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Original Research Article

Population density and bio-control of phytophagous mites infesting grape yards with special reference to associated predacious mites

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Keywords

Mites; grapes; biological control; ecology; biopesticides; population density.

A B S T R A C T

A field experiment was conducted to study the population density of phytophagous and predator mites along the vegetative period of grape trees, *Vitis vinifera* variety Seedless, as well as to study the efficacy of two commercial biological pesticides against phytophagous mites and the side effect on the beneficial predacious mites. Results on the phytophagous mites indicated that there were five genera, i.e. *Brevipalpus californicus*, *Eriophyes vitis*, *Tetranychus urticae*, *Tarsonemus spp*, *Tydeus spp*, in addition to three genera of predacious mites, i.e. *Amblyseius andersoni*, *Typhlodromus pyri*, *Agistemus exsertus*. *E. vitis* mite recorded the highest mean of population density (225.4 individuals / 10 leaves), followed by *B. californicus* recording (198.7 individuals / 10 leaves) and *T. urticae* (54.7 individuals / 10 leaves), while *Tarsonemus spp.* gave (26.05 individuals / 10 leaves), and *Tydeus spp.* recorded the least numbers (13.95 individuals / 10 leaves). The grand mean reduction of *B. californicus* after 30 days pesticides treatment was 59.7 % and 73.52 % with Apasuper and Romectin, while it was 68.3 % and 81.96 % on *E. vitis* with the two pesticides and it was 66.26 % and 91.75 % on *T. urticae* for Apasuper and Romectin, respectively. The grand mean decrease in *A. andersoni* numbers after 30 days of Apasuper and Romectin treatments was 53.65 % and 77.76 % while it was 50.9 % and 71.93 % on *T. pyri*, and 44.92 % and 73.13 % on *A. exsertus* for the tested pesticides, respectively.

Introduction

Grape is the second crop of fruit after citrus crop in the Arab countries. Many grapevine varieties are prone to the attack of a variety of insect and mite pests. Phytophagous mites are common pests in gardens and can be found in orchards feeding on many fruit trees and vegetable crops (Dreistadt *et al.*, 1994, Flint, 1998, Abdallah, 2002 and Negloh *et al.*,2010). Many of these phytophagous mites are common mite populations on fruit trees, in addition, predacious mites associated with them (Dellei and Szendrey, 1988). James, *et* *al.,* (1995) found that, mite populations on grapevines in five Canberra district vineyards during 1991-1993 were characterized by large numbers of phytoseiids and small, non-damaging populations of the pests grape leaf blister mite, *Colotnerus vifis* (Pagenstecher) and grape leaf rust mite, *Culepifritnerus vitis* (Nalepa).

Typhlodromus doreenae was the dominant species and occurred in all vineyards, in addition *Phytoseius folheringharniue* was abundant in a single vineyard. Duso and Vettorazzo (1999) determined the mite populations in two vineyards, each having two grape varieties, in both vineyards native phytoseiids were present: *Amblyseius andersoni* in one vineyard and *Phytoseius finitimus* in the other. Chemical control approach against mites populations associated with grape and other fruit trees is recommended in many parts of the world (Gotoh *et. al.,* 2001). Iskander (1993) reported that vertimec was the most toxic chemical against *Brevipalpus californicus* followed by three local mineral oils. The use of pyrethroids in commercial orchards in Ontario caused decreases in phytoseiid populations compared with orchards that had no pyrethroid treatments (Thistlewood, 1991).Some previous studies reported the efficiency of abamectin on predator/prey ratios in integrated management such as Kim and Paik (1996) on *Tetranychus urticae* Koch and *T. kanzawai* Kishida and uchovskiene and Surviliene (2009) on *T. urticae*. Olszak and Sekrecka (2009) studied the influence of thiacloprid and spirodiclofen on survival and reproduction of the predatory mite *T. pyri* (Phytoseiidae) under laboratory conditions on natural substrate. Results indicated that spirodiclofen had limited effects on *T. pyri* and could be used in IPM programmes. Hardman *et al*., (2009) found that commercial orchards treated with pyridaben had higher mite day accumulations for *T. urticae* in next year and required more acaricide applications than did orchards treated with the favourably selective acaricides, abamectin and clofentezine. In the scab-resistant research orchard acaricides were applied in mid-July 2008. Bifenazate and acequinocyl were favourably selective because they were more toxic to *T. urticae*, the more troublesome pest, than to *P. ulmi* and *T. pyri*. Spirodiclofen was neutrally selective because it strongly suppressed all three mites. Pyridaben was unfavourably selective because it had prolonged activity against *P. ulmi* and *T. pyri* but only suppressed *T.urticae* for a short interval. Nadimi *et al*., (2008) evaluated the toxic effects of hexythiazox (Nisorun®, EC 10%), fenpyroximate (Ortus®, SC 5%) and abamectin (Vertimec®, EC 1.8%) on *Phytoseiulus persimilis*. Percent predator mortality was evaluated from the protonymph up to the adult stage including first five days of the oviposition period.

The results showed that the total effect values of all concentrations of hexythiazox were below the lower threshold thus it could be considered a harmless acaricide to this predatory mite. In contrast, the total effect of all concentrations of fenpyroximate and field, as well as, one half the field concentration of abamectin were found toxic to predatory mite and above upper threshold.

Predatory mites play an important role in suppressing pest population occupying different habitats (Amitai, 1992). Predatory mites (Phytoseiidae) have been successfully used in the biological control of numerous agricultural pest world wide (Khan *et al.*,2010 and Onzo *et al.*,2012)

The present work aimed to study the population density of phytophagous and predator mites along the vegetative period of grape trees seedless, as well as to control mites by commercial biopesticides as a safe products specially against the predacious mites which play important role in the biological control of harmful mites and other arthropods.

Materials and Methods

The experiments were conducted at a private vineyard, *Vitis venifera* variety Seedless at El-Menoufia locality which was naturally infested with different phytophagous mites to study the population density of phytophagous and predator mites along the vegetative period of grape trees, seedless, as well as to control mites by commercial biopesticides. Biweekly leaf samples were collected from the chosen farm along the period from the first of April to 30 November 2012. Each sample was consisted of 100 leaves and put in paper bags; each sample was collected from 10 grape trees. Samples were transferred to the laboratory for mite examination with the aid of electric stereo binuclear. Key references of Krantz (1978) and Zaher (1992) Examinations were replicated three times.

The effect of two biopesticides were determined under field conditions, where pesticides were sprayed at 15 of April, 2012 using a handle sprayer with continuous pressure, each treatment was replicated three times as three grape trees. Samples of 50 leaves were collected before treatment and after 1, 2, 3 and 4 weeks. Three grape trees were left without any treatments served as control treatment.

The tested materials are

1- Apasuper 3.6 EC , as a trade name of a biological control agent manufacture from bacterial origin namely *Streptomyces avermitilis* produced by Fertiagro Pte Ltd, Singapore , and applied using a handle sprayer with continuous pressure (10 liter) as spraying solution of 1.5 ml per 10 liter of water.

2- Romectin 1.8 EC, as a trade name of a biological control agent manufactures from bacterial origin namely *Streptomyces avermitilis* produced by Rotam Agro. Chemicals, Hong Kong, and applied using a handle sprayer with continuous pressure (10 liter) as spraying solution of 3 ml per 10 liter of water.

The obtained results were analyzed by the computer, using ANOVA test with LSD at 5% level (SAS Institute. 2003).

The reduction percentages of the phytophagous mites were computed for all tested pesticides using Henderson and Tilton formula (Fleming and Retnakaran, 1985), as follow:

$$\text{Reduction\%} = \frac{[1 - \text{treatment after x control before}]}{\text{treatment before x control after}} \text{x}100$$

Results and Discussion

The obtained results on the population density of phytophagous and predacious mites associated with Seedless grape trees along the vegetative period from April to November, 2012 are shown in Table (1).

Data on the phytophagous mites indicated that there were five genera, i.e. *Brevipalpus californicus, Eriophyes vitis, Tetranychus urticae, Tarsonemus spp, Tydeus spp*, in addition to three genera of predacious mites, i.e. *Amblyseius andersoni*, *Typhlodromus pyri*, *Agistemus exsertus Eriophyes vitis* mite recorded the highest mean of population density (225.4 individuals / 10 leaves), followed by *Brevipalpus californicus* recording (198.7 individuals / 10 leaves) and *Tetranychus urticae* (54.7 individuals / 10 leaves), while *Tarsonemus spp* gave (26.05 individuals / 10 leaves), and *Tydeus spp* recorded the least numbers (13.95 individuals / 10 leaves).

Data revealed that the highest population of phytophagous mites was recorded during September, October, and November months, while the least numbers were recorded at April, May, and June months, while the rest months recorded intermediate values.

Statistical analysis of data (Table 1) indicated that there were significant differences in the mean numbers of phytophagous mites per 10 leaves among the months of study, where there were significant differences between September and October months and all other months.

As for *B. californicus*, there were significant differences in the mean numbers between October months and all other months, the highest mean numbers was recorded at October (198.7) while the least mean numbers was at April (21.05) (P.0.05= 16.3) .

As for *Eriophyes vitis*, there were significant differences in the mean numbers between September month and all other months, the highest mean numbers was recorded at September (255.4) while the least mean numbers was at April (35.5) (P.0.05= 31.6) .

As for *Tetranychus urticae*, there were significant differences in the mean numbers between October month and all other months, the highest mean numbers was recorded at October (54.7) while the least mean numbers was at April (11.15) (P.0.05= 9.0) month and all other months, the highest mean numbers was recorded at June (26.05) while the least mean numbers was at September (8.3) (P.0.05= 5.8).

As for *Tydeus spp* , there were significant differences in the mean numbers between August and November months and all other months, the highest mean numbers was recorded at August (13.95) while the least mean numbers was at October (2.9) (P.0.05= 3.4) .

Regarding to the mean numbers of the population density of Predacious mites associated with grape trees, results in Table (1) indicated that the highest mean numbers was recorded with *T. pyri* giving (15.75 individuals / 10 leaves) followed by *A. andersoni* giving (6.85 individuals / 10 leaves), while *A. exsertus* recorded the least numbers.

Statistical analysis of data Table (1) indicated that there were significant differences in the mean numbers of predacious mites among the months of study.

As for *A. andersoni*, there were significant differences in the mean numbers between July , August , September ,October months and all other months, the highest mean numbers was recorded at September and October (6.85) while the least mean numbers was at April (2.05) (P.0.05= 1.4)

As for *T. pyri*, there were significant differences in the mean numbers between September , October months and all other months, the highest mean numbers was recorded at October (15.75) while the least mean numbers was at April (1.95) (P.0.05= 2.3) .

As for *A. exsertus*, there were significant differences in the mean numbers between October months and all other months, the highest mean numbers was recorded at October (12.8) while the least mean numbers was at November (0.7) (P.0.05= 1.3) .

Control studies

Effect of spraying two biopesticides on the population density of phytophagous and predacious mites associated with grape trees during April month of 2013 year was studied on six mite species.

Results in Tables (2 and 3) show the effect of Apasuper and Romectin on the population density of three mite species after 2, 7, 14 and 30 days of spraying and the reduction percentages in different mite numbers.

As for *Brevipalpus californicus*, results indicated that there were significant differences in mite numbers, between the two pesticides and control, where the grand mean of mite numbers was 8.98 at Apasuper treatment and 6.25 at Romectin treatment compared with 30.3 at control.

The grand mean reduction of *B. californicus* after 30 days of Apasuper treatment was 59.7 % and 73.52 % with Romectin treatment.

As for *Eriophyes vitis*, results indicated that there were significant differences in mite numbers, between the two pesticides and control, where the grand mean of mite numbers was 12.73 at Apasuper treatment and 7.6 at Romectin treatment compared with 49.3 at control treatment.

The grand mean reduction of *Eriophyes vitis* after 30 days of Apasuper treatment was 68.3 % and 81.96 % with Romectin treatment.

As for *Tetranychus urticae*, results indicated that there were significant differences in mite numbers, between the two pesticides and control, where the grand mean of mite numbers was 3.88 at Apasuper treatment and 1.85 at Romectin treatment compared with 15.2 at control

The grand mean reduction of *Tetranychus urticae* after 30 days of Apasuper treatment was 66.26 % and 91.75 % with Romectin treatment.

Results in Tables (4 and 5) show the side effect of Apasuper and Romectin on the population density of three predacious mite species after 2, 7, 14 and 30 days of spraying.

As for *Amblyseius andersoni*, results indicated that there were significant differences in mite numbers, between the treatments of the two pesticides and control, where the grand mean of mite numbers was 1.38 at Apasuper treatment and 0.9 at Romectin treatment compared with 3.08 at control treatment. The grand mean decrease in *Amblyseius andersoni* numbers after 30 days of Apasuper treatment was 53.65 % and 77.76 % with Romectin treatment.

As for *Typhlodromus pyri*, results indicated that there were significant differences in mite numbers, between the treatments of the two pesticides and control, where the grand mean of mite numbers was 1.03 at Apasuper treatment and 0.73 at Romectin treatment compared with 2.73 at control treatment.

Table.1 Population density of different mite species associated with grape trees under field conditions

Month	Date	Phytophagous mites					Predacious mites		
		Brevipalpus californicus	***Eriophyes vitis***	***T. urticae***	***Tarsonemus spp***	***Tydeus spp***	***A. andersoni***	***T. pyri***	***A. exsertus***
Average numbers of mites / 10 leaves									
Apr.	1	15.3	38.6	9.1	9.3	6.4	2.3	2.6	0.0
	15	26.8	32.4	13.2	13.6	4.6	1.8	1.3	2.2
Mean		**21.05 e**	**35.5e**	**11.15e**	**11.45 bc**	**5.5 c**	**2.05 c**	**1.95c**	**1.1 cd**
May	1	22.5	55.2	8.6	7.5	4.8	3.1	1.5	3.1
	15	32.9	48.6	16.3	16.3	6.4	4.3	5.9	1.4
Mean		**27.7 e**	**51.9e**	**12.45e**	**11.9 bc**	**5.6 c**	**3.7 b**	**3.7dc**	**2.25 bc**
Jun.	1	39.1	77.1	23.7	32.4	8.2	4.7	7.5	1.0
	15	53.5	96.9	20.6	19.7	1.6	2.1	3.4	1.2
Mean		**46.3 d**	**87 d**	**22.15d**	**26.05 a**	**4.9 c**	**3.4 bc**	**5.45d**	**1.1 cd**
Jul.	1	40.3	98.7	28.3	10.4	5.1	5.3	8.1	2.1
	15	49.8	115.9	36.9	3.9	3.2	6.1	8.4	0.0
Mean		**45.05 d**	**107.3cd**	**32.6bc**	**7.15 c**	**4.15 c**	**5.7 a**	**8.25c**	**1.05 cd**
Aug.	1	78.2	145.4	22.8	4.4	12.1	4.3	9.5	3.1
	15	112.8	198.2	38.9	8.9	15.8	7.7	12.1	1.5
Mean		**95.5 c**	**171.8b**	**30.85cd**	**6.65 c**	**13.95a**	**6.0 a**	**10.8b**	**2.3 bc**
Sep.	1	147.6	213.4	43.5	8.7	13.5	7.2	14.1	4.1
	15	168.9	297.4	36.8	7.9	6.5	6.5	16.4	2.8
Mean		**158.25 b**	**255.4 a**	**40.15b**	**8.3 c**	**10.0 b**	**6.85 a**	**15.25a**	**3.45 b**
Oct.	1	186.1	205.4	45.6	11.1	4.3	6.5	15.2	13.1
	15	211.2	198.6	63.8	17.5	1.5	7.2	16.3	12.5
Mean		**198.7 a**	**202 b**	**54.7a**	**14.3 b**	**2.9 c**	**6.85 a**	**15.75a**	**12.8 a**
Nov.	1	102.4	138.1	44.2	16.2	12.0	3.4	12.1	0.0
	15	98.6	135.4	36.1	17.2	13.4	4.2	10.2	1.4
Mean		**100.5 c**	**136.8 c**	**40.15b**	**16.7 b**	**12.7ab**	**3.8 b**	**11.15b**	**0.7 d**
LSD 5%		**16.3**	**31.6**	**9.0**	**5.8**	**3.4**	**1.4**	**2.3**	**1.3**

Table.2 Effect of spraying two biopesticides on the population density of phytophagous mites infesting grape trees during April month of 2012 year.

Treatment	Rate of application	Average numbers of mites / 10 leaves					Grand mean
		Pre treatment	Days post treatment				
			2	7	14	30	
Brevipalpus californicus							
Apasuper	**0.2 ml/1 liter water**	**19.8**	**16.1**	**12.6**	**7.1**	**0.1**	**8.98b**
Romectin	**0.3 ml/1 liter water**	**22.5**	**16.3**	**8.4**	**0.3**	**0.0**	**6.25b**
Control	**-**	**23.2**	**22.8**	**28.1**	**32.5**	**37.8**	**30.30a**
LSD 5%							**11.65**
Eriophyes vitis							
Apasuper	**0.2 ml/1 liter water**	**34.2**	**28.4**	**18.6**	**0.8**	**3.1**	**12.73b**
Romectin	**0.3 ml/1 liter water**	**36.4**	**22.3**	**8.1**	**0.0**	**0.0**	**7.60 b**
Control	**-**	**40.2**	**45.7**	**48.9**	**52.3**	**50.3**	**49.3a**
LSD 5%							**11.65**
Tetranychus urticae							
Apasuper	**0.2 ml/1 liter water**	**10.2**	**9.3**	**5.6**	**0.6**	**0.0**	**3.88b**
Romectin	**0.3 ml/1 liter water**	**15.4**	**7.3**	**0.1**	**0.0**	**0.0**	**1.85b**
Control	**-**	**12.7**	**18.7**	**10.3**	**14.2**	**17.6**	**15.2a**
LSD 5%							**3.46**

Values in column followed by different letter(s) are significantly different at 5% level.

Table.3 Reduction percentages of three mite species infested grape trees sprayed with two biopesticides during April month of 2012 year

Treatment	Rate of application	Reduction% days after spray				Grand mean reduction %
		2	7	14	30	
Brevipalpus californicus						
Apasuper	**0.2 ml/1 liter water**	**17.26**	**47.46**	**74.40**	**99.69**	**59.70**
Romectin	**0.3 ml/1 liter water**	**26.28**	**68.76**	**99.04**	**100**	**73.52**
Eriophyes vitis						
Apasuper	**0.2 ml/1 liter water**	**26.95**	**55.29**	**98.20**	**92.76**	**68.30**
Romectin	**0.3 ml/1 liter water**	**46.11**	**81.71**	**100**	**100**	**81.96**
Tetranychus urticae						
Apasuper	**0.2 ml/1 liter water**	**38.08**	**32.31**	**94.74**	**100**	**66.26**
Romectin	**0.3 ml/1 liter water**	**67.81**	**99.20**	**100**	**100**	**91.75**

Table.4 Effect of spraying two biopesticides on the population density of predatory mites associated with grape trees during April month of 2012 year

Treatment	Rate of application	Average numbers of mites / 10 leaves					Grand mean
		Pre treatment	Days post treatment				
			2	7	14	30	
Amblyseius andersoni							
Apasuper	**0.2 ml/1 liter water**	**2.3**	**1.9**	**1.5**	**0.6**	**1.5**	**1.38 b**
Romectin	**0.3 ml/1 liter water**	**3.5**	**2.6**	**0.8**	**0.0**	**0.2**	**0.9 b**
Control	**-**	**2.3**	**2.5**	**3.1**	**3.1**	**3.6**	**3.08 a**
LSD 5%							**1.67**
Typhlodromus pyri							
Apasuper	**0.2 ml/1 liter water**	**1.5**	**1.2**	**1.0**	**0.6**	**1.3**	**1.03 b**
Romectin	**0.3 ml/1 liter water**	**2.0**	**1.9**	**0.4**	**0.0**	**0.6**	**0.73 b**
Control	**-**	**1.9**	**2.5**	**2.3**	**3.0**	**3.3**	**2.73 a**
LSD 5%							**1.63**
Agistemus exsertus							
Apasuper	**0.2 ml/1 liter water**	**1.3**	**1.0**	**0.9**	**0.7**	**0.0**	**0.65 b**
Romectin	**0.3 ml/1 liter water**	**1.8**	**1.3**	**0.4**	**0.0**	**0.0**	**0.43 b**
Control	**-**	**2.3**	**2.1**	**1.8**	**2.6**	**1.4**	**1.98 a**
LSD 5%							**1.17**

Values in column followed by different letter(s) are significantly different at 5% level

The grand mean decrease in *Typhlodromus pyri* numbers after 30 days of Apasuper treatment was 50.9 % and 71.93 % with Romectin treatment. As for *Agistemus exsertus*, results indicated that there were significant differences in mite numbers, between the treatments of the two pesticides and control, where the grand mean of mite numbers was 0.65 at Apasuper treatment and 0.43 at Romectin treatment compared with 1.98 at control treatment.

The grand mean decrease in *Agistemus exsertus* numbers after 30 days of Apasuper treatment was 44.92 % and 73.13 % with Romectin treatment. These results are in harmony with those obtained by Dellei and Szendrey (1988); Zaher (1992). James, *et al*., (1995) and Duso and Vettorazzo (1999) who studied the ecology and distribution of different phytophagous mite genera and the predacious mites associated with grape yards under different ecosystems.

Furthermore, obtained results on the bio-control of phytophagous mites infesting grape trees and the side effect of these biocides on the beneficial mites , are in agreement with those conducted by Kim and Paik (1996); Gotoh, *et al.*, (2001); Hardman *et al*., (2007) ; Duchovskienė (2009);and Güven SurvilienėandMadanlar (2009) and Hardman, *et al*., (2009) who controlled phytophagous mites infesting different fruit crops using bio-pestides in order to protect our environment from bad effects and pollution caused by using chemical pesticides in the control programmes, as well as to save the life of the biological enemies.

Table.5 Decrease percentages of three predatory mites associated with grape trees sprayed with two biopesticides during April month of 2012 year

Treatment	**Rate of application**	**Reduction% Days after spray**				**Grand mean Reduction %**
		2	**7**	**14**	**30**	
Amblyseius andersoni						
Apasuper	**0.2 ml/1 liter water**	**24.00**	**51.61**	**80.65**	**58.33**	**53.65**
Romectin	**0.3 ml/1 liter water**	**31.66**	**83.04**	**100**	**96.35**	**77.76**
Typhlodromus pyri						
Apasuper	**0.2 ml/1 liter water**	**33.91**	**44.93**	**74.67**	**50.10**	**50.90**
Romectin	**0.3 ml/1 liter water**	**21.52**	**83.48**	**100**	**82.73**	**71.93**
Agistemus exsertus						
Apasuper	**0.2 ml/1 liter water**	**15.75**	**11.54**	**52.37**	**100**	**44.92**
Romectin	**0.3 ml/1 liter water**	**20.90**	**71.60**	**100**	**100**	**73.13**

Finally, it could be concluded that most of phytophagous mites on grape trees recorded its highest population during winter season (September, October and November), in addition, predacious mites took the same trend. Romectin pesticide gave higher reduction percentages against phytophagous mites, than Apasuper. It could be recommend that the use of biocides against phytophagous mites infesting grape yards , at March or April months will be more effective in reducing mite population, as the population density will be at the least numbers, moreover these agents are less toxic against beneficial mites in comparison with other organic pesticides.

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