

EFFICIENCY OF SOME CHEMICAL COMPOUNDS AGAINST THE MITE *Varroa jacobsoni* ON HONEYBEE

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ABSTRACT

The present study was carried out at the apiary of Sakha Agricultural Research Station, Kafr El-Sheikh Governorate during 2000 season to evaluate the effectiveness of four materials; formic acid, oxalic acid, malathion powder and mitac 20% on varroatosis. The results indicated that all treatments were effective against the mite, but had little or no effects on the bees. Mitac 20% (acaricide) was the most effective compound on mites after a period of 8 days from treatment (620.6 mites), followed by Malathion (611.2), formic acid (212.6), while oxalic acid had the least effect (159.4 mites). The number of the associated mites was found to be higher with drones than those with workers (510 and 329 mites/100 bees, respectively).

INTRODUCTION

The mite, *Varroa jacobsoni* O., was discovered in 1972 in eastern Europe by Haragsim and Samsinak and has progressively reached all the western parts of the continent and also to South America (Ritter and DeJong, 1984). It was detected in Egypt for the first time in 1983 (Wienands, 1988) and since then, it spread all over the country in areas where bees are kept, and caused great losses in many apiaries during this period.

To control the *Varroa* mite, mitac 20 EC (An emulsifiable concentrate containing 20% W/V amitraz.) and malathion, as powder, were used in Geece (Santas, 1983 and 1986). In USSR, Luganskii *et al.* (1987) reported that application of both formic acid and oxalic acid for controlling *Varroa* results in certain disadvantages. Aqueous solution of oxalic acid 40 g/lit (4 ml per frame) sprayed into hives at comb surface area, reduced infestation by 64-80%, with a little adverse effect on the bees. In Egypt, Abd El-Fattah *et al.* (1991) found that Apistan and malathion were the most efficient chemicals to control it. Also, in Italy, Marchetti *et al.* (1994) reported that some beekeepers used mitac solution for controlling *V. jacobsoni* mite.

The present work aimed to evaluate the effectiveness of four chemical materials; formic acid, oxalic acid, malathion powder and mitac 20 EC against varroatosis in Egypt.

MATERIALS AND METHODS

This study was carried out at the apiary of Sakha Agricultural Research Station, in January and February, 2000. The colonies of honeybee of this experiments were of F₁-Caraniolan hybrid headed by young sister queens, similar in strength (honey, brood and bees) and heavily infested by the *Varroa mite* twenty colonies (5 combs each) were divided into four groups

(treatments), each of five colonies (replicates). Five extra colonies were used as a check (without treatments).

Treatment:

Each of the following treatments were applied 4 times at 9-day intervals:

1. Formic acid (60%): Ten milliliters of the acid were sprayed on a thick sheet of paper (20 x 20 cm) and placed on the top of the combs (at a rate of 2 ml/comb).
2. Oxalic acid (40 g/lit): Two ml were sprayed on both sides of each combs, using an atomizer.
3. Malathion powder (0.1%): Malathion 1% was mixed with talc powder. Each colony was dusted by 3.5 g of the mixture in between the top of the combs.
4. Mitac 20 EC): A piece of wood was treated with 1/2 ml of the acaricide and placed in between the top of combs near the unsealed brood.
5. Check colonies: Hives used as control were smoked with classic fumes for two minutes.

Each of the abovementioned treatments were repeated four times at 9-days intervals.

Evaluate the efficiency of the different treatments:

1. To evaluate the efficiency of the different treatments on the mortality of the ectoparasite mite, *Varroa jacobsoni* and their side effects on the bees, a paper board covered with vaseline was placed on the bottom board of the hives, to receive the dropping insects. Dead individuals of mites and bees stuck to vaseline were counted 2, 4, 6 and 8 days after application.
2. To study the distribution of mites on different parts of the adult bee body, 100 bees were anesthetized and the occurring mites on different parts of the body were counted. After counting, the re-active bees were returned to their hives (Shabanov *et al.*, 1980).
3. In order to examine the effect of tested substances on sealed brood, fifty cells of broods from each colony were uncapped to characterize the infestation with different stages of the *Varroa* mites; larvae, nymphs and adults according to the techniques of Wolf-Gang (1981).

RESULTS AND DISCUSSION

The results in Table (1) show that all tested compounds reduced the mite population. The highest parasite mortality was observed with Mitac 20 EC application (620.6 individuals) followed by that of Malathion powder (611.2 individual) and then formic acid (212.6 individual), while oxalic acid produced the lowest effect on the *Varroa* mite (159.4 dead individual). Considering the time effect of these compounds, it was found that both malathion and formic acid have an accumulative effect up to the first 4 days after treatment, then, their efficiency started to decline, since 317.2, 174.2, 73.4 and 46.4 mites died by malathion and 210, 150.2, 140 and 130.4 mites died by mitac 20% after 2,

4, 6 and 8 days, respectively. On the other hand, the effect of formic acid rarely stable during the period of treatment , as well as oxalic acid which has a scanty cumulative effect all over the 8 days of the testing period. Data in Table (1) indicated that the toxicity of compounds on the honeybees were slight. Formic acid was the most toxic while oxalic acid was the least one, since 16.2 and 18 of dead adult workers per colony were recorded for these two treatments, respectively.

Table (1): Effect of different compounds on the mortality of the honeybee and their ectoparasite mite *V. jacobsoni*.

Treatment	Mean of recorded dead individuals (bees and mites)									
	Bees					Mites				
	Time in days					Time in days				
	2	4	6	8	Cumulative	2	4	6	8	Cumulative
Formic acid	7.2	3.2	2.2	3.6	16.2	100	62.4	34.2	16.0	212.6
Oxalic acid	5.4	1.8	2.2	1.6	11.0	34.2	45.0	50.8	29.4	159.4
Malathion powder	4.6	2.6	2.0	2.6	11.8	317.2	174.2	73.4	46.4	611.2
Mitac 20%	5.0	2.0	2.0	4.0	13.0	210.0	150.2	140.0	130.4	620.6
Control	0.0	1.3	1.7	1.0	4.0	2.7	2.4	5.4	4.4	14.9

The present results agree with the findings of Santas (1986) who used successfully a malathion powder in concentrations below 1% to control the *Varroa* mite with no direct or side adverse effect on the honeybee adults and broods. Similar results were also obtained by Infantidis (1990) and Abd Al-Fattah *et al.* (1991). Luganskii *et al.* (1987) and Okada and Nakane (1998) used formic acid, lactic acid and oxalic acid to spray or fumigate colonies infested by *Varroa*. They observed that the mites died within 10 hrs after treatments with no adverse effects on both workers and queens. Moosbeckhofer and Derakhshifar (1986) and Shower *et al.* (1993) referred to formic acid and lactic acid as efficiency chemical for controlling *V. jacobsoni* mite in the brood. They found that formic and lactic acid have no direct or side adverse effect on honeybee worker, drone or brood. Similar observations were also detected by Marchetti *et al.* (1984); Ruttner *et al.* (1984) and Klinar (1985), as all observations confirm the results of the present study.

Data in Table (2) show that number of mites associated with the drones (510 individuals/100 adults) was higher than those with workers (329/100 adults) Mite density varied according to the different parts of adult bodies as 303, 22 and 4 mites were recorded on the abdomen, thorax and head, respectively of 100 of bee workers before treatments. Treating bees with the different compounds resulted in the reduction of mite population, however the trend of distribution before and after treatment was nearly the same. The highest percentage of reduction in infestation was recorded on mitac 20% (95.2 for workers and 94.2% for drones) followed by malathion, formic and oxalic acid, 93.4, 76.7 and 68.9% for workers & 92.9, 60.3 and 57.0 for drones, respectively. In this respect Abd Al-Fattah *et al.* (1991) recommended Apistan, Bayvarol and malathion compounds of adequate bioactivity against *Varroa* mite, while the Folbex and Apitol gave lower activity.

Table (2): Distribution of *V. jacobsoni* mite on honeybee adults treated with four compounds.

Treatment	Workers			Drones			Total		% Reduction	
	Head	Thorax	Abdomen	Head	Thorax	Abdomen	Worker	Drone	Worker	Drone
Before treatment										
Formic acid	0	8	56	1	5	57	64	63	-	-
	1	5	100	1	10	147	106	158	-	-
Oxalic acid	1	3	72	0	7	162	76	169	-	-
Malathion	2	6	75	1	7	112	83	120	-	-
Mitac 20%										
Total	4	22	303	3	29	478	329	510	-	-
Control	1	6	65	1	7	122	72	130	-	-
After treatment										
Formic acid	0	1	14	1	11	13	15	25	76.6	60.3
Oxalic acid	0	2	31	0	32	36	33	68	68.9	57.0
Malathion	0	1	4	0	5	7	5	12	93.4	92.9
Mitac 20%	0	1	3	0	3	4	4	7	95.2	94.2
Total	0	5	52	1	51	60	57	112	82.7	78.0
Control	1	1	91	0	3	49	93	52	-	-

Table (3) shows that the recorded data after each application of any treatment affected number of the different stages of the *Varroa* mite either on drone or worker pupae. The data also show that number of all mite stages associated with drones pupae were nearly 5 fold of those found on worker pupae. After the first application, the percentages of reduction in mite individuals were 20.3 & 10.0, 3.4 & 10.3, 14.6 & 12.5 and 15 & 18.6% for formic acid, oxalic acid, mitac and malathion for both worker and drones, respectively.

Table (3): Effect of four treatments on *V. jacobsoni* mite attached to honey bee pupae (sealed brood).

Treatment	Before treatment		After treatment							
	Worker	Drone	Application 1		Application 2		Application 3		Total	
			Worker	Drone	Worker	Drone	Worker	Drone	Worker	Drone
Formic acid	64	3.9	51	278	47	247	22	200	113	756
% Reduction	-	-	20.3	10.0	26.6	20.1	65.6	35.3	112.3	65.4
Oxalic acid	88	244	85	219	64	168	46	127	195	514
% Reduction	-	-	3.4	10.3	27.3	13.2	47.3	47.9	78	71.4
Malathion	60	311	51	253	53	211	52	168	156	632
% Reduction	-	-	15	18.6	11.7	32.2	13.3	46.0	40.0	96.8
Mitac 20%	82	240	70	210	67	207	65	200	201	617
% Reduction	-	-	14.6	12.5	18.3	13.8	20.7	16.7	53.6	43.0
Control	53	318	58	313	60	327	63	316	172	956
% Reduction	-	-	-10.0	-1.6	-13.2	-2.8	-20	-0.6	-42.1	-5.0

$$\text{Reduction \%} = \frac{A - B}{A} \times 100$$

A= Number of individuals before treatment
 B = Number of individuals after treatment

A similar trend was observed after the second application and the best effect was observed after the third one. In case of worker pupae, the highest reduction in percentages (65.6) of associated mites was recorded in hives treated with formic acid as decreased to 47.3, 20.7 and 13.3% after

treatment with oxalic acid, mitac and malathion, respectively. On the other hand, oxalic acid was the most effective against mites of drone pupae, as it reduced 47.9% of the mite population followed by 45.8, 34.2 and 16.7% for malathion, formic acid and mitac, respectively. In this respect, Santas (1986) found that malathion powder gave a good result for controlling *Varroa* mites in the brood. He mentioned that malathion powder had no direct or side adverse effect either on the honeybee adults as previously mentioned and/or on the brood. In addition, no residues was traced in honey.

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**تقييم بعض المواد المستخدمة فى مكافحة طفيل الفاروا على نحل العسل
حمدى احمد متولى منصور
معهد بحوث وقاية النبات مركز البحوث الزراعية - دقى - جيزه**

تم إجراء هذه الدراسة بمنحل محطة البحوث الزراعية بسخا - كفر الشيخ واثناء الموسم 2000 وذلك لتقييم تأثير معاملة طوائف نحل العسل باربعة مركبات كيميائية هى حمض الفورميك - حمض الاكسالك - الملاثيون 1% والميتاك 20% على طفيل الفاروا .
وقد اوضحت النتائج أن الميتاك 20% كان اكثر المركبات كفاءة فى قتل طفيل الفاروا حيث سجل أعلى موت (620.6 فرد) مقارنة بالملاثيون (611.2 فرد) وحمض الفورميك (212.6) بينما سجل حمض الاكسالك اقل موت لطفيل الفاروا (159.4 فرد).
ولدراسة تأثير هذه المركبات فى نفس الوقت على نحل العسل وجد ان تأثيرها قليل السمية على النحل حيث كان حمض الفورميك هو الاكثر فاعلية وادى الى موت 16.2 فردا بينما أدت المعاملة بحمض الاكسالك إلى قتل 11 فردا وكانت اقل المعاملات تأثيرا على النحل بينما كانت نتائج المعاملة بالملاثيون والميتاك متوسطه حيث أدت إلى قتل 11.8 ، 13 فردا على التوالي.
ولقد كان لهذه المواد تأثير فعال على افراد طفيل الفاروا المصاحبة لعذارى شغالات وذكر النحل حيث كان حمض الفورميك اكثرها فاعلية على أفراد الطفيل الموجود مع عذارى الشغالات (اختزل 65.6% فرد بينما كان حمض الاكسالك هو الاكثر فاعلية على افراد الطفيل المصاحبة لعذارى الذكور 47.9% فرد).