RESULTS AND DISCUSSION

4. RESULTS AND DISCUSSION

Effect of different fermented matters on the attraction of red palm weevil in date palm trees:

These experiments were carried out from November 1999 until October 2000 at the infested chosen area Abo-Naga at Ismailia Governorate Egypt to investigate the attraction power of different fermented matters, i.e. pineapple, apple, molasses, date, sugar cane and banana as kairomone of red palm weevil.

The obtained results were recorded in table (1) and fig (2). Data indicated that the traps loaded with fermented banana during a whole year caught the highest number 210 weevils/year. The lowest number (77 weevils/year) was attracted to the traps loaded with apple. The other fermented matters caught 188, 167, 155 and 144 weevils/year for those tarps loaded with molasses, sugarcane, date fruits and pineapple, respectively.

The above results indicated that attractiveness varied significantly with season fig (3) and many more adult weevils were caught during the warmer summer months than during cooler winter months within each month capture rates were extremely variable. Comparison of monthly means of daily temperature table (1) show that weevils were caught at the highest rates relative to mean temperature in the months of April, May, June, July and August. This corresponds to the onset of warmer weather in Egypt.

Table (1): Effect of different fermented local matters on the attractiveness of red palm weevil.

Month	Number of weevils attracted per month						
	Pineapple	Apple	Molasses	Date	Sugarcane	Banana	Total
Nov 1999	8	4	15	14	24	19	84
Dec	7	7	9	4	11	14	52
Jan 2000	9	4	11	4	5	14	47
Feb	7	1	3	15	3	2	31
Mar	9	12	14	13	18	21	87
Apr	13	6	16	19	16	34	104
May	9	7	26	10	20	27	99
Jun	18	8	19	22	18	20	105
Jul	15	2	19	20	17	22	95
Aug	12	4	21	6	15	12	70
Sep	19	13	18	21	9	15	95
Oct	18	9	17	7	11	10	72
Total	144	77	188	155	167	210	941

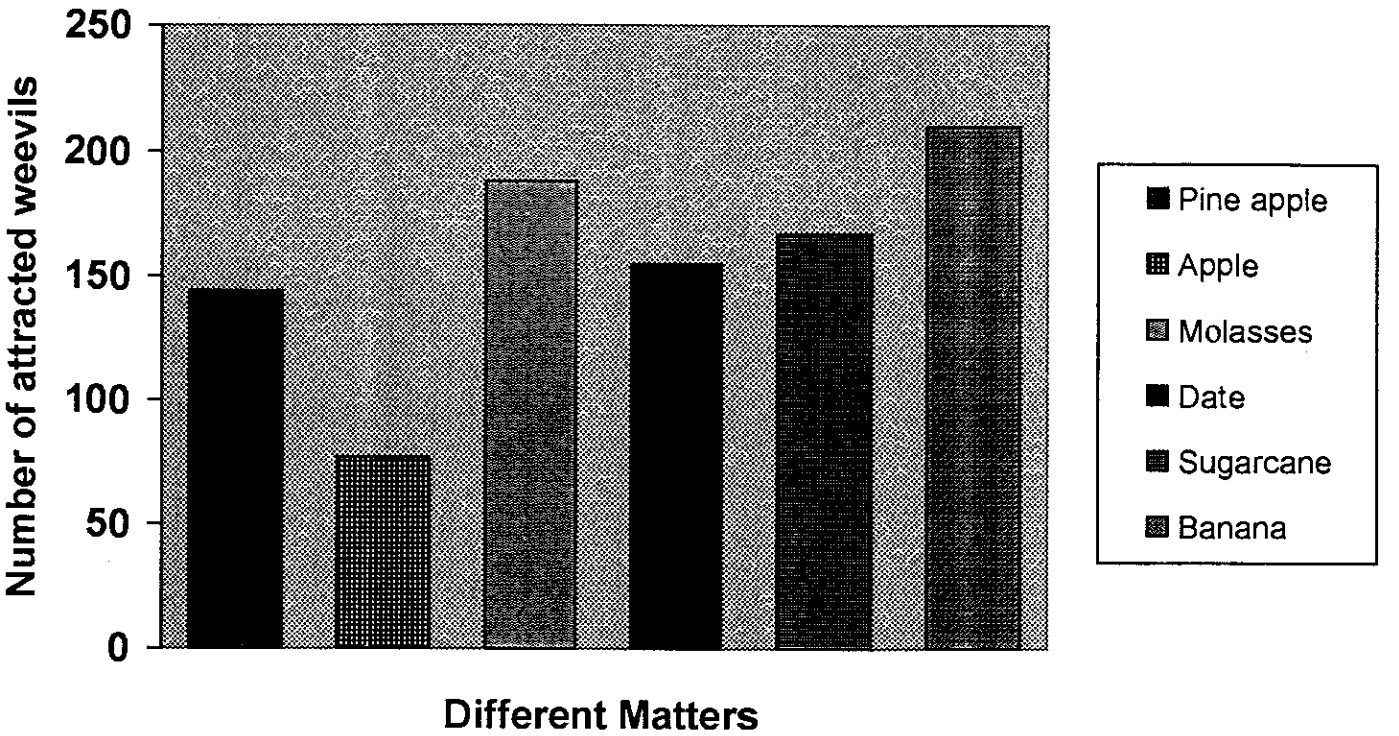

Fig (2): Number of attracted weevils to the different fermented matters combined with pheromone in the traps distributed at Abo – Naga location, Ismailia, Egypt during Nov 1999 – Oct 2000.

The higher capture rate during this period is probably due to the emergence of broads whose development had been slowed by the cooler winter months. Since very low number of weevils were caught in December and January. **Weissling *et al.*, (1994)** found that there was a high seasonal variation in the flight of red palm weevil which corresponded to the onset of spring in Florida. These results are in agreement with those reported by **El-Garhy (1996).** Data were statistically analyzed and illustrated in table (2) which shows mean numbers of attached weevils of red palm weevil for different fermented matters. The analysis shows that there are three groups differ significantly in number of attracted weevils on the different matters (F=4.69, L.S.D=4.69) as follows:

a) Banana, Molasses, Sugarcane and Date

b) Molasses, Sugarcane, Date and Pineapple

c) Apple

The mean numbers of weevils caught per month were found to be 17.5 (range 2-35), 15.5 (range 3-26), 13.9 (range 3-26), 12.9 (range 4-22), 12 (range 7-19) and 6.4 (range 1-13) weevils in traps loaded with banana, molasses, sugarcane, date and pineapple, respectively.

Table (2): Mean numbers of attracted weevils of red palm weevil for different fermented materials

Materials	Mean	Range	Group	
Banana	17.5	2 – 34	A	
Molasses	15.7	3 – 26		B
Sugarcane	13.9	3 – 24		
Date	12.9	4 – 22		
Pine apple	12	7 – 19		
Apple	6.4	1 – 13	C	

L.S.D. = 4.96

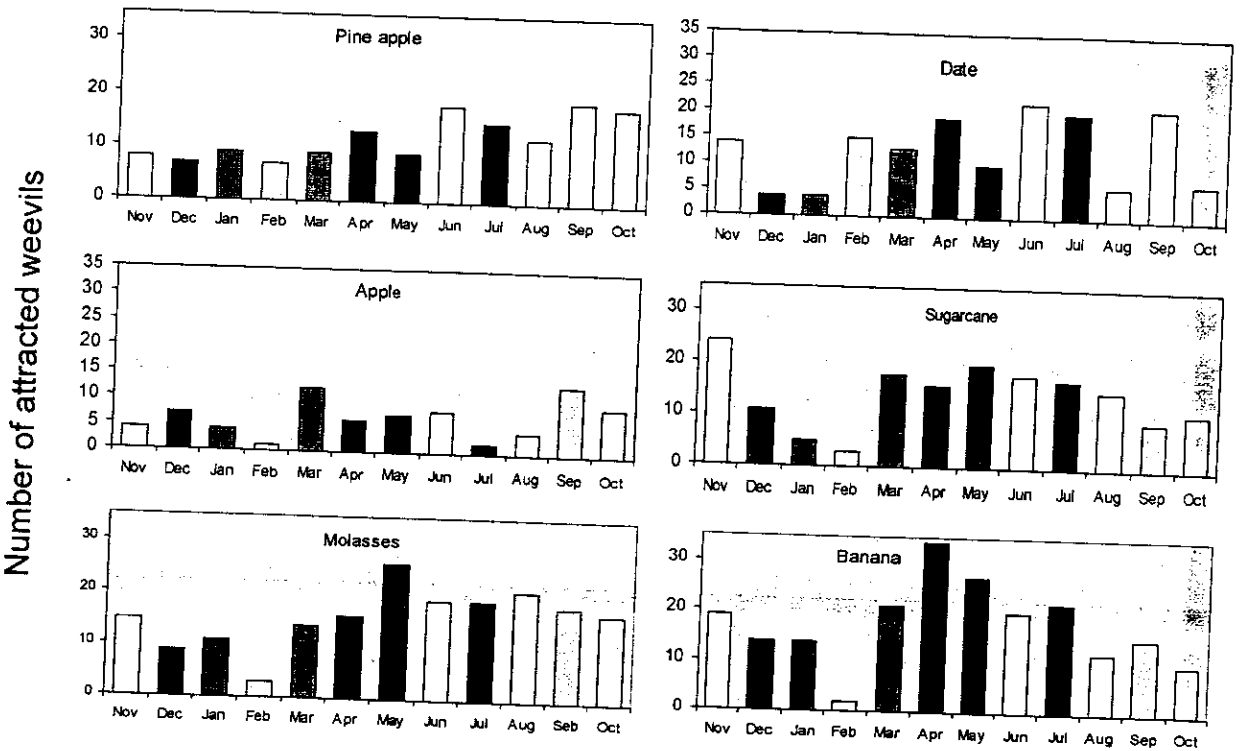

Fig (3): Number of attracted weevils to the different fermented matters combined with pheromone in the traps distributed at Abo Naga location, Ismailia, Egypt during every month beginning from Nov 1999 – Oct 2000.

Comparison among the effect of pheromone lure (4-methyl-5-nonanol,4-methyl-5-nonanone ferrugineol) only (as control) and different fermented matters with pheromone on the numbers of attracted weevils are show in Table (3) illustrated in Fig (3). These results show that the total number of captured weevils during April by using 5 traps with pheromeone was found to be 5 weevils. While, more weevils were captured in bucket traps loaded with different fermented matters. The number of red palm weevils attracted with bucket traps within different matter were 13,6,16,19,16 and 34 weevils for pineapple, apple, molasses, date, sugar cane and banana, respectively.

In the United Arab Emirates, significantly more red palm weevil were attracted to the ferrugineol treatment with fermented matters than to pheromone alone.

Also, **Moura *et al.*, (1997)** found that treatment with pheromone plus insecticide was 65-89% greater than those treated with insecticide only.

Statistical analysis of above results table (4) showed highly significant difference between the numbers of attracted weevils to the different fermented matters (F=10.24). Three significant groups were obtained (L.S.D.=1.8) as follows:

a) Banana.

b) Date, molasses, Sugarcane and Pineapple.

c) Pineapple, Apple and pheromone.

Table (3): Comparison between the effect of pheromone only and different matters with pheromone on the numbers of attracted weevils in traps Abo Naga, Qassasine, Ismailia Governorate, during April 2000.

Replicate	Pheromone						Pheromone only
	+ Pineapple	+ Apple	+ Molasses	+ Date	+ Sugarcane	+ Banana	
1	3	1	2	3	2	4	1
2	2	1	4	2	5	7	2
3	1	2	3	5	3	8	0
4	4	1	2	3	3	10	1
5	3	1	5	6	3	5	1
Total	13	6	16	19	16	34	5
Average	2.6	1.2	3.2	3.8	3.2	6.8	1

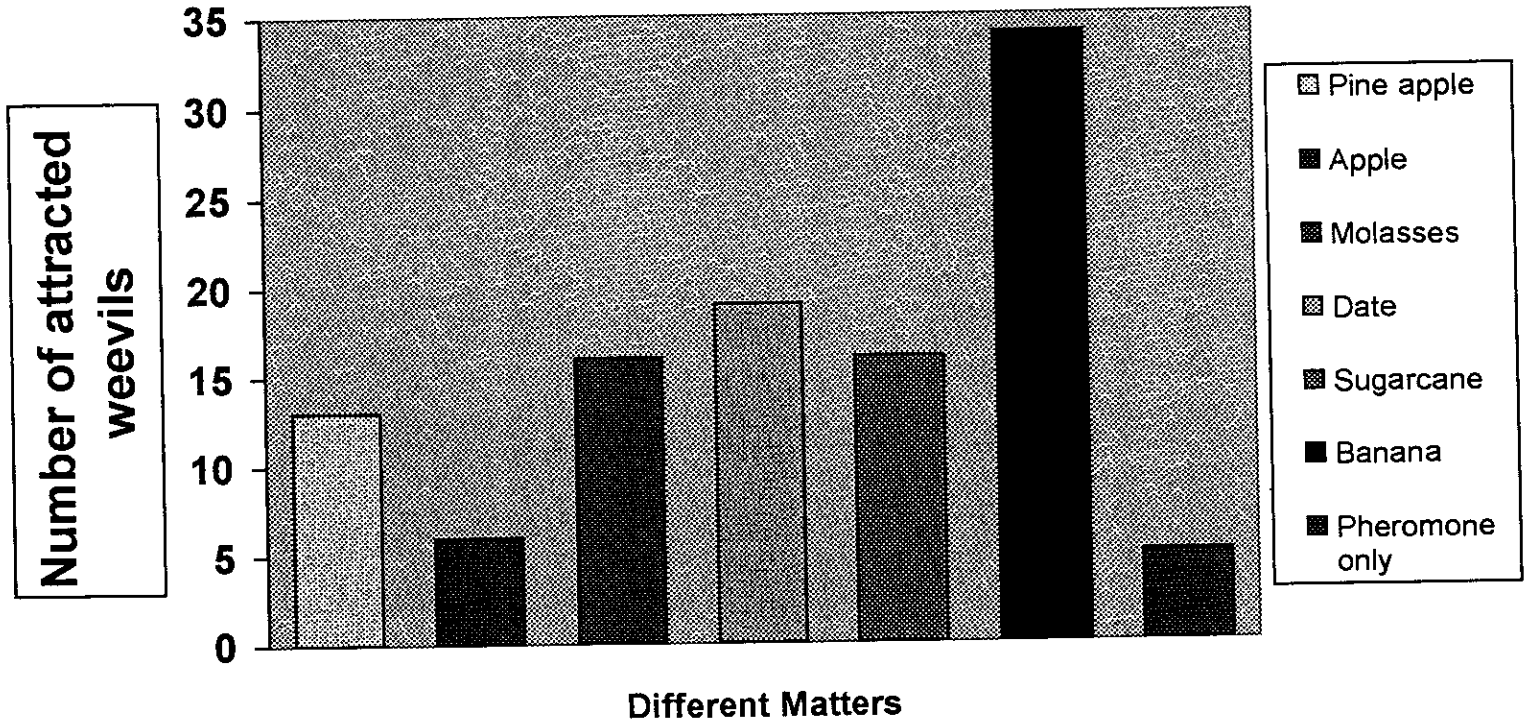

Fig (4): Comparison between the effect of pheromone only and different fermented matters with pheromone on the number of attracted weevils.

Table (4): Comparison between the effect of pheromone only and different matters with pheromone on the number of attracted weevils during April 2000.

Materials	Mean	Range	Group	
Banana	6.8	4 – 10	A	
Date	3.8	2 – 6	B	
Molasses	3.2	2 – 5	B	
Sugarcane	3.2	2 – 5	B	
Pine apple	2.6	1 – 4	B	C
Apple	1.2	1 – 2		C
Pheromone only	1	0 – 2		C

L.S.D. 1.8

4.2. Identification of the extracted products compounds after the fermentation process:

These experiments were carried out in order to study some local fermented matters molasses (as a regular food) pineapple, apple, banana and date fruit which were placed in a regular traps bucket to identify the final-end product of fermentation which affects the attraction of weevils.

After analyzing the fermented products by GLC, thirteen different compounds were separated with relative retention time (R.R.T.) ranging from 0.55 to 2.09 Table, (5a). Compound number seven (R.R.T. = 1.00) was found in all fermented matters and was identified as ethyl acetate which is one of the attractive matters for the red palm weevil. There was gradual increase in the area percentage of ethyl acetate as fermentation periods increase in all matters.

However, it's fermented time and its concentration during the fermentation period was found to be differ among these materials.

Table (5b) shows the effect of fermentation period on the percentage of produced ethyl acetate during 1, 3, 5 and 7 days. These results indicate that the peak time of all tested fermented matters was 10 to 31 min. However, the percentage of ethyl acetate produced was increased up to a certain point with increasing fermented period.

Table (5a): GLC analysis for compounds produced from five fermented matters after 1, 3, 5 and 7 days.

Compounds	R.T.	R.R.T.	Area percent																			
			Molasses				Pine apple				Apple				Banana				Date			
			1 day	3 days	5 days	7 days	1 day	3 days	5 days	7 days	1 day	3 days	5 days	7 days	1 day	3 days	5 days	7 days	1 day	3 days	5 days	7 days
1	5.62	0.55	5.72	6.99	16.95	21.09	7.82	5.73	9.05	10.32	46.42	70.13	11.39	25.68	10.27	34.90	35.87	4.29	7.45	48.93	61.92	27.58
2	5.98	0.58	4.26	25.13	17.53	5.60	14.15	3.28	29.80	6.54	—	—	3.235	—	47.88	4.47	2.82	3.98	—	—	—	—
3	6.16	0.60	—	—	—	—	—	—	—	—	—	—	—	—	33.41	8.42	11.48	31.62	1.54	—	—	—
4	7.29	0.71	45.84	52.07	56.12	61.99	64.65	74.75	42.50	65.93	27.09	17.55	48.25	46.47	4.60	23.07	28.39	36.95	28.99	15.18	7.19	12.90
5	8.05	0.78	10.00	2.68	—	—	8.20	—	0.95	—	5.21	8.98	1.75	1.49	—	2.36	2.265	—	—	2.28	0.78	8.49
6	9.60	0.88	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5.28	1.91	—	—
7	10.31	1.00	4.89	8.66	9.40	11.32	5.17	16.23	10.48	17.21	Tr	3.45	7.30	9.59	3.874	6.38	19.96	23.11	1.01	1.38	1.12	2.17
8	12.10	1.17	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3.75	1.32	—	—
9	12.76	1.24	8.66	—	—	—	—	—	—	—	8.61	4.72	6.26	5.06	—	17.11	—	—	1.12	0.74	8.38	—
10	13.58	1.32	16.75	—	—	—	—	—	—	—	8.49	—	3.54	2.31	—	2.27	—	—	1.08	3.11	6.48	7.64
11	18.60	1.80	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	9.24	19.07	43.58
12	19.75	1.92	3.85	—	—	—	—	—	—	—	2.19	0.92	1.18	2.35	—	1.02	—	—	—	3.65	8.43	—
13	21.52	2.09	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5.37	0.28	8.81

R. T.: Retention Time
R.R. T.: Relative Retention Time
Tr: Trace

Table (6): Number of attracted weevils to the traps contained ethyl acetate only and ethyl acetate with pheromone located at Abo – Naga, Ismailia, Egypt during 2000.

Month	Number of weevils	
	Ethyl acetate	Ethyl acetate + Pheromone
January 2000	6	10
February	8	14
March	12	19
April	20	32
May	19	25
June	7	16
July	8	8
August	7	11
September	10	16
October	6	14
November	12	22
December	12	21
Total	127	208
Mean	10.5	17.16
Range	6 – 20	8 – 32

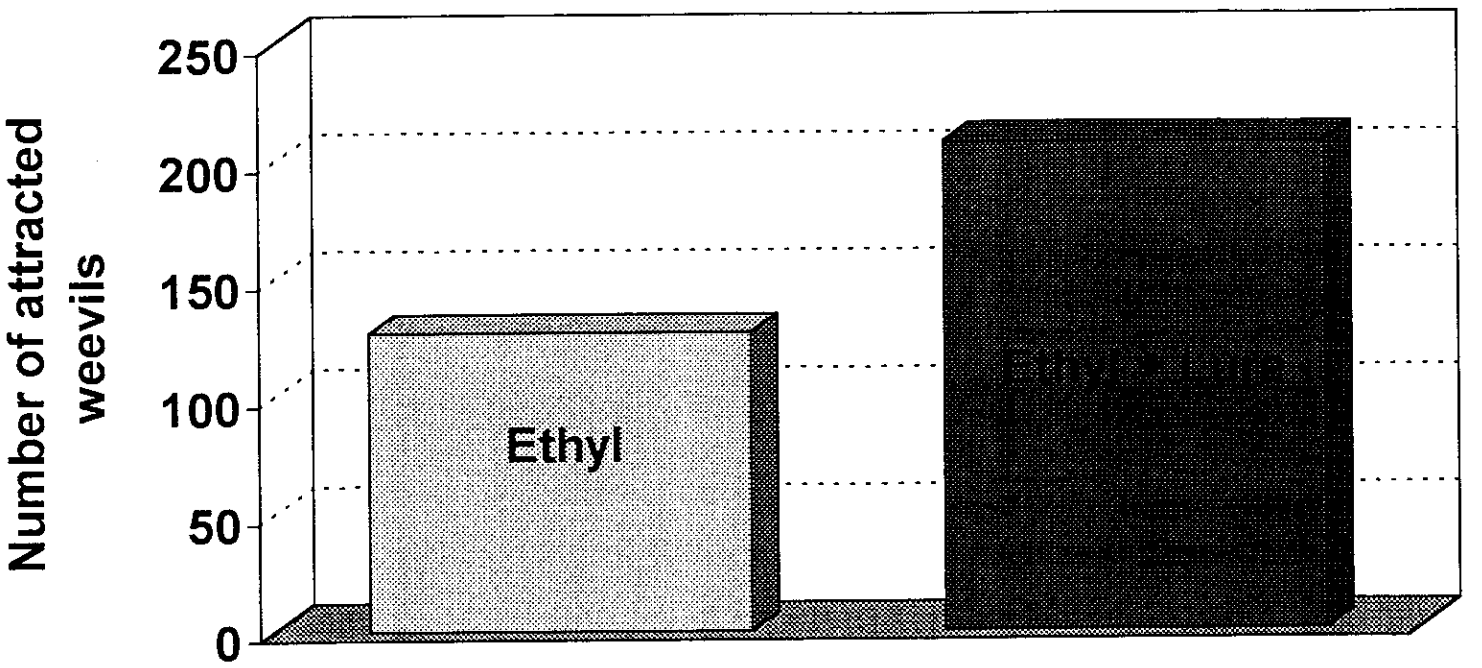

Fig.(5): Number of attracted weevils to the traps contained ethyl acetate and ethyl acetate with pheromone located at Abo-Naga, Ismailia, Egypt during 2000.

However, the maximum numbers of weevils (20 and 32 weevils) were observed during April in traps either baited with ethyl acetate only or mixed with pheromone. The lowest flight catches was recorded during January-February-June and October in traps contained ethyl acetate only. On the other side, traps loaded with ethyl acetate and pheromone caught larger numbers of weevils than traps contained ethyl acetate only.

Statistical analysis showed significant differences between the mean number of weevils in traps baited with ethyl acetate only (10.5 range 6-20) and those in traps contained ethyl acetate and pheromone (17.16 range 8-32). These results are in good harmony with noted by **Oehlschlager *et al.*, (1995) and Rochat *et al.*, (1993).**

4.4. Effect of released ethyl acetate on the attracted weevils in the field:

Table (7) and Fig (6) show that the number of attracted weevils red palm weevil to the traps contained vials of ethyl acetate perforated as one, two and three holes. This experiment was carried out during January-December 2000 at Abo-Naga, Ismailia, Egypt.

Generally, the seasonal number of captured weevils was differ in different kinds of traps. On the other hand, the number of weevils increased with increasing number of holes.

Table (7): Number of attracted weevils to the traps contained vials of ethyl acetate perforated as one, two and three holes.

Month	Number of weevils		
	One hole	Two holes	Three holes
January 2000	10	12	15
February	14	16	16
March	19	17	20
April	32	35	33
May	25	24	34
June	16	18	19
July	8	7	10
August	11	15	12
September	16	17	15
October	14	13	13
November	22	25	26
December	21	22	24
Total	208	221	237
Mean	17	18.4	19.8
Range	8 – 32	7 – 35	10 – 34

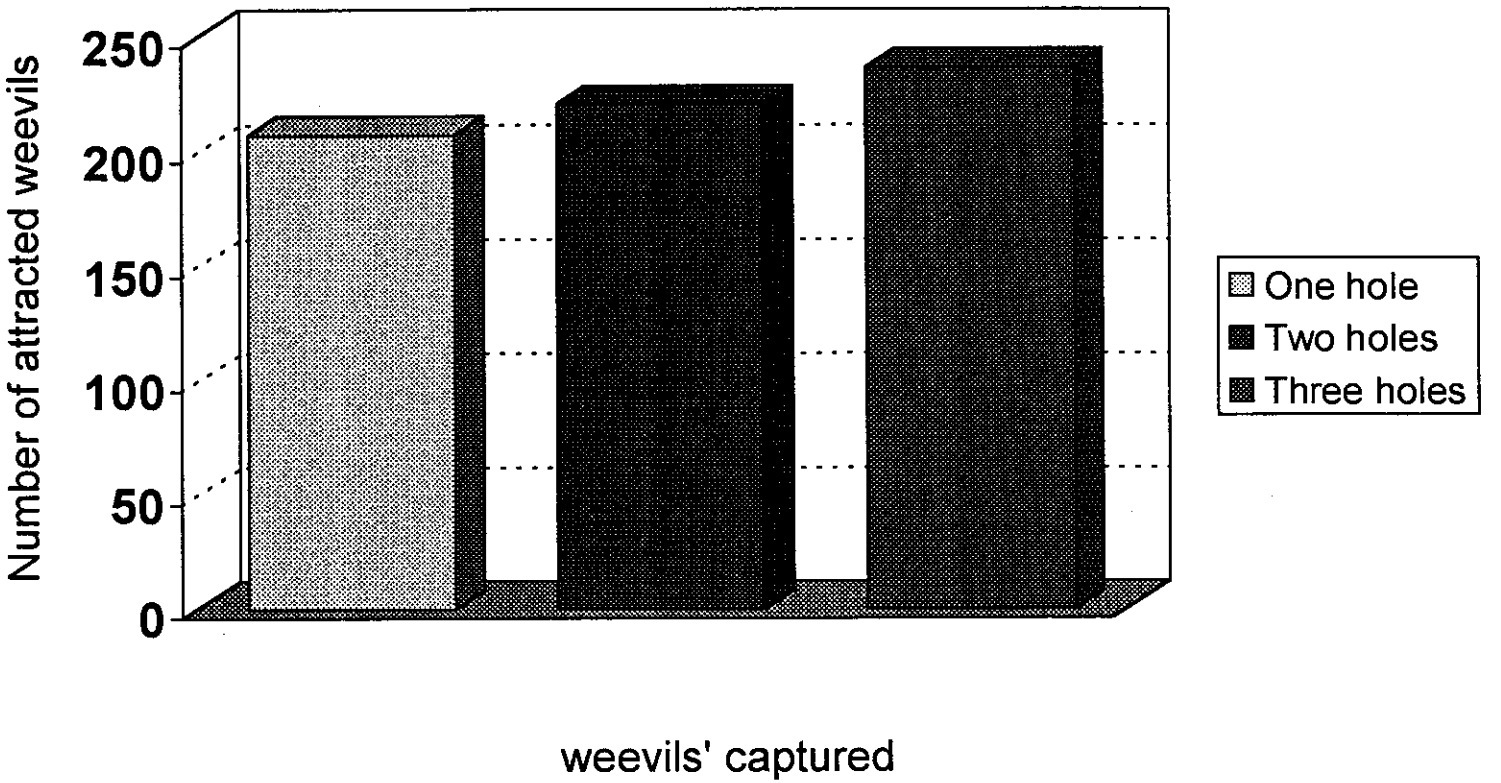

Fig.(6): Number of attracted weevils to the traps contained vials of ethyl acetate perforated as one, two and three holes.

The maximum number reached to 237 weevils in the traps with three holes while, it was 221 weevils in the traps with two holes and the least number of captured weevils (208 weevils) recorded in the traps with on hole only. Statistical analysis (F-test) showed that there were insignificant differences between the mean numbers of red palm weevil attracted to traps baited with ethyl acetate permeated through one, two and three holes (F=0.32).

4.5. The rate of ethyl acetate evaporation:

Data in Table (8) indicate that the loss weight of ethyl acetate after one week recorded (6.85, 12.29, 15.68g) from traps with one, two and three holes during April and May 2000, respectively.

The loss weight reached (78.16, 128.39, 154.91g) after 60 days of traps with one, two, three holes respectively.

Statistical analysis (F-test) showed that there were significant differences between the loss weights of ethyl acetate in vials with one, two or three holes (F=71.44)

Data in Table (9) presents the mean of loss weight of ethyl acetate from different traps and mean capture weevils to these traps, during two months. The statistical analysis showed that there were insignificant differences between the loss weights of ethyl acetate (F=71.44), while no significant difference was noticed between the mean number of capture weevils in traps (F=0.67).

Table (8): Loss in weight of ethyl acetate (as a Kairomone source) in gram by the time elapsed according to number of holes (one, two and three) made in the Plastic vials contains 180 grams

	Time (days)								
	One hole								
Replicates	7	14	21	28	35	42	49	56	63
1	7.86	18.33	31.77	42.97	53.12	60.35	73.22	84.35	91.65
2	6.28	14.96	25.89	33.14	41.38	47.78	53.98	61.54	68.14
3	6.12	14.78	25.03	31.97	40.05	46.15	55.55	64.02	72.63
4	7.08	16.51	29.11	37.25	47.12	54.62	65.62	73.16	80.23
Average	6.85	16.14	27.95	36.4	45.41	52.22	62.09	70.76	78.16
	Two holes								
1	11.35	25.15	42.84	54.23	67.5	79.10	94.40	105.31	118.20
2	11.23	25.02	41.86	52.49	64.55	74.15	89.75	101.24	123.72
3	11.76	26.56	43.59	55.39	68.46	78.36	93.41	106.56	129.40
4	14.84	28.49	46.18	57.88	71.99	82.59	97.79	110.80	142.23
Average	12.29	26.30	43.61	54.99	68.12	78.55	93.83	105.97	128.39
	Three holes								
1	14.81	33.25	55.74	71.65	88.56	101.56	123.36	143.15	162.13
2	15.80	32.91	57.62	72.47	88.04	100.94	118.74	132.70	150.25
3	15.65	33.75	58.24	74.28	86.77	103.67	122.77	139.50	156.14
4	16.46	32.70	53.04	66.96	85.81	98.21	116.21	128.05	151.15
Average	15.68	33.15	56.16	71.34	87.29	101.09	120.27	135.85	154.91

Table (9): The number of attracted weevils and loss weight of ethyl acetate on the traps during two months April and May.

Number of holes	The number of weevils attracted		Loss weight of ethyl acetate due to evaporation	
	Mean	Range	Mean	Range
1	14.25	11 – 17	78.16	68.14 – 91.65
2	14.5	12 – 18	128.39	118.2 – 142.23
3	16.75	14 – 20	154.9	150.3 – 162.13
	F = 0.67		F = 71.44	