THE RELATIVE SUSCEPTIBILITY AND MONITORING OF GRAPEVINE VARIETIES TO *CHLOROPHORUS VARIUS* BORER INFESTATION IN VINEYARDS IN EGYPT

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Abstract

The relative susceptibility and monitoring of nine widely spread grapevine local and established foreign varieties, Banaty "white Thompson seedless", Flame "red seedless", Superior, Red Romi, Balady, Bez El-Anza, Fayoumi, King Robby and Kremson to the wasp beetle, *Chlorophorus varius* (Coleoptera: Cerambycidae) borer infestation as well as the population fluctuation were studied at Giza governorate, during the three successive years 2004, 2005 and 2006. The mean rate and degree of susceptibility of grapevine varieties to *C. varius* infestation reached 22.5% infestation and 5.2 holes / tree, respectively. According to different varieties, the commencement dates of *C. varius* flight varied according to varieties from early April to early May until stopped in late September, October or November. Mostly there were two peaks of beetles activities during June / July and July, August or September. Summer months recorded the maximum flight (0.06-1.67 beetles), followed by spring (0.02-0.85 beetles), then autumn (0.01-0.30 beetle) /tree, and stopped during winter. The total numbers of beetles per year ranged from 0.09 to 2.55 beetles /tree. Mostly, it had one or two brood and the beetles' activity lasted 4 to 8 months according to varieties. Infestation was almost doubled during only one year, but 3.2 times during two year. This is a serious parameter that imposes urgent need of controlling the pest in vineyards yearly. Effect of weather factors on the borers activity was mostly positively significant with day maximum, day minimum, and day mean temperatures but negatively and insignificantly with day mean relative humidity.

INTRODUCTION

In Egypt, grapevine is an economic exporting crop and most favorite popular fruit. In addition to the local varieties (Banaty, Balady, Red Romi, Fayoumi, Bez El-Anza, ..etc), several new foreign varieties (mainly Flame, Superior, Early Superior, King Robby, Kremson,...etc) were introduced to accommodate exporting and increase the harvesting period. Moreover, the new supporting systems (Gabol and Baron) increased the susceptibility to the borers infestation. Frequent field observations allover the governorates of Egypt indicated that the most important boring pests in vineyards are *Chlorophorus varius* and *Paropta paradoxa* (Tadros, 1982 and 1992), as well as *Enneadesmus obtusedentatus* (Tadros *et al.*, 1997 and Tadros, 2003) and

recently, *Phonapate frontalis*, El-Assal and Tadros, in press). *C. varius* is widely distributed allover the Mediterranean Sea area, Europe and Russia (Winkler, 1932; Porta, 1934; Bodenheimer, 1934 and Schmidt, 1962) as well as in Egypt (El-Zoheiry, 1950). In addition to grapevine, *C. varius* attack 21 fruit, tree species (Tadros, 1994), 14 wood and ornamental tree species (Nour, 1963 and Haggag, 1982). Larvae of *C. varius* feed inside the stem and main branches of trees and cause their death, and the total life cycle was completed in an almost one year (Tadros, 1993).

Studies on the rate and degree of infestation, seasonal fluctuation of the target pest population, the progress of infestation, the seasonal cycle, and the effect of the main weather factors are essential in successful integrated pest control. However, the literature on the relative susceptibility of grapevine varieties to borers infestation is lacking allover the world and in Egypt.

The present comparative ecological study is an attempt to contribute to such a gap in the knowledge on the population fluctuation and the relative susceptibility of grapevine tree borers to different grapevine varieties. The broad objective of investigation is to add new information that may help in planning vineyards structure system, choice of economic varieties and effective "Integrated Control Programs" for the management of tree borers in grapevine yards.

MATERIALS AND METHODS

The relative susceptibility of the following five widely spread grapevine local varieties, Banaty "white Thompson seedless", Balady, Red Romi, Bez El-Anza, Fayoumi, and the four established foreign varieties, Flame "red seedless", Superior, King Robby and Kremson to *C. varius* borer infestation as well as the population fluctuation were subjected to the present study.

Infestation and monitoring studies of the target borer were carried out during three successive seasons (2004 – 2006) in grape-vineyards (more than five years old and about 2 - 5 feddan area) located at El-Khatatba and El-Qata districts, Giza governorate.

1. Rate and Degree of Infestation

The rate of infestation was assessed by the percentage of numbers of infested trees with *C. varius* in each grapevine variety randomly distributed in vineyard each year. The degree of infestation was estimated by the mean number of adult beetles per tree (indicated by the exit holes) that completed their life cycle and emerged from each variety in random vineyards each year.

2. Population Fluctuation

2.1. Seasonal abundance

Monitoring studies were carried out during three successive years extending from early January, 2004 until late December, 2006. No chemical treatments were applied in the selected areas throughout population fluctuation studies.

During December 2003, the old exit holes of *C. varius* on 100 randomly distributed infested grapevine trees were canceled using a paint marker.

From January 1st, 2004 until December 31, 2006, the new exit holes - indicating emergence of *C. varius* beetles were counted at half-monthly intervals on the 15th and last day of every month. However, from January 1st, weekly counting was carried out to verify the precise starting dates of adults emergence, then-after, half-monthly counting was applied. To avoid repeated counting new exit holes were canceled with a spray/pin paint marker.

To smooth the frequency distribution curve to an almost normal curve, data were calculated according to the following formula:

{(twice the actual number) + the previous number + the following number} / 4

2.2. Progress of infestation and seasonal cycles

Data of the seasonal abundance were accumulated from January 1st, 2004 until December 31, 2006 for each half-monthly interval. The total number of adults represented the accumulated number for the three years together.

The presented figures indicated the periods of the seasonal cycles of adults activity and inactivity. Progress of infestation also indicated the rate of increase in each borer infestation year after another.

2.3. Effect of weather factors on the activity of *C. varius*

Four main weather factors, the day maximum temperature (DMxT), day minimum temperature (DMnT), day mean temperature (DMT) and day mean relative humidity (DMRH) were considered. Necessary weather data were obtained from the Central Laboratory of Climate and Meteorology, ARC, MOA, Giza. Population data of *C. varius* taken into account and the meteorological data, both at half-monthly intervals, were presented.

The relationship between the four weather factors and the insect population data during the activity season was investigated for three successive years extending from January 2004 until December 2006 in grape-vineyards.

To determine the direct effect of each weather factor on the borer activity, population counts were plotted against the corresponding weather data. The simple correlation coefficients "r" for the relationship between each weather factor and *C. varius* population was then calculated out according to Fisher (1950).

RESULTS AND DISCUSSION

The relative susceptibility to *C. varius* and the population fluctuation of the following eight widely spread grapevine local varieties, Banaty "white Thompson seedless", Balady, Red Romi, Bez El-Anza, Fayoumi, and foreign varieties, Flame "red seedless", Superior, King Robby and Kremson to borers infestation were subjected to the present study.

1. Rate and Degree of Infestation

Table (1) indicated that the rate of *C. varius* infestation varied from one grapevine variety to another. Red Rom, Banaty and Balady varieties were highly susceptible to the borer infestation showing 40 – 49, with a mean of 44.7%, 37 – 45, with a mean of 41% and 31 – 39, with a mean of 34.7% infestation, respectively. Bez El-Anza, Fayoumi, Flame and Superior varieties were moderately susceptible as the respective percentages of the borer infestation were 24 – 28, with a mean of 26.3%, 18 – 26, with a mean of 21.7%, 10 – 16, with a mean of 12.7%, and 8 – 15, with a mean of 11.3%, respectively. The least susceptible grapevine varieties were King Robby and Kremson as the respective percentages of the borer infestation were 6 – 9, with a mean of 8% and 2 – 3, with a mean of 2.3%, respectively.

Table 1. Rate and degree of *Chlorophorus varius* infestation in Banaty "Thompson", Flame, Superior, King Robby, Red Romi, Balady, Bez El-Anza, Fayoumi, and Kremson varieties in grape-vineyards at Giza governorate during 2004, 2005 and 2006 activity seasons.

No.	Variety	Rate of infestation (%)				Degree of infestation (number of holes / tree)			
		2004	2005	2006	Mean	2004	2005	2006	Mean
1	Banaty	37	45	41	41	9	8	11	9.3
2	Flame	16	12	10	12.7	1	3	2	2
3	Superior	15	8	11	11.3	0	1	3	1.3
4	King Robby	9	9	6	8	2	2	1	1.7
5	Red Romi	40	49	45	44.7	11	9	12	10.7
6	Balady	31	39	34	34.7	7	6	9	7.3
7	Bez El-Anza	24	23	27	26.3	7	9	8	8
8	Fayoumi	21	18	26	21.7	7	6	4	5.7
9	Kremson	3	2	2	2.3	0	1	0	0.3
Total		196	210	202	202.7	44	45	50	46.3
Mean / variety		21.8	23.3	22.4	22.5	4.9	5	5.6	5.2

The general mean rate of susceptibility of grapevine varieties to *C. varius* infestation ranged between 21.8% and 23.3%, with a general mean of 22.5% infestation.

The degree of *C. varius* infestation showed also obvious variation between grapevine varieties. The highly susceptible varieties were Red Romi (9 – 12, with a mean of 10.7 holes / tree), Banaty (8 – 11, with a mean of 9.3 holes / tree), Bez El-Anza (7 – 9, with a mean of 8 holes / tree), Balady (6 – 9, with a mean of 7.3 holes / tree) and Fayoumi (4 – 7, with a mean of 5.7 holes / tree). On the other hand, Flame (1 – 3, with a mean of 2 holes / tree), King robi (1 –2, with a mean of 1.7 holes / tree), Superior (0 – 3, with a mean of 1.3 holes / tree) and Kremson (0 – 1, with a mean of 0.3 holes / tree) varieties were less susceptible.

The general mean degree of susceptibility of grapevine varieties to *C. varius* infestation ranged between 4.9 and 5.6, with a general mean of 5.2 holes / tree.

2. Population Fluctuation of Grapevine Tree Borer

2.1 Seasonal abundance

Monitoring studies on *C. varius* carried out in nine grapevine varieties (Banaty, Flame, Superior, King Robby, Red Romi, Balady, Bez El-Anza, Fayoumi and Kremson) at Giza governorate during three successive years extending from early January, 2004 until late December, 2006 indicated that beetle's emergence prevailed during the period from early April to late November (Tables, 2 and 5 and Figure, 1).

2.1.1. Commencement dates

Tables (2) and (5) further indicated that during the three years of study *C. varius* beetles started to emerge from Flame variety in the 1st half of April, but from Superior variety in the 2nd half of April. Emergency started also in the 1st half of April from Banaty and Fayoumi varieties during 2004 and 2006, from Balady variety during 2005 and 2006, from Bez El-Anza variety during 2004 and from Red Romi during 2006. Moreover, emergency started in the 2nd half of April from King Robby and Bez El-Anza varieties during 2005 and 2006, and from Banaty and Red Romi and Fayoumi varieties during 2005. Beetles started to emerge in the 1st half of May from King Robby, Red Romi and Balady varieties during 2004, and from Kremson variety during 2005 and 2006. The latest emergency date was from Kremson variety during 2004 season.

2.1.2. Last dates

As shown in Tables (2) and (5), *C. varius* beetles stopped emergence early in the 2nd half of September in Kremson variety during 2004, and in the 1st half of October in Superior variety during 2006. However, last flight of beetles activity was in

most varieties during late October and early November. In the 2nd half of October beetles stopped emergence from Flame and King Robby varieties during 2004 and 2006, but from Superior and Kremson varieties during 2004 and 2006, respectively. In Flame, Superior, King Robby and Kremson varieties vineyards, beetles stopped emergence in the 1st half of November during 2005. During the three years of study beetles stopped emergence in the 1st or 2nd half of November in Banaty, Red Rom, Balady, Bez El-Anza and Fayoumi varieties vineyards.

2.1.3. Peak dates

Tables (2) and (5) clarified that, there were two peaks of *C. varius* beetles activities in all varieties except Balady, Bez El-Anza variety which had three peaks during 2004 and 2005 only.

- **The first peak**

The first peak of beetles activities was recorded in the 1st half of June in Flame (0.09 beetle / tree), King robi (0.08 beetle / tree), Bez El-Anza (0.27 beetle / tree), Fayoumi (0.23 beetle / tree) and Kremson (0.02 beetle / tree) varieties during 2004, in Banaty (0.29 beetle / tree) variety during 2005, and Banaty (0.25 beetle / tree), Flame (0.07 beetle / tree), and Kremson (0.02 beetle / tree) varieties during 2006. First maximum beetles' flight was in the 2nd half of June in Banaty (0.25 beetle / tree), Superior (0.07 beetle / tree), and Red Romi (0.24 beetle / tree) varieties during 2004, in Flame (0.07 beetle / tree), King Robby (0.05 beetle / tree), Bez El-Anza (0.23 beetle / tree), and Kremson (0.02 beetle / tree) varieties during 2005, in Superior (0.08 beetle / tree), King Robby (0.05 beetle / tree), and Fayoumi (0.24 beetle / tree) varieties during 2006. First peak was in the 1st half of July in Balady (0.22 beetle / tree) variety during 2004, in Superior (0.10 beetle / tree), Red Romi (0.25 beetle / tree) and Fayoumi (0.25 beetle / tree) varieties during 2005, in Red Romi (0.30 beetle / tree), Balady (0.27 beetle / tree), and Bez El-Anza (0.28 beetle / tree) varieties during 2006. First peak was only in the 2nd half of July in Balady (0.29 beetle / tree) variety during 2005.

- **The second peak**

The second peak of beetles activities was reported in the 2nd half of July in Superior (0.06 beetle / tree) and Bez El-Anza (0.35 beetle / tree) varieties during 2004, and in King Robby (0.08 beetle / tree) variety during 2005. The second maximum beetles' flight was in the 1st half of August in King Robby (0.09 beetle / tree), and Fayoumi (0.29 beetle / tree) varieties during 2004, Bez El-Anza (0.34 beetle / tree) variety during 2005, and Banaty (0.36 beetle / tree), Flame (0.13 beetle / tree), Superior (0.06 beetle / tree), and in Kremson (0.02 beetle / tree) varieties

during 2006. The second peak was in the 2nd half of August in Flame (0.08 beetle / tree), and Red Romi (0.39 beetle / tree) varieties during 2004, Banaty (0.33 beetle / tree), Flame (0.12 beetle / tree), Fayoumi (0.27 beetle / tree) and Kremson (0.02 beetle / tree) varieties during 2005, and King Robby (0.08 beetle / tree), Bez El-Anza (0.37 beetle / tree) and Fayoumi (0.31 beetle / tree) varieties during 2006. The second peak was in the 1st half of September in Banaty (0.02 beetle / tree) and Balady (0.34 beetle / tree) varieties during 2004, in Superior (0.09 beetle / tree) and Red Romi (0.41 beetle / tree) varieties during 2005, and in Balady (0.33 beetle / tree) variety during 2006. The second peak was in the 2nd half of September in Kremson (0.02 beetle / tree) variety during 2004, in Balady (0.31 beetle / tree) variety during 2005, and in Red Romi (0.36 beetle / tree) variety during 2006.

- **The third peak**

A third peak of beetles activities was only noticed in Bez El-Anza (0.29 and 0.30 beetle / tree) variety the 1st half of September during 2004 and 2005, respectively.

- **Number of peaks after smoothing of date (normal curves)**

As shown in Figures (1 to 10), smoothed date to an almost normal distribution curves reduced the number of peaks from two to only one peak in Banaty variety in 2006, in Flame variety in 2005 and 2006, in Superior variety in 2004, in King Robby during 2005, in Balady variety during 2004, in Bez El-Anza variety during 2006, and the mean of the total nine varieties during 2004 and 2006.

However, in Bez El-Anza variety during 2005, smoothed date reduced the number of peaks from three to only one peak. In Kremson variety during 2005 and 2006, smoothed date increased the number of peaks from two to three peaks. This was due to the very few numbers of beetles (scant infestation) in this newly introduced variety in Egypt.

Smoothed date to an almost normal distribution curves resulted in only one peak in the total nine varieties during 2004, 2005 and 2006.

Table 2. Mean number of *Chlorophorus varius* beetles in Banaty "Thompson" (Ban), Flame (Fl), Superior (Su), King Robby (K-R), Red Romi (R-R), Balady (Bal), Bez El-Anza (B-A), Fayoumi (Fay), and Kremson (Kr) varieties in grape-vineyards at Giza governorate during 2004 activity seasons.

Date of inspection		Mean no. of beetles \ 100 trees									
		Ban	Fl	Su	K-R	R-R	Bal	B-A	Fay	Kr	Mean
January		0	0	0	0	0	0	0	0	0	0
February		0	0	0	0	0	0	0	0	0	0
March		0	0	0	0	0	0	0	0	0	0
Winter		0	0	0	0	0	0	0	0	0	0
April	1-15	1	1	0	0	0	0	1	1	0	0.4
	16-30	7	2	1	0	0	0	3	2	0	1.7
May	1-15	10	5	2	1	5	3	7	4	0	4.1
	16-31	11	6	3	3	9	2	16	18	0	7.6
June	1-15	18	9	5	8	17	9	27	23	1	13
	16-31	25	3	7	3	24	18	14	21	1	12.9
Spring		72	26	18	15	55	32	68	69	2	39.7
July	1-15	22	3	4	4	21	22	18	14	2	12.2
	16-31	16	4	6	5	19	21	35	18	1	13.9
August	1-15	11	6	3	9	28	25	22	29	1	14.9
	16-31	27	8	3	3	39	18	20	21	0	15.4
September	1-15	41	4	2	2	20	34	29	16	1	16.6
	16-30	14	2	1	1	12	16	21	11	2	8.9
Summer		133	27	19	24	139	136	145	109	7	82.1
October	1-15	11	1	1	1	5	9	16	5	0	5.4
	16-31	5	1	1	1	3	7	8	3	0	3.2
November	1-15	1	0	0	0	1	2	3	1	0	0.9
	16-30	0	0	0	0	0	0	1	0	0	0.1
December		0	0	0	0	0	0	0	0	0	0
Autumn		17	2	2	2	9	18	28	9	0	10.7
Grand Total		222	55	39	41	203	186	241	187	9	131.1
Grand Mean/ tree		2.22	0.55	0.39	0.41	2.03	1.86	2.41	1.87	0.09	1.31

Table 3. Mean number of *Chlorophorus varius* beetles in Banaty "Thompson" (Ban), Flame (Fl), Superior (Su), King Robby (K-R), Red Romi (R-R), Balady (Bal), Bez El-Anza (B-A), Fayoumi (Fay), and Kremson (Kr) varieties in grape-vineyards at Giza governorate during 2005 activity seasons.

Date of inspection		Mean no. of beetles \ 100 trees									
		Ban	Fl	Su	K-R	R-R	Bal	B-A	Fay	Kr	Mean
January		0	0	0	0	0	0	0	0	0	0
February		0	0	0	0	0	0	0	0	0	0
March		0	0	0	0	0	0	0	0	0	0
Winter		0	0	0	0	0	0	0	0	0	0
April	1-15	0	1	0	0	0	1	0	0	0	0.2
	16-30	3	3	1	1	2	2	1	3	0	1.8
May	1-15	12	4	2	1	6	2	5	6	1	4.3
	16-31	14	6	5	2	8	4	12	10	0	6.8
June	1-15	29	6	7	3	15	11	19	15	1	11.8
	16-31	26	7	8	5	20	16	23	20	2	14.1
Spring		84	27	23	12	51	36	60	54	4	39
July	1-15	18	5	10	4	25	24	20	25	1	14.7
	16-31	22	9	6	8	21	29	26	16	0	15.2
August	1-15	25	10	4	4	19	27	34	19	1	15.8
	16-31	33	12	5	4	27	15	25	27	2	16.7
September	1-15	21	7	9	3	41	28	30	21	1	17.9
	16-30	16	3	2	1	17	31	18	13	1	11.3
Summer		135	46	36	24	150	154	153	121	6	91.7
October	1-15	5	2	1	1	11	12	10	9	0	5.7
	16-31	4	1	2	0	2	4	9	5	1	3.1
November	1-15	2	1	1	1	0	0	2	3	1	1.2
	16-30	1	0	0	0	1	1	0	1	0	0.4
December		0	0	0	0	0	0	0	0	0	0
Autumn		12	4	4	2	14	17	21	18	2	10.4
Grand Total		231	77	163	38	215	207	234	193	12	141.1
Grand Mean/ tree		2.31	0.77	0.63	0.38	2.15	2.07	2.34	1.93	0.12	1.41

Table 4. Mean number of *Chlorophorus varius* beetles in Banaty "Thompson" (Ban), Flame (Fl), Superior (Su), King Robby (K-R), Red Romi (R-R), Balady (Bal), Bez El-Anza (B-A), Fayoumi (Fay), and Kremson (Kr) varieties in grape-vineyards at Giza governorate during 2006 activity seasons.

Date of inspection		Mean no. of beetles \ 100 trees									
		Ban	Fl	Su	K-R	R-R	Bal	B-A	Fay	Kr	Mean
January		0	0	0	0	0	0	0	0	0	0
February		0	0	0	0	0	0	0	0	0	0
March		0	0	0	0	0	0	0	0	0	0
Winter		0	0	0	0	0	0	0	0	0	0
April	1-15	1	1	0	0	1	1	0	1	0	0.6
	16-30	6	3	1	1	1	1	2	1	0	1.8
May	1-15	10	3	1	2	4	5	4	5	1	3.9
	16-31	22	4	3	2	11	6	9	12	1	7.8
June	1-15	25	7	7	3	14	8	15	19	2	11.1
	16-31	21	6	8	5	22	13	17	24	1	13
Spring		85	24	20	13	53	34	47	62	5	38.1
July	1-15	27	6	4	2	30	27	28	21	1	16.2
	16-31	29	10	1	3	24	16	23	18	2	14
August	1-15	36	13	6	5	7	18	32	15	2	14.9
	16-31	23	8	3	8	14	25	37	31	1	16.7
September	1-15	19	5	1	2	33	33	31	23	0	16.3
	16-30	12	3	2	1	36	29	16	17	1	13
Summer		146	45	17	21	144	148	167	125	7	91.1
October	1-15	13	2	1	0	18	10	13	6	2	7.2
	16-31	9	1	0	1	6	13	6	2	1	4.3
November	1-15	2	0	0	0	2	5	5	3	0	1.9
	16-30	0	0	0	0	1	2	1	0	0	0.4
December		0	0	0	0	0	0	0	0	0	0
Autumn		24	3	1	1	27	30	25	11	3	13.9
Grand Total		255	72	38	35	224	212	239	198	15	143.1
Grand Mean		2.55	0.72	0.38	0.35	2.24	2.12	2.39	1.98	0.15	1.43

Table 5. Commencement, peak, and last dates of *Chlorophorus varius* beetles in grape vineyards at Giza governorate, during 2004, 2005 and 2006 seasons.

Statement	Variety	Year		
		2004	2005	2006
Flight commencement	Banaty	1st half of Apr.	2nd half of Apr.	1st half of Apr.
	Flame	1st half of Apr.	1st half of Apr.	1st half of Apr.
	Superior	2nd half of Apr.	2nd half of Apr.	2nd half of Apr.
	King Robby	1st half of May	2nd half of Apr.	2nd half of Apr.
	Red Rom	1st half of May	2nd half of Apr.	1st half of Apr.
	Balady	1st half of May	1st half of Apr.	1st half of Apr.
	Bez El-Anza	1st half of Apr.	2nd half of Apr.	2nd half of Apr.
	Fayoumi	1st half of Apr.	2nd half of Apr.	1st half of Apr.
	Kremson	1st half of Jun.	1st half of May	1st half of May
Peaks	Banaty	2nd half of Jun. 1st half of Sep.	1st half of Jun. 2nd half of Aug.	1st half of Jun. 1st half of Aug.
	Flame	1st half of Jun. 2nd half of Aug.	2nd half of Jun. 2nd half of Aug.	1st half of Jun. 1st half of Aug.
	Superior	2nd half of Jun. 2nd half of Jul.	1st half of Jul. 1st half of Sep.	2nd half of Jun. 1st half of Aug.
	King Robby	1st half of Jun. 1st half of Aug.	2nd half of Jun. 2nd half of Jul.	2nd half of Jun. 2nd half of Aug.
	Red Rom	2nd half of Jun. 2nd half of Aug.	1st half of Jul. 1st half of Sep.	1st half of Jul. 2nd half of Sep.
	Balady	1st half of Jul. 1st half of Sep.	2nd half of Jul. 2nd half of Sep.	1st half of Jul. 1st half of Sep.
	Bez El-Anza	1st half of Jun. 2nd half of Jul. 1st half of Sep.	2nd half of Jun. 1st half of Aug. 1st half of Sep.	1st half of Jul. 2nd half of Aug.
	Fayoumi	1st half of Jun. 1st half of Aug.	1st half of Jul. 2nd half of Aug.	2nd half of Jun. 2nd half of Aug.
	Kremson	1st half of Jun. 2nd half of Sep.	2nd half of Jun. 2nd half of Aug.	1st half of Jun. 1st half of Aug.
Last flight	Banaty	1st half of Nov.	2nd half of Nov.	1st half of Nov.
	Flame	2nd half of Oct.	1st half of Nov.	2nd half of Oct.
	Superior	2nd half of Oct.	1st half of Nov.	1st half of Oct.
	King Robby	2nd half of Oct.	1st half of Nov.	2nd half of Oct.
	Red Rom	1st half of Nov.	2nd half of Nov.	2nd half of Nov.
	Balady	1st half of Nov.	2nd half of Nov.	2nd half of Nov.
	Bez El-Anza	2nd half of Nov.	1st half of Nov.	2nd half of Nov.
	Fayoumi	1st half of Nov.	2nd half of Nov.	1st half of Nov.
	Kremson	2nd half of Sep.	1st half of Nov.	2nd half of Oct.

2.1.4. Seasonal activities

The maximum beetles' flight was in summer months. Tables (1), (2) and (3) stated the following descending orders: Bez El-Anza (1.45 to 1.67 beetles / tree), Red Romi (1.39 to 1.50 beetles / tree), Balady (1.36 to 1.54 beetles / tree), Banaty (1.33 to 1.46 beeties / tree), Fayoumi (1.09 to 1.25 beetles / tree), Flame (0.27 to 0.46 beetles / tree), Superior (0.17 to 0.36 beetles / tree), King Robby (0.21 to 0.24 beetles / tree), Kremson (0.06 to 0.07 beetles / tree).

Spring months recorded moderate descending orders of beetles' activity: Banaty (0.72 to 0.85 beetles / tree), Fayoumi (0.54 to 0.69 beetles / tree), Bez El-Anza (0.47 to 0.68 beetles / tree), Red Romi (0.51 to 0.55 beetles / tree), Balady (0.32 to 0.36 beetles / tree), Flame (0.24 to 0.27 beetles / tree), Superior (0.18 to 0.23 beetles / tree), King Robby (0.12 to 0.15 beetles / tree), Kremson (0.02 to 0.05 beetles / tree).

Autumn months showed less beetles' activity, as the descending orders were: Bez El-Anza (0.21 to 0.28 beetles / tree), Balady (0.17 to 0.30 beetles / tree), Banaty (0.12 to 0.24 beetles / tree), Red Romi (0.09 to 0.27 beetles / tree), Fayoumi (0.09 to 0.18 beetles / tree), Flame (0.02 to 0.04 beetles / tree), Superior (0.01 to 0.04 beetles / tree), Kremson (0.00 to 0.03 beetles / tree), King Robby (0.01 to 0.02 beetles / tree).Beetles activity was stopped during winter months.

Moreover, the total numbers of beetles emerged during the whole year were: Bez El-Anza (2.34 to 2.41 beetles / tree), Banaty (2.22 to 2.55 beetles / tree), Red Romi (2.03 to 2.24 beetles / tree), Balady (1.86 to 2.12 beetles / tree), Fayoumi (1.87 to 1.98 beetles / tree), Flame (0.55 to 0.77 beetles / tree), Superior (0.38 to 0.63 beetles / tree), King Robby (0.35 to 0.41 beetles / tree), Kremson (0.09 to 0.15 beetles / tree).

2.2. Seasonal Broods

Smoothed data emphasized that *C. varius* had mostly one or two broods of beetles' activity, but sometimes had three broods (in Bez El-Anza during 2004 and Kremson during 2005 and 2006), prevailed from April to November in 2004, 2005 and 2006 Table (7).

3. Progress of infestation

The seasonal cycle of emerged beetles (Figure, 1) varied according to different varieties. It was 8 months of beetles activity in Bez El-Anza (2004), Balady (2005 and 2006) and Red Romi (2006) followed by 4 months of beetles' inactivity. In Banaty and Fayoumi (2004, 2005 and 2006), Red Romi and Flame (2005) and Bez El-Anza (2006) it was 7.5 months of beetles activity followed by 4.5 months of beetles inactivity. In Flame (2004), Superior, King Robby and Bez El-Anza (2005) it was 7 months of

beetles activity followed by 5 months of beetles inactivity. In Balady, Red Romi and Superior (2004), Kremson (2005) Flame and King Robby (2006) it was 6.5 months of beetles' activity followed by 5.5 months of beetles inactivity. In King Robby (2004), Superior and Kremson (2006) it was 6 months of beetles activity followed by 6 months of beetles inactivity. However, in Kremson (2004) it was only 4 months of beetles' activity followed by 8 months of beetles' inactivity.

Infestation was almost doubled (2 to 2.6 times in the different varieties, with a mean of 2.1 times) during only one year (from a mean of 1.31 beetles in 2004 to 2.72 beetles in 2005 / tree / year). However, infestation increased 2.8 to 4 times in the different varieties, with a mean of 3.2 times) during two year (from a mean of 1.31 beetles in 2004 to 4.15 beetles in 2006 / tree / year). This is a serious parameter that imposes urgent need of controlling the pest in vineyards yearly.

Table 7. Dates of broods of *C. varius* beetles in grape vineyards at Giza governorate, during 2004, 2005 and 2006 seasons.

Variety	Broods of *C. varius* beetles in grape vineyards		
	2004	2005	2006
Banaty	1st half of Apr. to 2nd half of Sep. 2nd half of Jul. to 1st half of Nov.	2nd half of Apr. to 1st half of Sep. 2nd half of May to 2nd half of Nov.	1st half of Apr. to 1st half of Nov.
Flame	1st half of Apr. to 2nd half of Jul. 2nd half of Jun. to 2nd half of Oct.	1st half of Apr. to1st half of Nov.	1st half of Apr. to 2nd half of Oct.
Superior	2nd half of Apr. to 2nd half of Oct.	2nd half of Apr. to 1st half of Sep. 1st half of Jul. to1st half of Nov.	2nd half of Apr. to 1st half of Aug. 1st half of Jul. to1st half of Oct.
King Robby	1st half of May to 1st half of Aug. 1st half of Jun. to 2nd half of Oct.	2nd half of Apr. to 1st half of Nov.	2nd half of Apr. to 2nd half of Jul. 2nd half of Jun. to 2nd half of Oct.
Red Romi	1st half of May to 2nd half of Oct. 1st half of Jun. to 1st half of Nov.	2nd half of Apr. to 1st half of Oct. 1st half of Jul. to 2nd half of Nov.	1st half of Apr. to 2nd half of Aug. 2nd half of Jul. to 2nd half of Nov.
Balady	1st half of May to 1st half of Nov.	1st half of Apr. to 2nd half of Sep. 2nd half of Jun. to 2nd half of Nov.	1st half of Apr. to 1st half of Sep. 1st half of Jul. to 2nd half of Nov.
Bez El-Anza	1st half of Apr. to 2nd half of Jul. 2nd half of May to 2nd half of Sep. 2nd half of Jul. to 2nd half of Nov.	2nd half of Apr. to 1st half of Nov.	2nd half of Apr. to 2nd half of Nov.
Fayoumi	1st half of Apr. to 1st half of Aug. 2nd half of May to 1st half of Nov.	2nd half of Apr. to 1st half of Sep. 1st half of Jun. to 2nd half of Nov.	1st half of Apr. to 2nd half of Aug. 2nd half of Jun. to 1st half of Nov.
Kremson	1st half of Jun. to 1st half of Sep. 2nd half of Aug. to 2nd half of Sep.	1st half of May to 1st half of Aug. 2nd half of Jul. to 2nd half of Oct. 2nd half of Sep. to 1st half of Nov.	1st half of May to 1st half of Sep. 1st half of Jul. to 2nd half of Sep. 1st half of Sep. to 2nd half of Oct.
Mean of all varieties	1st half of Apr. to 2nd half of Nov.	1st half of Apr. to 2nd half of Nov.	1st half of Apr. to 2nd half of Nov.

4. Effect of weather factors on *C. varius* activity

4.1. Effect of temperature on beetles activity

Statistical analysis revealed that in all studied grapevine varieties, fluctuation in *C. varius* beetles population was significant or highly significant and positively correlated with the day maximum temperature (DMxT) ("r" = from 0.6187 to 0.6925), day mean temperature (DMT) ("r" = from 0.5731 to 0.6453) and day minimum temperature (DMnT) ("r" = 0.5889 to 7074).

4.2 Effect of relative humidity on beetles activity

On the contrary, statistical analysis of fluctuation in *C. varius* beetles population in all studied grapevine varieties showed insignificant and negative correlation ("r" = - 0.1194 to – 0.3728) with the day mean relative humidity (DMRH).

4.3. Effect of temperature and relative humidity on beetles activity

Statistical analysis indicated that generally, there were combined effect of all the weather factors: the day maximum temperature (DMxT), day mean temperature (DMT), day minimum temperature (DMnT) and day mean relative humidity (DMRH) on *C. varius* beetles population fluctuation in all studied grapevine varieties than the effect of each single factor. The combined effect of these weather factors on beetles activity (explained variance "E.V.") ranged between 39.7 and 61.8%. This may be due to the hidden larval and pupal stages inside the wood of the trees not exposed to the direct weather factors. However, these weather factors strongly affect the whole atmosphere of the grape vineyard.

5. Discussion and conclusion

The present study affirmed the survey studies curried out by Tadros *et al.*, 1997 who indicated that *C. varius* is the dominant and most economically important boring insect pest in grape vineyards. The current study is unique in determining the relative difference in the susceptibility of local and established foreign varieties to the borer infestation.

Monitoring studies (especially the seasonal fluctuation of insect pest population, progress of infestation, seasonal cycle, and effect of the main weather factors on the target pests) are essential in planning successful and effective "Integrated Control Programs" for the management of boring insect pest.

Approximately ¼% of grapevine trees were infested with *C. varius* and obvious susceptibility was noticed between varieties (2.3 - 44.7%). Red Romi, Banaty, Bez El-Anza, Balady and Fayoumi were highly susceptible varieties (5.7 - 10.7 beetles / tree), while Flame, King Robby, Superior and Kremson were less susceptible varieties (0.3 - 2 beetles / tree). These results disagree with Tadros (1982) who found - more than 25

years ago - that the rate of the borer infestation in Banaty and Fayoumi varieties reached 72 and 64%, respectively, while the respective degree of infestation in the two varieties approximated 7.6 and 4.7 larvae / tree. This may be due to the advanced technology in viticulture.

C. varius flight activity varied according to different varieties. The commencement dates varied from early April to early May until stopped in late September, October or November. Mostly there were two peaks of beetles' activities during June / July or July and August or September. Summer months recorded the maximum flight (0.06-1.67 beetles), followed by spring (0.02-0.85 beetles), then autumn (0.01-0.30 beetle) /tree, and stopped during winter. The total numbers of beetles per year ranged 0.09 to 2.55 beetles /tree. *C. varius* had mostly one or two brood and the beetles' activity lasted 4 to 8 months according to varieties. Infestation was almost doubled during only one year, but 3.2 times during two year. This is a serious parameter that imposes urgent need of controlling the pest in vineyards yearly. These results are somewhat different from those of Tadros (1982) who stated that *C. varius* beetles sharply emerged from mid April to mid September during 1978, 1979 and 1980. He added that infestation increased 2.7 times during only one year, but 4.5 times during two year.

Effect of weather factors on the borers activity was mostly positively significant with day maximum, day minimum, and day mean temperatures but negatively and insignificantly with day mean relative humidity.

Figure 1. Smoothed mean numbers of *CHLOROPHORUS VARIUS* beetles in Banaty grapevine variety at Giza governorate during 2004, 2005 and 2006.

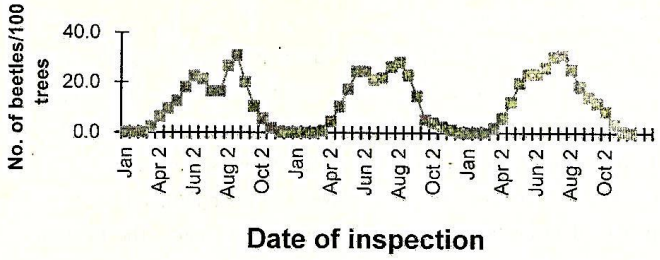

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Figure 2: Smoothed mean numbers of *CHLOROPHORUS VARIUS* beetles in Flame grapevine variety at Giza governorate during 2004, 5005 and 2006.

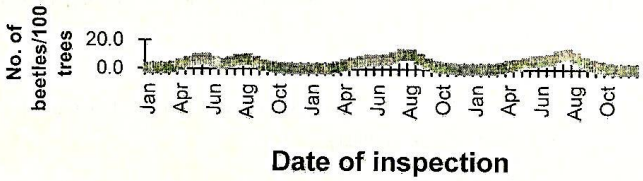

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Figure 3: Smoothed mean numbers of *CHLOROPHORUS VARIUS* beetles in Superior grapevine variety at Giza governorate during 2004, 2005 and 2006.

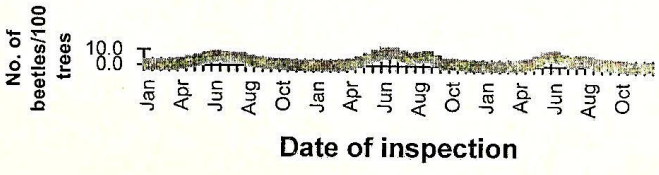

Figure 4: Smoothed mean numbers of *CHLOROPHORUS VARIUS* beetles in King Robby grapevine variety at Giza governorate during 2004, 2005 and 2006.

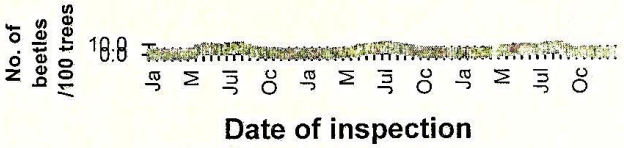

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Figure 5: Mean numbers of *CHLOROPHORUS VARIUS* beetles in Red Romi grapevine variety at Giza governorate during 2004, 5005 and 2006.

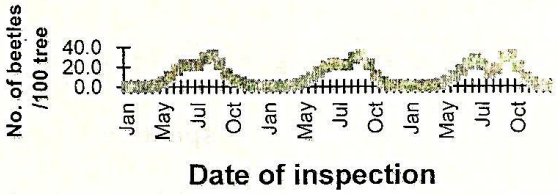

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figure 6: Mean numbers of CHLOROPHORUS VARIUS beetles in Red Romi grapevine variety at Giza governorate during 2004, 5005 and 2006.

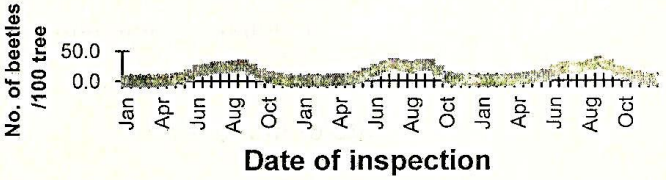

Figure 7: Smoothed mean numbers of *CHLOROPHORUS VARIUS* beetles in Bez el-Anza grapevine variety at Giza governorate during 2004, 2005 and 2006.

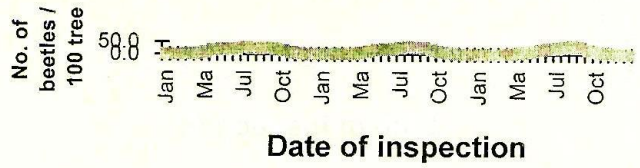

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Figure 8: Smoothed mean numbers of *CHLOROPHORUS VARIUS b* eetles in Fayoumi grapevine variety at Giza governorate during 2004, 2005 and 2006.

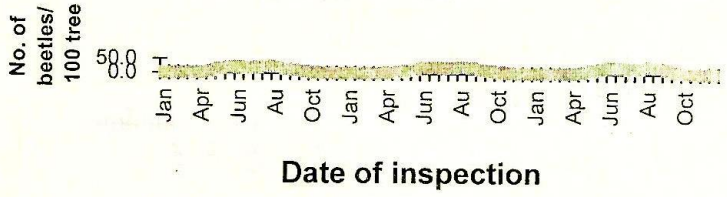

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Figure 9: Smoothed mean numbers of *CHLOROPHORUS VARIUS* beetles in Kremson grapevine variety at Giza governorate during 2004, 2005 and 2006.

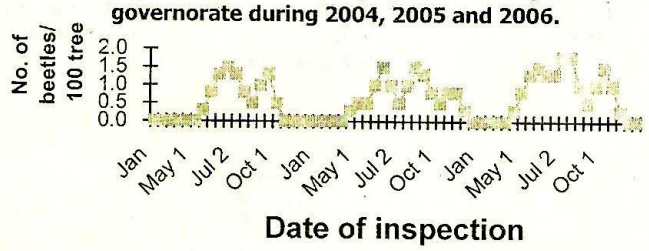
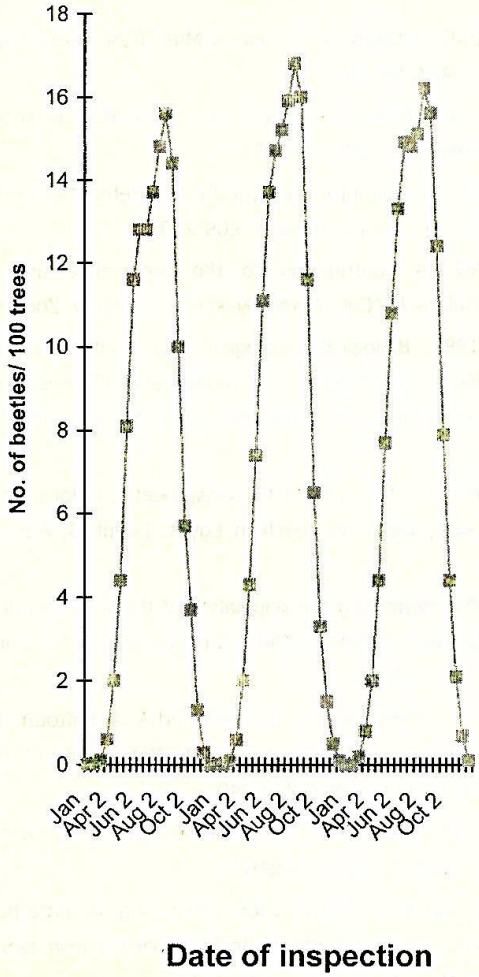


Figure 10: Smoothed mean numbers of *CHLOROPHORUS VARIUS* eetles in the nine grapevine varieties at Giza governorate during 2004, 2005 and 2006.



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الحساسية النسبية لإصابة أهم أصناف العنب بحفار ساق الخوخ ذو القرون الطويلة *Chlorophorus varius* (Coleoptera: Cerambycidae) في كروم العنب في مصر

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تم تتبع نشاط ومعدل ودرجة الإصابة بحفار ساق الخوخ ذو القرون الطويلة لدراسة الحساسية النسبية لتسعة أصناف محلية وأجنبية مستوطنة ومنتشرة في مصر حاليا في كروم العنب وهي البناتي (العنب الأبيض طومسون عديم البذور) والفليم (العنب الأحمر عديم البذور) والسوبيريور والرومي الأحمر والبلدي وبز العنزة والفيومي وكينج روبي وكريمسون في محافظة الجيزة علي مدار ثلاثة أعوام متتالية (٢٠٠٤، و ٢٠٠٥، و ٢٠٠٦). بلغ معدل الإصابة بالحفار (النسبة المئوية لعدد الأشجار المصابة) ودرجة الإصابة (عدد الحشرات التي خرجت من الأشجار مقدرة بعدد ثقوب الخروج) ٢٢,٥% و ٥,٢% ثقب للشجرة في المتوسط، علي التوالي. تتباين بداية النشاط الموسمي للحفار حسب الصنف من أوائل أبريل إلى أوائل مايو وينتهي في أواخر سبتمبر أو أكتوبر حتى نوفمبر. في الغالب هناك قمتان لنشاط الحفار في السنة، الأولي خلال يونيو/ يوليو أو يوليو، والثانية خلال أغسطس أو سبتمبر. سجلت شهور الصيف أعلى نشاط للحشرات (٠,٠٦–١,٦٧ حشرة)، يليها الربيع (٠,٠٢–٠,٨٥ حشرة). ثم الخريف (٠,٠١–٠,٣٠ حشرة). وتوقف النشاط خلال الشتاء. بلغ إجمالي عدد الحشرات التي خرجت من الشجرة خلال العام ٠,٠٩–٢,٥٥ حشرة. وللحفار غالبا حضنة واحدة أو حضنتان من النشاط خلال العام. واستغرقت دورة نشاط الخنافس مدة ٤ – ٨ شهور، حسب الصنف. تضاعف معدل الإصابة بالحفار خلال عام واحد وازداد ٣,٢ مرة خلال عامين مما يستوجب أجراء المكافحة باستمرار. تلاحظ أن تأثير العوامل الجوية علي نشاط حفار ساق الخوخ ذو القرون الطويلة غالبا موجبا ومعنويا مع درجات الحرارة الصغرى والمتوسطة والعظمي، ولكنها سالبة وغير معنوية مع متوسط الرطوبة النسبية.