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PRODUCTIVITY INCREASE OF HONEY BEE COLONIES TREATED WITH FORMIC AND OXALIC ACIDS FOR CONTROLLING VARROA MITE

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ABSTRACT

Thirty eight frame colonies (1st Carniolan hybrid) were chosen to study the effect of Formic acid 60% and Oxalic acid 3% on productivity of infested colonies with Varroa mite. The brood rearing ratios in treated honeybee colonies were significantly surpassed those of untreated colonies during 2003 and 2004 years. The highest rates of increase in sealed brood cells due to formic-oxalic acids applications. In 2003, the rates of increase in number of wax combs covered from both sides with adult bees after Formic-oxalic acids applications ranged between 8.39% on December 7 and 45.52% on March 18. The corresponding values in 2004 were 2.64% on September 14 and 32.40% on June 22. Treating the honeybee colonies with Formic-oxalic acids increased the amounts of stored honey as compared with those in untreated colonies. The rate of increase in 2003 ranged between 2.48% on January 18 and 53.3% on March 6. The corresponding range in 2004 was 1.5% on November 25 and 35.7% on September 26 and October 8. The rates of increase in the amounts of stored honey were high in treated colonies during citrus, clover and cotton flowering periods.

The amounts of stored pollen grains in honeybee colonies were higher in colonies treated with Formic-oxalic acids than in untreated colonies. In 2003, the rate of increase ranged between 5.61% on May 29 and 52.82% on March 6. The corresponding values in 2004 were 3.28% on January 30 and 76.18% on September 26. As in case of stored honey, the rates of increase in the amounts of stored pollen were high during the citrus, clover and cotton flowering periods. Generally, treating the honeybee colonies with formic and oxalic acid caused on obvious decrease of infestation with Varroa mite to the minimum rate and productivity increase of honeybee colonies moreover cheap costs, available of easy use and more safe.

INTRODUCTION

Varroa disease causes a serious problem in world beekeeping due to its harmful effect to the insect host (Ritter, 1981; Infantidis, 1987; Fouly, 1988 and Fathy& Fouly, 1993). Migratory beekeeping, importation of colonies, packages of bees and queens, are considered to be the possible ways of Varroa spread. The spread of Varroa within colonies is due to swarming, robbing and foraging. Varroa disease resulted in weakened bee colonies malformations in wings and abdomen (Dehibes *et al.*, 1992) and finally led to death of the colony in case of severe infestation. This study was carried out in the apiary of private sector located in (Qualubia and Beni-Suif) during 2003 and 2004 aiming to achieve, the relation between infestation with Varroa mite and honeybee colonies activities (number of worker sealed brood cells, weight of stored pollens, stored honey and number of wax combs filled from both sides with adult bees) in untreated colonies and those treated with 60% formic and 3% oxalic acids.

MATERIAL AND METHODS

The present work was carried out in the apiary at of private sector located at Aghour in Qualubia Governorate to study the relation between the activities of honey bee colonies and their infestation with Varroa mite after treating them with 60% Formic acid at last week of December and 3% oxalic acid at last week of June.

The percentages of infestation during the experimental years in sealed brood cells and on the adult worker bees were described by Abou Elenain *et al.* (1999). The reduction percentages due to different treatments were calculated according to Henderson and Tiliton (1955). These colonies were divided into two groups.

The first group (15 colonies) were treated with Formic acid 60% and Oxalic acids 3% as the following: Formic acid 60% was used by Nassenheider evaporator (Varroform apparatus) with 120 ml and put on the floor of the experimental hive to evaporate 8 ml of the acid per day. The amount of acid in the apparatus completely evaporated after 15 days. This procedure repeated two times to expose the honey bee individuals to this acid for one month, i.e., from the beginning of the fourth week of December 2002 till the end of the third week of the following January 2003 and the procedure was repeated at the same time on 2003 and 2004.

Oxalic acid 3% was used by spraying the experimental honey bee colony directly with 25 ml of this acid four times, once a week. This procedure was conducted from the fourth week of June 2003 till the end of the third week of the following July 2003 and the procedures was repeated at the same time on 2004.

The second group (15 colonies) was left untreated as a control. After the flowering season of citrus in Qualubia governorate, the experimental colonies were transferred to El-Maasara, Beni-Suif Governorate during the flowering seasons of clover and cotton. Activities of the two groups of colonies were measured every 12 days during 2003 and 2004 years as follows: Numbers of worker sealed brood cells, Numbers of combs covered with adult bees, Weights of stored honey, Weights of stored pollen grains and Rates of increase in different honey bee activities due to Varroa mite control.

RESULTS AND DISCUSSION

1. Reduction of Varroa mite infestation in honey bee colonies treated with formic and oxalic acids:

a. Infestation in honeybee sealed brood cells:

As shown in Table (1) In 2003, the percentages of *Varroa* infestation in the brood cells of untreated colonies ranged between 16.26% on July 28 and 33.6% on December 7. These percentages reduced after treating the colonies with Formic acid followed by oxalic acid to reach an infestation range of 4.80% on February 11 and 23.06% on July 4. In 2004, the infestation in brood cells of untreated colonies ranged between 18.13 on September 2 and 32.53% on December 7 and 19. These values reduced to 5.06% on January 30 and 22.66% on April 23 after treating the colonies with Formic and oxalic

acids. Generally, treating the colonies with these organic acids caused a significant decrease of infestation to the minimum rate in January and February and the maximum rate in April and June.

Table (1): Mean percentages of *Varroa destructor* infestation in sealed brood cells of 1st Carniolan hybrid bee colonies treated with 60% formic acid and 3% oxalic acid during 2003 and 2004 years.

Dates	Infestation %				Reduction (%)		
	(2003)		(2004)		2003	2004	Mean
	Untreated	Treated	Untreated	Treated			
Jan. 6	-	-	21.73±1.55	11.73±0.74	-	-	-
18	22.67±2.55	5.33±0.3	22.13±1.02	10.40±1.02	76.48	53.00	64.74
30	24.27±1.81	7.20±0.89	22.13±2.22	5.06±0.62	70.33	77.14	73.73
Feb.1	25.60±1.60	4.80±0.69	21.33±1.09	7.20±0.80	81.25	66.24	73.74
23	27.20±0.47	8.00±0.88	23.73±0.99	9.60±0.86	70.58	59.54	65.06
Mar. 6	22.67±1.55	5.60±0.76	23.73±1.07	12.27±0.73	75.29	48.29	61.79
18	18.13±1.16	6.93±1.14	25.86±0.94	12.53±0.86	61.77	51.55	56.66
30	23.73±1.67	9.33±0.64	25.33±1.01	15.20±0.97	60.68	39.99	50.33
Apr. 11	25.86±1.09	12.0±1.10	26.40±1.15	18.13±0.94	53.59	31.32	42.45
23	18.93±1.58	16.13±1.75	24.53±1.34	22.66±0.84	14.79	7.62	11.20
May 5	26.13±1.70	17.60±1.02	24.53±0.87	16.26±0.83	32.64	33.71	33.17
17	22.66±1.86	17.33±1.15	25.14±1.22	19.46±0.77	23.52	22.59	23.10
29	20.80±0.89	14.93±1.20	23.52±1.01	18.67±0.64	28.22	20.62	24.42
Jun. 10	22.26±1.45	19.46±1.09	23.46±0.66	17.07±1.07	12.57	27.24	19.90
22	25.06±1.26	19.20±0.69	24.80±0.97	18.93±4.88	23.38	27.23	25.30
Jul. 4	26.40±1.22	23.06±1.19	22.67±0.64	17.86±0.67	12.65	21.22	16.93
16	19.20±1.17	15.46±1.09	20.26±0.61	17.90±0.54	19.47	11.65	15.56
28	16.26±1.14	14.93±1.07	19.47±0.75	17.87±0.76	8.17	8.22	8.19
Aug. 9	16.53±0.95	16.00±0.96	18.93±0.73	16.72±0.73	3.20	14.05	8.62
21	23.20±0.80	20.53±0.86	18.40±0.66	16.80±0.57	11.51	8.69	10.10
Sep. 2	21.07±0.83	16.86±0.23	18.13±0.53	16.53±0.67	19.98	8.83	14.40
14	25.07±1.14	11.20±1.05	19.73±0.74	19.47±0.77	55.32	6.39	30.85
26	25.87±1.02	5.60±1.01	22.13±0.86	16.27±0.73	78.35	26.48	52.41
Oct. 8	27.47±1.29	8.00±0.79	24.53±0.95	10.40±0.76	70.87	57.60	64.23
20	29.07±1.32	7.83±0.56	25.33±1.09	13.70±0.99	73.06	46.10	59.58
Nov. 1	29.13±1.62	8.67±0.87	26.13±1.09	15.20±0.97	70.23	41.83	56.03
13	32.80±0.97	7.20±0.70	28.80±0.97	17.60±0.65	78.04	38.88	58.46
25	31.20±1.22	6.13±1.09	29.33±1.01	19.73±0.73	80.35	32.73	56.54
Dec. 7	33.60±1.60	5.30± 0.74	32.53±0.77	20.53±0.67	84.22	36.89	60.55
19	32.53±1.51	10.61±0.84	32.53±1.09	16.51±0.77	67.38	49.25	58.31
31	29.30±1.73	12.53±0.87	-	-	-	-	-
F value					73.83**	83.71**	
L.S.D. at 0.05					3.89	3.04	

b. Infestation of honeybee adults with Varroa mite:

As shown in Table (2) in 2003, the percentages of Varroa infestation on adult bees in untreated colonies ranged between 16.37% on April 23 and 30.60% on December 7. These percentages reduced to 3.97% on February 11 and 19.19% on September 2 after treating the colonies with Formic and

oxalic acids. In 2004, the infestation on adult bees of untreated colonies ranged between 15.74% on September 2 and 29.43% on December 19. The infestation was reduced to 2.98% on January 30 and 17.76% on July 4 in colonies treated with Formic and oxalic

Table (2):Mean percentages of *Varroa destructor* infestation on adult workers of 1st carniolan hybrid bee colonies treated with 60 % formic acid and 3 % oxalic acid during 2003 and 2004 years.

Dates	Infestation %				Reduction (%)		Mean
	(2003)		(2004)		2003	2004	
	Untreated colonies	Treated colonies	Untreated colonies	Treated colonies			
Jan. 6	-	-	18.67 ± 1.26	7.93 ± 0.18	-	-	-
18	16.74 ± 1.81	6.15 ± 0.20	19.00 ± 0.79	7.95 ± 0.71	63.26	59.68	61.47
30	18.18 ± 1.49	6.10 ± 0.63	18.77 ± 0.82	2.98 ± 0.56	66.45	84.12	75.28
Feb. 11	20.91 ± 1.72	3..97 ± 1.03	20.32 ± 1.00	4.62 ± 0.43	81.01	77.26	79.13
23	19.29 ± 1.19	6.02 ± 0.56	21.32 ± 0.87	7.14 ± 0.55	68.79	66.51	67.65
Mar. 6	19.34 ± 1.24	5.62 ± 0.75	21.95 ± 0.73	10.46 ± 0.61	70.94	52.39	61.66
18	16.42 ± 0.77	7.45 ± 0.75	22.48 ± 0.99	11.11 ± 0.46	54.63	50.58	52.60
30	17.80 ± 1.68	7.87 ± 0.57	23.11 ± 0.96	13.22 ± 0.39	55.79	42.79	49.29
Apr. 11	20.86 ± 1.07	10.34 ± 0.55	23.24 ± 1.05	14.64 ± 0.49	50.43	37.78	44.10
23	16.37 ± 1.29	13.18 ± 0.78	21.92 ± 0.79	16.67 ± 0.56	19.48	23.95	21.71
May 5	22.14 ± 1.94	16.62 ± 1.98	21.33 ± 0.64	13.84 ± 0.57	24.93	35.11	30.02
17	20.28 ± 1.49	14.88 ± 0.79	22.38 ± 0.75	15.39 ± 2.03	26.62	31.23	28.92
29	16.88 ± 0.98	12.95 ± 0.86	22.32 ± 0.67	15.21 ± 0.61	23.28	31.85	27.56
Jun. 10	18.55 ± 1.39	15.09 ± 0.64	20.68 ± 0.69	14.00 ± 0.63	18.65	32.30	25.47
22	21.85 ± 2.35	15.78 ± 0.72	21.37 ± 0.75	15.80 ± 0.64	27.78	26.06	26.92
Jul. 4	22.87 ± 1.19	18.97 ± 1.13	19.37 ± 0.65	17.76 ± 0.52	17.05	8.31	12.68
16	17.11 ± 3.87	13.80 ± 0.98	18.94 ± 0.52	15.56 ± 0.58	19.34	17.85	18.59
28	15.17 ± 1.01	13.87 ± 0.82	17.69 ± 0.88	15.77 ± 0.58	8.56	10.85	9.70
Aug. 9	15.83 ± 0.57	14.13 ± 0.67	17.51 ± 0.69	15.06 ± 0.67	10.73	13.99	12.36
21	19.94 ± 0.78	18.72 ± 0.76	17.04 ± 0.61	14.44 ± 0.63	6.11	15.26	10.68
Sep. 2	19.54 ± 0.91	19.19 ± 1.21	15.74 ± 0.59	13.82 ± 0.43	1.79	12.20	6.99
14	22.32 ± 0.94	10.44 ± 1.13	16.84 ± 0.64	15.96 ± 0.43	53.22	5.23	29.22
26	24.78 ± 1.14	6.15 ± 1.88	20.21 ± 0.63	13.08 0.52±	75.18	35.28	55.23
Oct. 8	24.47 ± 1.20	6.30 ± 0.46	22.22 ± 0.61	8.65 ± 0.59	74.25	61.07	67.66
20	25.56 ± 1.27	8.80 ± 0.80	22.31 ± 0.76	11.04 ± 0.75	65.57	50.51	58.04
Nov. 1	27.90 ± 0.94	8.12 ± 0.62	24.11 ± 0.56	12.59 ± 0.51	70.89	47.78	59.33
13	29.73 ± 1.01	4.47 ± 0.67	26.31 ± 0.59	14.29 ± 0.54	84.96	45.69	65.32
25	29.88 ± 1.08	5.79 ± 0.98	27.03 ± 0.67	15.93 ± 0.53	80.62	41.06	60.84
Dec. 7	30.60 ± 1.14	4.86 ± 0.49	27.88 ± 0.62	17.71 ± 0.58	84.11	36.48	60.29
19	27.51 ± 1.18	9.66 ± 0.69	29.43 ± 0.70	11.74± 0.53	64.88	60.11	62.49
31	27.94 ± 1.69	11.26 ± 0.72	-	-	-	-	-
F value					96.51**	76.21**	
L.S.D. at 0.05					5.33	4.91	

a. Numbers of wax combs in the colony covered from both sides with adult bees:

In 2003 the number of wax combs covered with adult bees from both sides in the experimental untreated colonies ranged between 4.13 combs/colony on January 18 and 10.4 combs/colony on May 29, while in treated colonies, it ranged between 4.87 combs/colony on January 18, and 12.6 combs/colony on July 16 (Table 4). The same trend could be applied for 2004 year, i.e., the number of combs covered with adult bees ranged

between 4.6 combs/colony on December 7 and 11.4 combs/colony on July 16 in untreated colonies. These values increased in treated colonies and ranged between 5.27 combs/colony on December 19 and 12.8 combs/colony on September 2. The rates of increase in number of combs covered with adult bees due to formic-oxalic acids treatments ranged between 8.39% on December 7 and 45.52% on March 13 in 2003 year. The corresponding values in year 2004 were 2.64% on September 14 and 32.4% on January 22. Irrespective of the experimental year, using formic and oxalic acids for controlling Varroa mite caused an obvious increase in the number of wax combs covered with adult bees by 8.08% on August 9 and 28.76% on September 26.

Table (3): Mean numbers of worker sealed brood cells in bee colonies treated with 60% formic acid and 3% oxalic acid for controlling *Varroa destructor* during 2003 and 2004 years.

Dates	(2003)		(2004)		Increase (%)		Mean
	Untreated colonies	Treated Colonies	Untreated colonies	Treated colonies	2003	2004	
Jan. 6	-	-	2190 ± 116.0	2227 ± 170.0	-	-	-
18	2645 ± 271.2	2768 ± 123.0	2363 ± 134.0	3402 ± 196.0	4.45	30.54	17.49
30	3513 ± 79.6	4427 ± 75.00	3097 ± 144.0	4122 ± 77.00	20.63	24.87	22.75
Feb. 11	3534 ± 146.5	5123 ± 159.0	3984 ± 205.0	4698 ± 128.0	31.02	15.20	23.11
23	3770 ± 275.1	5632 ± 102.0	4198 ± 157.0	5347 ± 162.0	33.06	21.49	27.27
Mar. 6	3835 ± 125.4	8027 ± 257.0	5853 ± 147.0	6595 ± 198.0	52.00	11.24	31.62
18	3767 ± 87.30	7400 ± 535.0	6342 ± 301.0	8843 ± 272.0	49.09	28.28	38.68
30	3380 ± 81.10	6680 ± 437.0	7538 ± 266.0	9155 ± 273.0	49.39	17.65	33.52
Apr. 11	7697 ±265.0	9858 ± 351.0	6492 ± 338.0	9147 ± 304.0	21.92	29.02	25.47
23	8380 ± 381.0	9092 ± 642.0	6287 ± 147.0	8258 ± 314.0	7.83	23.87	15.85
May 5	7000 ± 526.0	11356±432.0	7205 ± 193.0	10047±276.0	38.35	28.28	33.31
17	10997±548.0	13558±636.0	9007 ± 351.0	14045±436.0	18.88	35.87	27.37
29	11220±618.0	14560±912.0	9448 ± 309.0	12103±483.0	22.93	21.93	22.43
Jun. 10	10700±696.0	14404±775.0	11245±259.0	15953±515.0	25.72	29.51	27.61
22	9635 ± 486.0	15700±812.0	8610 ± 388.0	14857±771.0	38.63	42.05	40.34
Jul. 4	8442 ± 264.0	10458±411.0	9670 ± 290.0	12528±477.0	19.27	22.85	21.06
16	6775 ± 339.0	8267 ± 559.0	12205±503.0	14175±552.0	18.04	13.89	15.96
28	7323 ± 421.0	8457 ± 427.0	10532±549.0	13425±282.0	13.40	21.55	17.47
Aug. 9	8098 ± 295.0	8906 ± 370.0	10588±236.0	11095±512.0	9.07	4.56	6.81
21	7132 ± 335.0	9312 ± 334.0	6082 ± 288.0	8548 ± 475.0	23.41	28.85	26.13
Sep. 2	7160 ± 309.0	7838 ± 305.0	11930±545.0	13293±225.0	8.65	10.25	9.45
14	6695 ± 254.0	7400 ± 471.0	9902 ± 334.0	10247±428.0	9.52	3.36	6.44
26	6182 367.0±	8763 ± 321.0	6670 ± 238.0	10403±196.0	30.02	35.88	32.95
Oct. 8	5740 ±310.0	8670 ± 302.0	6745 ± 407.0	9658 ± 231.0	33.79	30.16	31.97
20	5897 ± 757.0	6005 ± 258.0	7638 ± 484.0	10372±319.0	1.80	26.35	14.07
Nov. 1	4108 ± 328.0	4748 ± 284.0	7253 ± 266.0	8833 ± 318.0	13.47	17.88	15.67
13	4050 ± 368.0	5685 ± 248.0	4808 ± 172.0	5833 ± 211.0	28.75	17.57	23.16
25	4300 ± 275.0	5132 ± 246.0	4877 ± 221.0	6013 ± 206.0	16.21	18.90	17.55
Dec. 7	2937 ± 398.0	4000 ± 271.0	2755 ± 108.0	4030 ± 139.0	26.58	31.63	29.10
19	4383 ± 367.0	5392 ± 238.0	2277 ± 156.0	3764 ± 185.0	18.70	39.51	29.10
31	2928 ± 178.0	4693 ± 175.0	-	-	-	-	-
	F value				**67.13****	**50.2****	
	L.S.D. at 0.05				**2.89**	**2.4**	

Table (4):Mean numbers of wax combs in the colony covered from both sides with adult bees in bee colonies treated with 60% formic acid and 3% oxalic acid for controlling *Varroa destructor* during 2003 and 2004 years.

Dates	(2003)		(2004)		Increase (%)		Mean
	Untreated colonies	Treated Colonies	Untreated colonies	Treated colonies	2003	2004	
Jan. 6	-	-	5.06 ± 0.110	5.33 ± 0.120	-	-	-
18	4.13 ± 0.910	4.87 ± 0.190	5.86 ± 0.090	5.93 ± 0.060	15.20	11.80	13.5
30	5.60 ± 0.130	5.73 ± 0.120	5.80 ± 0.110	6.26 ± 0.110	22.69	7.350	15.02
Feb. 11	5.20 ± 0.170	6.67 ± 0.120	6.13 ± 0.090	6.46 ± 0.130	22.04	5.110	13.57
23	5.33 ± 0.270	7.06 ± 0.120	6.06 ± 0.060	6.40 ± 0.130	24.50	5.310	14.90
Mar. 6	5.27 ± 0.120	8.47 ± 0.220	6.20 ± 0.110	6.60 ± 0.130	34.24	6.060	20.15
18	4.50 ± 0.100	8.26 ± 0.150	6.13 ± 0.090	6.93 ± 0.150	45.52	11.54	28.53
30	5.20 ± 0.110	7.60 ± 0.230	6.46 ± 0.130	7.06 ± 0.110	31.58	8.500	20.04
Apr. 11	6.60 ± 0.160	9.40 ± 0.160	6.80 ± 0.144	8.26 ± 0.110	29.79	17.68	23.73
23	8.78 ± 0.290	9.67 ± 0.160	7.13 ± 0.090	8.13 ± 0.090	8.27	12.30	10.28
May 5	7.13 ± 0.340	10.3 ± 0.290	8.13 ± 0.170	10.5 ±0.170	30.98	22.27	26.62
17	9.73 ± 0.160	11.5 ± 0.190	8.93 ± 0.240	11.6 ± 0.190	15.17	23.02	19.09
29	10.4 ± 0.170	12.3 ± 0.120	9.40 ± 0.190	11.3 ± 0.270	15.24	17.03	16.13
Jun. 10	10.1 ± 0.120	12.5 ± 0.220	10.5 ± 0.190	12.7 ± 0.110	19.63	17.28	18.45
22	9.93 ± 0.180	12.2 ± 0.220	8.20 ± 0.380	12.1 ± 0.380	18.61	32.40	25.50
Jul. 4	10.0 ± 0.098	11.9 ± 0.140	9.13 ± 0.190	11.6 ± 0.300	15.75	21.29	18.52
16	9.07± 0.067	12.6 ± 0.310	11.4 ± 0.400	12.4 ± 0.230	27.90	8.060	17.98
28	8.60 ± 0.130	10.0 ± 0.000	10.1 ± 0.500	12.7 ± 0.120	4.00	19.98	11.99
Aug. 9	9.33 ± 0.120	10.3 ± 0.120	10.0 ± 0.270	10.66 ± 0.450	9.98	6.190	8.08
21	10.1 ± 0.060	11.3 ± 0.230	5.86 ± 0.250	8.26 ± 0.380	11.21	29.06	20.13
Sep. 2	8.13 ± 0.090	9.06 ± 0.060	11.3 ± 0.440	12.8 ± 0.240	10.26	11.48	10.87
14	7.00 ± 0.090	9.00 ± 0.130	9.60 ± 0.280	9.86 ± 0.380	22.22	2.640	12.43
26	7.06 ± 0.210	9.13 ± 0.130	6.60 ± 0.240	10.1 ± 0.220	22.67	34.85	28.76
Oct. 8	7.26 ± 0.150	9.40 ± 0.2100	6.73 ± 0.370	9.40 ± 0.190	22.77	28.40	25.58
20	6.86 ± 0.160	9.33 ± 0.9200	7.53 ± 0.450	10.1 ± 0.260	26.47	15.15	20.81
Nov. 1	5.60 ± 0.130	6.60 ± 0.1200	7.13 ± 0.290	8.66 ± 0.280	15.15	17.67	16.41
13	5.46 ± 0.190	7.13 ± 0.1300	4.86 ± 0.160	5.73 ± 0.240	23.42	15.18	19.30
25	5.33 ± 0.120	6.30 ± 0.2100	4.73 ± 0.210	5.86 ± 0.230	15.40	19.28	17.34
Dec. 7	5.13 ± 0.090	5.60 ± 0.1500	4.60 ± 0.130	5.60 ± 0.130	8.39	17.87	13.13
19	5.30 ± 0.120	6.06 ± 0.2000	3.93 ± 0.070	5.27 ±0.1200	12.54	25.43	18.98
31	4.60 ± 0.120	6.00 ± 0.1300	-	-	-	-	-
F value					46.7**	46.31**	-
L.S.D. at 0.05					2.7	2.82	

c. Amounts of stored honey in colonies:

As shown in Table (5), the amounts of stored honey in untreated bee colony ranged between 182 g on December 31, 2003 and 3841 g on April 23, 2003. The minimum and maximum amounts of honey in 2004 were 498 and 3344 g on December 19 and June 22, respectively. Treating the experimental honeybee colonies with formic-oxalic acids, increased the amounts of stored honey, ranging between 248 g on December 31, 2003 and 6097 g on June 22 of the same year, and 623 g on December 19, 2004 and 6178 g on June 22 of the same year. The rate of increase ranged between 2.48% on January 18 and 53.3% on March 6, 2003. The corresponding range in 2004 was 1.5% on November 25 and 35.7% on September 26 and October 8. Irrespective of the experimental year, using formic and oxalic acids for controlling Varroa mite increased the rate of stored honey in the honeybee colonies by 8.01%

on September 2 and 43.29% on June 22.this results coincide with Poklukar (2001), Khattaby and Yousri (1993).

Table (5): Accumulated weights (g) of stored honey in bee colonies treated with 60% formic acid and 3% oxalic acid for controlling *Varroa destructor* during 2003 and 2004 years.

Dates		(2003)		(2004)		Increase (%)		Mean
		Untreated colonies	Treated Colonies	Untreated colonies	Treated colonies	2003	2004	
Jan.	6	-	-	922.7±28.92	940.3±25.54	-	-	-
	18	726.5±47.40	745±25.90	568±27.100	757±42.50	2.480	24.96	13.72
	30	967.7±21.9	1220±20.45	767±35.400	1067±19.60	20.68	28.12	24.40
Feb.	11	974.1±40.42	1410±45.10	985±54.200	1210±32.90	30.90	18.76	24.83
	23	1004.7±63.4	1475±28.50	1036±37.40	1327±45.30	31.88	21.93	26.90
Mar.	6	1027.7±23.7	2201±84.00	1270±33.14	1589±67.00	53.30	20.07	36.68
	18	861.9±20.02	1828±77.60	1383.4±65.5	2036±58.00	52.85	32.07	42.46
	30	773.1±19.99	1635±62.20	1594±52.40	1995±66.00	52.72	20.10	36.41
Apr.	11	1733.7±63.6	2298±93.60	2101±48.320	3019±64.90	24.56	30.41	27.48
	23	3841±174.5	4452±132.30	2229±45.30	3141±63.80	13.72	29.04	21.38
May	5	1670±125.7	2697±105.00	1539±38.10	2094±48.50	38.08	26.50	32.29
	17	2623±130.9	3229±148.40	2082±77.70	2267±80.60	18.77	8.16	13.46
	29	2485±134.13	3168±204.30	2191±75.90	2431±78.10	21.56	9.87	15.71
Jun.	10	3470±245.5	4760±256.00	2438±49.30	2848±92.40	27.10	14.40	20.75
	22	3615±189.9	6097±230.00	3344±166.00	6178±310.0	40.71	45.87	43.29
Jul.	4	2293±70.96	3646±142.00	1693±50.70	2325±141.0	37.11	27.18	32.14
	16	1632±88.34	1973±133.30	1539±64.10	2053±87.10	17.30	25.03	21.16
	28	1752±100.7	2330±118.00	1549±82.50	2062±58.00	24.81	24.87	24.84
Aug.	9	2533±94.45	3113±129.00	1768±47.30	2349±10.00	18.63	24.73	21.68
	21	2750±129.0	3933±141.00	2441±109.00	3285±108.0	30.08	25.70	27.89
Sep.	2	2104±91.00	2185±95.00	1936±71.50	2208±60.00	3.710	12.31	8.01
	14	1489±57.00	1573±75.00	1494±56.00	1734±38.40	5.340	13.84	9.59
	26	1193±56.25	1967±70.00	1104±40.00	1717±39.40	39.35	35.70	37.52
Oct.	8	1234±52.40	1859±70.00	1145±30.30	1781±48.90	33.62	35.70	34.66
	20	1423±59.90	1530±60.40	1436±72.70	1591±59.60	6.990	9.74	8.36
Nov.	1	1085±318.0	1182±44.20	817±23.700	1120±63.10	8.210	27.05	17.63
	13	764±71.030	986±35.600	891±24.400	1121±29.00	22.51	20.52	21.51
	25	558±38.900	923±48.700	1173±49.300	1191±36.00	39.54	1.50	20.52
Dec.	7	342±41.400	490±33.400	551±35.700	0752±52.00	30.20	26.73	28.46
	19	418±30.400	434±25.700	498±25.300	0623±31.00	3.68	20.10	11.89
	31	182±10.5300	248±11.700	-	-	-	-	-
F value						65.71**	53.81**	
L.S.D. at 0.05						4.92	2.97	

d. Amounts of stored pollen grains in colonies:

As shown in Table (6), the amounts of stored pollen grains in untreated bee colonies ranged between 669.2 g on May 29 and 20.33 g on January 18, 2003. The minimum and maximum amounts of pollen in 2004 were 24.6 and 508.3 g on December 19 and May 17, respectively. Treating the experimental honeybee colonies with formic-oxalic acids increased the amounts of stored pollen, ranging between 26.53 g on January 18, 2003 and 871.6 g on March 18 of the same year, and the rate of increase ranged between 5.61% on May 29 and 52.82% on March 6. In 2004, the maximum weight of stored pollen (655 g) was recorded on June 10 and the minimum (42.76 g) was however, obtained on December 7. The rates of increase due to treatments were

3.28% on January 30 and 76.18% on September 26. Irrespective of the experimental year, using formic-oxalic acids for controlling Varroa mite increased the rate of pollen storage in the honeybee colonies by 13.49% on November 1 and 51.80% on September 26. this results was in agreement with Allen and jeffree (1956), Steel (1958) and Todd and Bishop (1970).

Table (6): Accumulated weights (g) of stored pollen grains in bee colonies treated with 60% formic acid and 3% oxalic acid for controlling *Varroa destructor* during 2003 and 2004 years.

Dates		(2003)		(2004)		Increase (%)		Mean
		Untreated colonies	Treated Colonies	Untreated colonies	Treated colonies	2003	2004	
Jan.	6	-	-	88.4±5.22	91.73±5.92	-	-	-
	18	20.33±1.21	26.53± 1.83	32.13±6.83	202.3±10.35	23.36	34.68	29.02
	30	56.86±5.17	80.0±5.30	341.33±13.51	352.93±15.90	28.93	3.28	16.10
Feb.	11	61.6±4.62	83.47±4.57	244.2±12.30	285.7±9.93	26.20	14.53	20.36
	23	45.27±3.23	81.33±4.39	286.9±13.50	386.7±17.50	44.33	25.81	35.07
Mar.	6	58.47±1.92	123.93±1.39	203.3±13.30	232.2±10.38	52.82	12.46	32.64
	18	510.0±32.20	871.6±20.19	324.3±13.60	467.93±15.10	41.41	30.70	36.05
	30	80.3±2.50	161.8±6.15	206.0±9.930	297.13±17.18	50.37	30.67	40.52
Apr.	11	182.2±7.30	515.8±9.90	296.8±17.10	434.73±26.02	15.56	31.72	23.64
	23	226.9±11.16	291.07±8.67	235.1±6.98	329.86±8.72	22.04	28.73	25.38
May	5	247.0±14.01	473.0±23.03	378.9±11.40	452.6±15.50	47.78	16.29	32.03
	17	486.0±22.83	664.0±21.60	508.3±24.10	593±20.30	26.81	14.29	20.55
	29	669.2±35.10	709.0±77.89	426.7±15.46	578.5±23.28	5.610	26.22	15.91
Jun.	10	408.0±56.20	721.0±70.90	397.8±11.68	655.0±25.60	43.41	39.26	41.33
	22	376.0±19.45	565.0±20.07	235.8±14.30	320.0±20.60	33.45	26.23	29.84
Jul.	4	317.3±11.76	416.6±16.55	93.86±3.22	123.0±4.52	23.83	23.47	23.65
	16	284.8±18.07	355.3±23.90	164.13±9.10	194.1±9.89	19.84	15.45	17.64
	28	523.5±17.39	373.7±17.56	180.13±9.46	215±.11.99	13.43	16.21	14.82
Aug.	9	344.0±15.41	367.2±11.79	204.5±7.62	299.13±13.00	6.320	31.64	18.98
	21	323.0±16.38	372.2±15.01	39.0±7.31	92.1±14.22	13.70	57.63	35.66
Sep.	2	235.1±10.73	292.4±19.38	173.73±16.5	251.1±10.10	19.39	30.80	25.09
	14	192.2±10.27	260.0±14.63	93.53±5.96	108.93±6.27	26.08	14.13	20.10
	26	192.3±10.90	265.0±11.39	67.1±9.85	204.4±15.20	27.43	76.18	51.80
Oct.	8	174.0±9.28	258.2±9.30	89.1±11.57	108.3±11.92	32.61	17.78	25.19
	20	191.8±8.80	229.4±12.80	47.0±7.21	71.8±7.53	16.36	34.54	25.45
Nov.	1	119.0±21.20	139.1±20.30	55.5±5.97	97.8±6.49	14.45	12.54	13.49
	13	117.0±11.14	159.5±72.00	99.60±9.96	122.1±9.64	26.64	18.40	22.52
	25	120.0±7.90	169.6±9.04	101.13±12.80	114.93±13.65	29.24	12.01	20.62
Dec.	7	69.3±9.600	90.5±6.20	34.13±3.60	42.67±3.63	23.43	20.01	21.72
	19	88.5±7.02	90.8±5.50	24.6±3.35	44.93 ± 4.68	2.530	45.24	23.88
	31	34.1±2.170	50.7±2.80	-	-	-	-	-
F value						62.31**	76.4**	
L.S.D. at 0.05						3.05	3.11	

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زيادة انتاجية طوائف نحل العسل بمكافحة حلم الفاروا بحامضي الفورميك والاوكساليك

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- تفوقت معنويا طوائف نحل العسل المعاملة بحامضي الفورميك (٦٠%) والأكساليك (٣%) عن الطوائف الغير معاملة في معدلات تربية الحضنة في عام ٢٠٠٣، ٢٠٠٤ وعموما ترجع الزيادة في النسب المئوية لتربية الحضنة في الطوائف المعاملة بهذة الاحماض.
- في عام ٢٠٠٣ تراوحت معدلات الزيادة في عدد الأقراص المغطاة بالنحل البالغ من الجهتين بعد المعاملة بأحماض الفورميك والأكساليك ما بين ٨,٣٩% في ٧ ديسمبر ، ٤٥,٥٢% في ١٨ مارس ، يقابلها في عام ٢٠٠٤ زيادة قدرها ٢,٦٤% في ١٤ سبتمبر ، ٣٢,٤٠% في ٢٢ يونية.
- معاملة طوائف نحل العسل بأحماض الفورميك والأكساليك أدت الى زيادة كميات العسل المخزن بمقارنتها بالطوائف الغير معاملة. حيث تراوحت هذه الزيادة في عام ٢٠٠٣ ما بين ٢,٤٨% في ١٨ يناير ، ٥٣,٣٠% في ٦ مارس يقابلها في عام ٢٠٠٤ زيادة قدرها ١,٥% في ٢٥ نوفمبر ٣٥,٧٠% في ٢٦ سبتمبر ، ٨ أكتوبر. وكانت معدلات الزيادة في كميات العسل المخزن في الطوائف المعاملة أعلي من الطوائف الغير معاملة أثناء فترات تزهير الموالح، والبرسيم والقطن
- سجلت كميات حبوب اللقاح المخزنة أعلي معدلات لها في الطوائف المعاملة عن الطوائف الغير معاملة ، ففي عام ٢٠٠٣ بلغ معدل الزيادة ما بين ٥,٦١% في ٢٩ مايو ، ٥٢,٨٢% في ٦ مارس ، يقابلها في عام ٢٠٠٤ زيادة قدرها ٣,٢٨% في ٣٠ يناير ، ٧٦,١٨% في ٢٦ سبتمبر. ونفس الحالة في العسل المخزن ، كانت معدلات الزيادة مرتفعة في كميات حبوب اللقاح المخزنة أثناء فترات تزهير الموالح والبرسيم والقطن.

وتوصي النتائج: بان معاملة طوائف نحل العسل المصابة بالفاروا بحامضي الفورميك ٦٠%(في الشتاء) والاكساليك ٣% (في الصيف) ادي الي انخفاض الاصابة الي اقل معدل ممكن هذا بالاضافة الي زيادة انشطة طوائف نحل العسل المختلفة (وهذة الاحماض رخيصة وامنة علي النحل ومنتجاتة)