

The efficiency of different materials for controlling vine mealybug, *Planococcus ficus* (Signoret) (Hemiptera: Pseudococcidae) on grapes during the period of investigation.

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ABSTRACT

The vine mealybug, *Planococcus ficus* (Signoret) (Hemiptera: Pseudococcidae) was a major pest in many grape vines growing regions in the world and Egypt. It is feeding on several agricultural and weedy plant species. However, grape vines are a preferred host, and are the most adversely affected by this insect. Like other mealybugs, vine mealybug feeds on phloem sap, but it can be found throughout the plant-even on the roots. The pest were suppressed by preventive measures with a view to reducing the impact of the attack. Allowed substances acting on the suitable time, if appropriate. Insecticide of plant origin citric acid are used in May before coloration. Along with the biological control of *Chrysoperla carnea* in July after coloration, as well as, low toxicity insecticide (Malathion) in January after pruning process. In the spring where the small buds appear a sequence of mineral oil (KZ) are used. The obtained data showed a significant effect on the different stages of the total insect population. The obtained data indicated that, tested compound Citric acid on *P. ficus* infested grape showed a slight effect after three days from treatment, then their effect increased gradually to give the highest effectiveness after 18 days. Using the predator, *C. carnea* for controlling *P. ficus* infested grape, showed the effectiveness of this predator in reducing the *P. ficus* after releasing.

INTRODUCTION

Grapes, *Vitis vinifera* L. (Family: Vitaceae) is considered one of the most important fruit crop in Egypt, not only as a popular fruit, but also for using in many agricultural industries. Vineyards are attacked by several pests; causing several types of damage. The pseudococcid, *Planococcus ficus* (Signoret) (Hemiptera: Pseudococcidae) is the most important one; in few years became an economic pest in Egypt, especially in the newly reclaimed areas. The problem with *P. ficus* in grape vine is already very grave and the ways to diminish the losses should be searched for and the only sustainable way on a long term basis is in biological control (Marotta *et al.*, 2001). The predator, *Chrysoperla carnea* (Stephens) use to

control the targeted, *Saccharicoccus sacchari* (Cockerell) on sugarcane (Abd El-Gawad and Mohamed, 2009)

Formulation plays an important role in agriculture field; it makes a very small amount of active component to spread over a very large area. Also it facilitates the penetration of the active ingredient to reach its target and achieve its action (EL-Kady, 2008). Citric acid as soluble powder formulation exhibited highly activity for the control of *Ferrisia virgata* (Cockerell) (Mohamed *et al.*, 2009).

The aims of this work is to study the efficiency of different materials for controlling vine mealybug, *P. ficus* on grapes during the period of investigation.

MATERIALS AND METHODS

Population dynamics of *P. ficus* were carried out on grape-vine, at El-Noubaria, El-Beheira governorate during 2010. The selected orchards did not receive any chemical control for many years before starting monitoring and within the studying period. All, vines (Thompson seedless) received the same routine horticultural practices by their owners. Selected ten vine were similar in size, shape and vegetation as possible. Vine of each host plants were homogenous in their infestation with *P. ficus*.

Half-monthly samples were carried out from January to December 2010. Each sample consisted of 400 leaves (10 leaves/vine) and 40 randomly bunches (1bunch / vine); from each bunch 10 berries were examined. From the trunk, the mealybug individuals were counted in a square inch, while from roots sampling was carried out from December to April 2010, with one square inch / vine. The numbers of *P. ficus* (pre. adults and adult femals) were counted and recorded.

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*Different material

A- Used insecticide:

Malathion:

Emulsifiable concentrate of O, O-dimethyl dithiophosphate of diethyl mercaptosuccinate. Samples of malathion used in this study was 57% E.C. and

formulated by the American Cyanamid Company. Rate of use: 2.5 ml/l L.

B- Used mineral oil:

KZ oil:

Formulated by Kafr El-Zayat chemical Co. contains 95% paraffinic oil (W/W) and 5% inert ingredients (emulsifying additions). Rate of use: 15 ml /1 L.

C- Used natural compound:

Citric acid :

As asoluble powder, formulation (Sp 90%) were prepared by second author, according to method described with EL-Kady (2008).

D- Used insect's predator:

***Chrysoperla carnea* (Stephens):**

The angoumois grain moth, *Sitotroga cerealella* (Olivier) and *Chrysoperla carnea* (Stephens) were cultured in laboratory according to the method described by Abd El-Gawad and Mohamed (2009).

***Experimental design**

Eight orchards (quarter feddan) of grape vine were heavily infested with *P. ficus*, four of them treatment different material (Malathion, KZ oil, citric acid and the predator *C. carnea*) while the last four orchards left as a control. These orchards were carefully selected at El-Noubaria, El-Beheira Governorate.

Grape vine were about 8 years-old, and free of any insectidal application for years previous to these experiments. Four treatments were applied. Every treatment was replicated 3 times each using 5 grape vine. The application included winter and summer. Date of application is shown in (Table 1).

Table 1: Timing for different programs.

Treatments	Date of applications
Malathion Spraying in (Winter after pruning and Remove loose bark of the vine)	January
KZ oil Spraying in (Spring after fruit set).	April
Citric acid Spraying in (Summer before coloring).	May
<i>Chrysoperla carnea</i> releasing (Summer after coloring).	July

Spraying applications of different material (Malathion, KZ oil and citric acid) were accomplished by means of 6 horse-powered motor sprayer, (600 liters tank), at a rate of 25-30 liters of insecticide solution per Grape vine to ensure complete coverage Grape vine at a pressure of 400 pounds per square inch (25 kg/cm²).

Releasing of the predator application was at the rate of 14400 predators/feddan 3 times at 15 day intervals.

* Counting and evaluation of treatments:

A sample of 25 unite (5cm² of branch or leaves) from grape vine, each replicate were picked up at random, from different sides of the treated grape vine. The unite (5cm²) of branch or leaves were put in polyethylene bags and transferred to the laboratory for inspection.

Pre-treatment counts were taken immediately before spraying. Three post-treatment counts were taken 15, 30 and 45 days after application. The percentage of a live pre-adults and adults per leaf before and after spraying and releasing was recorded. The evaluation of (Malathion, KZ oil, citric acid and the predator *C. carnea*) were based on the reduction in the population density of a live individuals per unit.

The percent reduction of the different stages of the *P. ficus* in relation to the pre-treatment count was estimated according to Henderson and Tilton formula, (1955):

$$\% \text{ Population reduction} = 100 * [1 - (Ta / Tb) * (Cb / Ca)]$$

where:

Cb = mean alive number of pest / unit in untreated before spraying.

Ca = mean alive number of pest / unit in untreated after spraying.

Tb = mean alive number of pest / unit in treatment before spraying.

Ta = mean alive number of pest / unit in treatment after spraying

unit (5cm² of Roots or branch or leaves or Clusters).

RESULTS AND DISCUSSION

Population dynamics of *P. ficus* on all parts of the vine:

The population dynamics of *P. ficus* on all parts of the vine (Thompson) from January to December 2010. could be traced in Table (2).

Infestation in roots:

Counts (Table 2) began with small numbers (pre. adults 13.5 & adult females 4.8 individuals / sq. inch) in Jan., 15 and disappearance from vine roots until Nov., 15 increased gradually till Dec.,15 (pre. adults 10.5 & adults females 3.73 individuals / sq. inch).

Infestation in trunk:

During the season, (2010) (Table 2), population started in Jan., 1; increasing gradually till representing a small peak in Feb. 1, with a mean count of 26.8 pre. adults /sq. inch and 4.21 adult females/ sq. inch, with a total of 31.01 individuals /sq. inch. This peak was followed by a decrease in population size in mid – June, as a result of the movement of *P. ficus* individuals from the bark to leaves and bunches. Thereafter, the population increased gradually to form the the highest peak in mid- August; being represented by 61.88 pre. adults and 2.8 adult females / sq. inch , with a total count of 64.68 individuals /sq. inch. In Nov. 15, the peak was observed; being represented by 23.99 pre. adults and 4.38 adult females ,with a total of 28.37 individuals /sq. inch.

Infestation in leaf:

In (Table 2) pre. adults and adult females started to appear in 15 June; increasing gradually to reach a peak of 29 individuals/ leaf (27.18 pre. adults + 1.31 adult females) in Aug. 1. This peak was followed by a decrease till Oct. 15. During Nov., no individual was detected.

Table 2: Mean numbers of all alive *P. ficus* (Pre - adult and Adult female) found on each sample on Thompson seedless grapevines during 2010 season, at El-Noubaria, El-Beheira Governorate.

Date	Mean numbers of all alive <i>P. ficus</i> (Pre - adult and Adult female) / sample										
	Square inch Roots		Square inch Trunk & branches		Ten Leaves		One Clusters		General total (Roots+Trunk+Leaves+Clusters)		
	P. A.	A. F.	P. A.	A. F.	P. A.	A. F.	P. A.	A. F.	P. A.	A. F.	Total
Jan.1	9.11	3.31	13.20	1.92	----	----	----	----	22.31	5.22	27.53
Jan.15	13.50	4.80	21.53	5.50	----	----	----	----	35.03	10.30	45.34
Feb.1	8.14	2.88	26.80	4.21	----	----	----	----	34.94	7.09	42.03
Feb.15	5.57	1.60	22.86	3.16	----	----	----	----	28.43	4.76	33.19
Mar.1	0.00	0.00	8.79	2.28	----	----	----	----	8.79	2.28	11.07
Mar.15	0.00	0.00	21.07	2.21	0.00	0.00	----	----	21.07	2.21	23.28
Apr.1	0.00	0.00	13.42	1.49	0.00	0.00	0.00	0.00	13.42	1.49	14.91
Apr.15	0.00	0.00	9.43	1.26	0.00	0.00	0.00	0.00	9.43	1.26	10.69
May.1	0.00	0.00	19.55	2.64	0.00	0.00	0.00	0.00	19.55	2.64	22.19
May.15	0.00	0.00	10.73	1.38	0.00	0.00	0.00	0.00	10.73	1.38	12.11
Jun.1	0.00	0.00	12.02	1.25	0.00	0.00	0.45	0.02	12.02	1.25	13.27
Jun.15	0.00	0.00	5.72	1.03	1.96	0.04	1.82	0.03	7.68	1.07	8.75
Jul.1	0.00	0.00	4.89	0.82	3.78	0.26	7.77	0.04	8.67	1.08	9.75
Jul.15	0.00	0.00	39.80	3.03	18.50	0.79	27.10	0.12	58.30	3.82	62.12
Aug.1	0.00	0.00	53.07	2.46	27.18	1.31	29.30	0.49	80.25	3.78	84.03
Aug.15	0.00	0.00	61.88	2.80	17.42	0.72	0.00	0.00	79.74	3.54	83.28
Sep.1	0.00	0.00	39.15	2.79	8.40	0.81	----	----	49.37	3.63	53.00
Sep.15	0.00	0.00	26.42	1.97	6.93	0.06	----	----	41.12	2.07	43.19
Oct.1	0.00	0.00	21.45	5.26	0.32	0.00	----	----	48.87	5.39	54.25
Oct.15	0.00	0.00	16.09	4.21	0.29	0.00	----	----	45.68	4.69	50.37
Nov.1	0.00	0.00	12.79	4.21	0.00	0.00	----	----	12.79	4.21	17.00
Nov.15	5.46	2.24	23.99	4.38	0.00	0.00	----	----	29.46	6.62	36.08
Dec.1	6.75	2.99	15.97	3.63	----	----	----	----	22.72	6.62	29.34
Dec.15	10.5	3.73	16.15	2.99	----	----	----	----	27.45	6.72	34.17

P. A. = Pre-adult

A. F. =Adult female

Infestation in bunches:

In (Table 2), infestation began in 1 June; reaching its greatest count in Jul. 15; a total of 27.13 individuals / berry. Afterwards, the population decreased till no individual was detected.

The obtained results are presented in (Table 2) observed biweekly mean count of *P. ficus* on (roots + trunk + leaves +clusters) of Thompson seedless grapevines during 2010. Total biweekly counts reached 45.03 individuals /sq. inch. This peak was, followed by a decrease in population size in June, 15 and July 1, as a result of the movement of *P. ficus* individuals from the bark to leaves and bunches. Thereafter, the population increased gradually to form the highest peak in Aug. 1; with a total count of 84.03 individuals /sq. inch. In Oct 1, the peak was observed; with a total of 54.25 individuals /sq. inch.

Bently *et al.* (1999), reported that *P. ficus* could be found on all parts of the vine including roots; the case that didn't report for other mealybugs infesting grapes.

These results are in line with Tawfik *et al.*, (2005); Mohamed & Gaser, (2010). Duso, (1989) who mentioned that focus of infestation is detected in winter by removing portion of the bark near the trunk.

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The following indicates the results of applying different material (Malathion, KZ oil, Citric acid and *C. carnea*) in four programs during 2010 using *P. ficus* as a target pest. The obtained results are presented in Tables, (3,4) as mean individual count and percent reduction of insect population.

Table 3 : Effect of different material on pre- adult of *P. ficus* on thompson seedless grape vine at El-Noubaria, El-Beheira Governorate.

Different material	Rate of application	Date of application	Percentage of reduction after spraying			
			7 day	15 day	30 day	Average percentage of reduction
Malathion	2.5ml/l	5 Jan.	97.5	93.2	89.2	95.7
KZ oil	20 ml/l	10 Apr.	72.3	76.7	78.7	77.6
Citric acid	1000 ppm	14 May.	90.7	92.4	93.4	92.7
<i>C. carnea</i>	144000/ feddan	18 Jul.	45.2	46.1	49.1	47.3

Table 4: Effect of different material on adult of *P. ficus* on thompson seedless grape vine at El-Noubaria, El-Beheira Governorate.

Different material	Rate of application	Date of application	Percentage of reduction after spraying			Average percentage of reduction
			after	7 day	15 day	
Malathion	2.5ml/l	5 Jan.	95.2	94.5	81.4	91.5
KZ oil	20 ml/l	10 Apr.	70.2	75.6	81.3	75.9
Citric acid	1000 ppm	14 May.	94.1	95.6	97.8	94.6
<i>C. carnea</i>	144000/ feddan	18 Jul.	46.3	48.2	54.3	47.1

One week after application, Malathion proved superiority showing 97.5 % reduction in insect population. Citric acid came in second category 90.7 % reduction insect populations. KZ oil ranked the thirdt category as 72.3 % reduction. *C. carnea* ranked the lowest category as 45.2 % reduction.

Two week after application only Malathion kept its superiority showing 93.2 % reduction in insect population. Citric acid came in the second category 92.4 % reduction insect populations. KZ oil ranked the third category as 76.7 % reduction. *C. carnea* ranked the lowest category as 46.1 % reduction.

Thirty days after application only Citric acid proved superiority showing 93.4 % reduction in insect population. Malathion came in the second category 89.2 %. KZ oil came in the third category 78.7 %. *C. carnea* ranked the lowest category as 49.1 % reduction (Table 3).

Average percentage of reduction in insect population pre- adult of *P. ficus* for Malathion, Citric acid, KZ oil and *C. carnea* were 95.7, 92.7, 77.6 and 47.3 %, respectively.

The obtained results are presented in Table,(4). One week after application, Malathion proved the superiority showing 95.2 % reduction in insect

population. Citric acid came in the second category 94.1 % reduction insect populations. KZ oil ranked the third category as 70.2 % reduction. *C. carnea* ranked the lowest category as 46.3 % reduction.

Two week after application Citric acid proved the superiority showing 95.6 % reduction in insect population. Malathion came in the second category 94.5 % reduction in insect populations. KZ oil ranked the third category as 75.6 % reduction. *C. carnea* ranked the lowest category as 48.2 % reduction.

Thirty days after application only, Citric acid proved superiority showing 97.8 % reduction in insect population. Malathion and KZ oil came in the second category 81.4 and 81.3 %. *C. carnea* ranked the lowest category as 54.3 % reduction.

Average percentage of reduction in insect population pre- adult of *P. ficus* for KZ oil, Malathion, Citric acid and *C. carnea* were 94.6, 91.5, 75.9 and 47.1%, respectively.

The obtained results of the conducted programs indicated that Malathion and Citric acid were the most effective control agenst for *P. ficus*. The effectiveness of the tested materials increased over time where thirty days

after application showed the highest reduction. The three selected dates of application were assumed to be the proper time for controlling this mealy bug. This may emphasize that applying programs at the proper time may increase their efficacy. These results are in agreement with those of Mohamed *et al.*, (2009) evaluated citric acid against *F. virgata*. Citric acid activity increased gradually to give the highest effectiveness after 18 days. The reduction percentages after 18 days was 93.3 %.

Abd El-Gawad and Mohamed (2009): mentioned that reduction in *S. sacchari* population on sugarcane was 54.51% & 58.85% during the two seasons, respectively.

El-Deeb, (1999) mentioned that average percentage (2- 4 weeks) of reduction in insect population of *Planococcus citri* for KZ oil was 90. 84 %.

Abdel-Rhaman, *et al* (2002) reported that after ten weeks when Kemesol mixed with malathion on *P. fucus* the reduction percentage (87.7 %).

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ARABIC SUMMARY

كفاءة المواد المختلفة لمكافحة بق العنب الدقيقي في مراحل نمو العنب المختلفة.

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يعتبر بق العنب الدقيقي من الأفات الهمامة التي تصيب كرمات العنب في العديد من مناطق زراعة العنب في العالم ومصر. تصيب هذه الأفة العديد من المحاصيل الزراعية الهمامة ومع ذلك العنب هو العائل المفضل وهو الأكثر تضرراً من هذه الحشرة. بق العنب الدقيقي يتغذى على عصارة النبات وهي تصيب جميع أجزاء النبات حتى الجذور. الهدف من هذا العمل دراسة تأثير كل من (المركيبات الكيميائية والشيبة و اسد المن كعدو حيوي) على بق العنب الدقيقي تبعاً لكل مرحلة من مراحل نمو كرمة العنب. تستخدم هذه المواد منفردة في الوقت المناسب لمراحل نمو العنب حيث استخدم (الملايثيون) في بنایر بعد عملية التقليم. وفي الربيع حيث البراعم الصغيرة استخدم الزيت المعدني (KZ). استخدم مركب حمض السترريك في مايو قبل تلوين حبات العنب. استخدم اسد المن كمفتوس في يوليو بعد التلوين. وأظهرت النتائج تأثير كبير للمواد المستخدمة على تعداد الحشرات في كل مرحلة من نمو العنب. وقد أشارات النتائج لمركبات الملايثيون و الزيت المعدني KZ على العنب المصايب ببق العنب الدقيقي أن هذه المركبات لها تأثير فعال على الأعمار المختلفة من هذه الأفة. وقد أشارت النتائج أيضاً إلى التأثير الجيد للشيبة على بق العنب الدقيقي بعد 18 يوم من المعاملة. أما بالنسبة لتأثير اسد المن على بق العنب الدقيقي فقد أشارات النتائج إلى تأثيره في تقليل أعداد بق العنب الدقيقي بعد إطلاقه.