) and Fig. (1).

2- Varroa infestation (%) in sealed drone brood

In natural Varroa infestation levels of honeybee colonies, there were clearly statistical regression attributed to environmental surroundings of the colonies particularly

temperature relative humidity variations as shown in Table (1). The Varroa infestation during winter, spring, summer and autumn were 26.56%, 12.86%, 14.50% & 32% respectively in sealed drone brood honeybees.

3- Varroa infestation (%) in adult workers

Presented data in Table (1) showed relationship between Varroa infestation level and season of the year. Late winter consider Varroa population activities period, it recorded the highest Varroa infestation level reaching up to 27.67% with 15.75°C and 54.5 RH. However the Varroa infested honeybee colonies was approaching the winter levels in late autumn season particularly in non-controlled one.

4- Fallen dead Varroa mites

The mean numbers of Varroa fallen on the white board sheet was related with infested worker brood rate the temperature degrees and humidity percentage. When the infestation levels were 16.29, 14.33, 18.19 & 2.62% during winter, autumn, spring and summer seasons of the year 2004 the mean Varroa fallen were 34.21, 34.95, 14.00 & 17.86 mites/colony respectively.

The mean number of highest Varroa mites fallen in late autumn, 2004 was 54.33 mites/colony particularly at 21/12/2004 when temperature was 15.75°C at relative humidity 54.5%. The lowest number of fallen Varroa in late spring and summer seasons, 2004 was 6.67 mites/colony at 9/6 & 26/8/2004 with 31.10, 27.90°C & 43.00, 53.00 RH respectively.

Table (1): Population dynamics and *Varroa destructor* infestation level percentages at Beni-Sweif City region, Beni-Sweif Governorate during 2004

Date	Temp. (°C)	Relative Humidity (%)	Infestation level (%)			Mean No. of Fallen Varroa	Strength of colony		
			WB	DB	AW		Area of sealed brood (inch ²)		No. of comb covered with bees
22-4/12/ (2003)	14.75	52.00	20.67	—	21.67	42.67	140.00	—	6.00
4-6/1/ 2004	16.00	45.50	17.67	—	19.33	52.67	250.00	—	6.00
17-19	14.95	58.50	16.67	15.67	18.33	19.33	480.00	3.00	6.00
30/1-1/2	17.55	47.50	17.67	20.33	18.00	27.33	750.00	6.00	6.00
12-14/2	16.70	57.00	18.67	20.67	17.00	30.33	770.00	7.00	6.33
25-27	19.80	48.50	16.33	33.33	12.67	39.67	850.00	7.00	6.67
9-11/3	17.90	52.50	17.67	35.67	12.00	19.33	970.00	15.00	7.00
22-24/3	21.15	49.00	12.33	33.67	11.33	42.33	980.00	23.00	7.00
Mean	17.35	51.31	17.21	26.56	16.29	34.21	648.75	10.17	6.38
4-6/4	20.80	52.50	11.67	21.33	11.00	19.33	1000.00	22.00	8.00
17-19/4	24.30	48.50	10.33	18.33	10.67	16.67	1050.00	20.00	8.67
30/4-2/5	23.90	49.00	9.33	12.33	8.33	6.67	1250.00	18.00	8.67
13-15/5	36.00	28.50	10.33	11.33	8.00	12.33	1350.00	16.00	9.00
26-28/5	36.00	21.00	8.33	10.67	7.33	7.67	1400.00	11.00	9.00
8-10/6	31.10	43.00	6.67	8.33	6.33	6.67	1500.00	9.00	9.33
21-23/6	30.50	44.00	5.33	7.67	5.67	28.67	1650.00	7.00	9.67
Mean	28.94	40.93	8.86	12.86	8.19	14.00	1314.29	14.71	8.91
4-6/7	30.60	48.00	4.67	—	4.33	9.67	1750.00	—	9.67
17-19/7	30.65	55.00	4.67	—	4.00	9.33	1800.00	—	9.67
30/7-1/8	27.35	47.00	2.33	—	2.33	6.67	1800.00	—	10.00
12-14/8	28.65	50.50	1.67	—	1.00	6.67	1850.00	—	10.00
25-27/8	27.90	53.00	1.33	—	0.67	6.67	1850.00	—	9.67
7-9/9	29.20	48.00	2.67	6.33	2.33	8.67	1750.00	5.00	9.67
20-22/9	22.65	47.50	4.33	22.67	3.67	7.33	1600.00	7.00	8.67
Mean	28.14	49.86	3.10	14.50	2.62	7.86	1771.43	6.00	9.62
3-5/10	26.50	48.00	4.00	30.33	4.00	42.67	1450.00	5.00	8.00
16-18/10	27.00	50.50	5.67	33.67	4.67	33.33	1400.00	2.00	8.00
29-31/10	24.55	50.00	11.33	—	8.33	24.67	1100.00	—	7.33
11-13/11	25.80	45.00	17.67	—	13.33	15.33	900.00	—	7.00
24-26/11	14.30	48.00	21.67	—	19.67	28.00	700.00	—	7.00
7-9/12	16.60	57.50	23.33	—	22.67	46.33	350.00	—	7.00
20-22/ 12/(2004)	15.75	54.50	28.33	—	27.67	54.33	150.00	—	7.00
Mean	21.50	50.50	16.00	32.00	14.33	34.95	865.71	3.50	7.33

WB= Worker brood

DB= Drone brood

AW= Adult worker

Results and Discussion

B. Ihnasia El-Madina Region

1- Varroa infestation (%) in sealed worker brood

It was remarkable that the higher % of Varroa infestation level in worker brood cells particularly during winter and autumn seasons was followed by fall in spring and summer seasons. They recorded as 17.3%, 14.72%, 8.19% & 2.52%, respectively, this is shown in Table (2).

2- Varroa infestation (%) in sealed drone brood

Data presented in Table (2) showed that the higher infestation level in sealed drone brood recorded 33.33% in February 2004 related with 19.8°C & 48.5 RH. The lowest level was 4.33% in June, 2004 with mean 30.5°C and 44 RH.

Generally the higher infestation level recorded in the year 2004 was at autumn and winter seasons, related with the lower temperature and relative humidity percentage, while the higher one was recorded at spring and summer seasons when temperature and relative humidity are higher.

3- Varroa infestation (%) on adult worker

There were strong relationship between temperature, relative humidity and Varroa infestation level and this was related to maximum infestation level which recorded during 2004. It was 25.33% for the first record and 22.67% for the second. While the lowest peak recorded during august 2004 was 0.67%.

4- Fallen dead Varroa mites

According to data presented in Table (2), the mean number of Varroa mites fallen on white board sheet during winter and autumn 2004 were 24.17 & 20.43 mites /colony, while the lowest value was 4.38 mites /colony during summer season.

Table (2): Population dynamics and *Varroa destructor* infestation level percentages at Ihnasia El-Madina region, Beni-Sweif Governorate during 2004

Date	Temp. (°C)	Relative Humidity (%)	Infestation level (%)			Mean No. of Fallen Varroa	Strength of colony		
			WB	DB	AW		Area of sealed brood (inch ²)		No. of covered comb
22-24/12/ (2003)	14.75	52.00	19.67	--	20.00	23.67	150.00	--	6.00
4-6/1/2004	16.00	45.50	18.67	--	19.00	21.33	300.00	--	6.00
17-19	14.95	58.50	15.00	10.00	17.00	29.67	680.00	4.00	6.00
30/1-1/2	17.55	47.50	17.33	15.00	16.33	19.67	850.00	6.00	6.00
12-14/2	16.70	57.00	17.33	21.67	16.00	29.33	900.00	7.00	6.00
25-27	19.80	48.50	18.00	33.33	12.33	27.67	940.00	7.00	6.33
9-11/3	17.90	52.50	17.33	30.33	11.00	18.67	1100.00	5.00	6.67
22-24/3	21.15	49.00	13.67	21.67	9.33	23.33	1100.00	25.00	7.67
Mean	17.35	51.31	17.13	22.00	15.12	24.17	752.50	9.00	6.33
4-6/4	20.80	52.50	11.00	15.33	8.33	29.33	1200.00	20.00	8.00
17-19/4	24.30	48.50	10.33	15.67	6.67	22.67	1200.00	20.00	9.00
30/4-2/5	23.90	49.00	8.67	10.67	7.00	27.67	1250.00	17.00	9.00
13-15/5	36.00	28.50	10.33	12.33	6.67	13.33	1300.00	14.00	9.33
26-28/5	36.00	21.00	7.33	8.67	4.33	11.67	1400.00	10.00	9.33
8-10/6	31.10	43.00	5.33	7.67	3.33	13.67	1500.00	8.00	9.67
21-23/6	30.50	44.00	4.33	4.33	3.00	7.67	1700.00	5.00	9.67
Mean	28.94	40.93	8.19	4.71	5.62	18.00	1364.29	13.43	9.14
4-6/7	30.60	48.00	3.33	---	2.67	5.33	1700.00	---	10.00
17-19/7	30.65	55.00	3.00	---	1.33	2.67	1800.00	---	10.00
30/7-1/8	27.35	47.00	2.67	---	0.67	1.00	1850.00	---	10.00
12-14/8	28.65	50.50	1.33	---	0.67	2.67	1800.00	---	10.00
25-27/8	27.90	53.00	1.67	---	1.00	7.33	1800.00	---	10.00
7-9/9	29.20	48.00	2.67	7.00	1.00	6.33	1750.00	5.00	10.00
20-22/9	22.65	47.50	3.00	10.33	6.67	5.33	1750.00	6.00	9.33
Mean	28.14	49.86	2.52	8.67	2.00	4.38	1778.57	5.50	9.90
3-5/10	26.50	48.00	4.67	20.67	7.33	11.33	1500.00	5.00	9.33
16-18/10	27.00	50.50	5.67	30.33	8.67	11.33	1500.00	3.00	8.33
29-31/10	24.55	50.00	9.33	---	13.33	15.67	1000.00	---	8.33
11-13/11	25.80	45.00	16.67	---	17.33	19.33	600.00	---	7.33
24-26/11	14.30	48.00	18.67	---	18.67	33.33	500.00	---	7.00
7-9/12	16.60	57.50	22.33	---	22.67	29.33	300.00	---	7.00
20-22/12/ (2004)	15.75	54.50	25.67	---	25.33	22.67	140.00	---	6.33
Mean	21.50	50.50	14.72	25.50	16.19	20.43	791.43	4.00	7.66

WB= Worker brood

DB= Drone brood

AW= Adult worker

Results and Discussion

C. Sids Al-Omaraa region

1- Varroa infestation (%) in seabed worker brood:

It could be remarked that during winter and autumn 2004 the highest Varroa infestation level reached to 15.83% and 13.1% with 21.50°C, 50.5 RH at 17.35°C, 51.31 RH, while the lowest values were recorded at summer and spring seasons were 2.52%, 7.57% respectively with 28.14°C, 49.86 RH & 28.94°C, 40.93 RH, respectively (Table 3).

2- Varroa infestation (%) in sealed drone brood

Drone honeybees which reared at late winter, rapidly increase and so their activities surge at late winter and spring. The probability of Varroa infestation level increase as drone brood area increase and can amount to 22% as shown in Table (3).

3- Varroa infestation (%) on adult worker

For the year 2004; presented data in Table (3) showed that all the tested apiaries infested with Varroa mites. Generally it could be concluded that the highest record of Varroa infestation levels were at winter and autumn seasons and the lowest one was at summer and spring.

4- Fallen dead Varroa mites

Naturally dead fallen Varroa mites dropped on board sheet of infested honeybee colonies showed maximum numbers in late autumn, approaching 42.67 mites/colony and this was related to the mean temperature 16.6°C & RH 57.5. While the lower values were recorded in summer season, 1.33 mites /colony with 28.65°C & 50.5 RH (Table 3).

Table (3): Population dynamics and *Varroa destructor* infestation level percentages at Sids region, Beni-Sweif Governorate during 2004 season

Date	Temp. (°C)	(% Relative Humidity	Infestation level (%)			Mean No. of Fallen Varroa	Strength of colony		No. of covered comb
			WB	DB	AW		Area of sealed brood (inch ²)	DB	
22-24/12/ (2003)	14.75	52.00	17.67	---	18.33	45.67	160.00	---	7.00
4-6/1/2004	16.00	45.50	17.33	---	17.67	32.33	330.00	---	7.00
17-19	14.95	58.50	17.00	8.33	16.33	29.33	740.00	6.00	7.00
30/1-1/2	17.55	47.50	16.33	15.67	15.67	33.67	900.00	8.00	7.00
12-14/2	16.70	57.00	16.00	15.67	16.33	25.33	950.00	9.00	7.00
25-27	19.80	48.50	16.67	30.33	11.67	16.67	970.00	11.00	7.67
9-11/3	17.90	52.50	14.67	33.67	10.33	18.33	1100.00	21.00	8.00
22-24/3	21.15	49.00	11.00	15.67	10.00	29.33	1200.00	35.00	9.33
Mean	17.35	51.31	15.83	19.89	14.54	28.83	793.75	15.00	7.50
4-6/4	20.80	52.50	9.00	18.33	9.33	18.67	1300.00	32.00	9.67
17-19/4	24.30	48.50	9.00	12.33	9.67	16.67	1300.00	30.00	9.67
30/4-2/5	23.90	49.00	8.33	10.67	6.67	11.67	1400.00	22.00	9.67
13-15/5	36.00	28.50	11.33	10.33	7.33	5.67	1400.00	16.00	10.00
26-28/5	36.00	21.00	6.67	8.33	6.33	4.67	1490.00	13.00	10.00
8-10/6	31.10	43.00	4.67	6.67	5.67	3.33	1650.00	8.00	10.00
21-23/6	30.50	44.00	4.00	4.67	4.67	5.67	1800.00	6.00	10.00
Mean	28.94	40.93	75.71	10.19	7.10	9.48	1477.14	18.14	9.86
4-6/7	30.60	48.00	4.00	---	3.67	3.67	1800.00	---	10.00
17-19/7	30.65	55.00	3.67	---	3.00	3.67	1800.00	---	10.00
30/7-1/8	27.35	47.00	2.33	---	1.33	3.67	1850.00	---	10.00
12-14/8	28.65	50.50	1.67	---	0.67	1.33	1850.00	---	9.67
25-27/8	27.90	53.00	1.00	---	0.33	3.33	1800.00	---	9.67
7-9/9	29.20	48.00	2.33	6.33	2.00	7.33	1700.00	5.00	9.33
20-22/9	22.65	47.50	2.67	8.33	3.00	12.33	1700.00	5.00	8.67
Mean	28.14	49.86	2.52	7.33	2.00	5.05	1785.71	5.00	9.62
3-5/10	26.50	48.00	3.67	15.67	3.33	12.33	1500.00	6.00	8.67
16-18/10	27.00	50.50	5.00	25.67	3.67	16.67	1500.00	5.00	8.33
29-31/10	24.55	50.00	8.67	---	7.33	23.33	1250.00	---	8.00
11-13/11	25.80	45.00	14.33	---	12.67	36.67	1000.00	---	8.00
24-26/11	14.30	48.00	16.67	---	17.00	39.33	600.00	---	7.67
7-9/12	16.60	57.50	19.67	---	19.67	42.67	40.00	---	7.00
20-22/12/ (2004)	15.75	54.50	23.67	---	21.33	36.67	200.00	---	7.00
Mean	21.50	50.50	13.10	20.67	12.14	29.67	921.43	5.50	7.81

WB= Worker brood

DB= Drone brood

AW= Adult worker

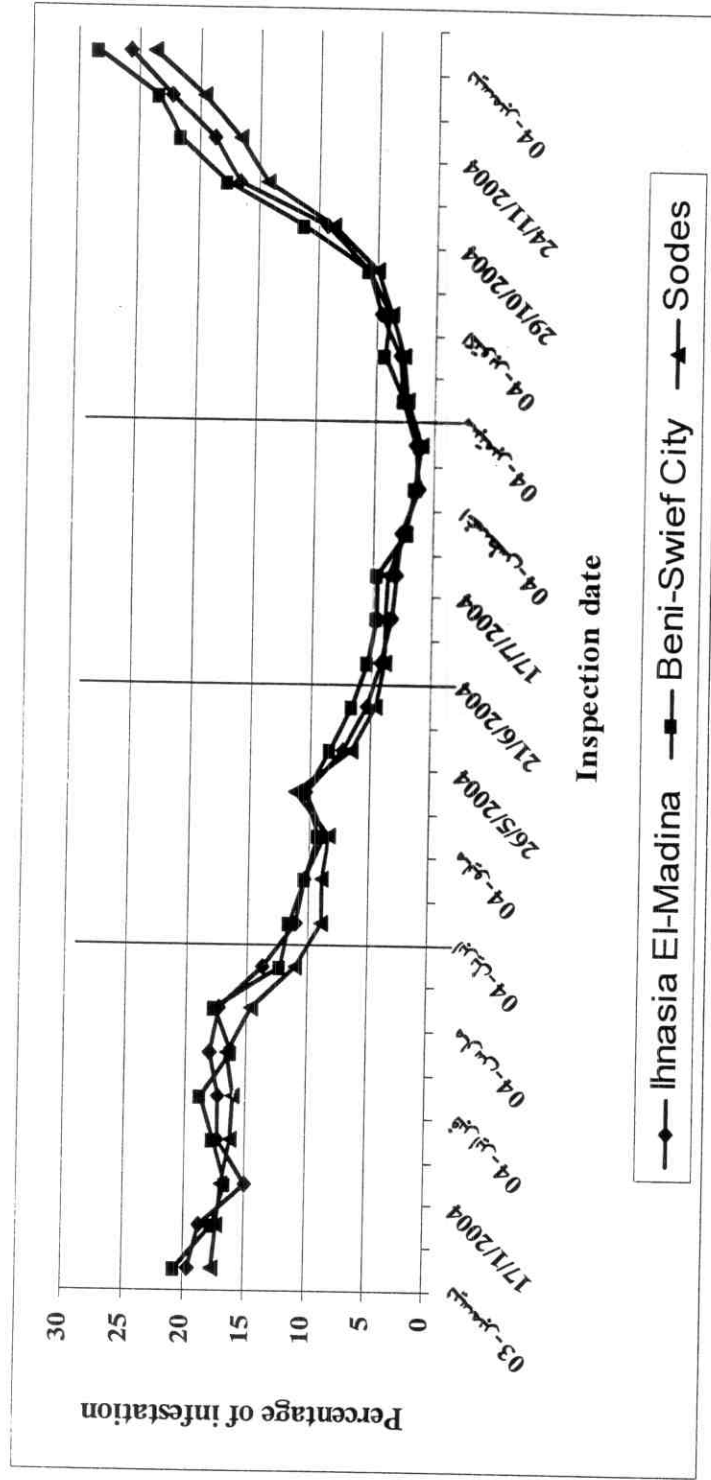


Fig. (1): The infestation level showed the population dynamics on worker brood during the year 2003-2004 in three regions of Beni-Sweif governorate.

Table (4): Population dynamics and *Varroa destructor* infestation level percentages at different regions of Beni-Sweif Governorate during 2004 season.

Regions	Temp. (°C)	Relative Humidity (%)	Infestation level (%)			Mean No. of Fallen Varroa	Strength of colony		
			WB	DB	AW		Area of sealed brood (inch ²)		No. of covered comb
							WB	DB	
Inspection date 22-24/12/(2003)- 22-24/3 (2004)									
Ihnasia El-Madina	17.35	51.31	17.13 ^{NS}	22.00 ^{NS}	15.12 ^{**}	24.17 ^{NS}	752.50	9.00	6.33
Beni-Swief City	17.35	51.31	17.21 ^{NS}	26.56 ^{NS}	16.29 ^{NS}	34.21 [*]	648.75	10.17	6.38
Sids region	17.35	51.31	15.83 ^{NS}	19.89 ^{NS}	14.54 [*]	28.83 ^{NS}	793.75	15.00	7.50
Inspection date 4-6/4 (2004) - 21-23/6 (2004)									
Ihnasia El-Madina	28.94	40.93	8.19 ^{NS}	4.71 ^{NS}	5.62 ^{NS}	18.00 [*]	1364.29	13.43	9.14
Beni-Swief City	28.94	40.93	8.86 ^{NS}	12.86 ^{NS}	8.19 ^{NS}	14.00 ^{NS}	1314.29	14.71	8.91
Sids region	28.94	40.93	75.71 ^{NS}	10.19 ^{NS}	7.10 ^{NS}	9.48 [*]	1477.14	18.14	9.86
Inspection date 4-6/7 (2004) - 20-22/9 (2004)									
Ihnasia El-Madina	28.14	49.86	2.52 ^{NS}	8.67 ^{NS}	2.00 ^{NS}	4.38 ^{NS}	1778.57	5.50	9.90
Beni-Swief City	28.14	49.86	3.10 ^{NS}	14.50 ^{NS}	2.62 ^{NS}	17.86 ^{NS}	1771.43	6.00	9.62
Sids region	28.14	49.86	2.52 ^{NS}	7.33 ^{NS}	2.00 ^{NS}	5.05 ^{NS}	1785.71	5.00	9.62
Inspection date 3-5/10 (2004)- 20-22/12/(2004)									
Ihnasia El-Madina	21.50	50.50	14.72 ^{NS}	25.50 ^{NS}	16.19 ^{NS}	20.43 [*]	791.43	4.00	7.66
Beni-Swief City	21.50	50.50	16.00 ^{NS}	32.00 ^{NS}	14.33 [*]	34.95 ^{NS}	865.71	3.50	7.33
Sids region	21.50	50.50	13.10 ^{NS}	20.67 ^{NS}	12.14 [*]	29.67 ^{NS}	921.43	5.50	7.81
WB= Worker brood			DB= Drone brood			AB= Adult worker			

Results and Discussion

Table (5): The regression values between season temperature, relative humidity and percentage of infestation with *Varroa destructor* of tested honeybee colonies at different regions of Beni-Suef Governorate during, 2004.

Season	Beni-Suef City				Ihnasia El-Madina				Sids Al-Omaraa				
	WB	DB	AW	VF	WB	DB	AW	VF	WB	DB	AW	VF	
Winter	0.776	0.933	0.909	0.851	0.701	0.845	0.946	0.651	0.808	0.630	0.883	0.713	
Spring	0.754	0.869	0.851	0.411	0.703	0.716	0.776	0.929	0.517	0.839	0.744	0.939	
Summer	0.078	0.850	0.217	0.855	0.353	0.722	0.738	0.137	0.404	0.692	0.249	0.760	
Autumn	0.865	0.658	0.908	0.777	0.846	0.856	0.840	0.929	0.441	0.999	0.882	0.810	
WB= Worker brood				DB= Drone brood				AW= Adult worker				VF= Varroa Fallen	

Because there were not adequate studies on different environmental factors particularly temperature and relative humidity in hot regions which can be affected together on Varroa population, so this study importance to this point.

From the results obtained. It could be deduced that, there was relationship between temperature and relative humidity rate and Varroa population dynamics at different Beni-Sweif regions under study as shown in Table (5). As the Varroa population dynamics is inversely proportional to the changes occurred on temperature and the relative humidity; that may be reflected on Varroa sensibility and death rate. So this study was interested to investigate this phenomena at Beni- Sweif districts. It could be concluded that;

- 1- There are regression variations between Varroa population dynamics and both temperature and relative humidity percentage.
- 2- Varroa infestation (%) in sealed worker brood recorded the higher rate at winter and autumn seasons, while the lower rate was recorded at summer and spring seasons at different Beni- Sweif governorate regions.
- 3- Varroa infestation (%) in sealed drone brood increased at season activity and was related to brood drone increase.
- 4- Varroa infestation (%) on adult workers was higher in late autumn, early winter and lower at summer season.
- 5- Varroa population in honeybee colonies is affected by many factors, as temperature and relative humidity. Varroa mostly decreased with increasing the temperature and relative humidity. Rate of Varroa

sensibility by the higher temperature degrees increased as relative humidity increase. **Arnold (1990)**, reported that Varroa mites can be sensitive to temperature variations and it capable of detecting a difference of approximately 1°C.

- 6- So, Beekeepers are advised to apply Varroa mites control particularly at august end.

The obtained results were in agreement with **Ritter and De-Jong (1984)** found that the infestation was higher in drone cells than in worker cells. **Rademacher (1985)** found that the natural death rate of mites varies with season, it increase slowly from May to July and reaches a peak in September. He added that there are considerable variations between different years and locations. **Accorti and Nannelli, (1989)** and **Buchler and Hofmann (1991)** reported that the drone brood cells are always highly infested and the reproduction ratio is almost double that in the worker brood in different countries due not only to the variability of extrinsic bio-climatic factor but also the presence of an intrinsic behavioral plasticity of the Varroa mites. Also, **Le Cont et al. (1990)** reported that the optimal temperature for development the mites were between 32.5 and 33.4°C. At 38°C mites began to die without reproduction.

While, **Moretto et al. (1991)** reported that the factor of climate had a strong influence on the population dynamics of Varroa mites.

Allam, (1994) which found that infestation reached their highest levels during autumn and spring, followed by winter and recorded their lowest numbers during summer.

Part (2): Evaluation the efficiency of some essential oils and chemical compounds for Varroa controls

First: Essential oils treatments and doses

The efficiency of some essential oils used to control Varroa mites [eucalyptus (*Eucalyptus globulus labillardiere*), thymol (*Thymus vulgaris* L.) and peppermint (*Mentha* sp.)] were tested for control measurements at different seasons of 2004 & 2005.

Our objective was to:

- 1- Estimate the percentage of reduction of Varroa infestation in worker brood and adults.
- 2- Determine number of dead fallen Varroa mites.

I- Feeding method

The following two main experiments were conducted for controlling Varroa mites during 2004 & 2005.

- a- Using single of essential oil treatments
- b- Using mixture of essential oil treatments.

A- Using single of essential oil treatments

1- August-September 2004 & 2005

a- Varroa reduction (%) in sealed worker brood and adults

The results of feeding honeybee colonies with eucalyptus, thymol and peppermint oils are shown in Table (6) and Fig. (2). It revealed higher reduction of mites percentage with all tested oils. The maximum effect was recorded with the thymol

followed with eucalyptus and peppermint during the two experiment years 2004 & 2005. The reduction percentages of the mites in the adult bees were 79.88%, 76.94% & 69.97% for thymol, eucalyptus and peppermint, respectively at 2004 and 77.67%, 61.8% & 49.2% at 2005. for the same oil mentioned later, respectively.

b- Fallen dead Varroa mites

The peak maximum effect of the essential oils on the Varroa mortality rate started to reduce after 14 days the beginning of the 2nd application as shown in Table (7) and Fig. (3), while the mean highest values of the mortality recorded during the same period were (34.67,32.28), (32.56,31.06) and (26.45,24.11)mites /colony, during season of 2004&2005, respectively, with thymol, eucalyptus and peppermint oils

2- October- November 2004 & 2005

a-Varroa reduction (%) in sealed worker brood and adults

Data presented in Table (8) and Fig (4) showed higher Varroa reduction percentage with all feeding treatments particularly with Thymol oil, Eucalyptus and peppermint for worker brood cells and adults. The reduction percentages in the worker brood were (84.78%, 78.87%), (75.50%, 71.79%) & (63.00%, 64.82%) for thymol, eucalyptus and peppermint respectively, during seasons of 2004 & 2005.

b- Fallen dead Varroa mites

The effect of the essential oils on Varroa mites mortality during October-November 2004 & 2005 were recorded.

Clearly significant differences of the mean number of dead Varroa mites fallen on sticky board resulted the treated with the essential oils were remarked. Higher mean number of the fallen dead Varroa mites with all tested essential oils was found particularly with thymol treatment, during experiments period of 2004 & 2005 were 197.01& 227 mite/colony respectively; in comparison with Eucalyptus and peppermint oils they were 157.66 & 131.01 mites/colony, respectively as shown in Table (9) and Fig. (5).

3- February – March 2005 & 2006

a- Varroa reduction (%) in sealed worker brood and adults

Feeding honeybee colonies with eucalyptus, thymol and peppermint oils by the rate of 1.5 ml (gm) caused reduction of Varroa percentage in cells ranged between (77.75%-80.33%), (69.97%-74.07%) & (61.08%-62.57%) with the two tested periods of 2005 & 2006, respectively. The Varroa reduction percentage was higher with adult bees when treated by the thymol followed with eucalyptus and peppermint oils, as shown in Table (10) and Fig (6).

b- Fallen dead Varroa mites

Counted fallen dead Varroa mites on the adhesive boards of treated honeybee colonies with the essential oils using feeding method during February-March 2005& 2006 showed three maximum peaks particularly after 14, 21 & 28 days of the 1st treatment as shown in Table 11 and Fig. 7.

It can be concluded that the grooming behavior towards Varroa invasion caused increase in the fallen rate of the Varroa

mites followed with essential oils parallel that with densities of newly emerged worker bees. There were significant differences between the essential oils treatments and the fallen dead Varroa mites.

From these results it could be established that the efficiency of the essential oils treatments is approved in the control of Varroa mites infestation and recommended for beekeepers to start their effective combat at specific seasons and specific climate conditions and this is essential for economic purposes.

Zakaria and Allam, (2007) found relationship between formic acid and black cumin oil treatments and the grooming behavior particularly baiting Varroa, in addition to that the mechanical defensive behavior of worker honeybees increased at the following use of these materials.

4- April – May 2005 & 2006

a- Varroa reduction in sealed worker brood and adults

There is a clear reduction in the percentage of Varroa mites inside sealed worker brood combs resulting from the treatment with Eucalyptus; thymol and peppermint oils. The reduction rate was 55.7%, 68.4% and 40.62%, respectively at the year 2005 and 48.87%, 59% & 46.24% for the same mentioned above respectively, for 2006.

The Varroa reduction percentage in adult worker honeybees were 62.08%, 68.67% for the year 2005 and were 70.65%, 75.82% & 61.43%, respectively during 2006 as shown in Table (12) and Fig (8).

From our results it could be established that the reduction percentage of Varroa infestation in worker brood cells and adult bees were decreased as the season activity increased (Tables 10 & 12).

b- Fallen dead Varroa mites

Number of fallen dead Varroa mites resulted in feeding honeybee colonies with the essential oils revealed presence higher significant differences between and within essential oils treatments and control one on 2005 season (Table 13 and Fig 9). On 2006, in spite of there is no significant differences between thymol and Eucalyptus oils treatments, they showed more fallen dead Varroa mites on the sticky board sheet of honeybee colonies, while peppermint oil showed slightly lower efficacy. Whereas there are no significant differences among essential oils treatments recorded, however, the difference between them and control one was clearly significant.

Table (6): Effect of some essential oils on the reduction of Varroa mites infestation during August-September (2004 & 2005) (Feeding treatment).

Seasons	Treatment (Oil)	Mean percentage of Varroa infestation				(%) Reduction	
		Before treatment		Post treatment (28 days)		Worker brood	Adult
		Worker brood	Adult	Worker brood	Adult		
2004	Eucalyptus	5.33	2.33	1.33	0.67	78.00	76.94
	Thymol	5.00	2.67	1.00	0.67	82.36	79.88
	Peppermint	5.00	2.67	1.67	1.00	70.55	69.97
	Control	5.00	2.67	5.67	3.33	---	---
2005	Eucalyptus	5.67	2.33	2.00	1.00	62.48	61.80
	Thymol	5.33	2.67	1.33	0.67	73.46	77.67
	Peppermint	5.33	2.33	2.33	1.33	53.50	49.20
	Control	5.67	2.67	5.33	3.00	---	---

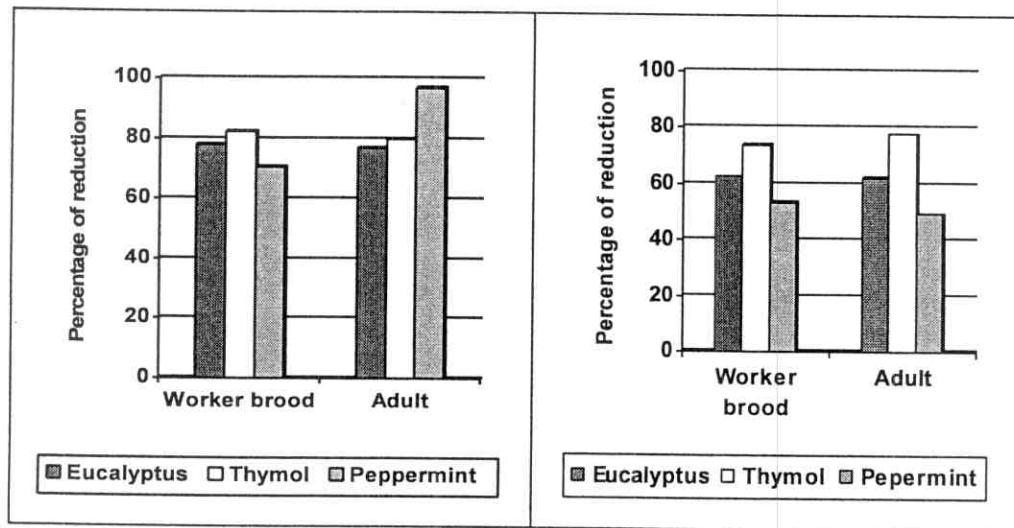


Fig. (2): Effect of some essential oils on the reduction of Varroa mites infestation in worker brood honeybee colonies during August-September (2004 & 2005).

Table (7): Effect of essential oils on the mortality of Varroa mites during August-September (2004 & 2005) (Feeding treatments).

Seasons	Treatment (oil)	Mean number of dead fallen Varroa mites at indicated days								
		Before treatment	Post treatment							Mean
			1	3	7	14	21	28	Total	
2004	Eucalyptus	4.67	18.33	25.67	20.00	46.67	60.00	24.67	193.34	32.56
	Thymol	4.67	21.33	29.00	22.00	49.33	65.67	20.67	208.00	34.67
	Peppermint	4.67	16.67	22.00	13.33	30.67	52.33	23.67	158.67	26.45
	Control	4.67	12.00	9.00	8.67	13.33	16.67	13.67	73.34	12.22
	F-value									2.930 ^{NS}
2005	Eucalyptus	6.00	19.33	32.00	18.00	40.67	52.00	24.33	186.33	31.06a
	Thymol	6.00	21.33	37.00	19.00	43.33	53.00	20.00	193.66	32.28a
	Peppermint	6.67	14.67	29.67	11.67	26.67	34.67	27.33	144.68	24.11ab
	Control	5.33	11.33	9.67	8.67	12.33	16.33	14.67	73.00	12.17b
	F-value									4.338*
	LSD at 5%									13.06

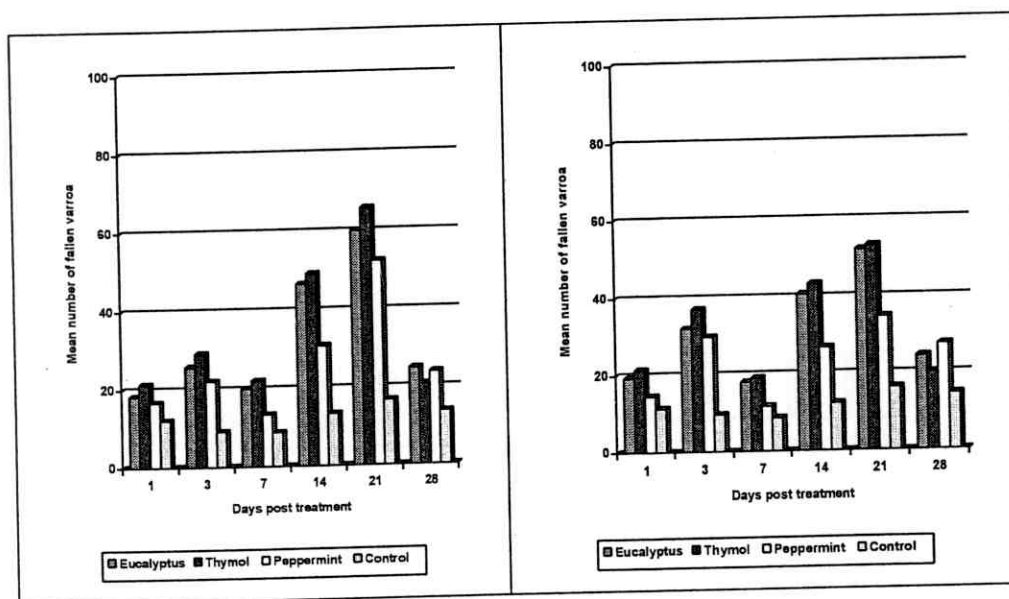


Fig. (3): Effect of essential oils on the mortality of Varroa mites during August-September (2004 & 2005).

Table (8): Effect of some essential oils on the reduction of Varroa mites infestation during October-November (2004 & 2005) (Feeding treatment).

Seasons	Treatment (Oil)	Mean percentage of Varroa infestation				(%) Reduction	
		Before treatment		Post treatment (28 days)		Worker brood	Adult
		Worker brood	Adult	Worker brood	Adult		
2004	Eucalyptus	12.33	8.00	2.33	1.33	75.50	76.54
	Thymol	11.33	8.33	1.33	1.00	84.78	83.06
	Peppermint	11.67	8.33	3.33	2.33	63.00	60.53
	Control	11.67	8.00	9.00	5.67	---	---
2005	Eucalyptus	11.67	7.67	2.67	1.33	71.79	74.48
	Thymol	11.67	7.67	2.00	1.00	78.87	80.81
	Peppermint	11.67	8.00	3.33	2.33	64.82	57.14
	Control	12.33	8.33	10.00	5.66	---	---

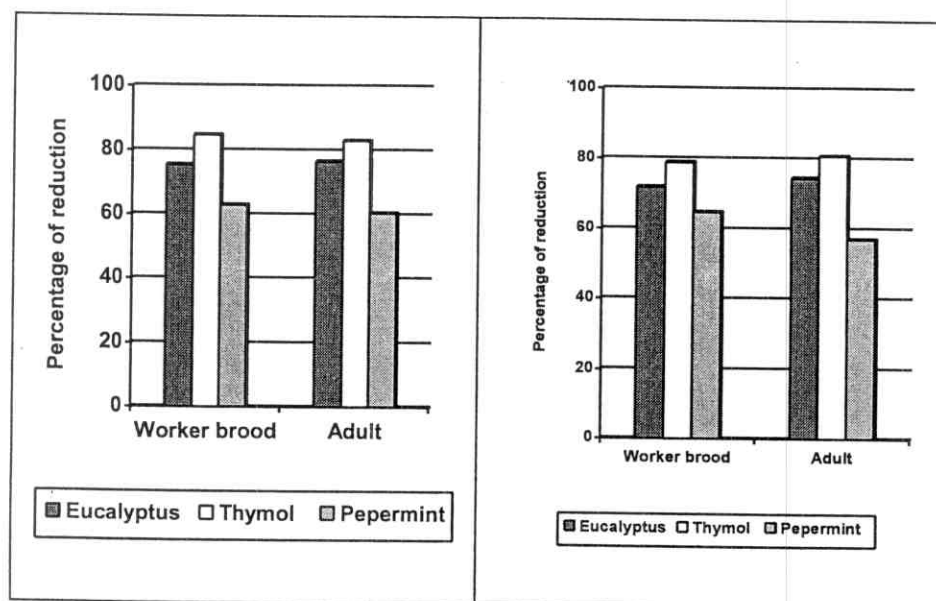


Fig. (4): Effect of some essential oils on the reduction of Varroa mites infestation in worker brood honeybee colonies during October-November (2004 & 2005)

Table (9): Effect of essential oils on the mortality of Varroa mites during October-November (2004 & 2005) (Feeding treatments).

Seasons	Treatment (oil)	Mean number of dead fallen Varroa mites at indicated days								
		Before treatment	Post treatment							
			1	3	7	14	21	28	Total	Mean
2004	Eucalyptus	5.00	7.33	18.00	17.00	51.33	38.00	26.00	157.66	26.28
	Thymol	4.33	14.67	22.67	18.33	54.00	64.67	22.67	197.01	21.84
	Peppermint	4.67	4.67	14.33	13.00	29.67	37.67	31.67	131.01	32.84
	Control	3.67	7.67	11.00	5.33	9.67	7.67	14.00	55.34	9.22
	F-value									2.725 ^{ns}
2005	Eucalyptus	8.67	18.00	24.33	12.67	48.67	58.33	27.33	189.33	31.56a
	Thymol	8.00	26.67	29.33	15.00	56.33	69.00	30.67	227.00	37.83a
	Peppermint	7.00	14.67	21.00	10.33	36.00	48.00	27.67	157.67	26.28ab
	Control	7.33	11.00	10.00	9.33	11.67	13.33	12.67	68.00	11.33b
	F-value									3.266*
	LSD at 5%									18.46

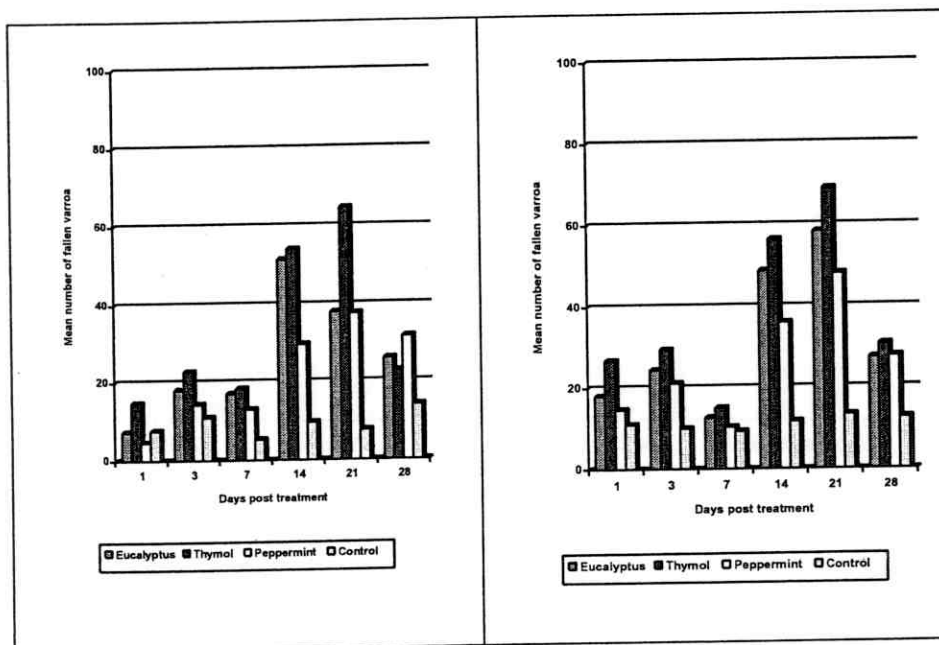


Fig. (5): Effect of essential oils on the mortality of Varroa mites during October-November (2004 & 2005).

Table (10): Effect of some essential oils on the reduction of Varroa mites infestation during February-March (2005) and (2006) (Feeding treatment).

Seasons	Treatment (Oil)	Mean percentage of Varroa infestation				((%) Reduction	
		Before treatment		Post treatment (28 days)			
		Worker brood	Adult	Worker brood	Adult	Worker brood	Adult
2005	Eucalyptus	17.67	12.33	3.00	1.33	74.07	75.89
	Thymol	18.00	12.67	2.33	1.33	80.23	76.54
	Peppermint	17.67	11.67	4.33	2.00	62.57	61.70
	Control	18.33	12.67	12.00	5.67	---	---
2006	Eucalyptus	18.67	10.67	3.67	2.00	69.97	70.16
	Thymol	18.67	10.67	2.67	1.67	77.75	75.08
	Peppermint	18.33	10.33	4.67	2.67	61.08	58.85
	Control	18.33	11.67	12.00	7.33	---	---

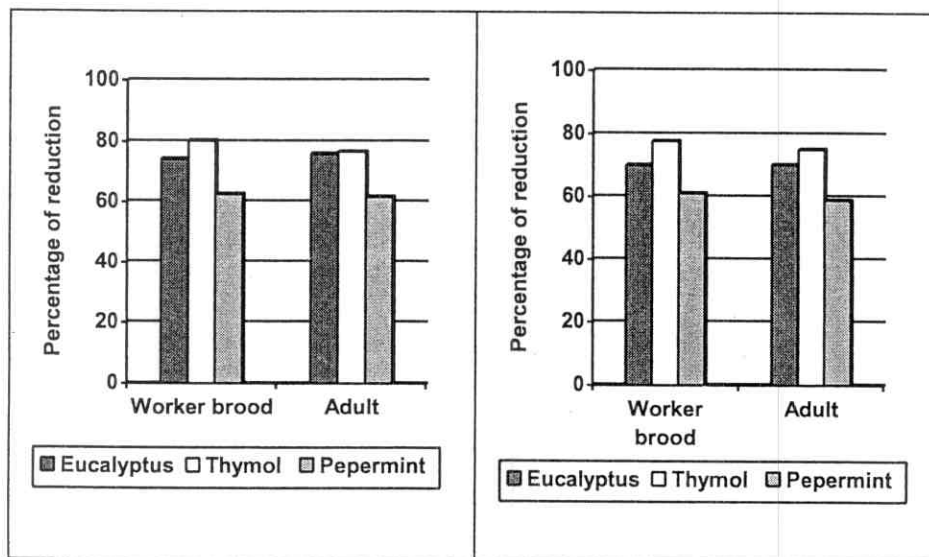


Fig. (6): Effect of some essential oils on the reduction of Varroa mites infestation in worker brood honeybee colonies during February-March (2005 & 2006).

Table (11): Effect of essential oils on the mortality of Varroa mites during February-March (2005 & 2006) (Feeding treatments).

Season	Treatment (oil)	Mean number of dead fallen Varroa mites at indicated days								
		Before treatment	Post treatment							Mean
			1	3	7	14	21	28	Total	
2005	Eucalyptus	6.67	23.00	27.33	11.67	44.67	69.67	69.00	245.34	40.89a
	Thymol	5.67	27.00	29.33	13.33	56.33	80.00	79.00	284.99	47.50a
	Peppermint	4.67	17.00	20.00	10.00	36.00	61.67	57.00	201.67	33.62ab
	Control	8.33	13.00	7.33	10.00	13.00	11.67	11.33	66.33	11.06b
	F-value									3.202*
	LSD at 5%									26.13
2006	Eucalyptus	9.00	28.00	34.67	16.67	44.67	65.67	65.00	254.68	42.45a
	Thymol	8.67	31.67	39.33	18.67	60.67	75.33	74.33	300.00	50.00a
	Peppermint	8.33	22.33	27.67	15.33	34.00	55.33	54.00	208.66	34.78a
	Control	7.33	12.33	10.00	9.67	15.67	11.67	16.67	76.01	12.67b
	F-value									5.040**
	LSD at 5%									21.18

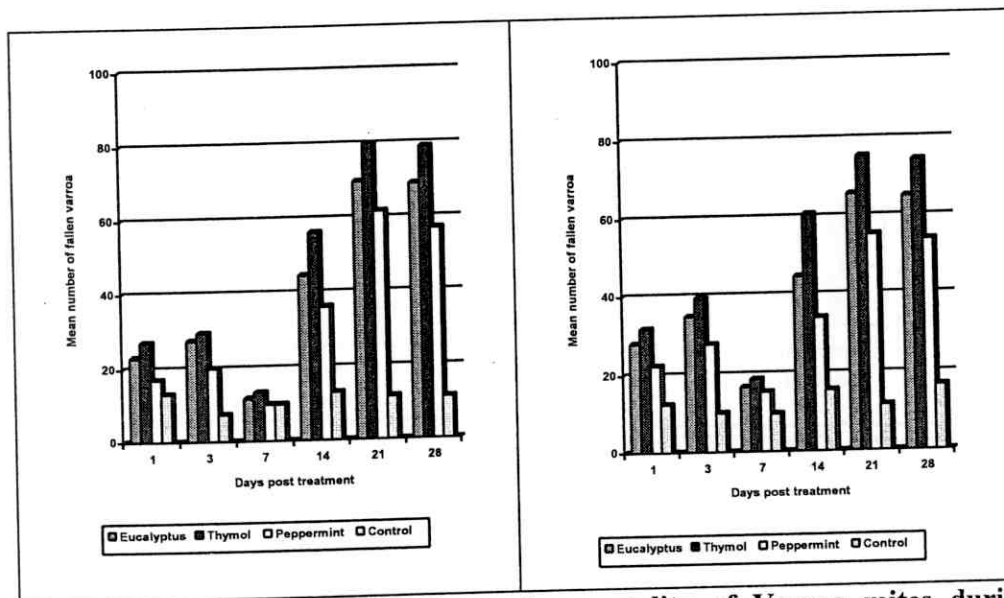


Fig. (7): Effect of essential oils on the mortality of Varroa mites during February-March (2005 & 2006)

Table (12): Effect of some essential oils on the reduction of Varroa mites infestation during April-May (2005 & 2006) (Feeding treatment).

Seasons	Treatment (Oil)	Mean percentage of Varroa infestation				(%) Reduction	
		Before treatment		Post treatment (28 days)			
		Worker brood	Adult	Worker brood	Adult	Worker brood	Adult
2005	Eucalyptus	13.33	7.33	2.67	1.33	55.70	62.08
	Thymol	14.00	6.67	2.00	1.00	68.40	68.67
	Peppermint	13.67	6.67	3.67	1.67	40.62	47.67
	Control	14.00	7.67	6.33	3.67	---	---
2006	Eucalyptus	13.67	7.67	3.33	1.33	48.87	70.65
	Thymol	13.67	7.00	2.67	1.00	59.00	75.82
	Peppermint	14.33	7.33	3.67	1.67	46.24	61.43
	Control	14.00	7.33	6.67	4.33	---	---

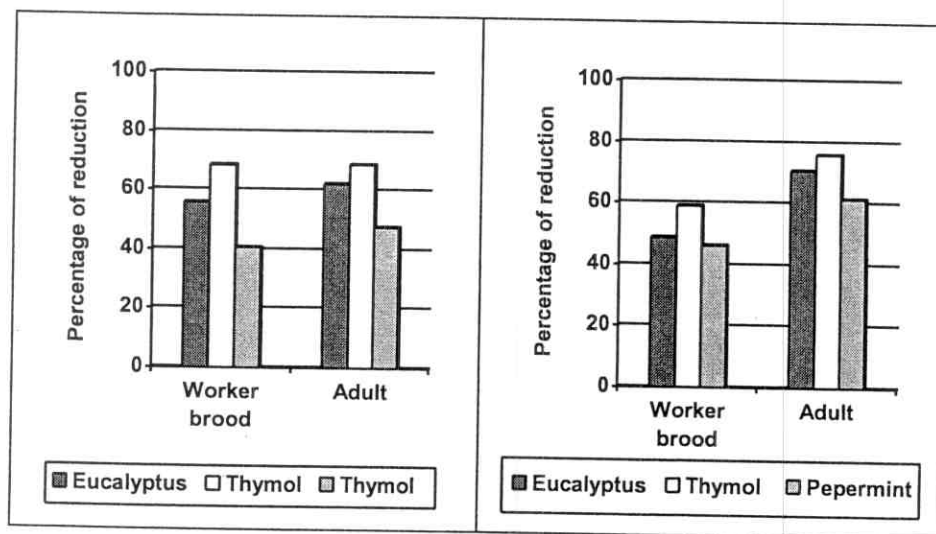


Fig.(8): Effect of some essential oils on the reduction of Varroa mites infestation in worker brood honeybee colonies during April-May (2005 & 2006).

Table (13): Effect of essential oils on the mortality of Varroa mites during April-May (2005 & 2006) (Feeding treatments).

Seasons	Treatment (oil)	Mean number of dead fallen Varroa mites at indicated days								
		Before treatment	Post treatment							
			1	3	7	14	21	28	Total	Mean
2005	Eucalyptus	5.67	23.33	44.00	23.33	56.00	64.33	32.33	243.32	40.55ab
	Thymol	6.33	24.33	53.67	29.67	72.00	76.67	33.33	289.67	48.28a
	Peppermint	5.67	16.00	24.67	18.33	34.00	44.33	36.33	173.66	28.94bc
	Control	5.33	10.33	14.33	7.33	15.00	9.33	14.33	70.65	11.78c
	F-value									6.455**
	LSD at 5 %									18.43
2006	Eucalyptus	5.33	24.33	44.33	20.67	58.00	65.67	29.33	242.33	40.39a
	Thymol	5.33	28.00	55.00	18.00	72.33	76.33	29.67	279.33	46.56a
	Peppermint	5.67	17.67	32.00	14.00	35.00	45.33	37.67	181.67	30.29a
	Control	6.67	11.67	11.00	4.33	12.33	11.67	10.00	61.00	10.17b
	F-value									5.465**
	LSD at 5 %									20.11

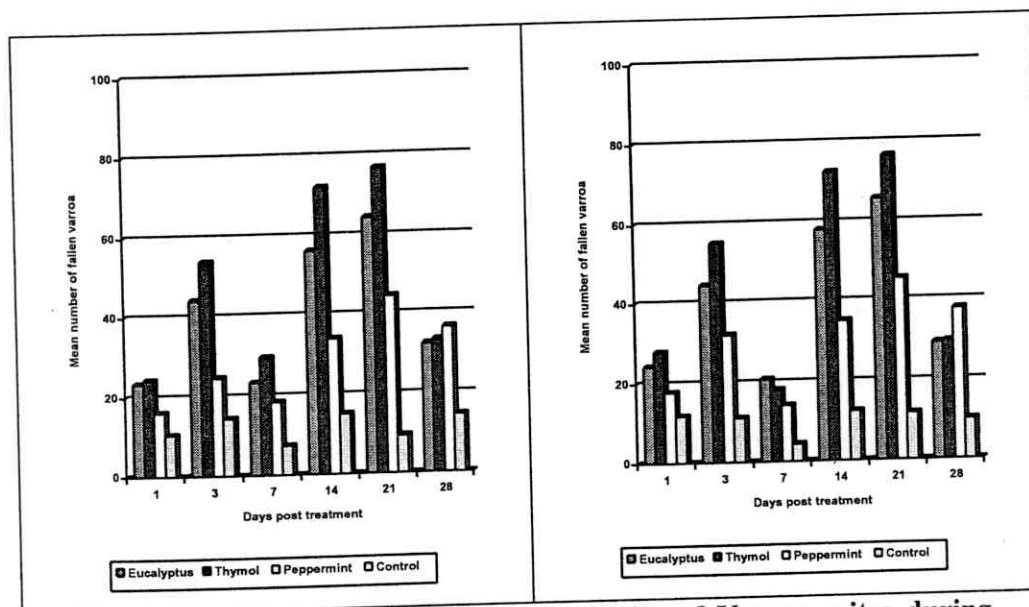


Fig. (9): Effect of essential oils on the mortality of Varroa mites during April-May (2005 & 2006)

B- Mixed essential oil treatments

Controlling Varroa mites using eucalyptus, thymol and peppermint oils as a mixture solution, 4 groups of honeybee colonies were fed on the mixture oils using the following concentrations:

A= 1: 1: 1, B= 2: 1: 1, C= 1: 2: 1 & D = 1: 1: 2

1- August-September 2004 & 2005

a-Varroa reduction (%) in sealed worker brood and adults

Treated honeybee colonies by different concentration of the mixture of the essential oils revealed higher reduction in the percentage of Varroa mites presented inside worker brood cells. The recorded values were 84.45%, 82.36%, 88.92% & 82.36% for A, B, C & D concentrations, respectively during 2004 year and 75.05%, 75.05%, 81.24% & 75.05%, respectively for the next year 2005, as shown in Table (14) and Fig. (10).

According to the obtained results it could be established that treated honeybee colonies with the mixed essential oils gives high reduction percentage of Varroa mites in sealed worker brood and adult bees than those used alone as shown in Tables (6 & 14) and Figs (2 & 10).

b- Fallen dead Varroa mites

Tested honeybee colonies with the mixture of the essential oils caused higher Varroa mortality in comparison with the control one. The fallen dead Varroa mites with the different essential oils (A, B, C & D) were 216.68, 226, 235 & 202 mites /colony during 2004 and 215.33, 225, 241.99 & 211.33 for the

Table (13): Effect of essential oils on the mortality of Varroa mites during April-May (2005 & 2006) (Feeding treatments).

Seasons	Treatment (oil)	Mean number of dead fallen Varroa mites at indicated days								
		Before treatment	Post treatment							
			1	3	7	14	21	28	Total	Mean
2005	Eucalyptus	5.67	23.33	44.00	23.33	56.00	64.33	32.33	243.32	40.55ab
	Thymol	6.33	24.33	53.67	29.67	72.00	76.67	33.33	289.67	48.28a
	Peppermint	5.67	16.00	24.67	18.33	34.00	44.33	36.33	173.66	28.94bc
	Control	5.33	10.33	14.33	7.33	15.00	9.33	14.33	70.65	11.78c
	F-value									6.455**
	LSD at 5 %									18.43
2006	Eucalyptus	5.33	24.33	44.33	20.67	58.00	65.67	29.33	242.33	40.39a
	Thymol	5.33	28.00	55.00	18.00	72.33	76.33	29.67	279.33	46.56a
	Peppermint	5.67	17.67	32.00	14.00	35.00	45.33	37.67	181.67	30.29a
	Control	6.67	11.67	11.00	4.33	12.33	11.67	10.00	61.00	10.17b
	F-value									5.465**
	LSD at 5 %									20.11

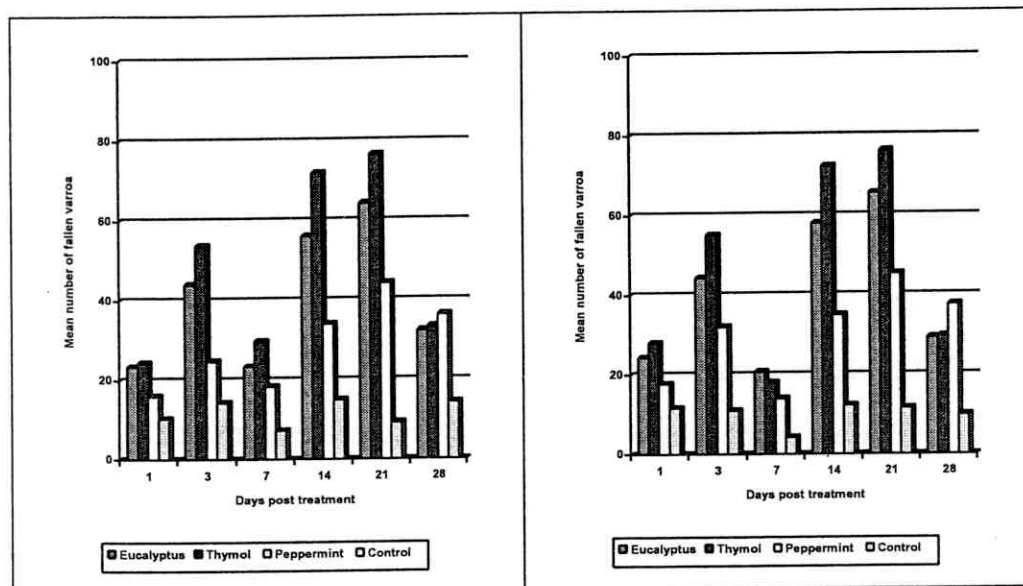


Fig. (9): Effect of essential oils on the mortality of Varroa mites during April-May (2005 & 2006)

B- Mixed essential oil treatments

Controlling Varroa mites using eucalyptus, thymol and peppermint oils as a mixture solution, 4 groups of honeybee colonies were fed on the mixture oils using the following concentrations:

A= 1: 1: 1, B= 2: 1: 1, C= 1: 2: 1 & D = 1: 1: 2

1- August-September 2004 & 2005

a-Varroa reduction (%) in sealed worker brood and adults

Treated honeybee colonies by different concentration of the mixture of the essential oils revealed higher reduction in the percentage of Varroa mites presented inside worker brood cells. The recorded values were 84.45%, 82.36%, 88.92% & 82.36% for A, B, C & D concentrations, respectively during 2004 year and 75.05%, 75.05%, 81.24% & 75.05%, respectively for the next year 2005, as shown in Table (14) and Fig. (10).

According to the obtained results it could be established that treated honeybee colonies with the mixed essential oils gives high reduction percentage of Varroa mites in sealed worker brood and adult bees than those used alone as shown in Tables (6 & 14) and Figs (2 & 10).

b- Fallen dead Varroa mites

Tested honeybee colonies with the mixture of the essential oils caused higher Varroa mortality in comparison with the control one. The fallen dead Varroa mites with the different essential oils (A, B, C & D) were 216.68, 226, 235 & 202 mites /colony during 2004 and 215.33, 225, 241.99 & 211.33 for the

second year as shown in Table (15) and Fig (11).

Among different treatments used to control Varroa mites, it was found that the efficiency of the mixture oils showed speed effect 3 days faster than individual oils (Tables 7 & 15 and Figs. 3 & 11).

2- October- November 2004 & 2005

a- Varroa reduction (%) in sealed worker brood and adults

Honeybee colonies which treated with different concentrations of the mixture of the essential oils, caused decreased of Varroa mites infestation in sealed worker brood and adult honeybees as shown in Table (16) and Fig. (12). It can summarize that the mixture of the essential oil via feeding syrups has a great effect on the Varroa progeny particularly with the mixture of eucalyptus, thymol and peppermint (1:2:1), respectively, as shown in Tables (8 & 16) and Figs (4 & 12).

b- Fallen dead Varroa mites

The tested different concentration of the essential oils caused higher Varroa mortality particularly with the concentration (C) as shown in Table (17) and Fig (13), in spite of there were not any clearly significant differences among of all them in 2004, but it found significant during same period for the years 2005.

3- December-January (2004 – 2005) and (2005/2006)

a- Varroa reduction (%) in sealed worker brood and adults

Feeding honeybee colonies with pollen supplements added to different concentrations of the essential oils (A, B, C &

D) provided as cakes indicate clear reduction in the Varroa infestation level as shown in Table (18) and Fig (14).

b- Fallen dead Varroa mites

Treated infested honeybee colonies with the mixture oils during December- January 2004 & 2005 and 2006 as feeding cakes caused higher significant mortality, than others fed with cake only (Table 19 and Fig. 15).

4- February-March 2005 & 2006

a- Varroa reduction (%) in sealed worker brood and adults

It was noticeable that the Varroa reduction levels in honeybee colonies increased rapidly especially with the concentration (C), during same period of the two years (Table 20 and Fig. 16).

b- Fallen dead Varroa mites

The differences in the number of the fallen dead Varroa mites among essential oil treatments and other oil concentration was non-significant, however significant differences were found between treated honeybee colonies and the control (Table 21 and Fig. 17).

5-April –May 2005 & 2006

a- Varroa reduction (%) in sealed worker brood and adults

The results listed in Table (22) and Fig (18) showed reduction percentage of Varroamites inside worker brood cells and on adult bees. The higher rate of reduction was seen particularly with concentration (C).

b- Fallen dead Varroa mites

Counting the average number of fallen Varroa mites on the white board sheet following the experiment colonies with feeding mixture oils at different tested concentrations (A, B, C & D). The recorded values were 270.34, 283.00, 285.68 & 264.34 mites/colony for the year 2005 and 260.34, 275.34, 268.67 & 251.67 mites/colony for the year 2006 respectively (Table 23 and Fig 19).

Table (14): Effect of applying mixed essential oils on the reduction of Varroa mites infestation during August-September (2004 & 2005) (Feeding treatment).

Seasons	Treatment (Oil)	Mean percentage of Varroa infestation				(%) Reduction	
		Before treatment		Post treatment (28 days)		Worker brood	Adult
		Worker brood	Adult	Worker brood	Adult		
2004	A	5.67	2.33	1.00	0.67	84.45	76.94
	B	5.00	2.67	1.00	0.33	82.36	90.09
	C	5.33	2.67	0.67	0.33	88.92	90.09
	D	5.00	2.67	1.00	0.67	82.36	79.88
	Control	5.00	2.67	5.67	3.33	---	---
2005	A	5.67	3.33	1.33	1.00	75.05	73.27
	B	5.67	2.33	1.33	0.67	75.05	74.41
	C	6.00	2.67	1.00	0.67	81.24	77.67
	D	5.67	2.0	1.33	0.67	75.05	70.19
	Control	5.67	2.67	5.33	3.00	---	---

(A) Eucalyptus: Thymol : Peppermint= 1:1:1
(C) Eucalyptus: Thymol: Peppermint= 1:2:1

(B) Eucalyptus: Thymol : Peppermint= 2:1:1
(D) Eucalyptus: Thymol: Peppermint= 1:1:2

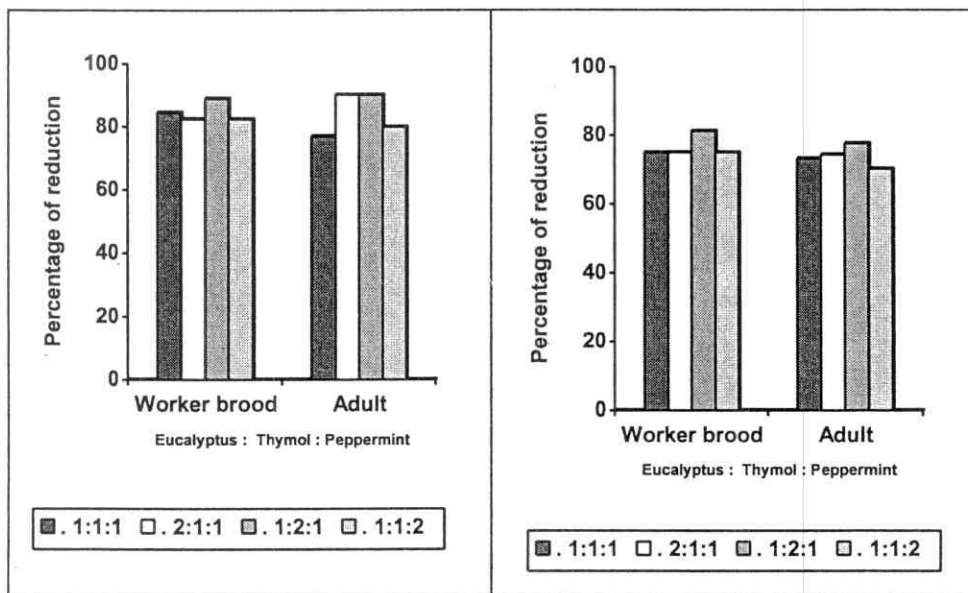


Fig. (10): Effect of applying mixed essential oils on the reduction of Varroa mites infestation in worker brood honeybee colonies during August-September (2004 & 2005).

Table (15): Effect of applying mixed essential oils on the mortality of Varroa mites during August-September (2004 & 2005) (Feeding treatments).

Seasons	Treatment (oil)	Mean number of dead fallen Varroa mites at indicated days								
		Before treatment	Post treatment							
			1	3	7	14	21	28	Total	Mean
2004	A	5.00	24.00	36.67	24.67	45.00	55.67	30.67	216.68	36.11a
	B	4.67	26.00	35.33	26.00	49.33	56.67	32.67	226.00	37.67a
	C	5.00	27.33	39.67	26.33	50.67	56.67	34.33	235.00	39.17a
	D	5.00	23.33	34.67	21.00	43.00	49.67	30.33	202.00	33.67a
	Control	4.67	12.00	9.00	8.67	13.33	16.67	13.67	73.34	12.22b
	F-value									6.165**
	LSD at 5%									13.04
2005	A	6.00	24.00	35.33	23.00	45.67	55.00	32.33	215.33	35.89a
	B	5.67	25.00	36.00	24.00	48.00	58.33	33.67	225.00	37.50a
	C	6.67	27.33	38.33	25.67	51.33	62.33	37.00	241.99	40.33a
	D	5.33	24.33	34.33	22.67	45.00	53.67	31.33	211.33	35.22a
	Control	5.33	11.33	9.67	8.67	12.33	16.33	14.67	73.00	12.17b
	F-value									5.624**
	LSD at 5%									13.98

(A) Eucalyptus: Thymol : Peppermint= 1:1:1

(C) Eucalyptus: Thymol: Peppermint= 1:2:1

(B) Eucalyptus: Thymol : Peppermint= 2:1:1

(D) Eucalyptus: Thymol: Peppermint= 1:1:2

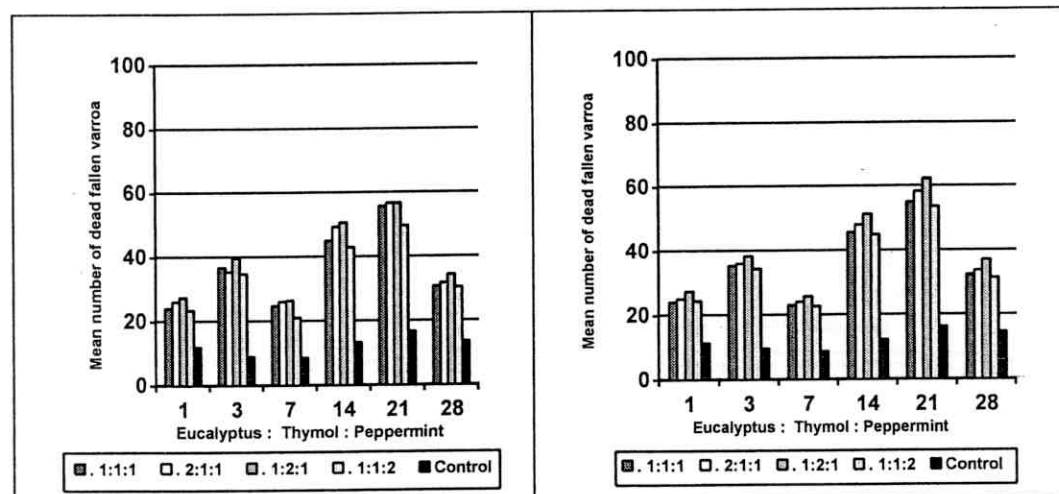


Fig. (11): Effect of applying mixed essential oils on the mortality of Varroa mites during August-September (2004 & 2005).

Table (16): Effect of applying mixed essential oils on the reduction of Varroa mites infestation during October-November (2004 & 2005) (Feeding treatment)

Seasons	Treatment (Oil)	Mean percentage of Varroa infestation				(%) Reduction	
		Before treatment		Post treatment (28 days)			
		Worker brood	Adult	Worker brood	Adult	Worker brood	Adult
2004	A	12.00	8.67	2	1.33	78.39	78.84
	B	11.33	8.33	1.67	1.00	80.89	83.06
	C	11.67	9.33	0.67	0.67	92.56	89.87
	D	11.33	8.33	2	1.67	77.11	71.71
	Control	11.67	8.00	9	5.67	---	---
2005	A	12.00	8.33	1.67	1.00	82.84	80.25
	B	11.67	8.00	1.67	1.00	82.36	79.43
	C	11.33	7.67	1.33	0.67	85.53	85.63
	D	12.00	9.33	1.67	1.67	82.84	70.55
	Control	12.33	9.33	10.00	5.67	---	---

(A) Eucalyptus: Thymol : Peppermint= 1:1:1

(B) Eucalyptus: Thymol : Peppermint= 2:1:1

(C) Eucalyptus: Thymol: Peppermint= 1:2:1

(D) Eucalyptus: Thymol: Peppermint= 1:1:2

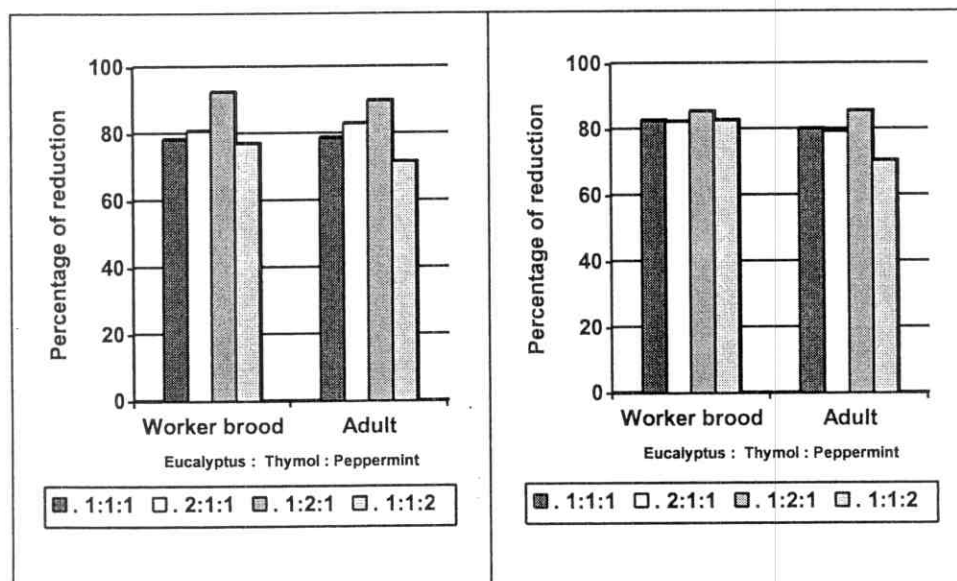


Fig. (12): Effect of applying mixed essential oils on the reduction of Varroa mites infestation in worker brood honeybee colonies during October-November (2004 & 2005)

Table (17): Effect of applying mixed essential oils on the mortality of Varroa mites during October-November (2004 & 2005) (Feeding treatments).

during October-November (2004 & 2005) (Feeding treatments)										
Season	Treatment (oil)	Mean number of dead fallen Varroa mites at indicated days								
		Before treatment	Post treatment						Total	Mean
			1	3	7	14	21	28		
2004	A	4.67	17.33	24.67	19.67	52.00	71.33	31.67	216.67	36.11
	B	4.00	16.00	27.67	20.67	54.00	77.33	38.00	233.67	38.95
	C	3.67	18.67	28.33	16.67	70.33	90.67	51.00	275.67	45.95
	D	3.67	16.33	21.67	15.67	44.33	67.00	32.67	197.67	32.95
	Control	3.67	7.67	11.00	5.33	9.67	7.67	14.00	55.34	9.22
	F-value									2.529 ^{NS}
2005	A	7.00	26.33	27.67	14.33	56.67	51.00	29.67	205.67	34.28a
	B	6.33	29.33	30.00	15.67	59.00	55.67	26.33	216.00	36.00a
	C	6.67	30.33	31.00	17.00	62.67	63.33	29.00	233.33	38.89a
	D	7.67	26.00	29.00	13.67	56.67	58.33	24.00	207.67	34.61a
	Control	7.33	11.00	10.00	9.33	11.67	13.33	12.67	68.00	11.33b
	F-value									2.915*
	LSD at 5%									19.03

(A) Eucalyptus: Thymol : Peppermint= 1:1:1
(C) Eucalyptus: Thymol: Peppermint= 1:2:1

(B) Eucalyptus: Thymol : Peppermint= 2:1:1
(D) Eucalyptus: Thymol: Peppermint= 1:1:2

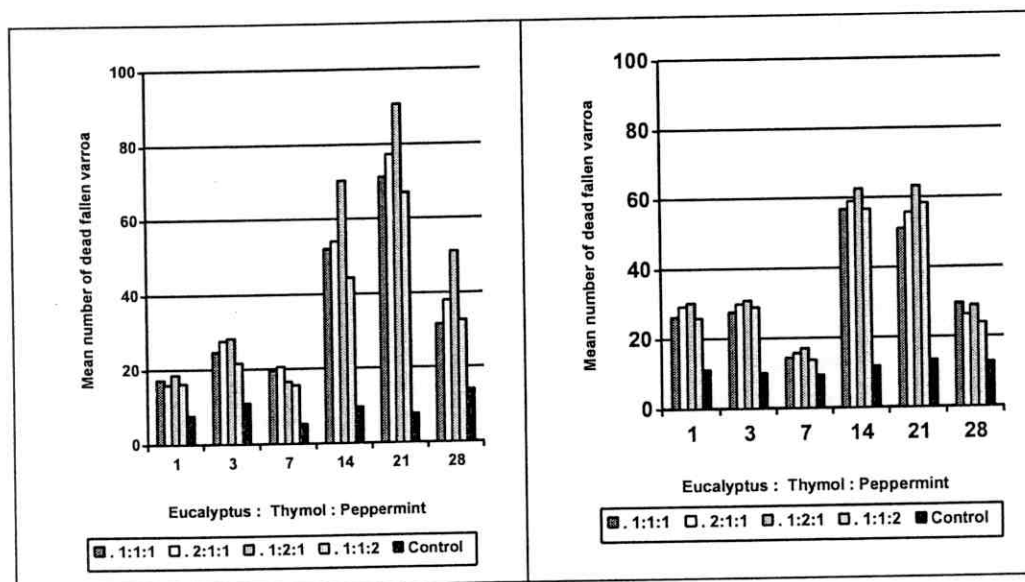


Fig. (13): Effect of applying mixed essential oils on the mortality of Varroa mites during October-November (2004 & 2005).

Table (18): Effect of applying mixed essential oils on the reduction of Varroa mites infestation during December-January, (2004/2005) and (2005/2006) (Feeding treatment).

Seasons	Treatment (Oil)	Mean percentage of Varroa infestation				(%) Reduction	
		Before treatment		Post treatment (28 days)			
		Worker brood	Adult	Worker brood	Adult	Worker brood	Adult
2004/2005	A	12.33	16.67	4.67	4.00	55.03	69.58
	B	13.00	17.00	4.67	3.33	57.34	75.17
	C	13.67	18.00	3.67	2.67	68.12	81.20
	D	16.33	18.00	3.67	4.33	73.31	69.50
	Control	12.67	17.33	10.67	13.67	---	---
2005/2006	A	13.33	18.33	3.67	4.33	66.23	65.82
	B	13.33	18.00	3.67	4.33	66.23	65.20
	C	13.00	18.00	3.67	4.33	65.37	65.20
	D	12.67	18.33	4.33	5.00	59.08	60.54
	Control	12.67	18.33	10.33	12.67	---	---

(A) Eucalyptus: Thymol : Peppermint= 1:1:1

(B) Eucalyptus: Thymol : Peppermint= 2:1:1

(C) Eucalyptus: Thymol: Peppermint= 1:2:1

(D) Eucalyptus: Thymol: Peppermint= 1:1:2

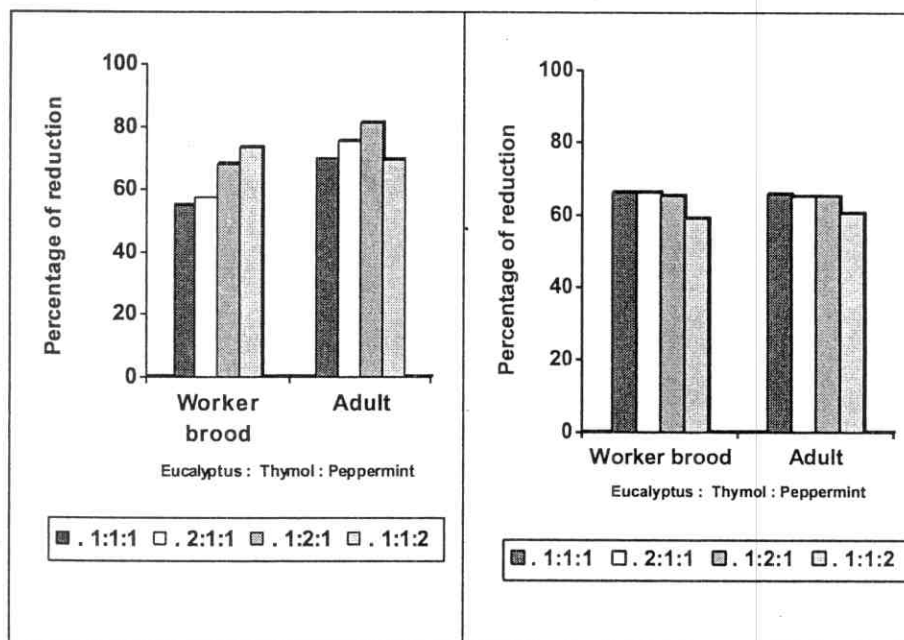


Fig. (14): Effect of applying mixed essential oils on the reduction of Varroa mites infestation in worker brood honeybee colonies during December/January, (2004/2005) and (2005/2006).

Table (19): Effect of applying mixed essential oils on the mortality of Varroa mites during December/January (2004/2005) and (2005/2006) (Feeding treatments).

Seasons	Treatment (oil)	Mean number of dead fallen Varroa mites at indicated days									
		Before treatment	Post treatment							Total	Mean
			1	3	7	14	21	28			
2004/2005	A	5.66	17.00	23.00	16.00	40.00	61.00	23.33	180.33	30.06	
	B	5.00	19.33	24.00	18.33	46.33	68.67	21.67	198.33	33.06	
	C	5.33	20.33	31.00	20.67	49.00	63.33	41.33	255.66	37.61	
	D	3.33	17.67	22.67	18.00	30.00	58.00	19.00	165.34	27.56	
	Control	3.00	6.67	7.33	11.33	14.67	16.67	14.33	71.00	11.83	
	F-value									2.277 ^{NS}	
2005/2006	A	7.00	26.33	27.67	14.33	56.67	51.00	29.67	205.67	34.28a	
	B	6.33	29.33	30.00	15.67	59.00	55.67	26.33	216.00	36.00a	
	C	6.67	30.33	31.00	17.00	62.67	63.33	29.00	233.33	38.89a	
	D	7.67	26.00	29.00	13.67	56.67	58.33	24.00	207.67	34.61a	
	Control	7.33	11.00	10.00	9.33	11.67	13.33	12.67	68.00	11.33b	
	F-value									2.915*	
	LDS at 5%									19.03	

(A) Eucalyptus: Thymol : Peppermint= 1:1:1 (B) Eucalyptus: Thymol : Peppermint= 2:1:1
(C) Eucalyptus: Thymol: Peppermint= 1:2:1 (D) Eucalyptus: Thymol: Peppermint= 1:1:2

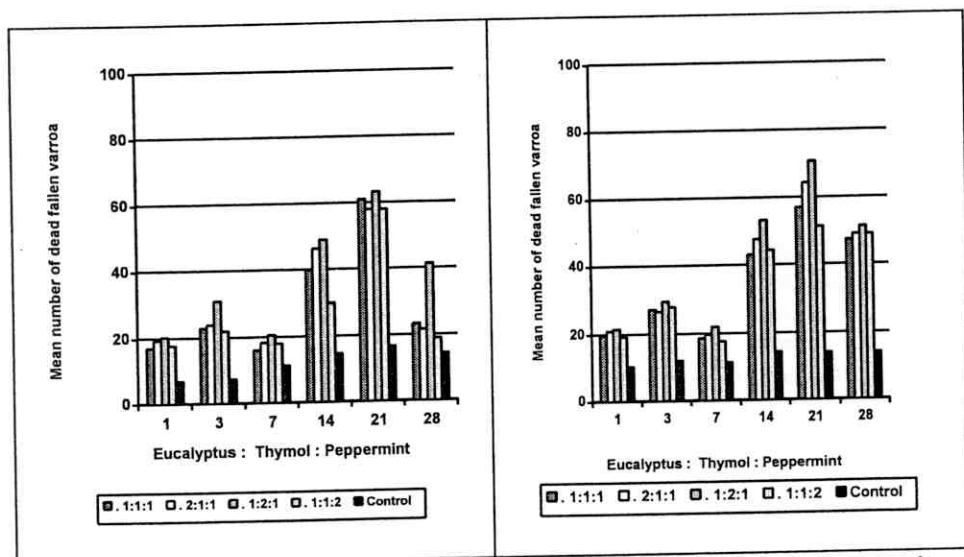


Fig. (15): Effect of applying mixed essential oils on the mortality of Varroa mites during December-January (2004/2005) and (2005/2006).

Table (20): Effect of applying mixed essential oils on the reduction of Varroa mites infestation during February-March (2005& 2006) (Feeding treatment).

Seasons	Treatment (Oil)	Mean percentage of Varroa infestation				(%) Reduction	
		Before treatment		Post treatment (28 days)			
		Worker brood	Adult	Worker brood	Adult	Worker brood	Adult
2005	A	17.33	13.00	2.33	2.00	79.46	65.62
	B	18.67	12.33	3.00	2.00	75.46	63.75
	C	18.00	13.67	3.33	1.33	71.74	78.26
	D	18.33	12.00	3.67	2.33	69.42	56.61
	Control	18.33	12.67	12.00	5.67	---	---
2006	A	18.67	12.00	3.33	2.33	72.76	69.09
	B	18.00	11.67	3.00	2.67	74.54	63.57
	C	18.00	11.33	3.00	2.00	74.54	71.90
	D	18.33	11.67	4.33	3.00	63.92	59.07
	Control	18.33	11.67	12.00	7.33	---	---

(A) Eucalyptus : Thymol : Peppermint= 1:1:1

(B) Eucalyptus : Thymol : Peppermint= 2:1:1

(C) Eucalyptus : Thymol : Peppermint= 1:2:1

(D) Eucalyptus : Thymol : Peppermint= 1:1:2

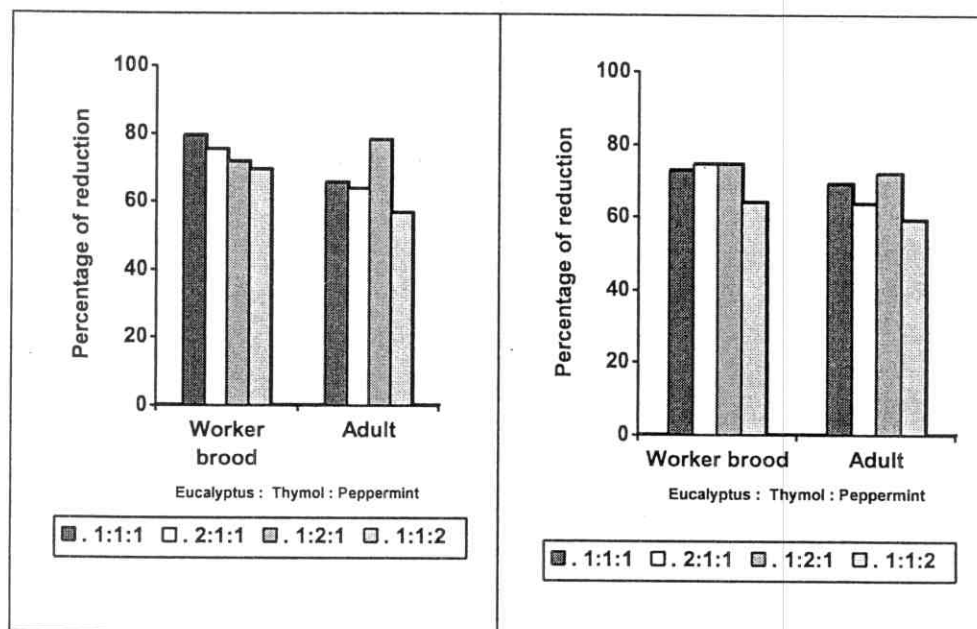


Fig. (16): Effect of applying mixed essential oils on the reduction of Varroa mites infestation in worker brood honeybee colonies during February-March (2005 & 2006).

Table (21): Effect of applying mixed essential oils on the mortality of Varroa mites during February- March (2005 & 2006) (Feeding treatments)

Seasons	Treatment (oil)	Mean number of dead fallen Varroa mites at indicated days								
		Before treatment	Post treatment							Mean
			1	3	7	14	21	28	Total	
2005	A	6.67	26.33	36.67	15.67	53.67	66.33	75.33	274.00	45.67 a
	B	7.67	27.67	34.67	17.33	56.67	70.33	85.00	291.67	48.61a
	C	6.67	29.33	48.00	18.67	62.00	79.33	81.00	318.33	53.06a
	D	6.33	20.67	25.00	13.33	40.67	65.00	68.33	233.00	38.83a
	Control	8.33	13.00	7.33	10.00	13.00	11.67	11.33	66.33	11.06b
	F-value									3.405*
	LSD at 5%									26.35
2006	A	7.33	29.33	37.00	17.00	49.00	57.33	67.33	256.99	42.83a
	B	7.33	35.33	36.00	17.33	50.33	63.33	71.67	273.99	45.67a
	C	7.33	31.33	37.00	16.00	55.00	74.00	69.00	282.33	47.06a
	D	7.33	26.33	29.67	15.33	37.00	68.67	70.67	247.67	41.28a
	Control	7.33	12.33	10.00	9.67	15.67	11.67	16.67	76.01	12.67b
	F-value									3.389*
	LSD at 5%									22.60

(A) Eucalyptus: Thymol : Peppermint= 1:1:1 (B) Eucalyptus: Thymol : Peppermint= 2:1:1
(C) Eucalyptus: Thymol : Peppermint= 1:2:1 (D) Eucalyptus: Thymol: Peppermint= 1:1:2

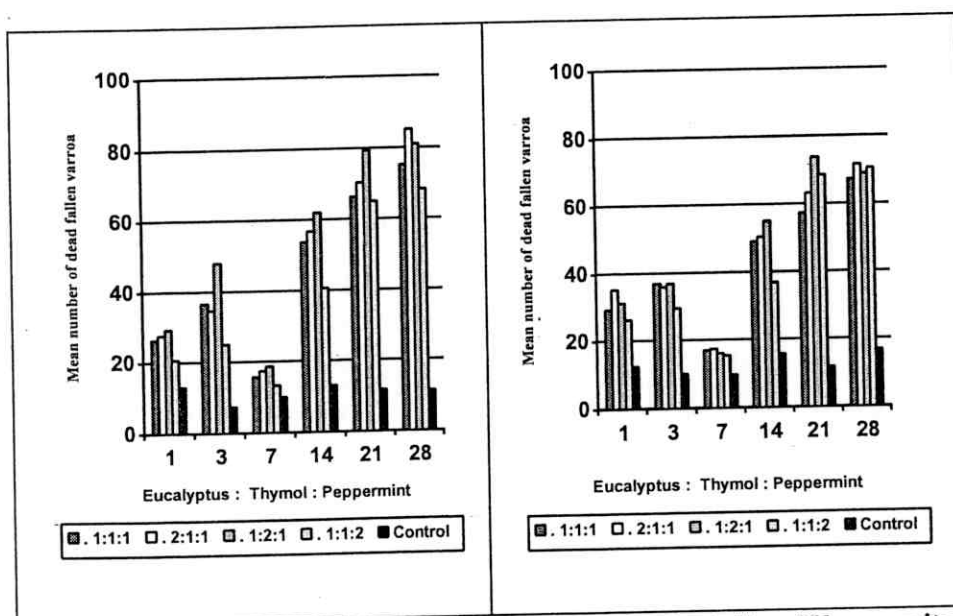


Fig. (17): Effect of applying mixed essential oils on the mortality of Varroa mites during February- March (2005 & 2006).

Table (22): Effect of applying mixed essential oils on the reduction of Varroa mites infestation during April-May (2005 & 2006) (Feeding treatment).

Seasons	Treatment (Oil)	Mean percentage of Varroa infestation				(% Reduction)	
		Before treatment		Post treatment (28 days)			
		Worker brood	Adult	Worker brood	Adult	Worker brood	Adult
2005	A	13.67	6.67	2.33	1.33	62.30	58.33
	B	13.00	7.33	2.00	1.33	65.97	62.08
	C	13.67	6.67	1.67	1.00	72.98	68.67
	D	14.00	7.00	2.67	1.33	57.82	60.29
	Control	14.00	7.67	6.33	3.67	---	---
2006	A	13.67	6.67	2.67	1.67	59.00	57.62
	B	13.67	6.67	2.33	1.67	64.22	57.62
	C	13.67	7.00	1.33	1.33	79.58	67.84
	D	14.00	7.00	2.67	1.67	59.97	59.61
	Control	14.00	7.33	6.67	4.33	---	---

(A) Eucalyptus: Thymol : Peppermint= 1:1:1

(B) Eucalyptus: Thymol : Peppermint= 2:1:1

(C) Eucalyptus: Thymol: Peppermint= 1:2:1

(D) Eucalyptus: Thymol: Peppermint= 1:1:2

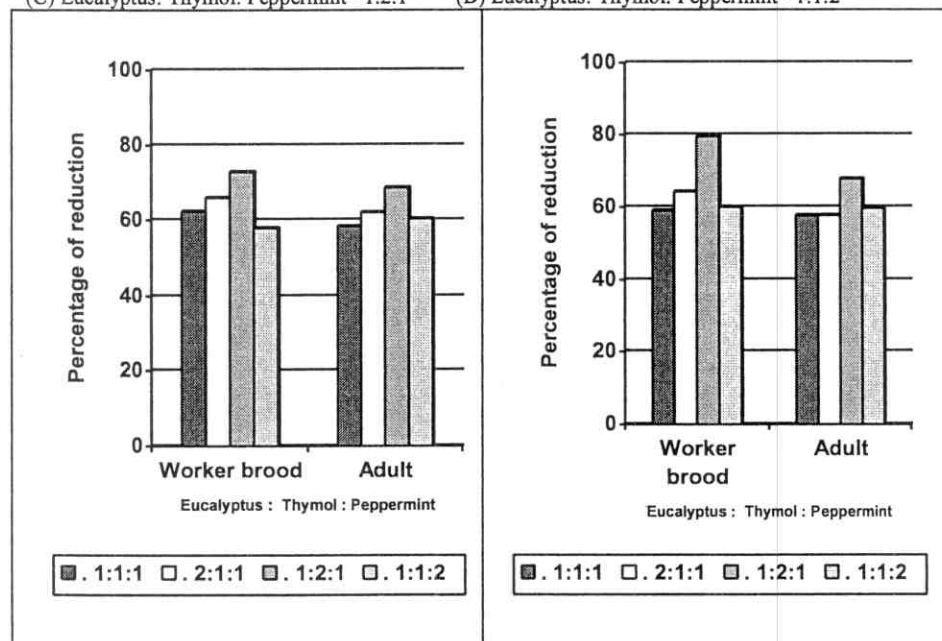


Fig. (18): Effect of applying mixed essential oils on the reduction of Varroa mites infestation in worker brood honeybee colonies during April-May (2005 & 2006).

Table (23): Effect of applying mixed essential oils on the mortality of Varroa mites during April-May (2005 & 2006) (Feeding treatments).

Seasons	Treatment (oil)	Mean number of dead fallen Varroa mites at indicated days								
		Before treatment	Post treatment							
			1	3	7	14	21	28	Total	Mean
2005	A	5.00	24.67	45.67	22.00	62.33	78.00	37.67	270.34	45.06a
	B	5.33	27.33	46.00	22.67	70.00	81.00	36.00	283.00	47.17a
	C	5.67	29.67	45.67	23.00	94.67	48.00	44.67	285.68	47.61a
	D	5.67	25.00	42.67	24.00	63.33	76.67	32.67	264.34	44.06a
	Control	5.33	10.33	14.33	7.33	15.00	9.33	14.33	70.65	11.78b
	F-value									3.306*
	LSD at 5%									24.61
2006	A	8.33	27.67	48.00	21.00	56.67	75.00	32.00	260.34	43.39a
	B	7.67	29.33	48.67	21.67	70.33	74.67	30.67	275.34	45.89a
	C	7.67	31.33	48.67	23.33	85.67	47.00	32.67	268.67	44.78a
	D	6.33	27.67	44.00	21.00	55.00	72.33	31.67	251.67	41.95a
	Control	6.67	11.67	11.00	4.33	12.33	12.00	10.00	61.33	10.22b
	F-value									3.852*
	LSD at 5%									22.53

(A) Eucalyptus: Thymol : Peppermint= 1:1:1 (B) Eucalyptus: Thymol : Peppermint= 2:1:1
(C) Eucalyptus: Thymol: Peppermint= 1:2:1 (D) Eucalyptus: Thymol: Peppermint= 1:1:2

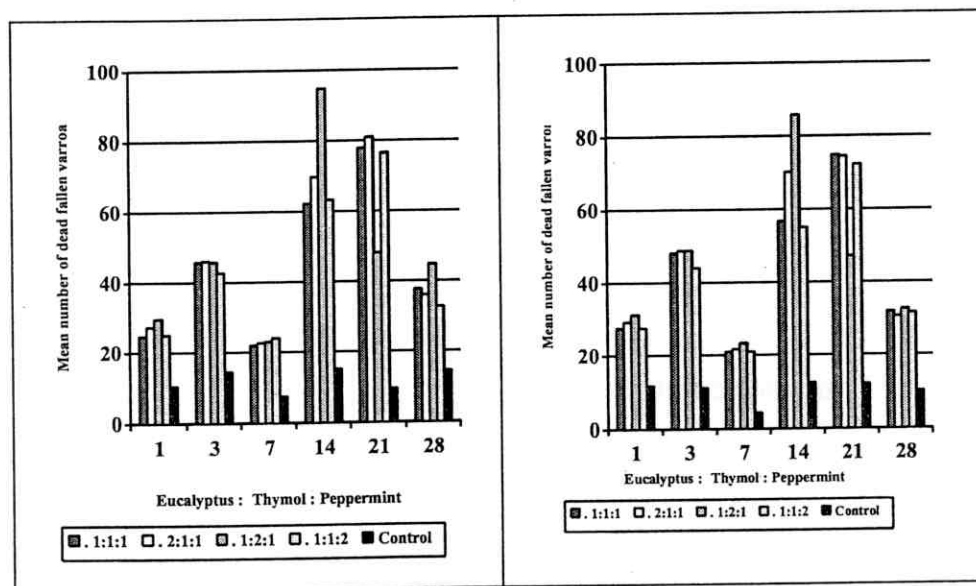


Fig. (19): Effect of applying mixed essential oils on the mortality of Varroa mites during April-May (2005 & 2006).

It could be summarized that the application of the essential oils against superior effects on the Varroa reduction percentage in sealed brood and adult worker honeybees as well as on fallen dead Varroa mites. Regarding of the efficacy of the essential oils during 2004 - 2006; it can be impress on the following points:

- 1- Using essential oils in controlling Varroa infestation gave marked reduction in the Varroa population.
- 2- The highest reduction percentage of Varroa mites was recorded with Thymol followed by Eucalyptus and then peppermint.
- 3- The rate of dropped Varroa mites by using the different methods of control with the essential oils adopted for our study, recorded highly significant values particularly during late winter and early spring seasons. However the difference between the essential oils themselves was not significant.
- 4- In spite of there were not clearly significant differences among the essential oil treatment group and control one in late autumn, there was a greater number of the fallen dead Varroa mites on the board sheet of infested honeybee colonies.
- 5- Sadv (1981) fed honeybee colonies on extracts of Pine needles (*Pinus*) mixed with candy in the 2nd half of the winter season and in early spring an improvement of the honeybee colony productivity parallel with the Varroa reduction population was remarked. Hassan (1998)

showed that the Varroa infestation level was decreased after feeding bee colonies on pollen substitute containing after the 1st treatment application was significant.

- 6- Three peaks of the fallen Varroa mites were recorded after 14, 21 & 28 days after the 1st treatment application during February and March of the year.
- 7- The efficacy of mixed essential oils used in controlling Varroa mites was 3 days earlier than oils used individually.
- 8- Honeybee colonies fed with sugar solution having to essential oils indicated significant highest mortality of *V. destructor* than colonies fed with food supplements admixed with essential oils.

The rate of the fallen Varroa mites 14 days The obtained results are in agreement with the finding of **Fathy and Fouly (1995)** who showed that the effect of different concentration (0.5, 1, 10 & 100 ppm) of the following volatile oils *Rosmarinus officinale* (Rosemary), *Thymus vulgaris* (Thymus), *Marjorana hortensi* (Margoram), *Foenivulum vulgare*, *Cymbopogon flexuosus* (Lemongrass) and *Saliva officinalis* (Sag) on Varroa mites population increased significantly as oil concentrations increase.

Sheppard et al. (2003) found that mites mortality in honeybee colonies treated with sucrose esters was significantly higher than in control one. **Zakaria and Allam, (2007)** found higher significant differences between formic acid and black cumin oil used. In addition there was potency relationship between different treatments by formic acid and black cumin oil

and sensation responses which give astonishing results in the grooming and hygienic behavior towards Varroa infestation further than improvement bee colony productivity.

Allam (2004) used the essential oils black cumin, Jasmine and mixture of Neem, black cumin and Jasmine by feeding method and found significant variance between all treatments and control.

Coriander honey than those fed with Eucalyptus honey, with higher fallen of Varroa mites.

Abd-Alhakam, (2002) used mixed of Basil and Geranium oils with supplemental pollen as potential Varroacontrol. The % infestation decreased from 26.00 to 5.67 % and from 22.00 to 1.33 % in colonies treated. **Prigel et al. (1991), Salem et al. (1998) and Noel et al. (2002)** used essential oils to controlling Varroa mites as mixture or individually showed that Varroa mites mortality was generally affected by all treatment.

II- Evaporation method

Honeybee parasitic mite, are potentially devastating to honeybee colonies and most beekeeper pest management expenses activities are directed to controlling them.

Essential oils are complex mixture of natural compounds, mostly of plant origin, extremely volatile and with an intense scent. Even if they represent only a small fraction of the plant from which they are derived, they gave the whole plant the characteristic aromatic smell for which these plants are employed by drug (Pizzale, et al, 1997). So it use the evaporation theory of the essential oil application to study the effect of the internal physiological system vitality of the parasite in minimizing the Varroa population and reduce mites number in beehives. The time required to controlling Varroa mites was five times a year.

A- Experimental periods

1- August-September 2004 & 2005

a- Varroa reduction (%) in sealed worker brood and adults

Our results indicate non-significant differences among the essential oil concentrations used for Varroa control as shown in Tables 24&25 and Fig 20, however difference between the essential oil treated colonies and untreated colonies was statistically significant. The highest reduction percentage of Varroa mites was recorded with the concentration 10% and 20% of the thymol and eucalyptus oils, respectively, approaching 100% during 2004 year.

Data shown in Table (24) represented the highest Varroa reduction percentage; the significant differences of Varroa reduction percentage were recorded with the first and second concentration during 2005 of the thymol oil which can approach 93.81% & 100%.

b- Fallen dead Varroa mites

During August and September, 2004 & 2005 non-significant differences among the number of fallen Varroa mites with different oil concentrations were recorded, in spite of significant differences between each of them and control. The highest number of Varroa fallen on the board sheet of infested honeybee colonies were recorded with the thymol oil followed by eucalyptus and peppermint oils and these were 306.67, 253.67 & 206.00 mites/colony, respectively while this number of Varroa falling was 94.66 mites/colony for the control one during 2004. However in the second year, the number of fallen Varroa mites/colony were 294.33, 267.00 & 229.67, respectively, and 73 mites/colony for the control, as shown in Table (26) and Fig (21).

2- October-November 2004 & 2005

a- Varroa reduction (%) in sealed worker brood and adults

During October and November 2004 & 2005, treatment with the essential oil through evaporation method, resulted in significant differences in the Varroa reduction percentage between different concentrations of each of the tested oils. In contrast the significant differences were recorded only between the first concentration of thymol, eucalyptus and peppermint oils

(5%). In the other side the higher reduction percentage of Varroa mites was recorded only with the 3rd oil concentration of the thymol (20%), (Tables 27 & 28) and Fig (22).

b- Fallen dead Varroa mites

In the late autumn of the experimental period of 2004& 2005 it could be observed that fallen dead Varroa mites can be quickly dropped on the board sheet of infested honeybee colonies following 24 hours of essential oil application, especially with the thymol oil followed by eucalyptus oil used in various concentrations. This is comparable to peppermint oil which affects Varroa mites maximally at day 7 of the 1st application (Table 29 & Fig. 23).

3- December-January (2004 – 2005) and (2005/2006)

a- Varroa reduction (%) in sealed worker brood and adults

According to obtained resulted shown in Tables (30 &31) and Fig. (24)of 2004 & 2005, Varroa reduction percentage generally increased with the essential oils applications. The Varroa infestation was reduced from 13% to 3%, 1.67% & 1.33% with concentrations of 5%,10% ,20% of the Eucalyptus oil, while for thymol oil they approached 1.67%, 1.33% & 0.67%, respectively, so this was considered a good sign of controlling infestation in comparison with those which recorded before. While for the peppermint oil treatment the Varroa infestation rate was reduced from 13%, 13% & 12.67% with the three concentrations before treatments to 4%, 3% & 2.33% after treatment completion. In addition significant differences were existed between each of the tested concentrations of the essential oil and control one were recorded.

b- Fallen dead Varroa mites

By the beginning of the winter season, the fallen Varroa rate was increased with all tested material concentration particularly after 72 hours, of the first application. The of rate fallen number of Varroa was recorded for treatment with persist constantly after the 2nd application, however the highest effect of the peppermint oil , followed by the 3rd treatment, whereas for thymol and the eucalyptus oils the fallen Varroa rate were still the lowest till the treatment end.

It could be summarized that both thymol and eucalyptus oils have higher and strong effect than peppermint oil, which need more than once application to produce its effect, as shown in Table (32) and Fig (25).

4- February-March 2005 & 2006

a- Varroa reduction(%) in sealed worker brood and adults

The Varroa reduction percentage in worker brood cells with different oil concentrations used was highest with the thymol oil in comparison with eucalyptus and peppermint oils.

During seasons 2005 & 2006 Varroa reduction percentage in worker bee brood was higher with the 3rd concentration of the thymol oil (91.19% & 91.92%) and (86% & 83%) for the eucalyptus, followed with the peppermint oil (77.75% & 80.6%) respectively (Tables 33 & 34 and Fig. 26).

b- Fallen dead Varroa mites

During late winter in February-March 2005& 2006, the peak of fallen dead Varroa mites was recorded with the 3rd and

2nd thymol concentrations. It was 577&519.33 mites /colony, respectively . However it was 465.34 mite/colony with the 3rd concentration of the eucalyptus oil, whereas the peppermint oil effective concentration was optimal with the 3rd one (365.01 mites/colony) as shown in Table 35 and Fig. 27.

5- April-May 2005 & 2006

a- Varroa reduction (%) in sealed worker brood and adults

The results obtained in Table (36 & 37) and Fig (28) showed that the Varroa reduction percentage approached 100% with the 3rd oil concentration of the thymol during the year 2005, while for the same concentration of eucalyptus it was 87.30%. Similarly, for the 3rd oil concentration of peppermint it was 80.48%. Clear significant differences between each of the tested concentrations of the essential oils and control one were recorded regarding Varroa reduction (%) in sealed worker brood and adults.

b- Fallen dead Varroa mites

Data presented in Table 38 and Fig 29 showed that the higher Varroa reduction percentage was recorded after 72 hours of the first treatment for all used concentrations of the tested essential oils .

During 2006 the Varroa drop rate was higher with different concentrations particularly after 14 days of 2nd treatment for the thymol, eucalyptus and peppermint, respectively. There were non-significant difference among different oil concentrations. However significant differences between each of the applied different concentrations of the essential oil treatments and control were recorded.

Table (24): Effect of evaporation of some essential oils at different concentrations on the reduction of Varroa mites infestation in worker brood honeybee colonies during August-September (2004 & 2005)

Treatment		Time of application	Concentration of tested oils								F-value	LSD
			Mean percentage of Varroa infestation in worker brood									
			5%	% Reduction	10 %	% Reduction	20 %	% Reduction	Control			
2004	Eucalyptus	Before treatment	5.67	---	5.33	---	5.33	---	---	---	---	---
		After treatment	0.67 b B	87.40	0.00 b B	100	0.00 b B	100	5.00 a A	52.250**	1.09	
	Thymol	Before treatment	5.33	---	5.33	---	5.67	---	---	---	---	
		After treatment	0.33 b B	93.40	0.00 b B	100	0.00 b B	100	5.00 a A	54.000**	1.09	
	Pepper	Before treatment	5.67	---	5.33	---	5.33	---	---	---	---	
		After treatment	1.00 b B	81.20	0.67 b B	86.60	0.67 b B	86.60	5.00 a A	20.167**	1.54	
	Control	Before treatment	5.33	---	5.33	---	5.33	---	---	---	---	
		After treatment	5.00 a	---	5.00 a	---	5.00 a	---	---	---	---	
	F-value	21.46 **	---	52.25**	---	52.25**	---	---	---	---	---	
	LSD	1.54	---	1.09	---	1.09	---	---	---	---	---	
2005	Eucalyptus	Before treatment	5.67	---	5.67	---	5.67	---	5.67	---	---	
		After treatment	1.00 B c	81.24	0.67 B bc	78.43	0.67 B bc	78.43	5.33 A	62.556**	0.94	
	Thymol	Before treatment	5.67	---	5.67	---	6.00	---	---	---	---	
		After treatment	0.67 B c	78.43	0.33 B c	93.81	0.00 B c	100	5.33 A	75.889**	0.94	
	Pepper	Before treatment	5.67	---	5.67	---	5.67	---	---	---	---	
		After treatment	2.00 B b	62.48	1.67 B b	68.68	1.33 B b	75.05	5.33 A	41.222**	0.94	
	Control	Before treatment	5.67	---	5.67	---	5.67	---	---	---	---	
		After treatment	5.33 a	---	5.33 a	---	5.33 a	---	---	---	---	
	F-value	81.833**	---	47.333**	---	68.889**	---	---	---	---	---	
	LSD	0.77	---	1.09	---	0.94	---	---	---	---	---	

*** = Highly significant

Means in a row followed with the same capital letter (s) are not significantly different at 5% level of probability (between concentrations).

Means in a column followed with the same small letter (s) are not significantly different at 5% level of probability (between treatments).

Results and Discussion

Table (25): Effect of evaporation of some essential oils at different concentrations on the reduction of Varroa mites infestation on adult worker honeybee colonies during August-September (2004 & 2005).

Treatment	Time of application	Mean percentage of Varroa infestation in adult brood										F-value	LSD
		Concentration of tested oils											
		5%	% Reduction	10%	% Reduction	20%	% Reduction	Control					
2004	Eucalyptus	Before treatment	2.00		1.67		2.00		2.33				
		After treatment	0.33 b B	80.78	0.00 b B	100	0.00 b B	100	2.00 A	33.000**	0.54		
	Thymol	Before treatment	1.67		1.67		1.67		2.33				
		After treatment	0.33 b B	76.98	0.00 b B	100	0.00 b B	100	2.00 A	33.000**	0.54		
	Pepper	Before treatment	1.67		1.67		1.67		2.33				
		After treatment	0.67 b B	53.26	0.33 b B	76.98	0.33 b B	76.98	2.00 A	7.556*	0.94		
	Control	Before treatment	2.33		2.33		2.33						
2005		After treatment	2.00 a		2.00 a		2.00 a						
	F-value		7.556*		33.000**		33.000**						
	LSD		0.94		0.54		0.54						
	Eucalyptus	Before treatment	2.33		2.67		2.33		2.67				
		After treatment	0.67 b B	74.41	0.67 b B	77.67	0.33 b B	87.39	3.00 A	9.944**	1.33		
	Thymol	Before treatment	2.33		2.33		2.67		2.67				
		After treatment	0.67 b B	74.41	0.33 b B	87.39	0.33 b B	89.00	3.00 A	9.111**	1.33		
2005	Pepper	Before treatment	3.00		2.33		2.33		2.67				
		After treatment	1.00 b B	70.33	0.67 b B	74.41	0.33 b B	87.39	3.00 A	6.458*	1.54		
	Control	Before treatment	2.67		2.67		2.67						
		After treatment	3.00 a		3.00 a		3.00 a						
	F-value		5.667*		9.111**		10.667**						
	LSD		1.54		1.33		1.33						

** = Highly significant

* = Significant

Means in a row followed with the same capital letter (s) are not significantly different at 5% level of probability (between concentrations).
Means in a column followed with the same small letter (s) are not significantly different at 5% level of probability (between treatments).

Results and Discussion

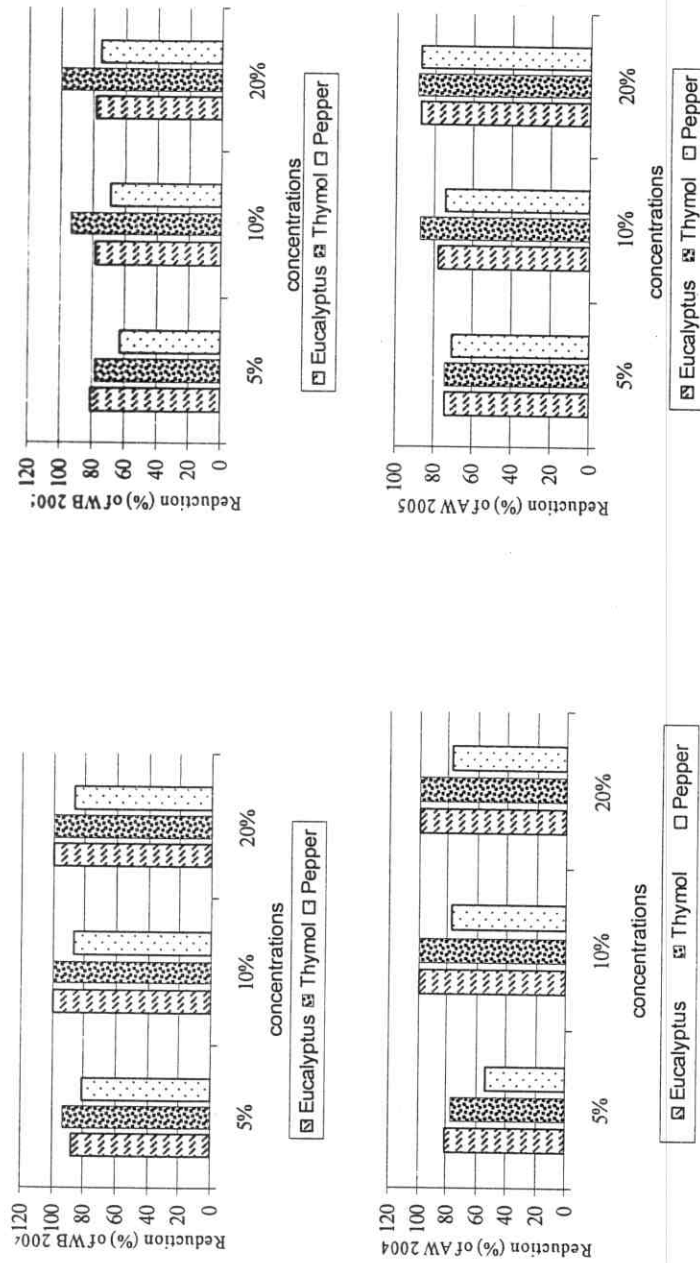


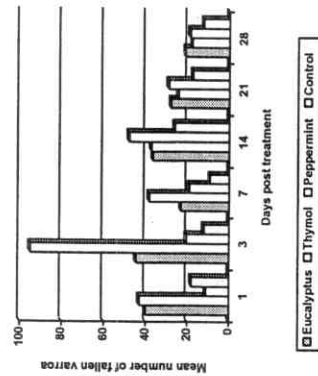
Fig. (20): Effect of evaporation of some essential oils at different concentrations on the reduction of Varroa mites infestation in worker brood and adult honeybee colonies during August-September (2004 & 2005).

Results and Discussion

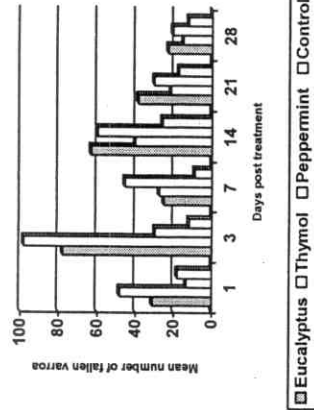
Table (26): Effect of evaporation of some essential oils at different concentrations against Varroa mites infestation during August- September (2004 & 2005).

Treatment	Concentration (%)	Mean number of dead fallen Varroa mites at indicated days									
		Before treatment	Post treatment								Total
2004	Eucalyptus oil	1	4.00	40.00	44.67	23.00	36.67	21.00	28.00	21.00	193.34
		2	5.33	48.33	98.33	27.67	40.33	15.33	21.67	15.33	251.66
		3	5.33	51.33	90.00	30.00	46.00	15.67	20.67	15.67	253.67
	Thymol oil	1	2.00	43.00	95.00	38.33	37.33	17.67	24.33	17.67	255.66
		2	2.33	63.67	108.33	54.00	42.33	15.33	26.00	15.33	309.66
		3	2.00	58.67	109.33	54.67	43.33	14.67	26.00	14.67	306.67
	Peppermint oil	1	5.00	11.00	20.33	19.00	48.00	18.67	29.00	18.67	146.00
		2	4.67	13.33	30.00	45.67	60.00	20.67	30.33	20.67	200.00
		3	4.00	15.00	32.00	45.33	59.67	22.00	32.00	22.00	206.00
	Control	---	4.67	18.00	12.00	9.00	26.00	12.33	17.33	12.33	94.66
2005	Eucalyptus oil	1	6.67	41.00	50.67	24.67	35.67	19.00	28.67	19.00	199.68
		2	7.33	52.33	99.00	31.33	40.00	14.00	20.67	14.00	257.33
		3	6.67	53.33	100.00	31.67	46.33	13.67	22.00	13.67	267.00
	Thymol oil	1	6.00	41.67	78.33	30.67	40.33	19.67	28.00	19.67	238.67
		2	5.67	60.00	99.67	35.00	45.00	17.67	31.33	17.67	288.67
		3	6.00	61.00	112.00	32.33	45.00	11.67	32.33	11.67	294.33
	Peppermint oil	1	6.33	25.33	40.00	22.67	35.33	21.00	27.00	21.00	171.33
		2	6.33	30.67	49.67	27.67	37.33	22.67	33.00	22.67	201.01
		3	6.00	35.67	62.00	30.67	41.33	24.33	35.67	24.33	229.67
	Control	---	5.33	11.33	9.67	8.67	12.33	14.67	16.33	14.67	73.00

5 % concentration



10 % concentration



20% concentration

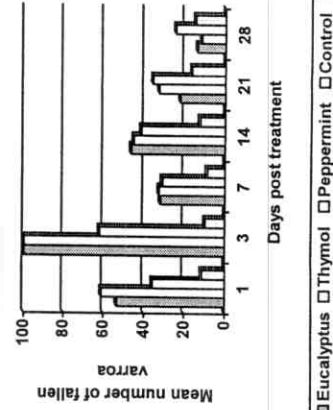
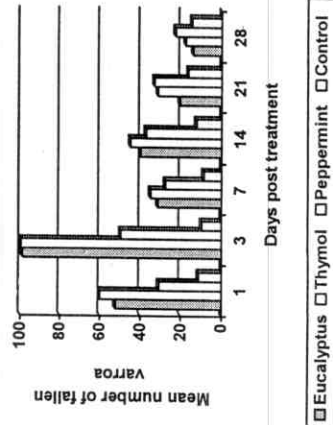
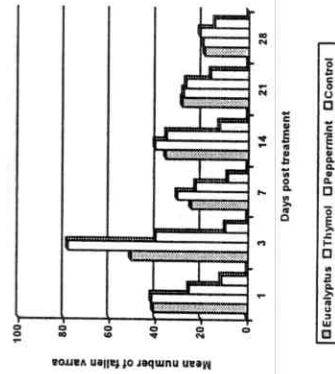
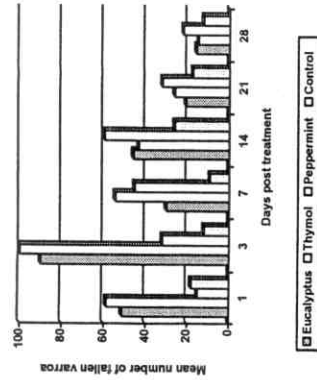


Fig. (21) Effect of essential oils on the mortality of Varroa mites during August-September 2004 & 2005.

Results and Discussion

Table (27): Effect of evaporation of some essential oils at different concentrations on the reduction of Varroa mites infestation in worker brood honeybee colonies during October-November (2004& 2005).

Treatment	Time of application	Mean percentage of Varroa infestation in worker brood										F-value	LSD
		Concentration of tested oils											
		5%	% Reduction	10%	% Reduction	20%	% Reduction	% Reduction	Control				
2004	Eucalyptus	Before treatment	12.00	---	11.67	---	11.67	---	11.67	---	11.67	---	---
		After treatment	1.67 bc B	81.95	1.00 b B	88.89	1.00 b B	88.89	1.00 b B	88.89	9.00 A	54.800**	1.72
	Thymol	Before treatment	11.33	---	11.00	---	11.33	---	11.67	---	11.67	---	---
		After treatment	0.67 c B	92.33	0.67 b B	92.10	0.33 b B	96.22	9.00 A	107.111**	9.00 A	107.111**	1.33
		Before treatment	11.67	---	11.33	---	11.67	---	11.67	---	11.67	---	---
	Pepper	After treatment	3.00 b B	66.67	2.00 b B	77.11	1.67 b B	81.44	9.00 A	60.714**	9.00 A	60.714**	1.44
2005	Control	Before treatment	11.67	---	11.67	---	11.67	---	11.67	---	9.00 A	60.714**	1.44
		After treatment	9.00 a	---	9.00 a	---	9.00 a	---	9.00 a	---	9.00 A	60.714**	1.44
	F-value	After treatment	62.792**	---	79.429**	---	73.333**	---	73.333**	---	9.00 A	60.714**	1.44
	LSD	After treatment	1.54	---	1.44	---	1.54	---	1.54	---	9.00 A	60.714**	1.44
	Eucalyptus	Before treatment	12.00	---	12.33	---	12.33	---	12.33	---	12.33	---	---
		After treatment	1.67 B b	82.84	1.33 B b	86.70	1.00 B b	90.00	10.00 A	135.733**	10.00 A	135.733**	1.22
2005	Thymol	Before treatment	13.00	---	12.33	---	12.33	---	12.33	---	12.33	---	---
		After treatment	1.33 B b	87.39	1.00 B b	90.00	0.67 B b	93.30	10.00 A	146.333**	10.00 A	146.333**	1.22
	Pepper	Before treatment	12.67	---	12.67	---	12.67	---	12.33	---	12.33	---	---
		After treatment	2.33 B b	77.33	2.00 B b	80.54	1.33 B b	87.06	10.00 A	119.667**	10.00 A	119.667**	1.22
	Control	Before treatment	12.33	---	12.33	---	12.33	---	10.00 a	---	10.00 a	---	---
		After treatment	10.00 a	---	10.00 a	---	10.00 a	---	10.00 a	---	10.00 a	---	---
2005	F-value	After treatment	102.444**	---	166.250**	---	146.333**	---	146.333**	---	10.00 a	119.667**	1.22
	LSD	After treatment	1.33	---	1.09	---	1.22	---	1.22	---	10.00 a	119.667**	1.22

** = Highly significant

Means in a row followed with the same capital letter (s) are not significantly different at 5% level of probability (between concentrations).

Means in a column followed with the same small letter (s) are not significantly different at 5% level of probability (between treatments).

Table (28): Effect of evaporation of some essential oils at different concentrations on the reduction of Varroa mites infestation on adult worker honeybee colonies during October-November (2004 & 2005).

Treatment	Time of application	Mean percentage of Varroa infestation in adult brood								F-value	LSD
		Concentration of tested oils									
		5%	% Reduction	10%	% Reduction	20%	% Reduction	Control			
2004	Eucalyptus	Before treatment	8.67		8.33		9.00		8.00		
		After treatment	1.67 b B	72.82	1.33 b B	77.47	1.00 b B	84.32	5.67 A	19.074**	1.63
	Thymol	Before treatment	9.67		9.33		10.00		8.00		
		After treatment	1.00 b B	85.41	0.67 b B	89.87	0.33 b B	95.34	5.67 A	25.296**	1.63
	Pepper	Before treatment	9.00		8.00		8.67		8.00		
		After treatment	2.33 b B	63.47	1.67 b B	70.55	1.67 b B	72.82	5.67 A	18.857**	1.88
	Control	Before treatment	8.00		8.00		8.00				
		After treatment	5.67 a		5.67 a		5.67 a				
2005	Eucalyptus	Before treatment	17.185**	26.286**		22.963**					
		After treatment	1.63	1.44		1.63					
	Thymol	Before treatment	8.33		8.67		8.33		8.33		
		After treatment	1.67 bc B	70.55	1.33 bc B	77.46	1.33 bc B	76.54	5.67 A	40.333**	1.09
	Pepper	Before treatment	9.67		9.33		10.00		8.33		
		After treatment	1.00 c B	84.81	0.67 c B	89.45	0.33 c B	95.15	5.67 A	37.944**	1.33
	Control	Before treatment	9.00		8.00		8.67		8.33		
		After treatment	2.00 b B	67.35	1.67 b B	69.33	1.67 b B	71.70	5.67 A	11.407**	1.63
LSD	Before treatment	8.33		8.33		8.33					
	After treatment	5.67 a		5.67 a		5.67 a					
	After treatment	25.500**		25.333**		32.444**					
			1.33	1.44		1.33					

** = Highly significant

Means in a row followed with the same capital letter (s) are not significantly different at 5% level of probability (between concentrations).

Means in a column followed with the same small letter (s) are not significantly different at 5% level of probability (between treatments).

Results and Discussion

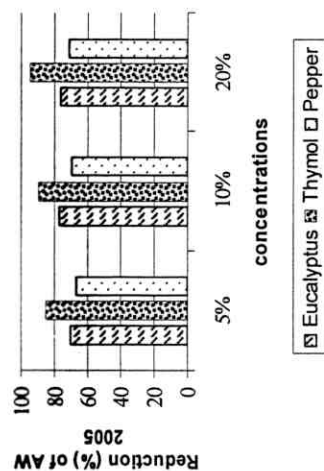
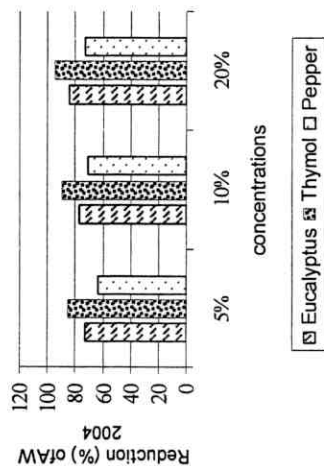
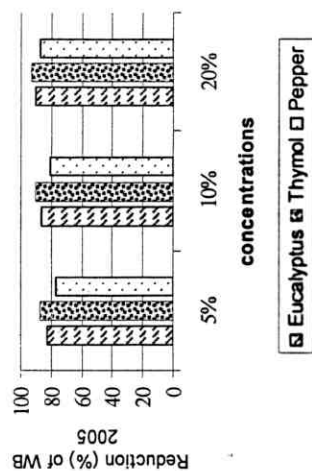
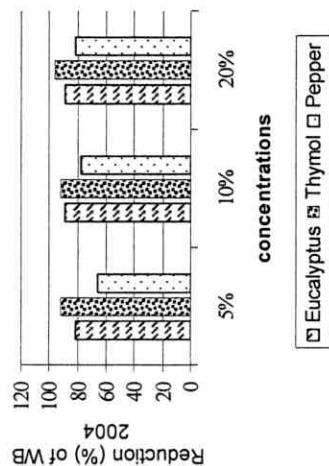


Fig. (22): Effect of evaporation of some essential oils at different concentrations on the reduction of Varroa mites infestation in worker brood and adult honeybee colonies during October - November (2004 & 2005).

Table (29): Effect of evaporation of some essential oils at different concentrations against Varroa mites infestation during October–November (2004 & 2005).

Treatment	Concentration (%)	Mean number of dead fallen Varroa mites at indicated days									
		Before treatment	Post treatment								Total
			1	3	7	14	21	28			
2004	Eucalyptus oil	1	3.33	50.67	55.33	45.67	115.00	32.33	18.33	317.33	
		2	3.33	74.00	52.00	46.00	155.67	36.67	14.00	378.34	
		3	4.33	50.40	66.67	61.33	193.67	44.33	12.67	429.07	
	Thymol oil	1	3.00	51.67	54.33	34.33	112.33	23.67	14.33	290.66	
		2	5.33	84.67	63.67	40.67	177.67	59.00	15.33	441.01	
		3	4.33	88.67	79.00	48.33	190.67	82.67	13.67	503.01	
	Peppermint oil	1	3.00	24.00	33.00	21.33	72.33	64.00	9.33	223.99	
		2	3.00	26.33	53.67	23.33	46.67	74.67	10.33	235.00	
		3	4.67	26.67	74.33	30.33	100.67	81.67	14.33	328.00	
Control	---	3.67	7.67	11.00	5.33	9.67	7.67	14.00	55.34		
2005	Eucalyptus oil	1	7.00	47.33	64.33	40.67	108.67	33.33	19.33	313.66	
		2	8.67	60.33	72.00	42.33	117.00	37.33	16.33	345.32	
		3	6.67	61.33	73.33	47.00	139.33	40.67	14.33	375.99	
	Thymol oil	1	7.33	52.33	61.67	43.67	112.33	26.00	19.67	315.67	
		2	7.00	63.67	69.33	46.00	121.67	24.33	15.67	340.67	
		3	7.00	65.67	77.33	47.00	128.33	20.33	12.67	351.33	
	Peppermint oil	1	7.33	16.33	30.67	21.33	68.00	71.33	49.00	256.66	
		2	6.67	17.67	37.33	23.33	74.67	84.33	52.67	290.00	
		3	7.33	20.00	42.33	29.00	81.67	96.33	33.00	302.33	
Control	---	7.33	11.00	10.00	9.33	11.67	13.33	12.67	68.00		

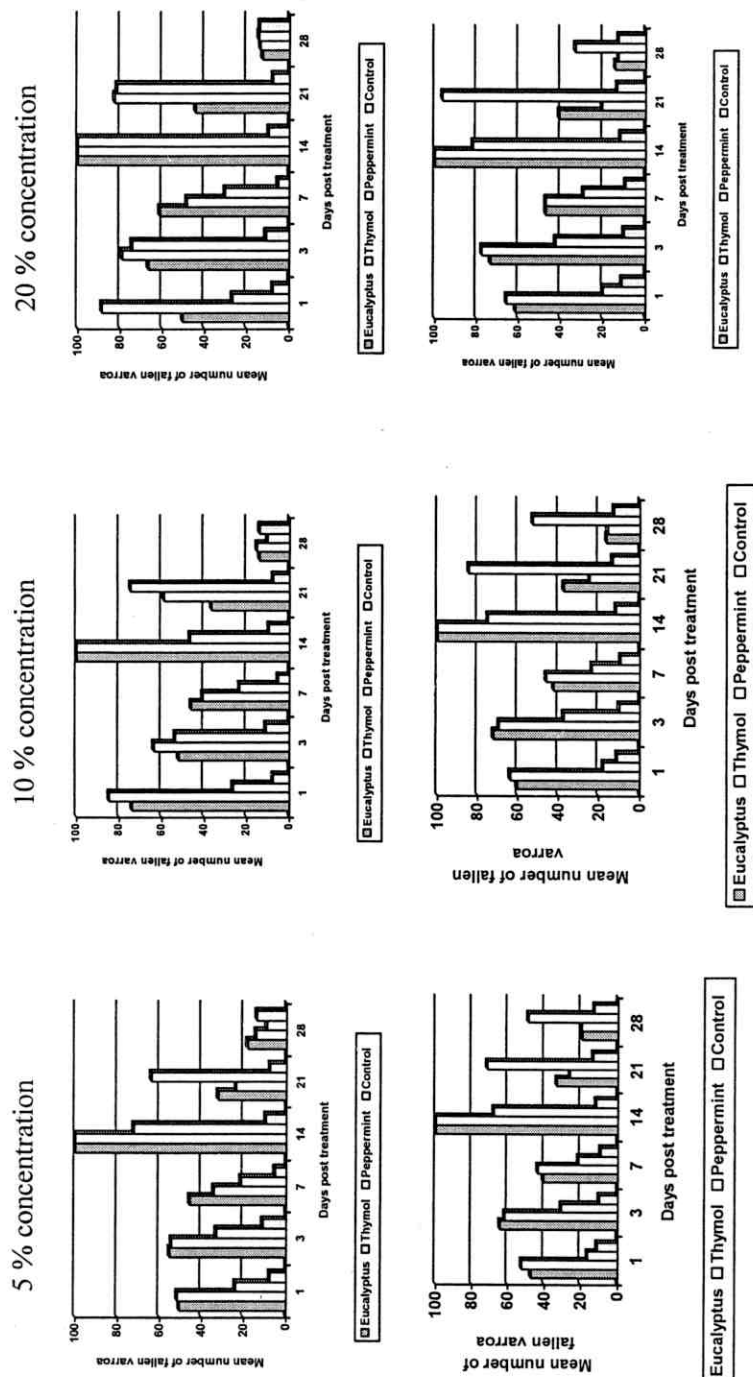


Fig. (23) Effect of essential oils on the mortality of Varroa mites during October-November 2004 & 2005.

Results and Discussion

Table (30): Effect of evaporation of some essential oils at different concentrations on the reduction of Varroa mites infestation in worker brood honeybee colonies during December, 2004 – January, 2005 and December, 2005 – January, 2006.

Treatment	Time of application	Mean percentage of Varroa infestation in worker brood										F-value	LSD
		Concentration of tested oils											
		5%	% Reduction	10%	% Reduction	20%	% Reduction	% Reduction	Control				
2004/2005	Eucalyptus	Before treatment	16.00	----	15.67	-----	14.67	-----					
		After treatment	2.33 b B	82.71	1.33 b B	89.92	1.00 b B	91.91	10.67 A	42.148**	2.31	-----	
	Thymol	Before treatment	14.00	-----	14.33	-----	14.33	-----					
		After treatment	1.67 b B	87.61	0.67 b B	94.45	0.67 b B	94.45	10.67 A	53.063**	2.17	-----	
	Pepper	Before treatment	14.67	-----	15.00	-----	14.00	-----					
		After treatment	3.67 b B	70.29	2.67 b B	78.86	2.00 b B	83.04	10.67 A	38.467**	2.23	-----	
	Control	Before treatment	12.67	-----	12.67	-----	12.67	-----					
		After treatment	10.67 a	-----	10.67 a	-----	10.67 a	-----					
	F-value	After treatment	38.563**	-----	48.250**	-----	47.902**	-----					
	LSD		2.17	-----	2.17	-----	2.24	-----					
2006	Eucalyptus	Before treatment	13.00	-----	13.00	-----	13.00	-----					
		After treatment	3.00 B b	71.70	1.67 B b	84.24	1.33 B b	87.45	10.33 A	30.651**	2.49	-----	
	Thymol	Before treatment	13.33	-----	12.67	-----	12.67	-----					
		After treatment	1.67 B b	84.24	1.33 B b	87.12	0.67 B b	93.51	10.33 A	39.649**	2.37	-----	
	Pepper	Before treatment	13.00	-----	13.00	-----	12.67	-----					
		After treatment	4.00 B b	62.26	3.00 B b	71.70	2.33 B b	77.44	10.33 A	21.145**	2.61	-----	
	Control	Before treatment	12.67	-----	12.67	-----	12.67	-----					
		After treatment	10.33 a	-----	10.33 a	-----	10.33 a	-----					
	F-value	After treatment	23.116**	-----	30.651**	-----	38.316**	-----					
	LSD		2.61	-----	2.49	-----	2.37	-----					

** = Highly significant

Means in a row followed with the same capital letter (s) are not significantly different at 5% level of probability (between concentrations).

Means in a column followed with the same small letter (s) are not significantly different at 5% level of probability (between treatments).

Table (31): Effect of evaporation of some essential oils at different concentrations on the reduction of Varroa mites infestation on adult worker honeybee colonies during December, 2004 – January, 2005 and December, 2005 – January, 2006.

Treatment	Time of application	Mean percentage of Varroa infestation in adult brood								F-value	LSD
		Concentration of tested oils									
		5%	% Reduction	10%	% Reduction	20%	% Reduction	Control			
2004/2005	Eucalyptus	Before treatment	19.00		20.00		18.00		17.33		
		After treatment	2.33 b B	84.45	1.67 b B	89.41	1.33 b B	90.63	13.67 A	127.833**	1.72
	Thymol	Before treatment	17.67		17.00		17.67		17.33		
		After treatment	1.33 b B	90.46	0.67 b B	95.00	0.33 b B	97.63	13.67 A	150.133**	1.72
	Pepper	Before treatment	17.33		17.00		16.67		17.33		
		After treatment	2.67 b B	80.47	1.67 b B	87.55	1.33 b B	89.89	13.67 A	126.000**	1.72
	Control	Before treatment	17.33		17.33		17.33				
		After treatment	13.67 a		13.67 a		13.67 a				
2006	Eucalyptus	F-value	121.333**		137.700**		145.200**				
		LSD	1.72		1.72		1.72				
	Eucalyptus	Before treatment	18.00		18.33		18.67		18.33		
		After treatment	3.00 b B	75.89	2.00 b B	84.21	1.33 b B	89.69	12.67 A	50.983**	2.43
	Thymol	Before treatment	18.00		18.33		18.00		18.33		
		After treatment	1.33 b B	89.31	1.00 b B	92.11	0.33 bB	97.35	12.67 A	83.644**	2.11
	Pepper	Before treatment	18.67		18.67		18.33		18.33		
		After treatment	3.33 b B	74.20	3.00 b B	76.75	2.33 b B	81.61	12.67 A	41.270**	2.49
Control	Before treatment	18.33		18.33		18.33					
	After treatment	12.67 a		12.67 a		12.67 a					
F-value	Before treatment	39.486**		65.500**		73.750**					
	After treatment	2.66		2.17		2.17					

**** = Highly significant**

Means in a row followed with the same capital letter (s) are not significantly different at 5% level of probability (between concentrations).

Means in a column followed with the same small letter (s) are not significantly different at 5% level of probability (between treatments).

Results and Discussion

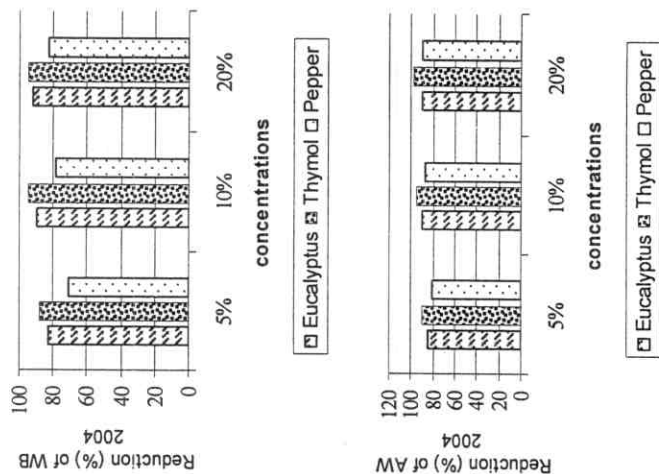


Fig. (24): Effect of evaporation of some essential oils at different concentrations on the reduction of Varroa mites infestation in worker brood and adult honeybee colonies during December– January, 2004 & December 2005 and January 2006.

Table (32): Effect of evaporation of some essential oils at different concentrations against Varroa mites infestation during December, 2004 – January, 2005 and December, 2005 – January, 2006.

Treatment	Concentration (%)	Mean number of dead fallen Varroa mites at indicated days										
		Before treatment	Post treatment									
			1	3	7	14	21	28	Total			
2004 / 2005	Eucalyptus oil	4.66	20.00	55.33	31.67	139.67	29.00	32.33	308.00			
		4.66	27.00	92.00	34.33	157.67	31.00	20.00	362.00			
		5.33	32.67	101.67	44.67	159.00	23.67	20.67	382.35			
	Thymol oil	4.00	35.67	84.33	46.33	154.67	28.67	30.67	380.34			
		3.67	43.00	102.00	42.33	168.33	37.67	24.00	417.33			
		3.33	47.67	108.33	41.00	178.00	41.33	21.67	438.00			
	Peppermint oil	4.33	9.67	42.33	23.33	46.33	94.00	32.00	247.66			
		2.33	10.67	47.33	27.33	81.67	103.67	26.00	296.67			
		3.33	15.33	49.00	31.33	85.00	110.33	27.00	317.99			
	Control	3.00	6.67	7.33	11.33	14.67	16.67	14.33	71.00			
2006	Eucalyptus oil	8.33	24.33	67.67	29.33	109.33	31.67	26.67	289.00			
		7.67	31.67	92.67	33.67	132.67	28.33	19.67	338.68			
		9.33	36.67	100.67	38.33	140.33	24.00	15.67	355.67			
	Thymol oil	9.00	28.00	70.67	36.67	121.67	25.67	18.33	301.01			
		8.67	33.67	102.00	45.67	143.67	22.00	16.67	363.68			
		8.33	44.33	107.00	48.00	156.67	21.00	11.33	388.33			
	Peppermint oil	8.67	13.00	27.00	19.00	51.33	64.33	38.33	212.99			
		8.00	13.67	34.33	21.33	86.33	71.33	36.00	262.99			
		7.67	15.67	47.00	23.00	93.67	80.33	41.33	301.00			
	Control	8.00	10.33	12.00	11.33	14.33	14.00	14.00	75.99			

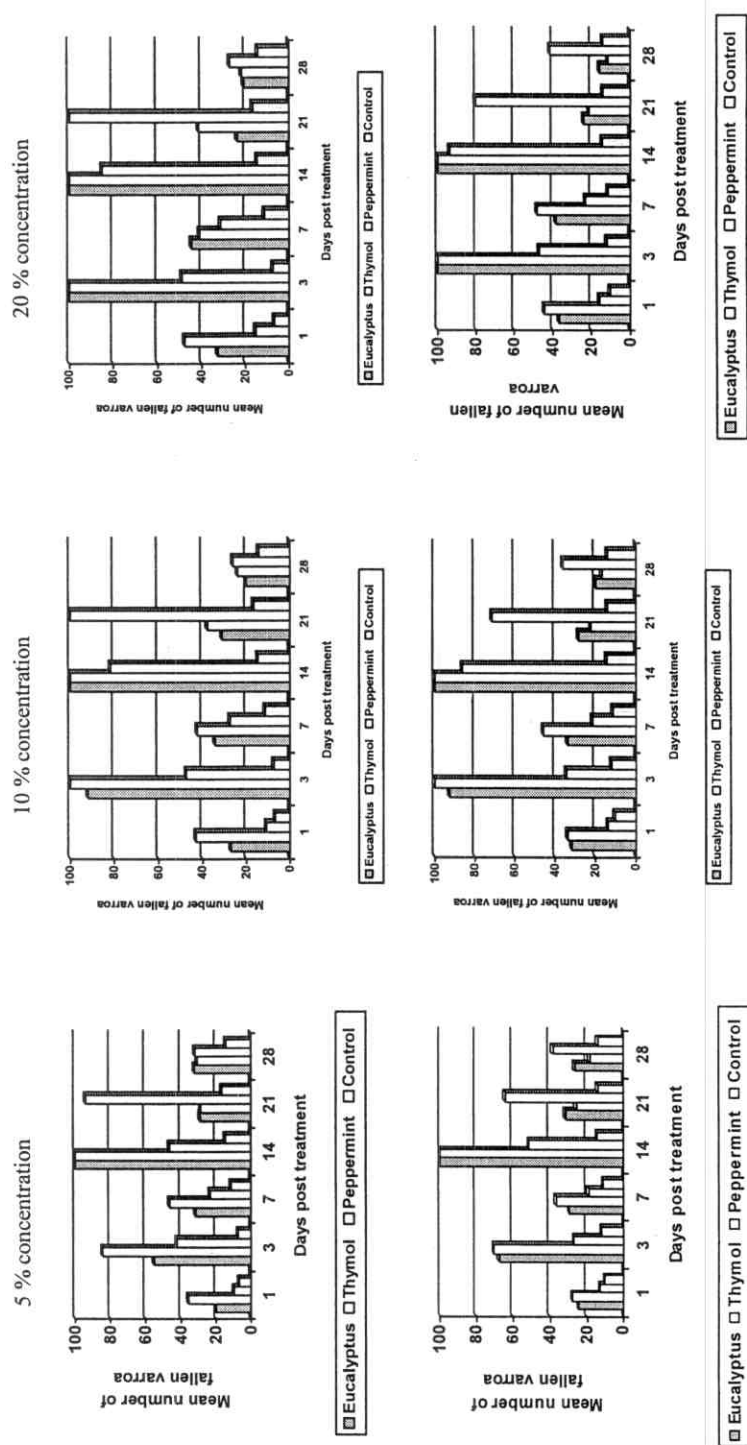


Fig. (25) Effect of essential oils on the mortality of Varroa mites during December 2004– January, December 2005 and January 2006.

Results and Discussion

Table (33): Effect of evaporation of some essential oils at different concentrations on the reduction of Varroa mites infestation in worker brood honeybee colonies during February-March (2005-2006).

Infestation in worker brood honeybee colonies during autumn (2005-2006)										
Treatment	Time of application	Mean percentage of Varroa infestation in worker brood							F-value	LSD
		Concentration of tested oils								
		5%	% Reduction	10%	% Reduction	20%	% Reduction	Control		
2005	Eucalyptus	Before treatment	19.00	---	18.33	---	18.67	18.33	---	---
		After treatment	3.00 b B	75.88	2.33 b B	80.58	1.67 b B	12.00 A	20.772**	3.48
	Before treatment	17.67	---	17.00	---	17.33	---	18.33	---	---
	Thymol	After treatment	2.33 b B	89.86	2.00 b B	82.03	1.00 b B	12.00 A	20.696**	3.69
		Before treatment	18.33	---	18.67	---	18.33	18.33	---	---
	Pepper	After treatment	3.67 b B	69.42	3.33 b B	72.76	2.67 b B	12.00 A	16.659**	3.522
2006		Before treatment	18.33	---	18.33	---	18.33	---	---	---
	Control	After treatment	12.00 a	---	12.00 a	---	12.00 a	---	---	---
	F-value	After treatment	18.041**	---	18.508**	---	21.578**	---	---	---
	LSD		3.48	---	3.61	---	3.61	---	---	---
	Eucalyptus	Before treatment	18.00	---	17.67	---	18.00	18.33	---	---
		After treatment	3.00 B b	74.54	2.67 B b	76.92	2.00 B b	12.00 A	32.360**	2.72
2006	Before treatment	12.67	---	12.67	---	12.67	---	18.33	---	---
	Thymol	After treatment	2.00 B b	75.89	1.00 B b	87.94	0.67 B b	12.00 A	48.045**	2.55
		Before treatment	18.00	---	17.67	---	18.33	18.33	---	---
	Pepper	After treatment	4.33 B b	63.26	3.33 B b	71.21	2.33 B b	12.00 A	29.167**	2.66
		Before treatment	18.33	---	18.33	---	18.33	---	---	---
	Control	After treatment	12.00 a	---	12.00 a	---	12.00 a	---	---	---
F-value	After treatment	29.760**	---	38.072**	---	42.594**	---	---	---	
LSD		2.72	---	2.61	---	2.61	---	---	---	

** = Highly significant

Means in a row followed with the same capital letter (s) are not significantly different at 5% level of probability (between concentrations).

Means in a column followed with the same small letter (s) are not significantly different at 5% level of probability (between treatments).

Results and Discussion

Table (34): Effect of evaporation of some essential oils at different concentrations on the reduction of Varroa mites infestation on adult worker honeybee colonies during February-March (2005 & 2006).

Treatment	Time of application	Mean percentage of Varroa infestation in adult brood								F-value	LSD
		Concentration of tested oils									
		5%	% Reduction	10%	% Reduction	20%	% Reduction	Control			
2005	Eucalyptus	Before treatment	11.33		12.67		11.67		12.67		
		After treatment	1.67 b B	67.06	1.67 b B	70.55	1.33 b B	74.53	5.67 A	28.250**	1.09
	Thymol	Before treatment	14.67		11.00		12.00		12.67		
		After treatment	2.00 b B	69.54	1.33 b B	72.98	1.00 b B	81.38	5.67 A	35.583**	1.09
	Pepper	Before treatment	11.00		10.00		11.33		12.67		
		After treatment	2.00 b B	59.37	1.67 b B	62.68	1.67 b B	67.06	5.67 A	17.111**	1.33
	Control	Before treatment	12.67		12.67		12.67				
	After treatment	5.67 a		5.67 a		5.67 a					
2006	Eucalyptus	Before treatment	22.000**		29.333**		24.444**				
		After treatment	1.09		1.09		1.33				
	Thymol	Before treatment	11.67		12.33		12.33		11.67		
		After treatment	2.67 b B	63.57	2.33 b B	69.91	1.67 bc B	78.44	7.33 A	60.333**	1.09
	Pepper	Before treatment	12.00		12.33		8.33		11.67		
		After treatment	2.67 b B	64.58	2.33 b B	69.91	1.00 c B	80.89	7.33 A	61.333**	1.22
	Control	Before treatment	8.00		8.33		12.33		11.67		
		After treatment	2.00 b B	60.20	1.67 b B	68.08	2.00 b B	74.18	7.33 A	75.889**	
2007	F-value	Before treatment	11.67		11.67		11.67				
		After treatment	7.33 a		7.33 a		7.33 a				
	LSD	Before treatment	36.444**		62.250**		153.333**				
		After treatment	1.33		1.09		0.77				

** = Highly significant

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Means in a column followed with the same small letter (s) are not significantly different at 5% level of probability (between treatments).

Results and Discussion

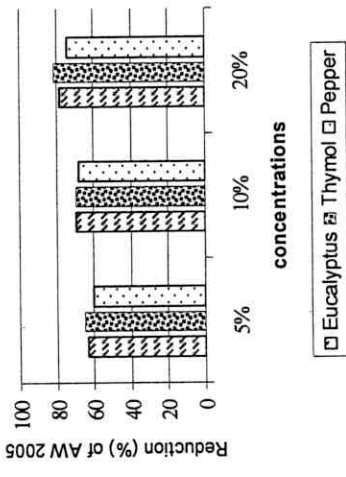
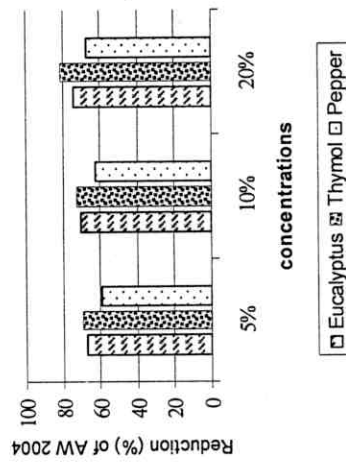
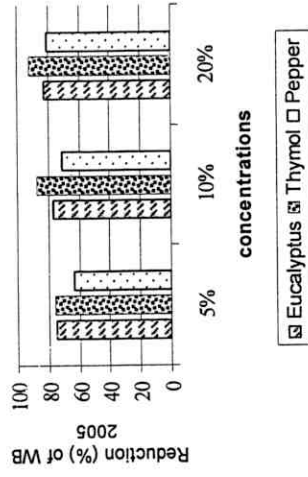
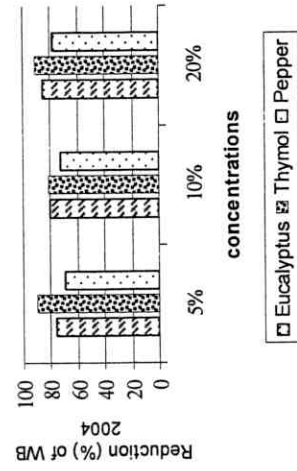


Fig. (26): Effect of evaporation of some essential oils at different concentrations on the reduction of Varroa mites infestation in worker brood and adult honeybee colonies during February-March (2005& 2006).

Table (35): Effect of evaporation of some essential oils at different concentrations against Varroa mites infestation during February-March (2005 & 2006).

Treatment	Concentration n (%)	Mean number of dead fallen Varroa mites at indicated days									
		Before treatment	Post treatment								Total
2005	Eucalyptus oil	1	52.00	75.00	52.00	82.33	78.33	18.33	357.99		
		2	60.00	92.33	60.67	94.33	91.00	16.33	414.66		
		3	70.00	102.67	71.67	108.67	100.33	12.00	465.34		
	Thymol oil	1	78.33	83.67	61.00	103.67	89.33	21.33	437.33		
		2	83.33	104.00	72.00	143.67	100.33	18.00	519.33		
		3	91.67	101.33	81.00	177.67	110.00	15.33	577.00		
	Peppermint oil	1	35.67	48.67	37.00	71.67	72.33	14.67	280.01		
		2	43.33	54.33	41.00	85.67	80.33	12.33	316.89		
		3	52.67	58.00	63.67	96.67	84.67	9.33	365.01		
	Control	---	8.33	7.33	10.00	13.00	11.67	11.33	66.33		
2006	Eucalyptus oil	1	58.33	69.00	45.67	80.33	72.00	17.00	342.33		
		2	61.67	78.33	53.67	90.00	83.00	16.33	383.00		
		3	77.33	96.00	67.00	99.00	87.67	10.33	437.33		
	Thymol oil	1	66.67	73.00	56.00	83.33	73.33	14.33	366.66		
		2	72.33	93.33	56.67	92.00	84.33	10.33	408.99		
		3	79.00	91.00	65.67	102.67	93.67	9.00	441.01		
	Peppermint oil	1	26.67	43.33	23.33	68.33	73.00	29.00	263.66		
		2	30.00	49.67	29.00	73.67	80.67	32.33	295.34		
		3	46.33	65.00	47.33	81.00	87.67	30.00	348.33		
	Control	---	12.33	10.00	9.67	15.67	11.67	16.67	76.01		

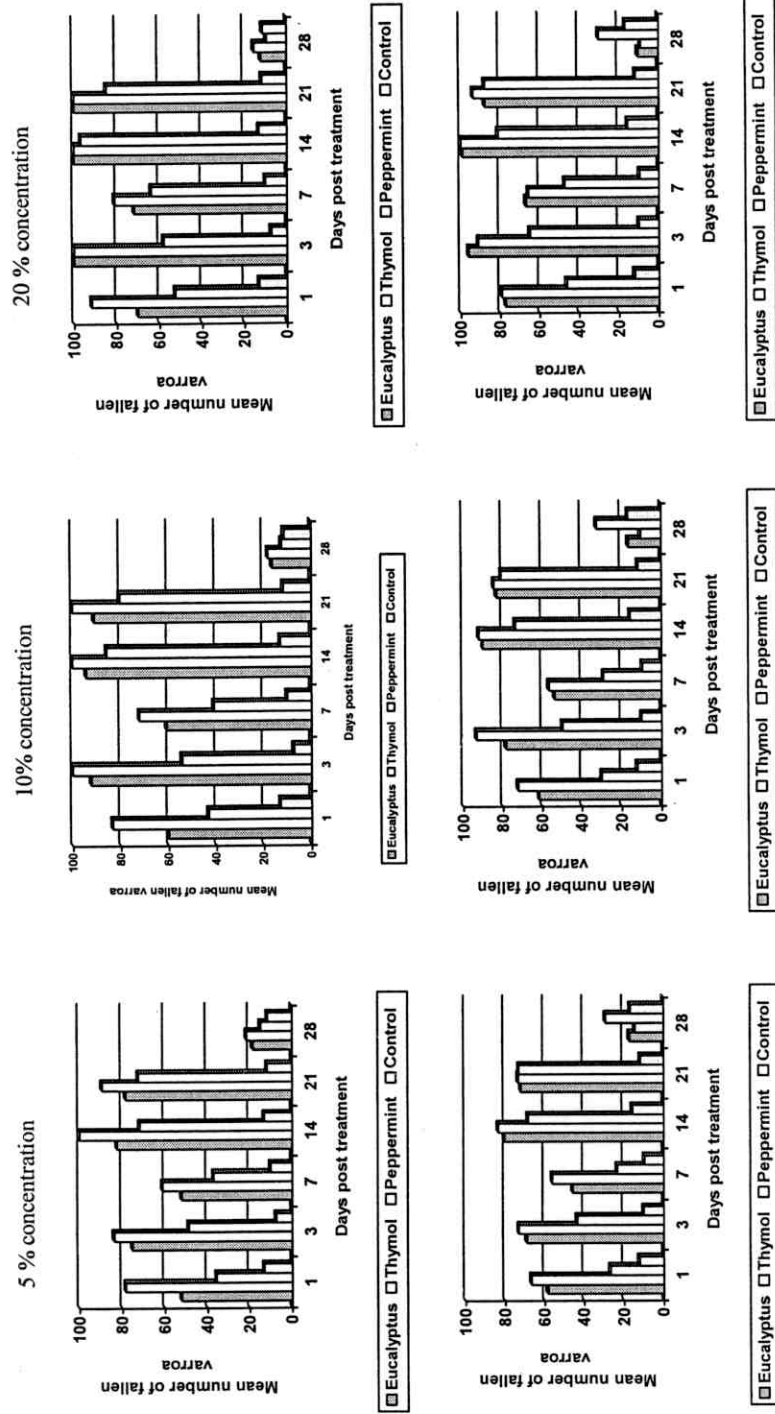


Fig. (27) Effect of essential oils on the mortality of Varroa mites during February-March 2005 & 2006.

Results and Discussion

Table (36): Effect of evaporation of some essential oils at different concentrations on the reduction of Varroa mites infestation in worker brood honeybee colonies during April-May (2005 & 2006).

Treatment	Time of application	Mean percentage of Varroa infestation in worker brood								F-value	LSD
		Concentration of tested oils									
		5%	% Reduction	10%	% Reduction	20%	% Reduction	Control			
2005	Before treatment	11.00	----	11.67	----	11.67	----	14.00	----	----	----
	After treatment	1.00 b B	79.89	0.67 b B	87.30	0.67 b B	87.30	6.33 A	23.222**	1.88	
	Before treatment	12.00	----	12.00	----	12.67	----	14.00	----	----	
	After treatment	0.67 b B	87.65	0.33 b B	93.92	0.00 b B	100	6.33 A	36.296**	1.63	
	Before treatment	10.67	----	11.33	----	11.33	----	14.00	----	----	
	After treatment	1.67 b B	65.38	1.33 b B	74.04	1.00 b B	80.48	6.33 A	25.296**	1.63	
	Before treatment	14.00	----	14.00	----	14.00	----	----	----	----	
	After treatment	6.33 a	----	6.33 a	----	6.33 a	----	----	----	----	
2006	Before treatment	20.972**	----	28.400**	----	38.333**	----	----	----	----	
	After treatment	1.88	----	1.72	----	1.54	----	----	----	----	
	Before treatment	14.00	----	13.33	----	13.67	----	14.00	----	----	
	After treatment	1.67 B b	74.96	1.33 B b	79.08	1.00 B b	84.65	6.67 A	28.741**	1.63	
	Before treatment	14.00	----	14.00	----	13.67	----	14.00	----	----	
	After treatment	1.33 B b	80.06	1.00 B b	85.01	0.67 B b	89.71	6.67 A	32.407**	1.63	
	Before treatment	13.67	----	13.33	----	13.67	----	14.00	----	----	
	After treatment	3.00 B b	53.94	2.33 B b	63.31	2.33 B b	64.22	6.67 A	12.972**	1.88	
Control	Before treatment	14.00	----	14.00	----	14.00	----	----	----	----	
	After treatment	6.67 a	----	6.67 a	----	6.67 a	----	----	----	----	
	After treatment	17.889**	----	27.407**	----	30.519**	----	----	----	----	
LSD		1.88	----	1.63	----	1.63	----	----	----	----	

** = Highly significant

Means in a row followed with the same capital letter (s) are not significantly different at 5% level of probability (between concentrations).

Means in a column followed with the same small letter (s) are not significantly different at 5% level of probability (between treatments).

Table (37): Effect of evaporation of some essential oils at different concentrations on the reduction of Varroa mites infestation on adult worker honeybee colonies during April-May (2005& 2006)

on adult worker honeybee colonies during April-May (2005& 2006)												
Treatment	Time of application	Mean percentage of Varroa infestation in adult brood								F-value	LSD	
		Concentration of tested oils										
		5%	% Reduction	10%	% Reduction	20%	% Reduction	% Reduction	Control			
2005	Eucalyptus	Before treatment	6.67		7.00							
		After treatment	0.67 b B	79.00	0.67 b B	79.99	0.67 b B	6.67	0.67 b B	79.00	22.000**	1.09
	Thymol	Before treatment	7.00		6.67							
		After treatment	0.33 b B	90.15	0.33 b B	89.66	0.00 b B	7.33	0.00 b B	100	35.889**	0.94
	Pepper	Before treatment	7.00		7.00							
		After treatment	1.00 b B	70.14	0.67 b B	79.99	0.67 b B	6.67	0.67 b B	79.00	12.667**	1.33
	Control	Before treatment	7.67		7.67							
		After treatment	3.67 a		3.67 a							
F-value		13.944**		22.000**				34.222**				
LSD		1.33		1.09				0.94				
2006	Eucalyptus	Before treatment	7.67		8.00							
		After treatment	1.67 bc B	63.14	1.33 bc B	71.86	1.00 bc B	8.00	1.00 bc B	78.84	13.944**	1.33
	Thymol	Before treatment	8.33		7.67							
		After treatment	0.67 c B	86.38	0.67 c B	85.21	0.33 c B	8.00	0.33 c B	93.02	18.476**	1.44
	Pepper	Before treatment	7.33		7.67							
		After treatment	2.33 b B	46.19	2.00 b B	55.86	1.67 b B	7.00	1.67 b B	59.61	8.611**	1.33
	Control	Before treatment	7.33		7.33							
		After treatment	4.33 a		4.33 a							
F-value		12.333**		15.278**				18.444**				
LSD		1.44		1.33				1.33				

** = Highly significant

Means in a row followed with the same capital letter (s) are not significantly different at 5% level of probability (between concentrations). Means in a column followed with the same small letter (s) are not significantly different at 5% level of probability (between treatments).

Results and Discussion

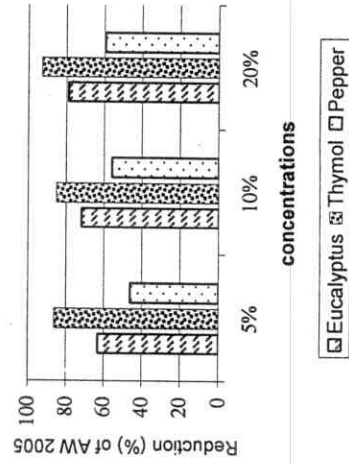
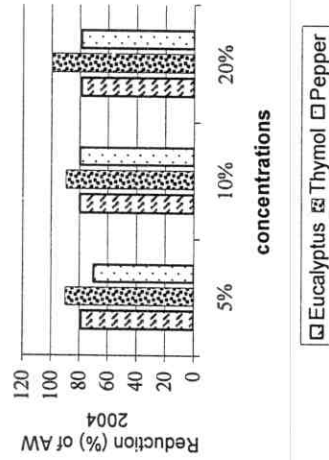
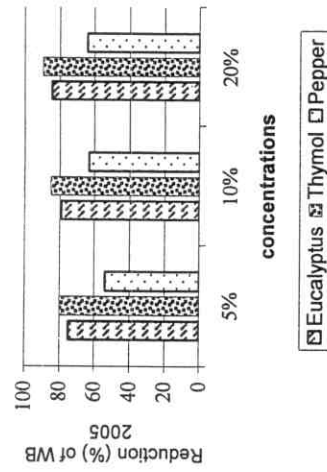
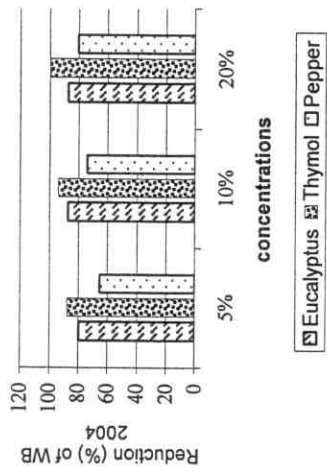


Fig. (28): Effect of evaporation of some essential oils at different concentrations on the reduction of Varroa mites infestation in worker brood and adult honeybee colonies during April-May (2005 & 2006).

Table (38): Effect of evaporation of some essential oils at different concentrations against Varroa mites infestation during April-May (2005 & 2006).

Treatment	Conc. (%)	Mean number of dead fallen Varroa mites at indicated days										
		Before treatment	Post treatment									
			1	3	7	14	21	28	Total			
2005	Eucalyptus oil	6.67	34.00	49.00	33.33	42.00	24.67	13.67	196.67			
		6.67	46.00	84.00	44.33	48.33	27.67	18.33	268.66			
		5.33	59.67	96.67	66.00	62.00	45.33	22.67	352.34			
	Thymol oil	7.67	43.33	52.33	38.67	43.00	27.33	24.00	228.66			
		7.33	54.33	92.00	50.67	52.67	32.00	19.67	301.34			
		5.33	54.67	54.67	68.00	62.67	45.00	14.67	299.68			
	Peppermint oil	7.33	26.00	40.33	27.33	37.00	19.33	18.67	168.66			
		6.00	40.33	55.67	38.33	41.67	22.67	20.67	219.34			
		6.67	48.33	65.67	57.67	51.00	44.33	26.33	293.33			
	Control	5.33	10.33	14.33	7.33	15.00	9.33	14.33	70.65			
2006	Eucalyptus oil	6.67	30.67	54.00	20.33	90.33	37.67	25.00	258.00			
		6.67	34.00	68.00	22.67	97.67	37.33	20.67	280.34			
		6.33	38.67	83.67	24.67	99.00	45.00	18.67	312.38			
	Thymol oil	8.33	43.33	84.33	32.67	98.00	43.67	24.33	326.33			
		7.67	48.67	88.67	40.67	107.33	42.67	24.33	352.34			
		6.67	50.00	97.00	48.00	105.33	49.33	17.67	367.33			
	Peppermint oil	8.33	27.00	34.67	17.00	46.00	41.67	30.00	196.34			
		7.33	30.67	51.67	19.33	59.00	49.33	34.00	244.00			
		7.67	32.00	62.33	20.00	75.33	51.67	37.33	278.66			
	Control	6.67	11.67	11.00	4.33	12.33	12.00	10.00	61.33			

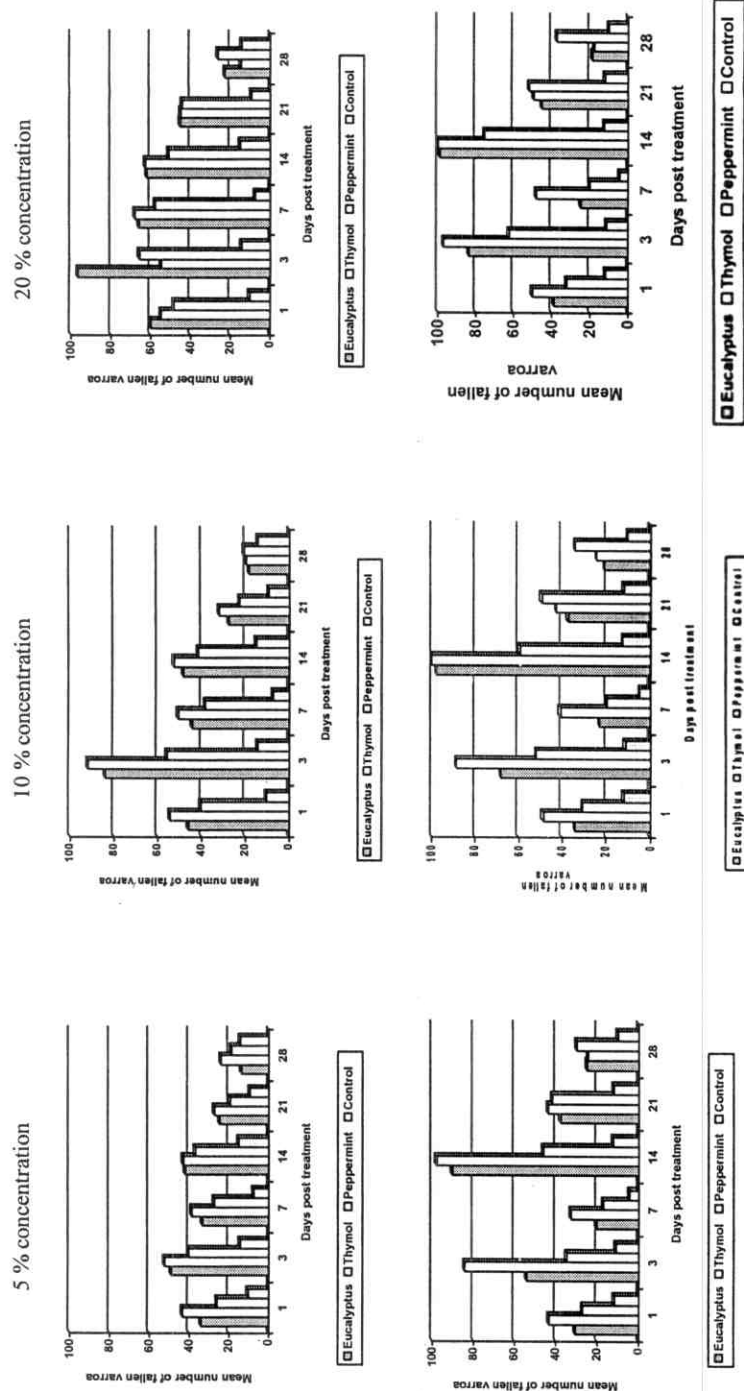


Fig. (29) Effect of essential oils on the mortality of Varroa mites during April-May 2005 & 2006.

Results and Discussion

It can be summarized that applying the evaporation method for Varroa control had minimized the Varroa population in the treated honeybee colonies

In this study it could be concluded that;

- 1- Essential oil treatment using evaporation technique was successfully applied method used in this study.
- 2- Evaporation of the thymol, eucalyptus and peppermint oils at different concentrations yielded higher reduction percentage than control one.
- 3- The 2nd and 3rd concentrations of the thymol oil caused higher Varroa reduction throughout most periods of the year, followed by Eucalyptus and peppermint oils .
- 4- Varroa population mortality rate with the essential oil treatments yielded higher significant values than control one.
- 5- According to the numbers of Varroa mites knocked down on the board sheet 3 days earlier the application of thymol oil have a speed action than the Eucalyptus oil.
- 6- The optimal concentration of thymol oil to control Varroa mites is the 3rd oil concentration (20%).

These results are in agreement of **Khattab, (2001a)**, who stated that thymol, eucalyptus, menthol and clove oils consider highly effective acaricides against Varroa mites which reduce Varroa infestation level. 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). 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 mites drops (Grant, and Giliard Jackson, 2004). Fathy and Fouly (1993) reported that treatment with camphor increase the efficacy of Varroa control. El-Shemy (1997) used six doses of the same essential oils to control the mite. All the tested oils gave a good effect on the parasitic mite. Mutinell et al. (1993) found that the Apilife-VAR killed (78.7%) mites per colony. Rezk and Gadelhak (1997) reported that the best effect was exerted by the application of Eucalyptus and matricary oils. The effects of both mint and clove oil-extracts were significantly lowest. Also, Hu-Fuliang and Li-Yinghua (2005) used thymol and thymol blended with other essential oils or essential oil components offer a promising exception. Mites 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), Abd El-Wahab et al. (2006), Greatti et al. (2006) and Abdol-Ahad et al. (2008) used several form essential oils against Varroa invasion, showed that Varroa was generally affected by all treatment.

Thymol is a volatile monoterpenoid found among many species of plants, and is toxic to Varroa at doses safe to their honeybee hosts (Imdorf et al. 1994, Lindberg et al. 2000). Applying the fumigation method, the Thymol gave highest astonish results because of its proven high to medium

effectiveness at killing Varroa, (Imdorf et al. 1999; Calderone 1999; Mattila and Otis 1999; Mattila et al. 2000; Whittington et al. 2000 and Ellis et al. 2001). Thymol showed effective control agent against a second mites parasite of honeybees, the tracheal mites (*Acarapis woodi* (Rennie). Thymol treatments for Varroa control resulted in residues in honey and beeswax (Bogdanov et al. 1998; Mattila and Otis 1999). This residues are not persistent and do not occur above level found naturally in honey, when applied following the harvest of annual honey crops in fall Varroa mites.

III- Spraying method

This method was used in the host periods August-September and April-May during the two successive years 2004 & 2005.

Experimental periods

1- August-September 2004 & 2005

a) Varroa reduction (%) in sealed worker brood and adults

Spraying of the essential oils on the honeybee colonies infested with Varroa mites resulted in non-significant differences among different essential oil concentrations; in spite of their superiority over control one significantly.

The thymol oil recorded the highest Varroa population reduction approached 93% with both the experimental years 2004 & 2005 , followed with peppermint and eucalyptus (88.12% & 85.75% , respectively) (Tables 39 & 40 and Fig. 30).

b) Fallen dead Varroa mites

A significant numbers of dropped Varroa was recorded with the thymol oil during the two study years approaching 301.33 & 313.67 mites /colony. The highest rate of fallen dead Varroa was 3 days earlier with the first treatment for all thymol oil concentrations than the other essential oils used. However for the 2nd & 3rd treatments it was retarded by 14 & 21 days, respectively.

The higher efficiency of the essential oils in 2004 than in 2005 may be attributed to the temperature variation which

ranged between (35-41°C) in the first year and (32-36 °C) in the second year 2005, and this is shown in Table (41) and Fig (31).

2- April – May 2005 & 2006

a. Varroa reduction (%) in sealed worker brood and adults

According to results obtained in Table 42 & 43 and Fig (32) there were higher Varroa percentages reduction in worker brood cells resulted from thymol treatment approaching 76.14%, 81.57% & 81.05% with applying concentrations 0.1%, 0.5% & 1% respectively. For Eucalyptus it recorded Varroa percentage reduction as 67.4%, 74.79% & 74.09% for the same concentrations mentioned above, respectively ; whereas with the peppermint oil the reduction were 54.52%, 60.96% & 73.27%, respectively during 2005. During 2006 the 3rd concentration of the thymol and peppermint oils caused the most significant reduction Varroa percentage.

b. Fallen dead Varroa mites

The maximum collected Varroa mites dropped on the board sheet resulted from application of oil therapy treatment were attributed to the thymol, eucalyptus and peppermint oils, approaching 313.67, 284.33 & 249.01 mite/colony for the above mentioned oils respectively, during the year 2005 whereas they recorded as 301.33, 278.66 & 259.33 mites /colony, during the year 2006. However the record was 70.65 & 61.00 mites for the control during the two experimental years as shown in Table (44) and Fig (33).

Table (39): Effect of spray some essential oils at different concentrations on the reduction of Varroa mites infestation in worker brood honeybee colonies during August-September (2004 & 2005)

Treatment	Time of application	Mean percentage of Varroa infestation on worker brood Concentration of tested oils								F-value	LSD
		0.1 %	% Reduction	0.5 %	% Reduction	1%	% Reduction	Control			
2004	Eucalyptus	Before treatment	5.33		5.00		5.33		5.33		
		After treatment	1.00 b B	80.00	0.67 b B	85.72	0.67 b B	86.60	5.00 A	20.167**	1.54
	Thymol	Before treatment	5.33		5.33		5.67		5.33		
		After treatment	0.67 b B	86.60	0.33 b B	93.40	0.33 b B	93.80	5.00 A	31.278**	1.33
	Pepper	Before treatment	5.33		5.33		5.00		5.33		
		After treatment	1.00 b B	80.00	0.33 b B	93.40	0.33 b B	92.96	5.00 A	36.267**	1.22
	Control	Before treatment	5.33		5.33		5.33				
2005	Eucalyptus	Before treatment	5.67		5.33		5.00		5.67		
		After treatment	1.33 B b	75.05	1.00 B b	80.04	0.67 B b	85.75	5.33 A	28.611**	1.33
	Thymol	Before treatment	6.00		5.67		5.67		5.67		
		After treatment	0.67 B b	88.12	0.33 B b	93.81	0.33 B b	93.81	5.33 A	54.000**	1.09
	Pepper	Before treatment	5.67		5.67		6.00		5.67		
		After treatment	1.33 B b	75.05	1.00 B b	81.24	0.67 B b	88.12	5.33 A	28.611**	1.33
	Control	Before treatment	5.67		5.67		5.67				
	F-value	5.33 a		5.33 a		5.33 a					
	F-value	41.000**		23.792**		51.583**					
	LSD	1.09		1.54		1.09					

** = Highly significant

Means in a row followed with the same capital letter (s) are not significantly different at 5% level of probability (between concentrations).

Means in a column followed with the same small letter (s) are not significantly different at 5% level of probability (between treatments).

Results and Discussion

Table (40): Effect of spray some essential oils at different concentrations on the reduction of Varroa mites infestation on adult worker honeybee colonies during August-September (2004 & 2005)

Treatment		Time of application	Mean percentage of Varroa infestation on adult broad worker honeybee colonies during August-September (2004 & 2005)										F-value	LSD
			Concentration of tested oils											
			0.1 %	% Reduction	0.5 %	% Reduction	1 %	% Reduction	Control					
2004	Eucalyptus	Before treatment	1.67	---	1.67	---	2.00	---	2.33	---	---			
		After treatment	0.33 b B	76.98	0.00 b B	100	0.00 b B	100	2.00 A	33.000**	0.54			
	Thymol	Before treatment	1.67	---	1.67	---	1.67	---	2.33	---	---			
		After treatment	0.33 b B	80.78	0.00 b B	100	0.00 b B	100	2.00 A	33.000**	0.54			
	Pepper	Before treatment	1.67	---	1.67	---	1.67	---	2.33	---	---			
		After treatment	0.67 b B	53.26	0.33 b B	76.98	0.33 b B	76.98	2.00 A	7.556**	0.94			
	Control	Before treatment	2.33	---	2.33	---	2.33	---	---	---	---			
		After treatment	2.00 a	---	2.00 a	---	2.00 a	---	---	---	---			
2005	Eucalyptus	Before treatment	7.556**	---	33.000**	---	33.000**	---	---	---	---			
		After treatment	0.94	---	0.54	---	0.54	---	---	---	---			
	Thymol	Before treatment	2.33	---	2.67	---	2.33	---	2.67	---	---			
		After treatment	0.67 b B	74.41	0.67 b B	77.67	0.33 b B	87.39	3.00 A	9.944**	1.33			
	Pepper	Before treatment	2.33	---	2.33	---	2.67	---	2.67	---	---			
		After treatment	0.67 b B	74.41	0.33 b B	87.39	0.33 b B	89.00	3.00 A	9.111**	1.33			
	Control	Before treatment	3.00	---	2.33	---	2.33	---	2.67	---	---			
		After treatment	1.00 b B	70.33	1.00 b B	74.41	0.33 b B	87.39	3.00 A	6.458*	1.54			
2005	Control	Before treatment	2.67	---	2.67	---	2.67	---	---	---	---			
		After treatment	3.00 a	---	3.00 a	---	3.00 a	---	---	---	---			
	F-value	5.667*	---	9.111**	---	10.667**	---	---	---	---	---			
		LSD	1.54	---	1.33	---	1.33	---	---	---	---	---		

** = Highly significant * = Significant

Means in a row followed with the same capital letter (s) are not significantly different at 5% level of probability (between concentrations). Means in a column followed with the same small letter (s) are not significantly different at 5% level of probability (between treatments).

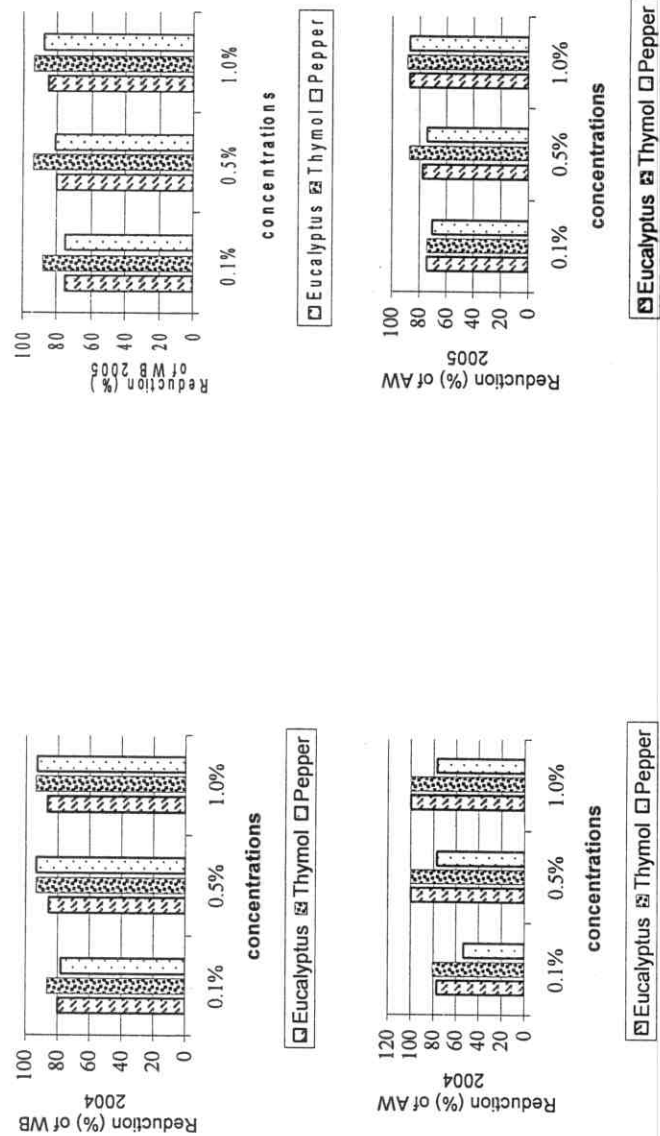


Fig. (30): Effect of spray of some essential oils at different concentrations on the reduction of Varroa mites infestation in worker brood and adult honeybee colonies during August-September (2004 & 2005).

Table (41): Effect of spraying different essential oils at tested concentrations against Varroa mites during August-September (2004 & 2005).

Mean number of dead fallen Varroa mites at indicated days													
Seasons	Treatment (oil)	Concentration (%)	Before treatment	Post treatment								Total	Mean
				1	3	7	14	21	28				
2004	Eucalyptus	1	4.67	20.33	63.33	29.67	60.00	25.67	12.33	211.33	35.22		
		2	4.00	22.67	73.33	43.67	106.67	28.67	13.00	288.01	48.00		
		3	5.33	36.33	76.33	44.00	109.33	31.33	10.33	307.65	51.28		
	Thymol	1	4.67	27.00	58.00	22.33	99.33	27.33	22.33	256.32	42.72		
		2	4.00	28.67	26.67	49.00	104.67	31.33	18.67	259.01	43.17		
		3	3.67	33.00	63.33	29.67	106.33	32.67	17.00	282.00	47.00		
	Peppermint	1	3.00	15.00	33.33	28.33	42.67	35.67	17.33	172.33	28.72		
		2	5.67	17.33	36.00	30.00	51.67	44.00	20.67	199.67	33.29		
		3	4.33	19.67	37.33	33.00	55.33	49.33	22.67	217.33	36.22		
2005	Control	--	4.67	18.00	12.00	9.00	26.00	17.33	12.33	94.66	15.78		
		1	5.33	18.00	41.67	23.67	84.33	22.33	11.00	201.00	33.50		
		2	5.33	20.67	45.33	29.33	110.00	25.67	9.00	240.00	40.00		
	Eucalyptus	3	5.67	22.67	46.33	31.00	120.00	28.00	8.00	256.00	42.67		
		1	6.33	32.00	64.67	24.00	107.00	30.00	18.67	267.34	44.56		
		2	6.33	37.67	66.33	33.00	109.00	38.00	18.67	302.67	50.45		
	Thymol	3	6.67	44.33	66.33	35.33	111.67	39.33	16.00	312.99	52.17		
		1	6.00	18.00	35.33	30.33	52.00	40.00	22.33	197.99	33.00		
		2	6.33	20.33	37.67	33.67	58.00	49.67	23.67	223.01	37.17		
Peppermint	3	5.67	21.00	42.00	36.67	61.67	54.33	28.33	244.00	40.67			
	---	5.33	0.00	9.67	8.67	12.33	16.33	14.67	61.67	10.28			

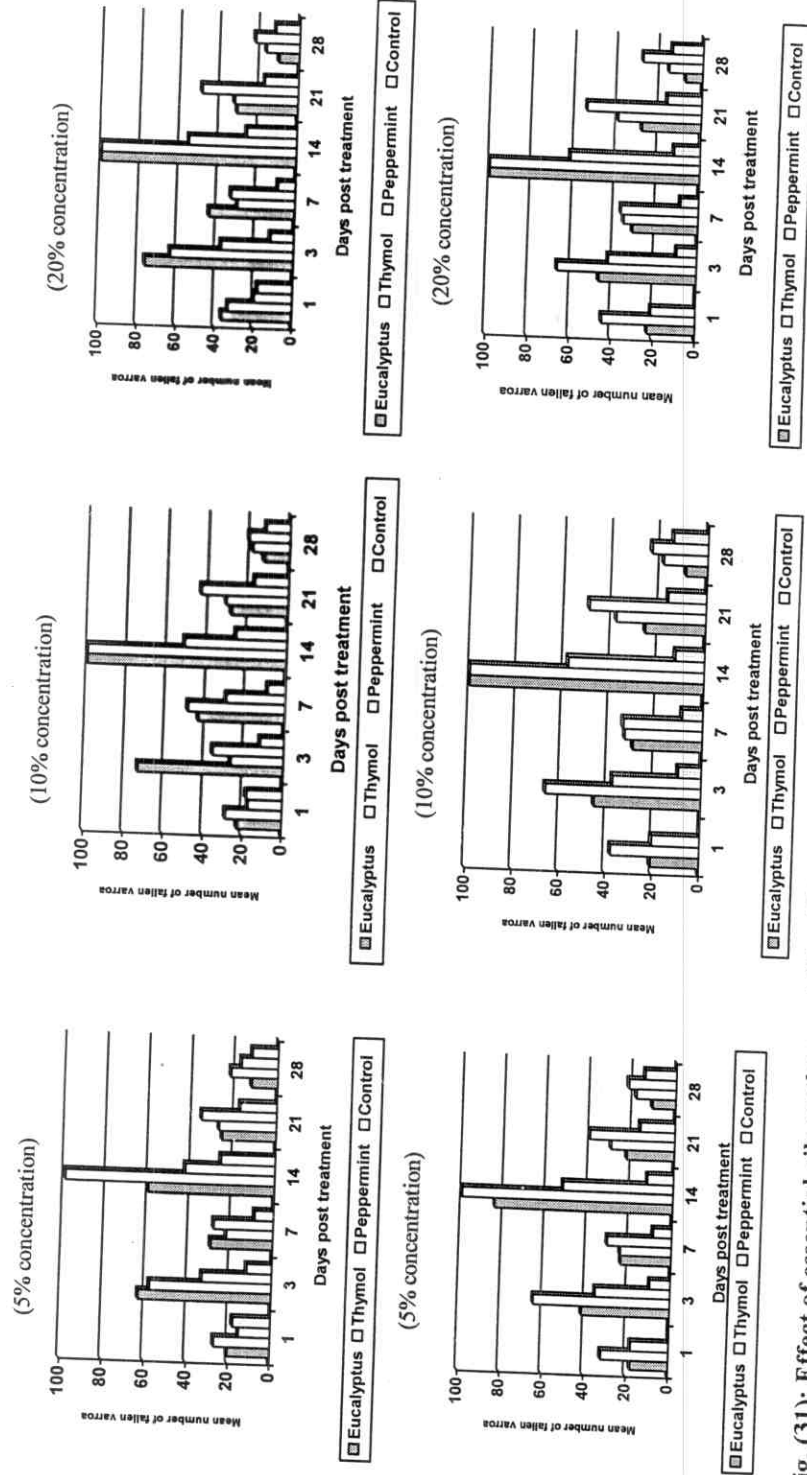


Fig. (31): Effect of essential oils on the mortality of Varroa mites during August-September (2004 & 2005).
Results and Discussion

Table (42): Effect of spray some essential oils at different concentrations on the reduction of Varroa mites infestation in worker brood honeybee colonies during April-May (2005 & 2006)

Treatment	Time of application	Mean percentage of Varroa infestation on worker brood							F-value	LSD
		Concentration of tested oils								
		0.1 %	% Reduction	0.5 %	% Reduction	1 %	% Reduction	Control		
2005	Eucalyptus	Before treatment	11.33	---	11.67	---	11.33	---	14.00	---
		After treatment	1.67 b B	67.40	1.33 b B	74.79	1.33 b B	74.04	6.33 A	21.600**
	Thymol	Before treatment	12.33	---	12.00	---	11.67	---	14.00	---
		After treatment	1.33 b B	76.14	1.00 b B	81.57	1.00 b B	81.05	6.33 A	30.792**
	Pepper	Before treatment	11.33	---	11.33	---	11.00	---	14.00	---
		After treatment	2.33 b B	54.52	2.00 b B	60.96	1.33 b B	73.26	6.33 A	20.444**
	Control	Before treatment	14.00	---	14.00	---	14.00	---		
		After treatment	6.33 a	---	6.33 a	---	6.33 a	---		
	F-value	19.300**	---	27.667**	---	26.222**	---			
	LSD	1.72	---	1.54	---	1.63	---			
2006	Eucalyptus	Before treatment	14.00	---	14.00	---	13.67	---	14.00	---
		After treatment	1.00 AB a	66.67	1.00 BC b	66.67	1.00 C b	65.86	3.00 A	9.833**
	Thymol	Before treatment	14.00	---	13.67	---	13.67	---	14.00	---
		After treatment	0.67 B b	77.67	0.67 B b	77.13	0.67 B b	77.13	3.00 A	12.667**
	Pepper	Before treatment	13.33	---	13.00	---	13.00	---	14.00	---
		After treatment	1.33 A a	53.44	2.33 A a	60.36	2.33 A a	60.36	6.33 A	3.167 NS
	Control	Before treatment	14.00	---	14.00	---	14.00	---		
		After treatment	3.00 a	---	3.00 a	---	3.00 a	---		
	F-value	6.222**	---	17.000**	---	15.167**	---			
	LSD	0.94	---	0.54	---	0.77	---			

** = Highly significant

Means in a row followed with the same capital letter (s) are not significantly different at 5% level of probability (between concentrations).

Means in a column followed with the same small letter (s) are not significantly different at 5% level of probability (between treatments).

Results and Discussion

Table (43): Effect of spray some essential oils at different concentrations on the reduction of Varroa mites infestation on adult worker honeybee colonies during April-May (2005 & 2006)

Treatment	Time of application	Mean percentage of Varroa infestation on adult broad								F-value	LSD
		Concentration of tested oils									
		0.1 %	% Reduction	0.5 %	% Reduction	1%	% Reduction	Control			
2005	Eucalyptus	Before treatment	7.33	----	7.33	----	6.67	----	7.67	----	----
	After treatment	1.00 b B	71.49	0.67 b B	80.90	0.67 b B	79.00	3.67 A	12.667**	1.33	
	Thymol	Before treatment	6.67	----	7.33	----	7.00	----	7.67	----	----
	After treatment	1.00 b B	68.67	0.67 b B	80.90	0.33 b B	90.15	3.67 A	27.889**	0.94	
	Pepper	Before treatment	7.00	----	6.33	----	7.00	----	7.67	----	----
	After treatment	2.00 b B	40.29	1.33 b BC	56.09	0.67 b C	79.99	3.67 A	9.944**	1.33	
	Control	Before treatment	7.67	----	7.67	----	7.67	----			
	After treatment	3.67 a	----	3.67 a	----	3.67 a	----				
	F-value	8.143**	----	18.250**	----	22.000**	----				
LSD	1.44	----	1.09	----	1.09	----					
2006	Eucalyptus	Before treatment	7.33	----	7.00	----	7.00	----	7.33	----	----
	After treatment	1.00 b B	76.91	1.00 b B	75.82	0.67 b B	83.80	4.33 A	9.788**	1.80	
	Thymol	Before treatment	8.67	----	7.67	----	8.00	----	7.33	----	----
	After treatment	1.67 b B	67.39	1.33 b B	70.65	0.67 b B	85.82	4.33 A	13.333**	1.44	
	Pepper	Before treatment	8.00	----	8.33	----	8.00	----	7.33	----	----
	After treatment	2.33 b B	50.70	2.33 b B	52.65	1.33 b B	71.86	4.33 A	8.143**	1.44	
	Control	Before treatment	7.33	----	7.33	----	7.33	----			
	After treatment	4.33 a	----	4.33 a	----	7.33	----				
	F-value	8.296**	----	9.000**	----	15.762**	----				
LSD	1.63	----	1.63	----	1.44	----					

** = Highly significant

** = Highly significant

Means in a row followed with the same capital letter (s) are not significantly different at 5% level of probability (between concentrations).
Means in a column followed with the same small letter (s) are not significantly different at 5% level of probability (between treatments).

Results and Discussion

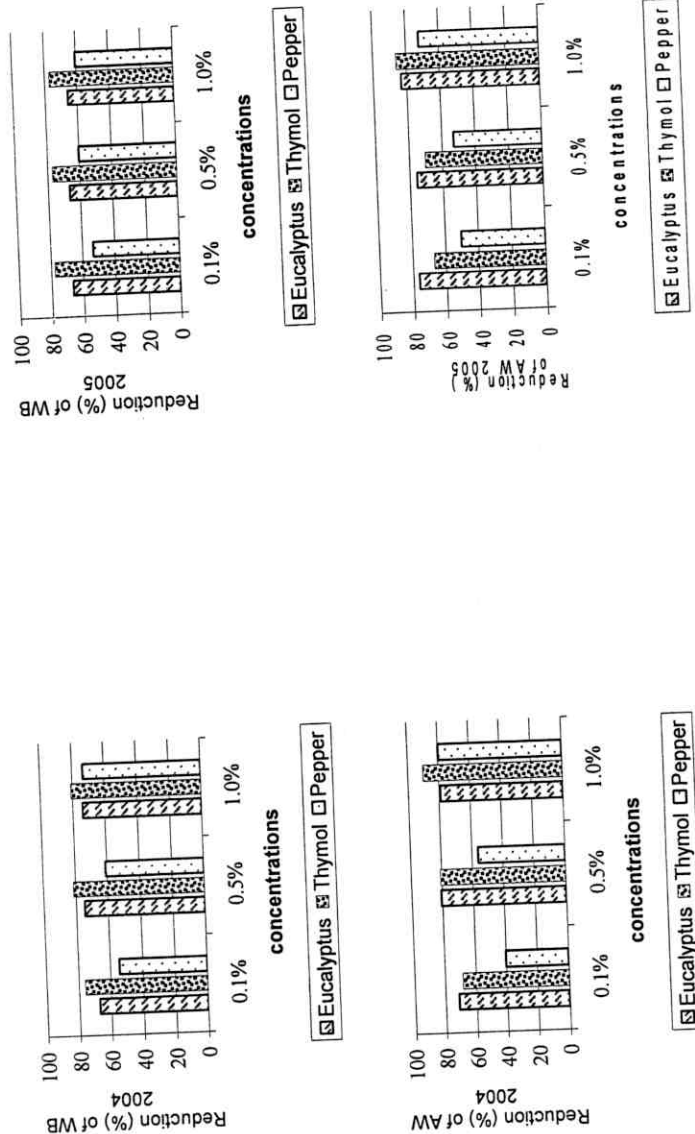


Fig. (32): Effect of spraying of some essential oils at different concentrations on the reduction of Varroa mites infestation in worker brood and adult honeybee colonies during April-May (2005 & 2006).

Table (44): Effect of spraying different essential oils at tested concentrations against Varroa mites during August-September (2004&2005).

Seasons	Treatment (oil)	Concentration (%)	Mean number of dead fallen Varroa mites at indicated days											
			Before treatment	Post treatment									Total	Mean
				1	3	7	14	21	28					
2004	Eucalyptus oil	1	6.00	26.67	76.33	21.00	54.67	53.33	20.33	252.33	42.06			
		2	5.67	31.33	78.00	25.33	63.33	38.67	23.00	259.66		43.28		
		3	6.00	33.33	89.67	26.67	75.00	43.33	16.33	284.33				
	Thymol oil	1	5.67	35.33	78.00	26.33	66.67	37.33	23.33	284.33	47.39			
		2	5.67	38.67	87.00	33.00	71.67	40.33	26.00	284.99		47.50		
		3	5.33	40.00	98.67	31.67	78.00	46.33	19.00	296.67				
	Peppermint oil	1	6.67	23.33	43.00	18.00	51.00	39.00	24.00	198.33	33.06			
		2	6.67	26.00	48.00	22.67	59.33	40.00	30.00	225.67		37.61		
		3	7.00	28.33	62.67	23.00	67.67	44.67	22.67	249.01				
	Control	---	5.33	10.33	14.33	7.33	15.00	9.33	14.33	70.65	11.78			
2005	Eucalyptus oil	1	7.33	27.67	76.00	19.00	53.00	37.33	22.00	235.00	39.17			
		2	7.67	33.00	80.67	23.00	60.00	41.33	25.00	263.00		43.83		
		3	6.33	33.67	89.33	26.67	66.33	45.33	17.33	278.66				
	Thymol oil	1	8.00	33.00	73.33	23.33	63.33	31.67	22.33	246.99	41.17			
		2	7.33	35.67	81.67	28.00	75.67	38.00	22.33	281.34		46.89		
		3	6.67	39.00	87.33	28.00	87.33	40.67	19.00	301.33				
	Peppermint oil	1	8.00	22.00	46.00	16.67	54.00	41.33	26.33	206.33	50.22			
		2	7.67	26.00	51.00	21.00	64.00	44.00	31.00	237.00		34.39		
		3	7.67	29.33	64.67	22.00	70.33	48.33	24.67	259.33				
	Control	---	6.67	11.67	11.00	4.33	12.33	11.67	10.00	61.00	10.17			

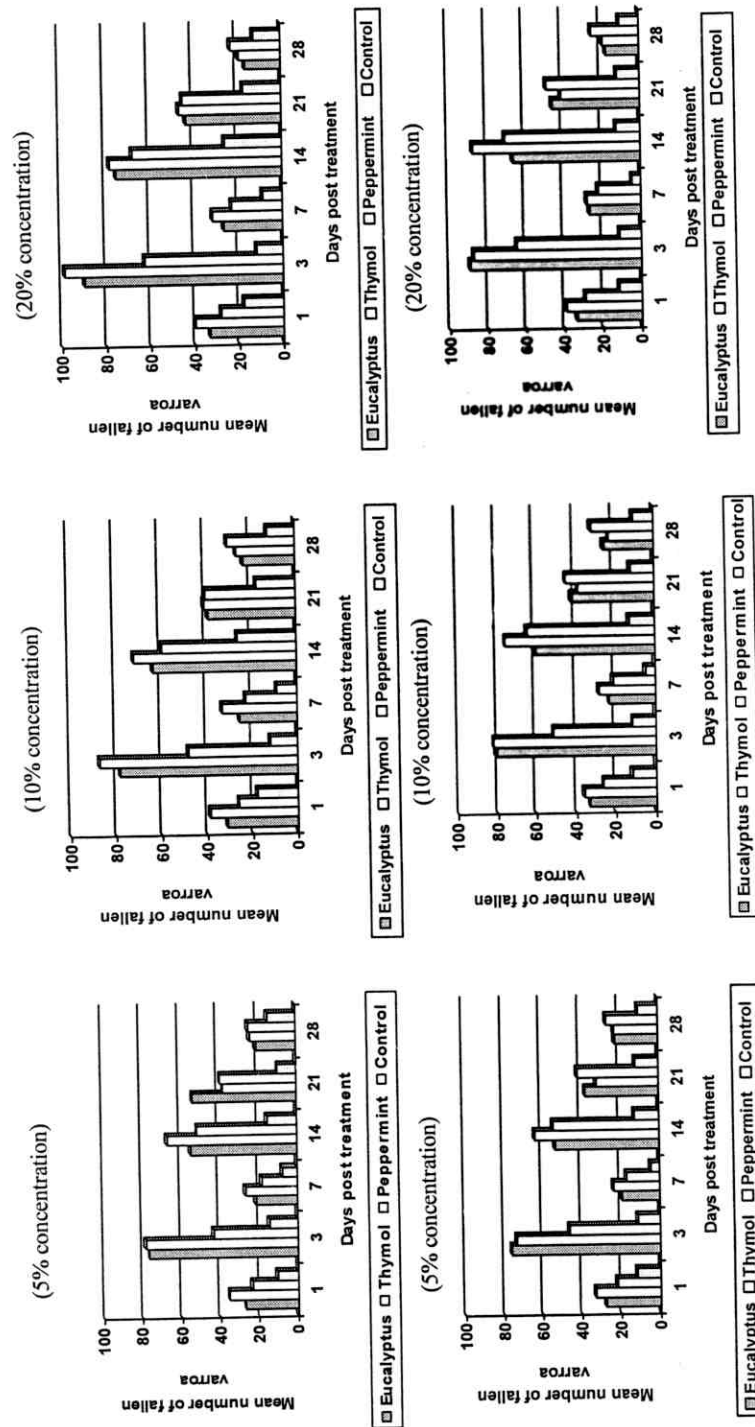


Fig (33): Effect of spraying different essential oils at tested concentrations against Varroa mites during April-May (2005 & 2006)

It can be summarized that applying spraying technique minimized the Varroa population and reducing mites numbers in beehives. In this study it could be conclude that;

- 1- Treatment with the thymol oil recorded in the maximum Varroa population reduction approaching 93% with both two experimental years 2004 & 2005 followed with peppermint and eucalyptus (88.12% & 85.75%, respectively).
- 2- The 3rd concentration (1%) of the thymol and peppermint oils resulted in the most significant differences from eucalyptus in Varroa mites reduction.
- 3- The highest fallen dead Varroa mites rate (43 - 98.67 mites/colony) was recorded early after the 3rd day of the first treatment with all oils concentrations used.
- 4- There were no significant differences among the applied concentrations of the essential oil on the number of fallen dead Varroa mites.
- 5- The spraying method was used in the late spring and early autumn, because the temperature was suitable, however it was difficultly applied.

Essential oils may be more effective in colonies when used in strips (evaporation) but when used by spraying the bees was more excited which may be attributed to the disturbance in queen pheromone inside colonies.

The obtained results are in agreement with the finding of Fathy and Fouly (1993) used camphor oil at different

concentrations caused reduction in Varroa mites by spraying method. **El-Shemy et al. (2001)** tested the efficacy of different natural oil, clove oil and found that mites reduction ranged from 45.75% to 92.2%. **Eshbah et al. (1995)** found that spraying German chamomile, thyme and pudding pipe extracts caused reduction in Varroa mites infestation with a range of 35 to 45%. **El-Shemy et al. (2001)** found that the efficiency of natural materials were higher in 1996 than in 1997 may be due to the temperature variations which ranged between (34-41°C) in the first year and (31-35°C) in the following year.

Second: chemical compounds

From the previous results it could be concluded that the Varroa population during honeybee colonies infestation is regulated by many factors including the chemical acaricides controls. In spite of the residues that remain in honeybee products when using chemical acaricides, compare between of the materials used for our 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 **Rice et al. (2002).**

Experimental periods

1- August-September 2004 & 2005

a- Varroa reduction (%) in sealed worker brood and adults

The results obtained in Table (45) and Fig (34) showed the effects of several chemical substances in control of the mites.

The highest reduction percentage of Varroa mites was recorded in worker brood with Apistan followed by Bayvarol and then oxalic acid. They were 90.09%, 79.88% & 60.06% respectively in the first year 2004, and 93.30%, 87.09% & 71.52% for the second year of 2005. For adult worker honeybee, the reduction percentages of Varroamites were 90.09%, 83.50%, 83.50% and 93.13%, 88.87%, 74.09% for the years 2004 and 2005 respectively.

b- Fallen dead Varroamites

High counts of fallen dead Varroamites were showed on the white board sheet of honeybee colonies with Apistan Bayvarol and oxalic acid treatments during 2004, however there

were non-significant differences between the experimental material and control one. While the higher significant differences occurred in the second year of the experiments application, Table (46) and Fig (35).

2- October - November 2004 & 2005

a- Varroareduction (%) in sealed worker brood and adults

The results shown in Table 47 and Fig 36 clearly indicated that the Varroamites reduction percentage in worker brood cells and in adult bees were higher with Apistan, Bayvarol and formic acid than control one. The highest Varroareduction percent was recorded with the Apistan strips (97.01% & 96.70%) at 2004 and (93.34% & 97.10%) at 2005, for brood and on adult bees, respectively.

b- Fallen dead Varroamites

The results presented in Table 48 and Fig 36 indicated that there a significant difference between each of the tested chemical products and control in the number of fallen dead Varroamites particularly during the first year of the treatment. The numbers of fallen dead Varroawere 525.32, 482.99 & 419.00 mite/colony for Apistan, Bayvarol and formic acid; respectively in comparison to control one which recorded 64.7mite/colony. For the second year they were 509.66, 502.99 & 405.00 mite/colony, for the same chemical mentioned above respectively; and 55.33 mites/colony for control colonies.

3- December- January (2004 – 2005) and (2005-2006)

a- Varroa reduction (%) in sealed worker brood and adults

Using the following chemical compounds, formic acid, Apistan and Bayvarol to reduce Varroa infestation levels for period extended to 28 days.

The mites infestation levels decreased from 14.33%. 14 %, 14.33 to 1.33%, 1 %, 2% inside worker brood cells after last treatment period during 2004. While for the second year, the highest levels of reduction is shown in Table (49) and Fig (38) .

It could be established that the Varroa reduction percentage followed treatments with formic acid, Apistan & Bayarol yielded high effect especially in the second year of the treatment within worker brood cells and in adult honeybees which approached 100%.

From these results it could be concluded that the chemical compounds used gave high Varroa reduction percentage particularly in the second year of the application period.

b- Fallen dead Varroa mites

Data presented in Table 50 and Fig 39 showed that formic acid, Apistan and Bayvarol greatly affected the fallen Varroa mites with the highest rate particularly at the 3rd day of treatment during 2005& 2006.

4 February – March 2005 & 2006

a- Varroa reduction (%) in sealed worker brood and adults

Data illustrated in Table 51 and Fig 40 clearly that, formic acid, Apistan and Bayvarol caused high Varroa reduction percentage throughout late winter (February-March) 2005 & 2006 which is recorded as 95.10%, 95 % & 90.08% and 91.32%, 95.54% & 95.54%, respectively.

b- Fallen dead Varroa mites

Treated honeybee colonies with the tested chemical compounds resulted in high reduction of Varroa levels infestation reached the maximum effect at the 3rd day of the 1st treatment while in the second year, 2006 during February and March the effect of the chemical substances increased as the Varroa mites population increase reached to 14 days period showing Table (52) and Fig. (41).

5- April – May 2005 & 2006

a- Varroa reduction (%) in sealed worker brood and adults

Using Apistan, Bayvarol and oxalic acid in two successive seasons of 2005& 2006 for 28 days caused marked reduction of the population of Varroa mite.

The results revealed high reduction percentages of Varroa mites when using these substances ,so Varroa mites reduced from 13.67%, 13.67%, 14% before treatment to 0.33%, 0.67%, 1.33% after treatment for the year 2005 and from 14.33%, 13%, 14.33% before treatment to 0.67%, 1.00%, 1.67% after treatment for the year 2006,for Apistan, Bayvarol and oxalic acid, respectively.

The same trend of high reduction percentages on adult bees as shown in Table 53 and Fig 42.

b- Fallen dead Varroa mites

From results obtained, it could be found that the maximum effect of the treated chemical compounds on the rate of fallen Varroa mites on the bottom board was at the 3rd day after the 1st treatment in the two experiment period according to (Table 54 and Fig 43).

Table (45): Effect of some chemical products on the reduction of Varroa mites infestation in worker brood honeybee colonies during August-September (2004 & 2005).

Seasons	Treatment	Mean percentage of Varroa infestation				(%) Reduction	
		Before treatment		Post treatment (28 days)			
		Worker brood	Adult	Worker brood	Adult	Worker brood	Adult
(2004)	Oxalic acid	5.33	2.00	1.33	0.33	60.06	83.5
	Apistan	5.00	3.33	0.33	0.33	90.09	90.09
	Bayvarol	5.33	2.00	0.67	0.33	79.88	83.5
	Control	5.33	2.00	3.33	2.00	---	---
(2005)	Oxalic acid	6.00	2.33	1.33	0.67	71.52	74.09
	Apistan	6.33	4.33	0.33	0.33	93.30	93.13
	Bayvarol	6.67	2.67	0.67	0.33	87.09	88.87
	Control	6.00	3.00	4.67	3.33	---	---

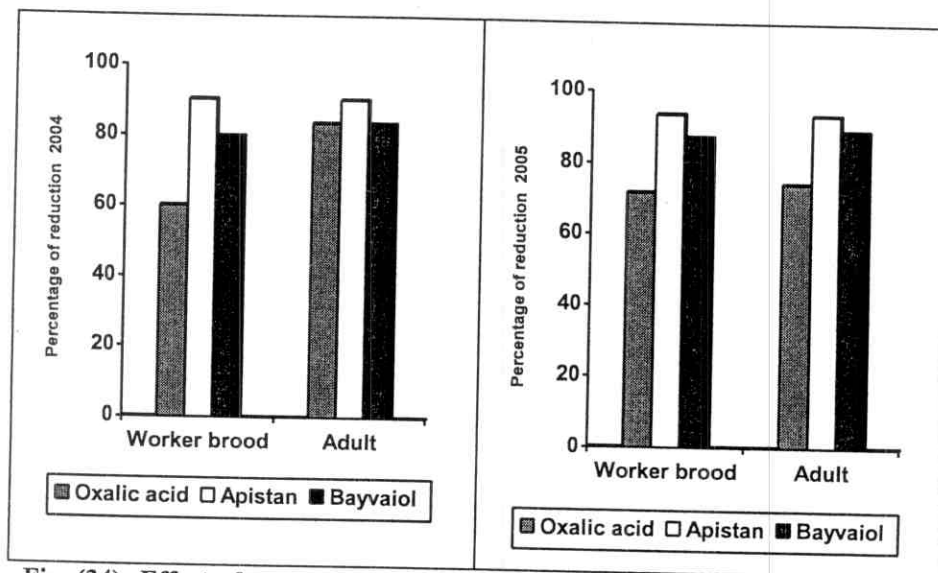


Fig. (34): Effect of some chemical products on the reduction of Varroa mites infestation in worker brood honeybee colonies during August-September (2004 & 2005)

Table (46): Effect of some chemical products on Varroa mites during August-September (2004 & 2005).

Seasons	Treatment	Mean number of dead fallen Varroa mites at indicated days								
		Before treatment	Post treatment							Mean
			1	3	7	14	21	28	Total	
2004	Oxalic acid	5.67	28.33	46.67	30.00	84.00	41.33	17.67	248.00	41.33
	Apistan	4.67	58.00	69.33	70.00	126.00	24.33	10.67	358.33	59.72
	Bayvarol	4.67	53.33	60.67	66.33	110.33	25.67	11.33	327.66	54.61
	Control	4.67	18.00	12.00	9.00	26.00	17.33	12.33	94.66	15.78
	F-value									2.704 ^{NS}
2005	Oxalic acid	4.00	30.67	35.67	31.67	64.67	46.33	23.33	232.34	38.72ab
	Apistan	4.00	63.33	82.67	116.67	94.33	27.33	9.67	394.00	65.67a
	Bayvarol	4.33	56.67	69.67	111.33	91.00	79.00	10.67	418.34	69.72a
	Control	4.00	15.33	13.33	13.33	11.00	13.33	12.00	78.32	13.05b
	F-value									5.433**
	LSD at 5%									33.37

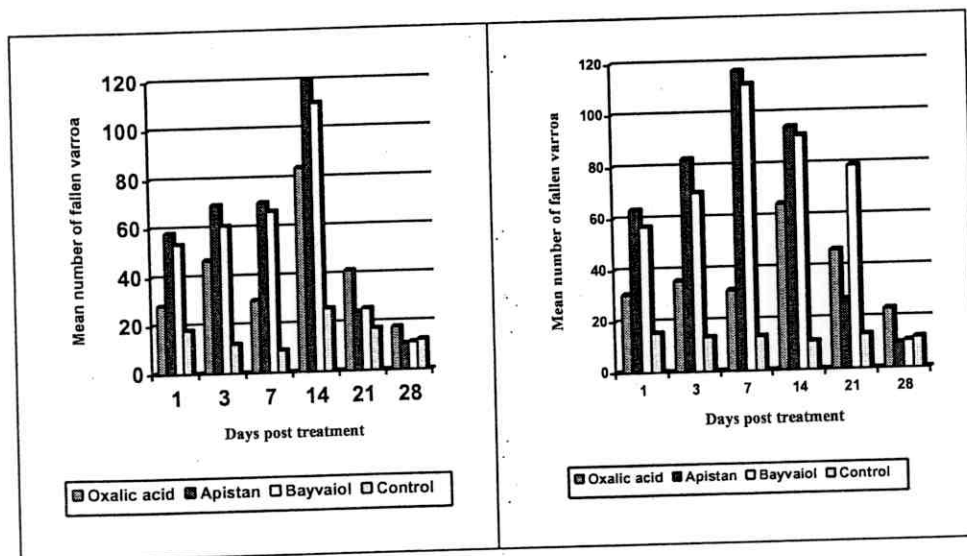


Fig. (35): Effect of some chemical products on Varroa mites during August-September (2004 & 2005)

Table (47): Effect of some chemical products on the reduction of Varroa mites infestation in worker brood honeybee colonies during October-November (2004 & 2005).

Seasons	Treatment	Mean percentage of Varroa infestation				(%) Reduction	
		Before treatment		Post treatment (28 days)			
		Worker brood	Adult	Worker brood	Adult	Worker brood	Adult
2004	Formic acid	11.67	8.67	0.67	0.67	93.92	91.26
	Apistan	11.67	8.33	0.33	0.67	97.01	90.91
	Bayvarol	12.00	8.67	0.67	1.00	94.09	86.96
	Control	12.00	8.67	11.33	7.67	---	---
2005	Formic acid	11.67	9.67	1.33	0.67	89.96	94.71
	Apistan	12.67	8.67	0.67	0.33	95.34	97.10
	Bayvarol	12.67	9.00	1.00	0.67	93.05	94.32
	Control	12.33	9.67	14.00	12.67	---	---

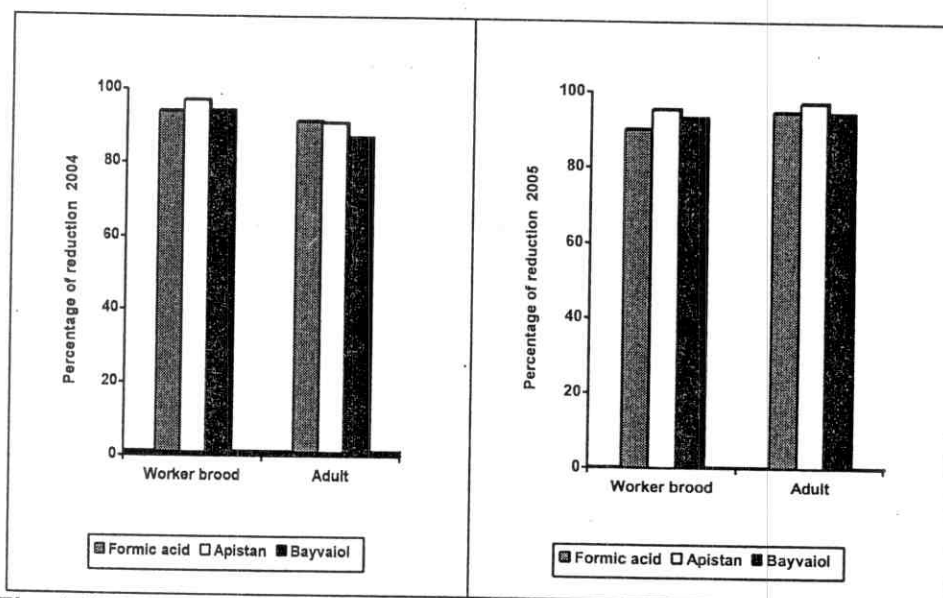


Fig. (36): Effect of some chemical products on the reduction of Varroa mites infestation in worker brood honeybee colonies during October-November (2004 & 2005)

Table (48): Effect of some chemical products on Varroa mites during October-November (2004 & 2005).

Seasons	Treatment	Mean number of dead fallen Varroa mites at indicated days								
		Before treatment	Post treatment							Mean
			1	3	7	14	21	28	Total	
2004	Formic acid	4.33	92.67	141.33	63.00	74.67	31.00	16.33	419.00	69.83a
	Apistan	5.00	101.33	185.33	94.00	105.00	29.33	10.33	525.32	87.55a
	Bayvarol	4.67	87.33	175.00	76.33	100.33	29.00	15.00	482.99	80.50a
	Control	4.67	8.33	13.67	10.67	11.00	10.67	10.33	64.67	10.78b
	F-value									57.67
	LSD at 5%									67.50
2005	Formic acid	5.00	89.00	126.67	60.33	79.00	32.00	18.00	509.66	84.94
	Apistan	5.33	99.33	196.67	162.33	38.00	12.00	1.33	509.66	84.94
	Bayvarol	4.67	91.33	178.33	173.00	41.33	17.33	1.67	502.99	83.83
	Control	5.00	7.00	8.67	7.00	10.33	9.33	13.00	55.33	9.22
	F-value									2.151 ^{NS}

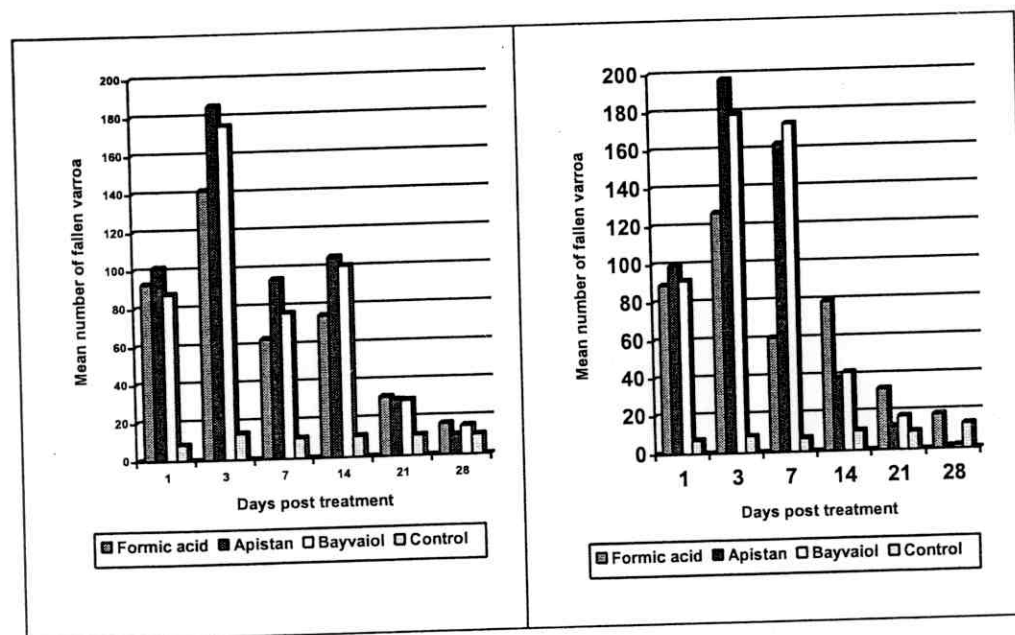


Fig. (37): Effect of some chemical products on Varroa mites during October-November (2004 & 2005))

Table (49): Effect of some chemical products on the reduction of Varroa mites infestation in worker brood honeybee colonies during December/January (2004/2005) and (2005/2006).

Seasons	Treatment	Mean percentage of Varroa infestation				(% Reduction	
		Before treatment		Post treatment (28 days)			
		Worker brood	Adult	Worker brood	Adult	Worker brood	Adult
2004/2005	Formic acid	14.33	17.67	1.33	0.67	90.72	96.21
	Apistan	14.00	17.67	1.00	0.67	92.51	96.21
	Bayvarol	14.33	17.00	2.00	1.00	85.37	94.12
	Control	14.33	17.67	13.67	17.67	---	---
2005/2006	Formic acid	15.67	18.00	1.00	0.33	93.02	97.17
	Apistan	15.33	17.33	0.67	0.00	95.22	100
	Bayvarol	15.33	18.33	0.67	0.00	95.22	100
	Control	15.67	18.00	14.33	11.67	---	---

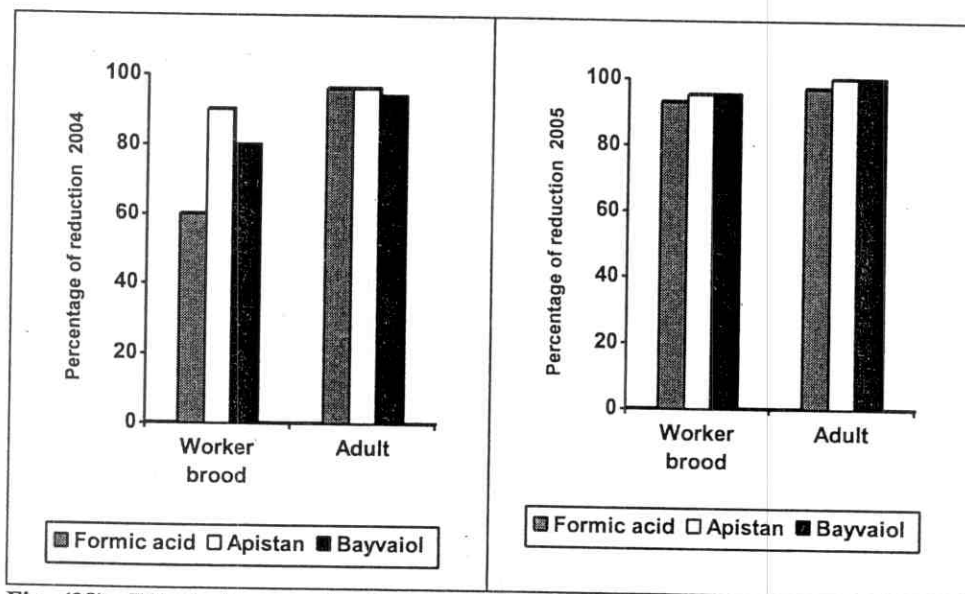


Fig. (38): Effect of some chemical products on the reduction of Varroa mites infestation in worker brood honeybee colonies December/January (2004/2005) and (2005/2006)

Table (50): Effect of some chemical products on Varroa mites during December/January (2004/2005) and (2005/2006).

Seasons	Treatment	Mean number of dead fallen Varroa mites at indicated days								
		Before treatment	Post treatment						Total	Mean
			1	3	7	14	21	28		
2004/2005	Formic acid	6.67	45.67	182.00	42.00	107.00	37.00	16.33	430.00	71.67
	Apistan	5.33	61.67	202.00	47.00	104.67	36.00	14.33	465.67	77.61
	Bayvarol	5.67	45.33	165.33	41.67	81.33	38.67	14.33	386.66	64.44
	Control	5.67	11.67	10.67	9.33	12.67	12.67	11.33	68.34	11.39
	F-value									1.950 ^{ns}
									417.00	69.50
2005/2006	Formic acid	5.00	50.00	198.00	44.33	85.67	30.67	8.33	482.33	80.39
	Apistan	4.67	62.00	266.67	65.33	68.33	17.33	2.67	482.33	80.39
	Bayvarol	5.67	49.00	156.67	50.67	65.00	18.33	3.33	343.00	57.17
	Control	5.67	7.67	10.33	8.33	7.67	10.00	10.67	54.67	9.11
	F-value									1.428 ^{ns}

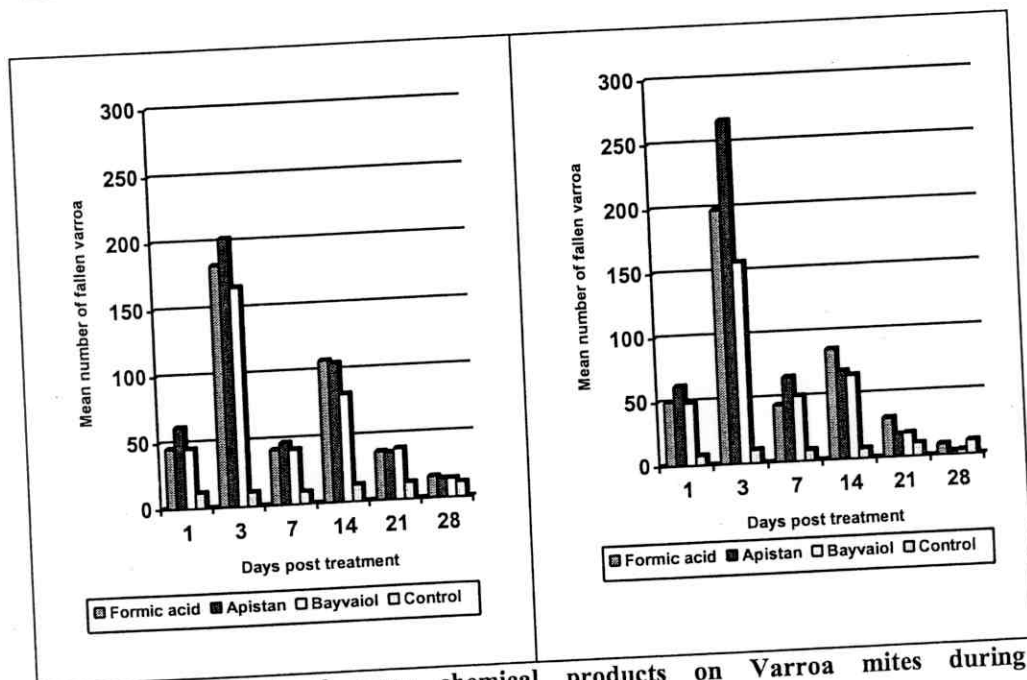


Fig. (39): Effect of some chemical products on Varroa mites during December/January (2004/2005) and (2005/2006)

Table (51): Effect of some chemical products on the reduction of Varroa mites infestation in worker brood honeybee colonies during February-March (2005 & 2006)

March (2005 & 2006)							
Seasons	Treatment	Mean percentage of Varroa infestation				(%) Reduction	
		Before treatment		Post treatment (28 days)			
		Worker brood	Adult	Worker brood	Adult	Worker brood	Adult
(2005)	Formic acid	17.67	11.33	0.67	0.33	95.10	96.04
	Apistan	17.33	12.33	0.67	0.33	95.00	96.36
	Bayvarol	17.33	12.00	1.33	1.33	90.08	84.93
	Control	17.67	11.33	13.67	8.33	---	---
	Formic acid	17.67	11.33	1.33	0.67	91.32	92.50
(2006)	Apistan	17.33	10.67	0.67	0.33	95.54	96.08
	Bayvarol	17.33	10.33	0.67	0.33	95.54	95.95
	Control	17.67	11.00	15.33	8.67	---	---
	Formic acid	17.67	11.33	1.33	0.67	91.32	92.50

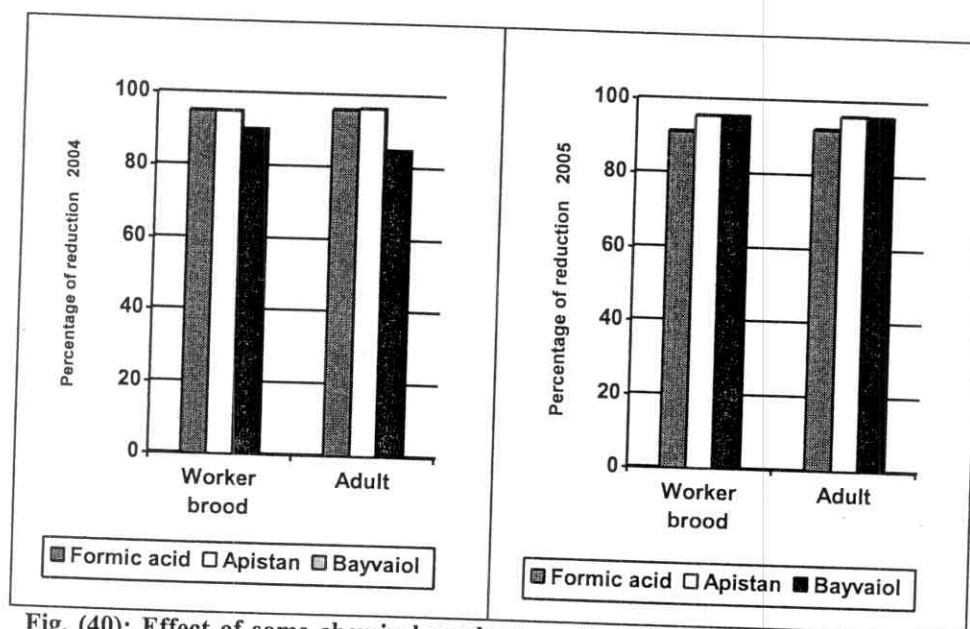


Fig. (40): Effect of some chemical products on the reduction of Varroa mites infestation in worker brood honeybee colonies during February-March (2005 & 2006).

Table (52): Effect of some chemical products on Varroa mites during February-March (2005 & 2006).

March (2005 & 2006).											
Seasons	Treatment	Mean number of dead fallen Varroa mites at indicated days									
		Before treatment	Post treatment							Total	Mean
			1	3	7	14	21	28			
2005	Formic acid	5.67	91.33	185.67	112.33	106.33	60.00	11.00	566.66	94.44a	
	Apistan	5.33	101.00	201.67	110.67	109.00	62.00	11.33	595.67	99.28a	
	Bayvarol	6.00	84.00	156.00	85.00	93.67	60.33	13.33	492.33	82.06a	
	Control	5.67	10.33	10.33	13.33	10.00	16.00	15.00	74.99	12.50b	
	F-value									4.107*	
	LSD at 5%									58.77	
2006	Formic acid	5.67	90.33	106.33	92.00	209.00	68.33	13.00	578.99	96.50a	
	Apistan	5.33	102.67	166.33	208.00	94.33	43.33	3.00	617.66	102.94a	
	Bayvarol	5.67	88.33	149.00	162.67	89.33	44.33	11.00	544.66	90.78a	
	Control	6.00	9.00	12.33	11.00	10.67	10.67	13.00	66.67	11.11b	
	F-value									3.360*	
	LSD at 5%									69.37	

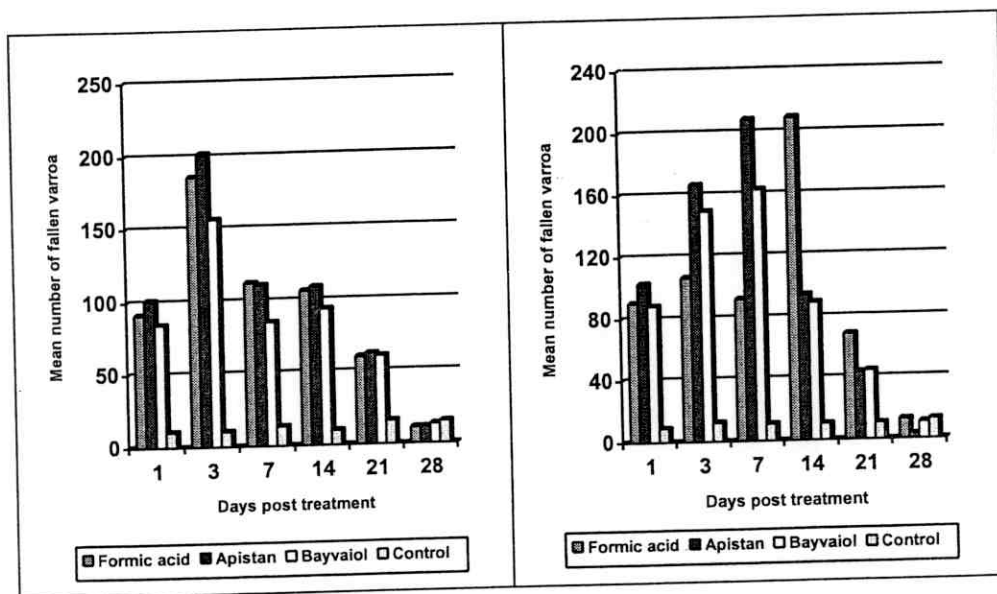


Fig. (41): Effect of some chemical products on Varroa mites during February-March (2005 & 2006).

Table (53): Effect of some chemical products on the reduction of Varroa mites infestation in worker brood honeybee colonies during April-May (2005 & 2006).

Seasons	Treatment	Mean percentage of Varroa infestation				(%) Reduction	
		Before treatment		Post treatment (28 days)			
		Worker brood	Adult	Worker brood	Adult	Worker brood	Adult
2005	Oxalic acid	14.00	9.67	2.67	1.33	59.97	72.50
	Apistan	13.67	9.33	0.33	0.33	94.93	92.92
	Bayvarol	13.67	10.67	0.66	0.67	89.87	87.43
	Control	14.00	8.67	6.67	4.33	---	---
2006	Oxalic acid	14.33	9.33	3.00	1.67	75.48	78.53
	Apistan	14.33	9.67	1.00	0.67	91.83	91.69
	Bayvarol	13.00	8.33	1.33	1.00	88.02	85.60
	Control	13.67	8.00	11.67	6.67	---	---

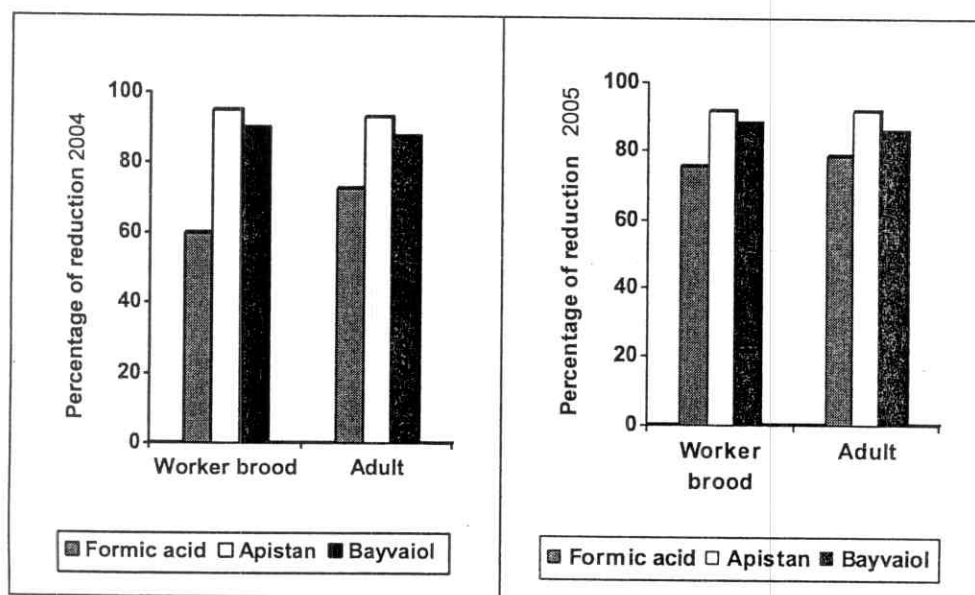


Fig. (42): Effect of some chemical products on the reduction of Varroa mites infestation in worker brood honeybee colonies during April-May (2005 & 2006).

Table (54): Effect of some chemical products on Varroa mites during April-May (2005 & 2006).

Seasons	Treatment	Mean number of dead fallen Varroa mites at indicated days								
		Before treatment	Post treatment							Mean
			1	3	7	14	21	28	Total	
2005	Oxalic acid	7.67	37.67	50.33	31.00	73.67	45.67	16.33	251.67	42.45ab
	Apistan	8.00	44.00	196.67	67.67	110.67	59.00	9.67	487.68	81.28a
	Bayvarol	7.67	40.33	155.33	69.33	97.00	59.67	10.67	432.33	72.06a
	Control	8.00	9.67	10.00	10.33	15.33	13.33	13.33	71.99	11.99b
	F-value									3.299*
	LSD at 5%									50.94
2006	Oxalic acid	6.67	35.67	48.00	21.33	76.67	64.00	12.33	258.00	43.00
	Apistan	6.33	40.00	177.33	80.67	118.33	28.33	1.67	446.33	74.39
	Bayvarol	6.00	30.67	141.67	74.33	111.33	35.33	3.00	396.33	66.06
	Control	6.67	7.00	11.33	12.33	13.00	12.00	10.33	65.99	10.99
	F-value									2.525 ^{NS}

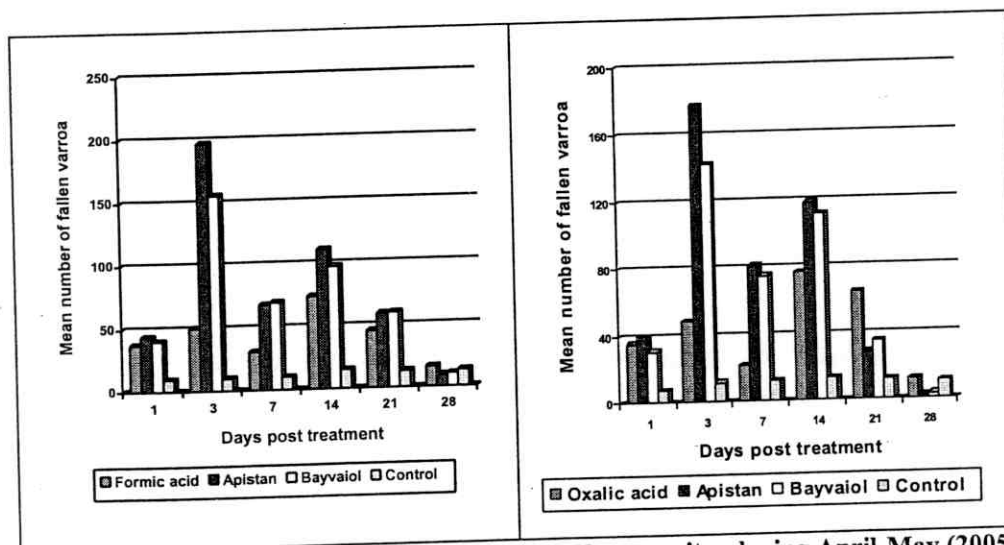


Fig. (43): Effect of some chemical products on Varroa mites during April-May (2005 & 2006).

It could be mentioned that the Varroa mites population dynamics is increasing in seasons of honey flow activity, while the brood rearing is highly amounts in colonies growth rates as well as available nectar and pollen in the field. This phenomenon accompanied with Varroa mites increase gradually with suitable environment in honeybee colonies.

On the light of the obtained data it could be concluded that;

1. The Apistan, Bayvarol, formic acid and oxalic acid caused high reduction percentages in the Varroa population.
2. The therapeutic activity of the tested chemical compounds towards varrao mites could be arranged according in the following descending order Apistan > Bayvarol > formic acid > oxalic acid.
3. The rate of the fallen numbers of the dead Varroa mites with chemical compounds treatment was faster than with essential oils treatment and this was evident after the 1st day of application.
4. The Varroa mites population was decreased within the first 24 hours followed chemical compounds treatment. As well as after worker brood appearance (nearly 14 days).
5. There were no clear significant differences among efficacy of the chemical compounds used, while a significant differences was recorded between each of them and the control .

6. Apistan and Bayvarol stripes conducted against Varroa mites were easily applied and gave high reduction of Varroa mites population.

These findings confirmed results of **Floris et al. (1995)** who reported that field experiment on the efficacy of Apistan showed killing about 99% of mites and the fluvalinate (active ingredient of Apistan) concentration in the plastic strips remained constant for 10 weeks. Also, **Cabras et al. (1997)** observed that during 10 week of treatment with Apistan the fluvalinate content in the plastic strips decreased by non significant differences between initial (11.5%) and terminal (10.70%) concentration. While **Abo-Takia and El-din (1992)** showed that the Apistan more effective than both formic acid and lactic acid. Also, **Gatien and Currie (1995)** reported that the treatment with Apistan achieved a highest reduction in the Varroa mites, followed by perizin and then formic acid. **Ferrer-Dufol et al. (1991)** used two acaricides; fluvalinate and flumethrin against Varroamites in honeybee colonies for 28 days. **Hoppe et al. (1989)** recorded that about 94% of the Varroa mites were killed by 4 treatments of formic acid at 4 days intervals. **Calderone and Nasr (1999)** mentioned that Apistan more effective (98%) against Varroa mites than formic acid (56%). **Fries, (1991) and Sherif (1998)** found that the number of dead Varroa mite. When used Apistan and Bayvarol comparison with those control especially after 2nd and 3rd days.

(**Imdorf et al. 1999**) the organic compounds such as organic acid and volatile oils are inexpensive alternatives of synthetic acaricides for the control of parasitic mites in

honeybee. They are also less of Chalkbrood risk compared to synthetic acaricides which may contaminated honeybee products or harm the beekeeper. Similar findings were reported for using oils for controlling Varroa. Menthol oil, the only registered treatment for tracheal mites in US has proved to be effective.

Herbert et al. (1988) and Abd Al-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 ontroling varrao mites. **Amrine and Noel (2006), Amrine et al. (2007) and Abd El-Raheem (1999)** used several chemical acaricides against Varroa invasion.

- **Comparison between efficiency of the essential oils and the chemical compounds for Varroa control**

Due to the residue remain in honeybee products when using chemical compounds and the natural (essential) oils were used and the comparison between them were concluded. According to the obtained results it could be concluded that there were non-clearly differences in the Varroa reduction percentage between chemical compounds and essential oils used in this experiments as shown in Table (55).

- **Productivity of the honeybee colonies**

Data showed in Table 56 indicated increasing percentage in the area of the sealed worker brood with treatment of Apistan, thymol, formic acid, Bayvoral, eucalyptus, oxalic acid and peppermint during two seasons. They were 201.31%, 193.69%, 199.36%, 181.99%, 176.64%, 134.44%, 132.8 % and 236.68%, 208.77%, 180.05%, 182.89%, 164.13%, 134.26% & 113.74%, respectively.

Also, it was showed an increasing percentage in the pollen stored in the treated colonies. in this study. They were 101.28%, 99.41%, 93.60%, 91.64%, 84.88%, 79.61% and 74.27% during the experimental season 2004 while the second season were 121.11%, 119.11%, 102.42%, 98.48%, 88% and 86.17% for treatment with the tested material mentioned above, respectively.

In case of royal jelly the increased percentage ranged from 99.85% to 141.1% in 2004 & 2005 seasons.

Data of the same table indicated that there were increase percentage of honey production of the treated colonies. They were 77.14%, 69.28%, 69.28%, 61.66%, 61.66%, 61.66% &

Table (55): Comparison between effects of some essential oils and chemical compounds 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
2004/2005	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
2005/2006	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: Peppermet (1:2:1)

Results and Discussion

Table (56): Effects of the essential oils and chemical compounds treatments on the productivity of the honeybee colonies during two seasons study (2005& 2006).

seasons	Products	Mean area of sealed worker brood (inch ²)			Pollen grain		Royal jelly		Honey	
		Before Treatment	After Treatment	% Increasing	Amount /gm	% Increasing	Amount /gm	% Increasing	Amount /kg	% Increasing
2005	Treatments									
	Eucalyptus oil	643.67	1780.67	176.64	383.34	84.88	11.33	69.86	7.00	61.66
	Thymol oil	60.67	1940.33	193.69	413.46	99.41	13.33	99.85	7.33	69.28
	Peppermint oil	713.33	1660.67	132.80	372.40	79.61	10.33	54.87	6.67	54.04
	Formic acid	652.33	1900.67	191.36	397.34	91.64	11.67	74.96	7.00	61.66
	Oxalic acid	699.67	1640.33	134.44	361.33	74.27	10.67	59.97	7.33	96.28
	Apistan	660.67	1990.67	201.31	417.34	101.28	13.33	99.85	7.67	77.14
	Bayvarol	670.33	1890.33	181.99	401.40	93.60	13.00	94.90	7.00	61.66
	Mean	671.52	1829.09	172.38	392.37	89.24	11.95	79.16	7.14	64.90
	Control	750.33	833.67	11.11	207.34	-	6.67	-	4.33	-
2006	Eucalyptus oil	715.67	1890.33	1641.13	391.69	98.48	10.67	88.18	6.67	66.75
	Thymol oil	680.33	2100.67	208.77	432.39	119.11	13.33	135.10	7.67	91.75
	Peppermint oil	720.67	1540.33	113.74	370.99	88.00	10.33	82.19	6.00	50.00
	Formic acid	723.33	2025.67	180.05	388.59	96.91	12.67	123.46	7.67	91.75
	Oxalic acid	670.33	1570.33	134.26	367.39	86.17	11.33	99.82	6.67	66.75
	Apistan	650.67	2190.67	236.68	436.34	121.11	13.67	141.10	7.67	91.75
	Bayvarol	705.33	1995.33	182.89	339.46	102.42	12.67	123.46	7.33	83.25
	Mean	965.19	1901.90	173.58	398.12	101.74	12.10	113.40	7.10	77.50
	Control	733.67	820.33	11.81	197.34	-	5.67	-	4.00	-

54.04% for treated of Apistan, thymol, oxalic acid, Bayvarol, formic acid, eucalyptus and peppermint during the first season, respectively, while the second seasons, they were 91.75%, 91.75%, 91.75%, 83.25%, 66.75%, 66.75% and 50% for treatment of Apsitan, thymol; formic acid, Bayvarol, oxalic acid, eucalyptus and peppermint, respectively. **Alekseenok and Shutov (1986)** recorded the amount of brood; 28200, 10800 & 6200 cells for colonies treated with KAS-81 (a mixture of wormwood and pine kernels containing essential oils, carotene and ascorbic acid), Folbex and control, respectively. Comparing KAS-81 to formic acid, brood areas were 655 and 22 cm², respectively. They added that colonies treated with KAS-81 produced more than 30% of bees over the season than colonies treated with formic acid. **Allam and Zakaria, (2009)** reported that the oils mixture and black cumin oil treatments increased the biological activities of treated bee colonies (Number of covered combs with bees & sealed worker brood area). Cutting Varroa mites from legs and coxae may be attributed to selected gene. Separated the ventral shield of the Varroa mites prevent the Varroa eggs of the development and exercise to deprivation chance of the fertilization. It could be summarized that; Separated gnathosoma with portions of the legs from coxae followed with biting up gnathsoma with segments of legs consider important hygienic behavior recorded with essential oils treatments

From results obtained it could be recommended that;

- 1- It is essential to start the varrooa control program after nectar flow. Season end directly, that in late of August and September beginning. Whereas the bee colonies be force and capable to tolerant materials control.

- 2- Advice the beekeepers to using essential oils with sugar solution added to pollen substitute. for their directly effect on the Varroa mite, that may be help the bee workers to the reactivation after the season end.
- 3- The Evaporation method applied can be recommended in the late autumn and winter beginning, whereas bees activity in brood rearing be little and most of the parasite members be found on adults bees, thus the controlling program positive results in Varroa reduction which is carried on the worker adults.
- 4- The essential oils particularly the thymol treatment using feeding or Evaporation method (on concentration 10% and 20%) which consider the prefers method in Varroa reduction.
- 5- It must be not uses the acaricides or the insecticides in controlling Varroa mites, whereas they can be pollute the wax and other bee products and left harmful residues in them.