Susceptibility of Four Watermelon Cultivars to Infestation with *Tetranychus urticae* Koch.

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ABSTRACT

Experiments were conducted to estimate the susceptibility of four watermelon cultivars (Aswan, Daytona, Molokai and Giza-1) to infestation with *Tetranychus urticae* Koch and its population fluctuation during the two successive seasons, summer 2009 and early summer 2010 at Qalubia Governorate. Aswan cultivar was the most highly susceptible recording average of 42.86 and 57.59 mite moving stages/leaf during the two successive seasons, respectively, followed by the moderately infested cultivars (Daytona) recording 28.10 and 39.75 mite individuals during the two seasons, respectively. The lowest infestation was recorded on Molokai and Giza-1 cultivars, being 19.18 & 25.90 for the former and 18.10 & 25.94 for the latter cultivar during the two successive seasons, respectively. Susceptibility of watermelon cultivars to infestation with *T. urticae* may be affected by plant leaf morphological structure and its chemical contents. The number of trichomes/cm^2 leaf averaged 647.78, 744.44, 1111.11 and 1296.67 for Aswan, Daytona, Molokai and Giza-1 respectively, the less number of trichomes the more mite infestation. Positive relationships occurred between mite infestation levels and total amino acids, free amino acids, nitrogen and total soluble sugars in watermelon cultivars, while negative relationship found with tannins and nearly shown with total phenolic compounds, total flavonoids and total carotenes. Mite populations reached its peak during July and May in the first and second seasons, respectively, and infestation was lower in the first season than in the second, which might be due to early plantation.

Key Words: Susceptibility, Host plant resistance, watermelon cultivars, Population dynamics, *Tetranychus urticae*.

INTRODUCTION

Watermelon *Citrullus lanatus* L. (Family: Cucubitaceae) is considered one of the most important vegetable crops in Egypt. It is usually infested with the spider mites, *Tetranychus urticae* Koch (Farrag *et al.*, 1984), *T. cinnabarinus* Boisd. (Mansour and Karchi 1994), *T. kanzawai* Kishida (Morishita & Yano 1996), and the tarsonemid mite *Polyphagotarsonemus latus* Banks (Kousik *et al.*, 2007).

Evaluation the susceptibility of some watermelon cultivars to infestation with *T. urticae* in order to select the most resistant ones is considered important to avoid using more pesticides. Chemical contents and morphological characteristics which normally vary from plant variety to another, may affect the population levels of herbivores. There are several studies on the host plant resistance to the infestation with *T. urticae*; Ahmed (1994), Tomczyk *et al.*, (1996), Hanafy (2004), Lopez *et al.*, (2005), Jyotika (2006), Ibrahim *et al.*, (2008) and (Abdallah *et al*, (2009).

The present work was conducted to determine the level of infestation of four watermelon cultivars with the two spotted spider mite *T. urtica*, and its relationship with plant leaf morphological characteristics and certain chemical contents. The population dynamics of the mite throughout the two successive seasons; 2009 and 2010 was studied.

MATERIALS AND METHODS

Experimental procedures:

Four different watermelon cultivars; Aswan, Daytona, Molokai and Giza-1 were cultivated in open field during the two successive seasons (i.e. summer season 2009 and early summer season 2010). An area of 612 m^2 in Qalubia Governorate was chosen for these experiments. Watermelon cultivars were planted in the fourth week of April in season 2009 and the last week of January in season 2010.

For population dynamics of *T. urticae*, weekly samples, each of 20 leaves, were randomly collected from every watermelon cultivar from the fourth week of May till the last week of August (2009) and from the second week of March till the second week of June (2010). Leaf samples were examined for *T. urticae* occurrence.

Morphological and Biochemical Studies:

Imaging the bottom surface of the four watermelon cultivars leaves using the Scanning Electron Microscopic technique (SEM) (Joel GM 4200) was used at the Applied Center for Entomonematodes (ACE), Faculty of Agriculture, Cairo University. Samples for SEM technique were dehydrated in ethyl alcohol and dried using the critical point procedure, then individually affixed using double sided sticky tape, and sputter coated with gold palladium according to Fashing *et al.*, (2000). Some specific chemical constituents of watermelon leaves were determined as follow: Acid hydrolysis was carried out according to method of Block *et al.*, (1958). Total free amino acids was carried out according to method of Chiang and Nip (1973). Total amino acids and free amino acids were determined according to the method of Etsushiro *et al.*, (1981). Total phenols content were determined by the Folin-Ciocalteu method described by Meda *et al.*, (2005). Total flavonoids content were determined by Folin-Ciocalteu method according to Hung & Morita (2008). Dried sample was extracted by boiling in 80% neutral aqueous ethanol for 6 h. Total soluble sugars were determined using the phenol-sulfuric acid method, according to Dubois *et al.*, (1956). Total carotenoides were determined colorimetrically according to Holden (1965). Alkaloids were determined titermetrically according to Sabri *et al.*, (1973).Tannins were determined using vanillin hydrochloric acid method according to Burn (1971). Total nitrogen was determined according to the method of analysis, Association of Official Agriculture Chemists (1995). Chemical analysis was carried out during the growing season of the four watermelon cultivars in the second season 2010 during two periods peak and late season of infestation. Watermelon leaves were collected and transferred to laboratory and dried at room temperature & relative humidity then transferred to the Faculty of Agriculture Research Park, Cairo Univ. for chemical analysis.

RESULTS AND DISCUSSION

Susceptibility of different watermelon cultivars to *T. urticae* infestation:

The tested watermelon cultivars significantly ($P < 0.05$) differed in their susceptibility to *T. urticae* infestation except in case of Giza-1 and Molokai. (Table 1). During the two successive seasons (2009 & 2010), it could be arranged in a descending order as follows: Aswan highly susceptible (39.60% & 38.60%), followed by Daytona moderately infested (25.96% & 26.65%) and the lowest infested were Molokai and Giza-1 cultivars (17.72% &17.36% and 16.72% & 17.39%) respectively.

Therefore, it could be concluded that all tested watermelon cultivars were variably infested with *T. urticae*. These results are in agreement with those obtained by, Tomczyk *et al.*, (1996), Edelstain *et al.* (2000), Castagnoli *et al.*, (2003), Maklad (2004), Ibrahim *et al.*, (2008) and Abdallah *et al.*, (2009).

The relationship between morphological characteristics leaves and some phytochemical compounds of watermelon cultivars with *T. urticae* infestation level:

Susceptibility of watermelon cultivars to infestation with *T. urticae* may be affected by plant leaf morphological structure. Therefore the differences between the four watermelon cultivars, Aswan, Daytona, Molokai and Giza-1, leaf morphological structure were studied. Average number of trichomes/cm^2 leaf was 647.78, 744.44, 1111.11 and 1296.67 for Aswan, Daytona, Molokai and Giza-1 respectively. Also the shape and length of trichomes differed with watermelon cultivars. (Figs. 1 & 2). Length, thickness and density of leaf trichomes are considered to be factors that affect strawberry plant resistance to infestation with *T. urticae*. Afifi *et al.*, (2009) and Ibrahim *et al.*, (2008), stated that the Sudanian watermelon has thick hairiness leaves compared with those of Snake watermelon (hairy), whereas Squash leaves are nearly hairless.

One of the most important factors which play a role in the susceptibility of watermelon cultivars to *T. urticae* infestation is leaf phytochemical components. Obtained data indicated positive relationships occurring between mite infestation levels and total amino acids, free amino acids, nitrogen and total soluble sugars in watermelon cultivars, while negative relationship found with tannins and nearly shown with total phenolic compounds, total flavonoids and total carotenes. (Table 2). These results are in agreement with those recorded by Tomczyk and Kropczynska (1985), Tomczyk *et al.*, (1987), Aggour *et al.*, (2001), Lopez *et al.*, (2005), Jyotika (2006), Kotb (2007), Ibrahim *et al.*, (2008), Abdallah *et al.*, (2009) and Afifi *et al.*, (2009) .

Population dynamics of *Tetranychus urticae* on four watermelon cultivars:

Population dynamics of the two spotted spider mite, *T. urticae* were recorded during the summer season 2009 from the fourth week of May till the last week of August and during the early summer season 2010 from the second week of March till the second week of June.

During season 2009, the infestation of watermelon cultivars; Aswan, Daytona, Molokai and Giza-1 with *T. urticae* started from the 4^{th} week of May then gradually increased to reach its peaks in the 3^{rd} week of July for Aswan cultivar, and the 4^{th} week for Daytona, Giza-1and Molokai cultivars. Then gradually decreased till the end of the season. The peak recorded the highest level on Aswan cultivar, followed by Daytona, Molokai and Giza-1 (Fig. 3).

The numbers, of motile stages of *T. urticae*/ leaf, for Aswan, Daytona, Molokai and Giza-1 cultivars averaged 10.10, 3.15, 6.50 and 3.20 at the beginning of infestation, respectively, then increased to 80.95, 55.55, 45.85 and 33.45 in peak of infestation, respectively.

Table (1): Susceptibility of four watermelon cultivars to *Tetranychus urticae* infestation during 2009 & 2010 seasons

watermelon cultivars	Mean number of *T. urticae* movable stages / leaf			
	Summer season 2009		Early summer season 2010	
	Mean No.	Infestation %	Mean No.	Infestation %
Aswan	$42.86^{a} \pm 7.35$	39.60	$57.59^{a} \pm 11.29$	38.60
Daytona	$28.10^{b} \pm 4.67$	25.96	$39.75^{b} \pm 7.26$	26.65
Molokai	$19.18^{c} \pm 3.71$	17.72	$25.90^{c} \pm 4.12$	17.36
Giza-1	$18.10^{c} \pm 2.24$	16.72	$25.94^{c} \pm 5.31$	17.39
LSD value at 0.05	3.50	-	6.65	-

Means with the same letter are not significant.

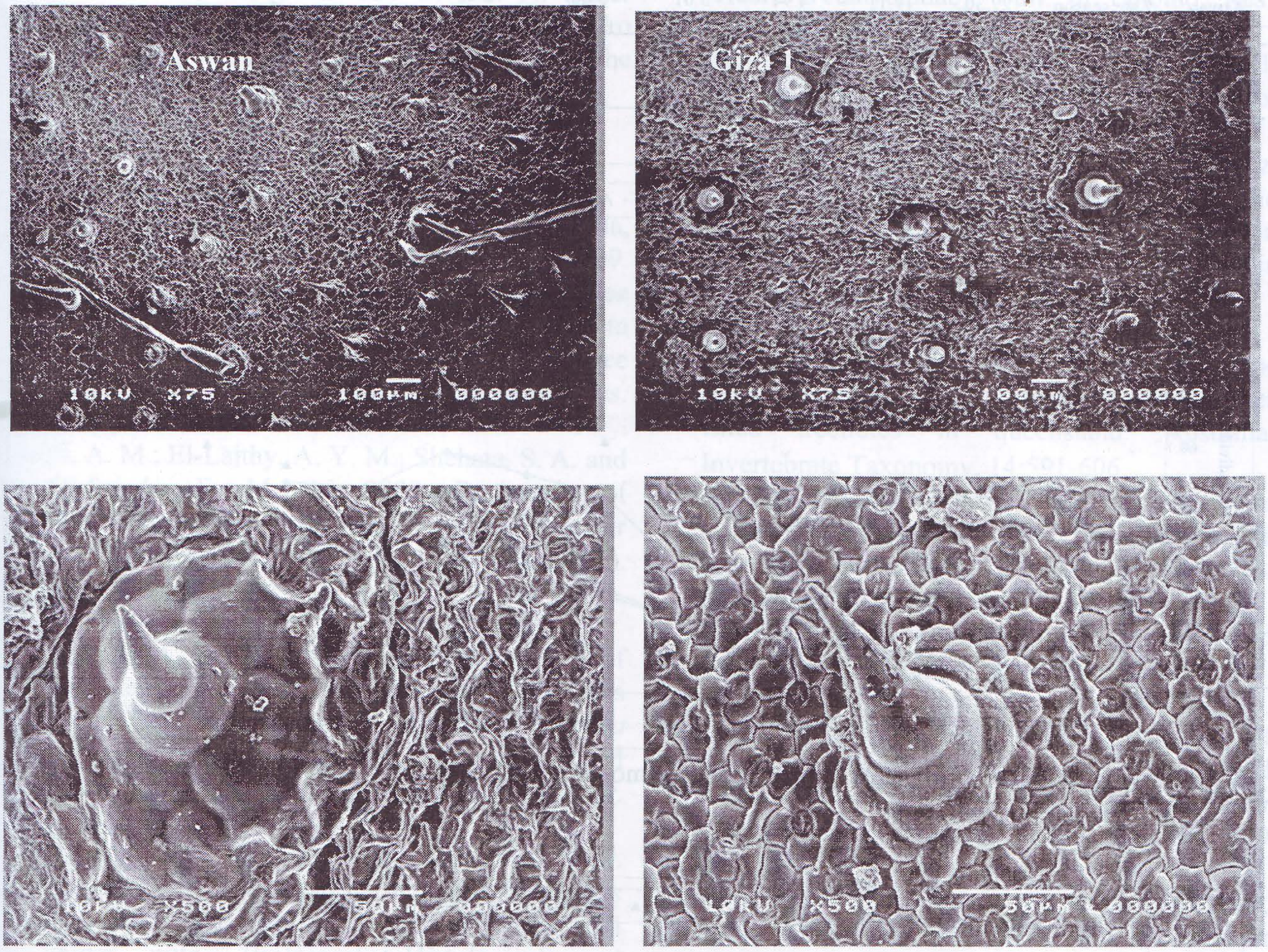

Fig. (1): Scanning electron microscopy of Aswan and Giza-1 watermelon cultivars trachoma.

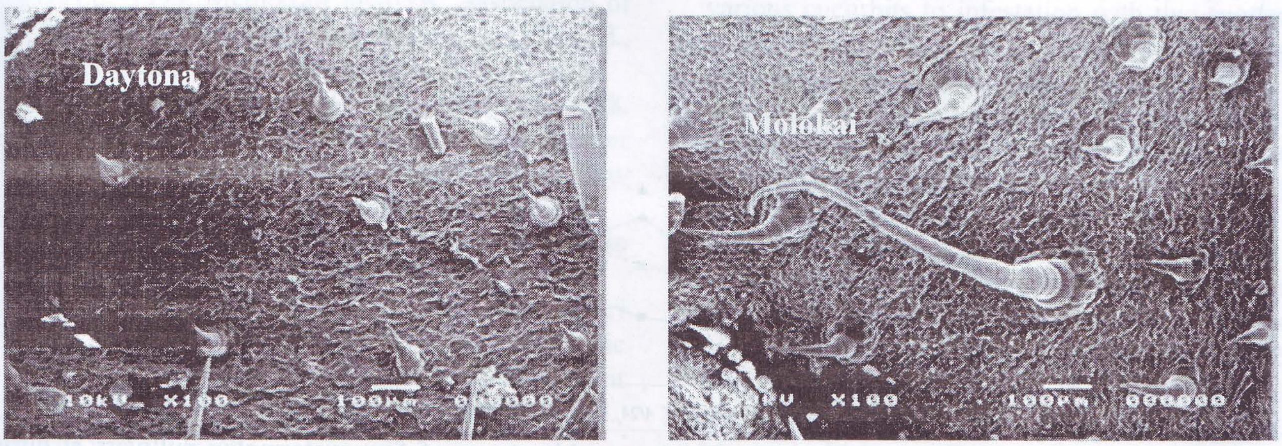

Fig. (2): Scanning electron microscopy of Daytona and Molokai watermelon cultivars trachoma.

Table (2): Relationship between phytochemical components of four watermelon cultivars leaves and population of *Tetranychus urticae*

Cultivars	Infestation	*Mean of T. urticae* movable stages	Phytochemical components								
			Total amino acids (g/100g)	Total free amino acids (g/100g)	Total nitrogen %	Total soluble sugars (g/100g)	Total phenolic compounds (g/100g)	Total flavonoids (g/100g)	Total Carotenes (mg/g)	Tannins (g/100g)	Alkaloids (g/100g)
Daytona	Peak	94.45	27.61	5.36	4.61	8.29	2.89	2.29	7.95	1.55	0.23
	Late season	26.50	17.63	4.48	2.81	10.14	2.39	1.89	7.37	1.19	0.23
	mean	60.48	22.62	4.92	3.71	9.22	2.64	2.09	7.66	1.37	0.23
Giza- 1	Peak	56.65	27.84	4.88	4.11	6.97	2.81	2.29	12.14	1.89	0.20
	Late season	35.25	16.21	2.97	2.11	9.34	3.21	2.89	10.46	2.15	0.12
	mean	45.95	22.03	3.93	3.11	8.16	3.01	2.59	11.30	2.02	0.16
Aswan	Peak	140.15	28.67	4.89	4.50	11.51	3.11	2.59	12.32	1.79	0.20
	Late season	27.30	17.11	4.94	3.01	9.80	2.46	2.29	5.62	1.30	0.20
	mean	83.73	22.89	4.92	3.76	10.66	2.79	2.44	8.97	1.55	0.20
Molokai	Peak	52.10	28.01	3.95	4.50	8.07	2.31	1.79	8.72	1.89	0.12
	Late season	14.10	16.92	3.98	2.71	8.57	2.67	2.29	8.18	1.95	0.20
	mean	33.10	22.47	3.97	3.61	8.32	2.49	2.04	8.45	1.92	0.16

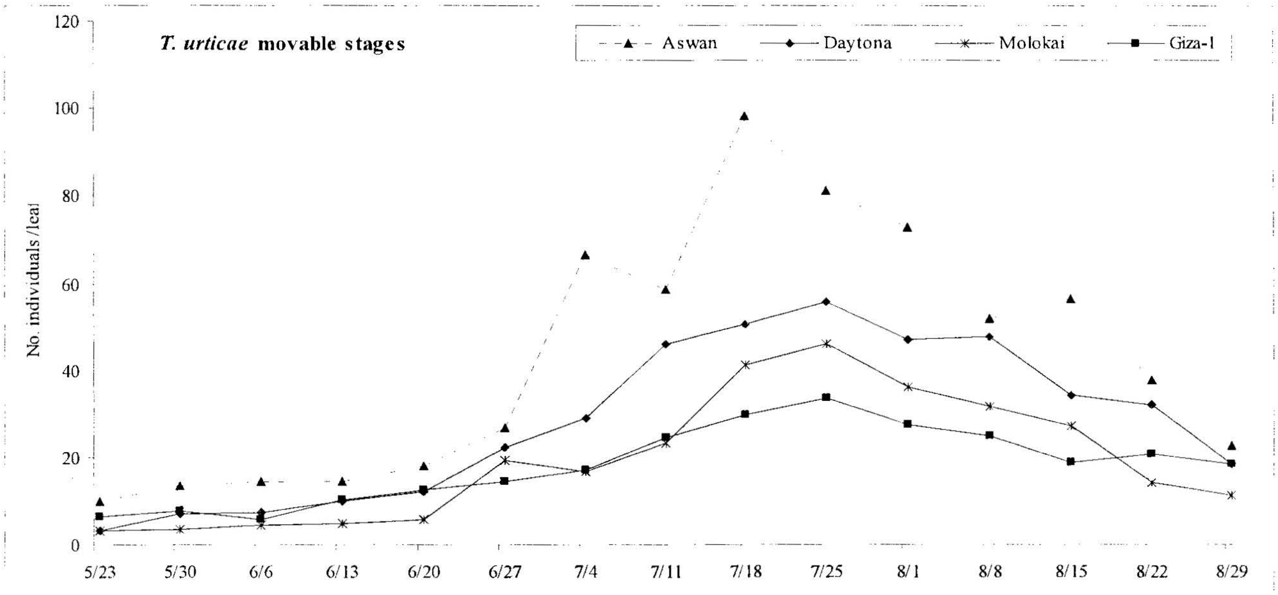

Fig. (3): Population dynamics of *T. urticae* Koch movable stages of four watermelon cultivars at during season 2009.

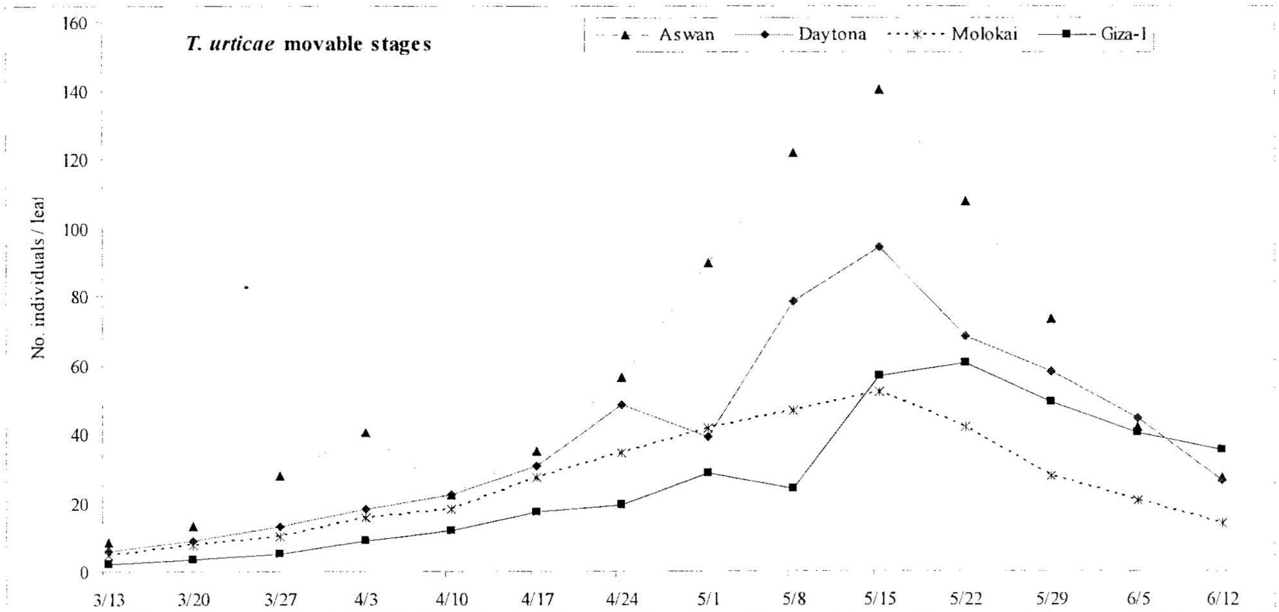

Fig. (4): Population dynamics of *T. urticae* Koch movable stages of four watermelon cultivars at during season 2010.

In early summer season 2010, the infestation of watermelon cultivars with *T. urticae* started on the 2nd week of March, then gradually increased to reach its peaks in the 3rd week of May for Daytona. Aswan and Molokai cultivars, while for Giza-1 cultivar it occurred in the 4th week of May. Thus, the population dynamics and number of *T. urticae* stages followed similar trend as in summer season 2009 (Fig. 4).

ACKNOWLEDGMENT

The authors are grateful to Dr. M. A. Zaher professor of Acarology, Fac., of Agriculture, Cairo University for his great advices and reviewing the manuscript.

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