Imbrications of Certain Cucurbit Crops Characteristics with the Two-Spotted Spider Mite Infestation

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ABSTRACT

The cucurbits; Sudanian watermelon, *Sitrullus lanatus* var. *colocynthoides*, Snake watermelon, *Cucumis melo* var. *flexuous* and squash, *Cucurbita pepo* L. were checked weekly to get relationship between the infestation with the two-spotted spider mite, and certain chemical and morphological leaf characteristics. The experiment was carried out in two districts; Bahar El-Bakar; south Port Said governorate and El-Hosainia plain, north El-Sharkia governorate; throughout the two successive growing seasons 2007 and 2008.The population of the mite *Tetranychus urticae* Koch varied according to the crop, season and district. Peak of infestation (29.4 individual/inch^2) occurred in July,2007 and (31.1 indiviuals/inch^2) in July,2008.The morphological characteristic cleared that Sudanian watermelon has thick hairiness leaves compared with those of Snake watermelon (hairy), whereas Squash leaves are nearly hairless. Chemical determinations of protein, carbohydrates, fats and crude fiber were (10.3, 70.1, 2.7 and 6.3 %) in Sudanian watermelon, (9.1, 56.7, 1.6 and 15.1%) in Snake watermelon and (7.2, 58.1, 1.5 and 15.4%) in Squash, respectively. Mite population positively correlated with increasing nutrient contents of leaves e.g. as crude proteins, crude fats, and carbohydrates and leaves hair.

Key Words: *Cucurbitaceae, leaf characteristics, Tetranychus urticae.*

INTRODUCTION

The Sudanian watermelon, *Sitrullus lanatus* var. *colocynthoides*, Snake watermelon, *Cucumis melo* var. *flexuous* and squash, *Cucurbita pepo* L. are considered important vegetable crops at new cultivated area.

The two-spotted spider mite, *Tetranychus urticae* Koch is one of the most important pests of cucurbits causing serious damage to plants (Abdel-Salam *et al*., 1982, Masaki *et al*., 1991; and Ibrahim, 2005).

Chemical contents and morphological characteristics are normally varied from crop to another, which may affect the population levels of herbivores. The most susceptible cucumber variety to aphids has high level of total protein and amino acids of leaf contents. The tolerant varieties may be attributed to low level of these contents, which provided a less nutritive diet for pests (Ahmed, 1994).

Mite fecundity was positively affected with nitrogen contents of plant leaves. Mites distinctly prefer to feed and oviposit on the young leaf compared with old ones (Wilson, 1994).

Cucurbitaceae plants contain cucurbitacins that have been shown to have feeding and oviposition deterrence and to reduce development pests (Miro 1995, and Tallamy *et al*. 1997). The first true leaves of cucumber produce 100 µg cucurbitacin/ g dry mass and cotyledons of some varieties produce up to 800 µg cucurbitacin/g dry mass (Agrawal *et al.* 1999).

Cucurbitacins have been demonstrated to function defensively against several widespread generalist herbivores, including spider mites, several beetles, lepidopterous larvae, mice, and vertebrate grazers (Da Costa & Jones 1971; Gould, 1978; Metcalf & Lampman 1989 and Tallamy *et al*. 1997). *C. pepo* var. *ambassador* contains cucurbitacin-d a molecule related to cucurbitacin-c found in cucumber (Agrawal, 2000). Cucurbitacin-c extracted also from *C.andreana* fruits (Halaweish & Tallamy, 1993). Plants that produce cucurbitacins are typically protected from herbivory by many herbivores (Agrawal *et al.* 2002).

Cucurbit varieties differ qualitatively in production of cucurbitacins (high cucurbitacins = bitter plants, and no cucurbitacins = sweet plants (Da Costa & Jones 1971, and Gould 1978). Bitter plants are typically hostile hosts for spider mites (Da Costa & Jones 1971; Gould, 1978 and Agrawal, 2000).

The morphological features of the plant such as leaf hairs and trichomes have a major impact on the searching ability of natural enemies (Van Haren *et al.*, 1987; Sutterlin & Lenteren, 1997; and Ricci & Capelletti, 1998).

The present work tries to investigate relationship between certain morphological characters and certain chemical contents of three cucurbit crops and

T. urticae infestation to establish database of the pest and the host.

MATERIALS AND METHODS

The experiment was performed at two districts El-Hosainia plain, north El-Sharkia governorate and Bahar El-Bakar; south Port Said governorate; throughout two successive seasons 2007 and 2008.

Experimental procedures:-

The experimental area was divided into 12 plots, measuring 10X12 m. each. The Sudanian watermelon, *S.lanatus* var. *colocynthoides*, Snake watermelon, *C.melo* var. *flexuous* and squash, *C.pepo* L. were planted in four plots as replicates for each, in 3rd week of May at the two districts. The experiment was designed as complete randomized plots. Normal agricultural practices were applied and no pesticides were used. Forty leaves from every examined cucurbit (10 leaves - in cross row - from each plot) were randomly picked weekly. All moving stages were counted per one square inch.

Morphological and Biochemical Studies:

Samples of the three of cucurbit crop leaves were randomly collected weekly, started on May 23rd and 22nd throughout the two growing seasons 2007 and 2008, respectively. The density of hairs, on both leaf surfaces was calculated as mean numbers of hairs/cm^2 according the method of Augustin (2002). Proteins, fibers, crude fats, carbohydrates, and ash in leaves were estimated at the Plant Analysis Laboratory of El-Hosainia Agricultural Research Station according to the method of Ranganna (1979). Cucurbitacins (Cucurbitacin–c and Cucurbitacin–d) were determined according the method of Rehm & Wessels 1957.

RESULTS AND DISCUSSION

Data presented in table (1) show the mean number of the two-spotted spider mite, *T. urticae* on Sudanian watermelon, Snake watermelon and squash at the two districts, Bahar El-Bakar and El-Hosainia plain throughout two successive seasons 2007 and 2008.

With regard to the mean number of mites at each district and the two successive seasons, it is obvious that the population of the mite slightly varied according to the district and season. The differences between mean numbers at the two districts were not significant. This may be due to that the two districts are adjacent. No differences also occurred between mean numbers in the two growing seasons.

Results reveal that the mite showed the highest population (23.7 individuals/inch^2) on Sudanian watermelon comprising 40.1% of the total count of mite; followed closely by Snake watermelon (18.6 individuals/inch^2); representing 31.5%, whereas squash recorded the lowest population (16.8 individuals/inch^2); recording 28.4% of the mite population.

Tables 2 and 3 show the population of the two-spotted spider mite, *T. urticae* on the three cucurbit crops at the two districts throughout the seasons 2007 and 2008.

Mite infestation started in few numbers ranging from 5.6 to 9.3 *T. urtica* individuals/leaf in 2007 and from 5.3 to 11.3 in 2008 (Tables 2 & 3). Also, infestation was, in general, slightly higher in 2008 compared with 2oo7.

Peak of infestation in 2007 occurred on Sudanian watermelon, (37.2 individuals/inch^2) on July 28, at Bahar El-Bakar, on Snake watermelon (32.7 individuals/inch^2) on July, 21, at El-Hosainia and on squash, (29.4 individuals/inch^2) on Aug., 4 at Bahar El-Bakar. In 2008, peak of infestation occurred on Sudanian watermelon, (38.4 individuals/inch^2) on August 3, on Snake watermelon (31.2 individual /inch^2) and on squash, (29.8 individuals/inch^2) on July, 27, at El-Hosainia.

In general, mite infestation was slightly higher in Bahr El-Baker than in El-Hosainia in the two years (Tables 1, 2 & 3).

Table (1): Means and percentages of the two-spotted spider mite, *Tetranychu urticae* on the three cucurbits at two districts throughout the two successive seasons 2007 and 2008.

Crops	Average numbers of mites /square Inch				*mean	** %
	Bahar El-Bakar		El-Hosainia			
	2007	2008	2007	2008		
Sudanian watermelon	23.8	24.8	22.5	23.7	23.7	40.1
Snake watermelon	18.5	19.7	17.1	19.2	18.6	31.5
Squash	17.1	17.8	15.9	16.5	16.8	28.4
Mean	20.3		19.2			
LSD 5%			--------		1.6	

*mean number of mite on individuals/leaf at two districts throughout two seasons

**% Representation percentages of mite on crop, at the two districts throughout two seasons

Table (2): Population fluctuations of the two-spotted spider mite, *Tetranychu urticae* Koch on three cucurbit crops at two districts throughout the season 2007.

Date of inspection		Average numbers of mites /square Inch					
		Bahar El-Bakar			El-Hosainia		
		Sudanian watermelon	Snake watermelon	Squash	Sudanian watermelon	Snake watermelon	Squash
June	23	9.3	6.8	5..6	7.5	6.2	5.7
	30	17.1	9.3	11.8	12.3	7.1	13.2
July	7	15.5	13.8	18.2	21.6	19.3	11.8
	14	27.3	19.5	16.5	30.7	16.6	19.5
	21	30.7	26.4	19.7	27.3	32.7	28.7
	28	37.2	25.6	23.1	35.4	30.1	25.2
Aug.	4	31.5	30.5	29.4	31.2	26.2	23.7
	11	27.4	24.2	19.6	29.3	20.5	18.4
	18	23.5	22.7	21.5	21.5	13.1	16.1
	25	27.2	21.1	17.4	23.2	16.7	13.2
Sep.	1	25.2	15.5	13.5	16.8	9.4	9.2
	8	13.2	7.3	8.6	13.6	7.6	6.3
Mean/week		23.8^{a}	18.5^{b}	17.1^{c}	22.5^{A}	17.1^{B}	15.9^{C}
LSD 5%			1.23			1.17	

Table (3): Population fluctuations of the two-spotted spider mite, *T. urticae* Koch on three cucurbit crops at two districts throughout the growing season 2008.

Date of inspection		Average numbers of mites /square Inch					
		Bahar El-Bakar			El-Hosainia		
		Sudanian watermelon	Snake watermelon	Squash	Sudanian watermelon	Snake watermelon	Squash
June	22	11.3	8.1	5.4	9.1	6.4	5.3
	29	16.5	10.2	11.2	15.8	10.1	11.2
July	6	21.2	13.3	19.7	23.1	19.7	9.7
	13	32.7	18.2	16.5	25.3	26.1	21.2
	20	37.1	25.5	22.3	37.8	29.5	27.4
	27	35.6	30.1	28.7	31.2	31.2	29.8
Aug.	3	38.4	26.7	25.4	28.5	27.7	22.1
	10	25.5	29.5	27.2	29.7	23.1	14.5
	17	27.1	23.3	21.7	27.5	17.7	18.2
	24	18.7	25.2	16.3	17.8	13.2	17.3
	31	21.2	16.3	11.4	21.2	15.3	13.4
Sep.	7	12.3	9.5	8.3	16.7	10.5	7.5
Means		24.8^{a}	19.7^{b}	17.8^{c}	23.7^{A}	19.2^{B}	16.5^{C}
LSD 5%			1.25			1.21	

Table (4): Certain morphological features and biochemical contents of studied cucurbit plants.

Leaf features	Leaf contents %		
	Sudanian watermelon	Snack watermelon	Squash
*Density of hairs	417.3	276.7	96.4
Crude protein %	10.3	9.1	7.2
Crude fibres %	6.3	15.1	15.4
Carbohydrates %	70.1	56.7	58.1
Crude fats %	2.7	1.6	1.5
Ash %	10.6	17.5	17.8
**Cucurbitacins (Bitterness)	-	+	+

*Dense of hairs on the abaixal leaf surface /cm^2.

** Amount of cucurbitacin 10-99 mg/kg fresh weight of cucurbitaceous seedling. According to (Rehm and Wessels, 1957).

Data in table (4) show some morphological characteristics and chemical contents of the leaves of three studied cucurbit crops.

The morphological characteristics cleared that Sudanian watermelon has thick hairy leaves compared with Snake watermelon, whereas squash leaves are nearly hairless.

Chemical estimation of protein, fibers, carbohydrates and fats was (10.3, 6.3, 70.1 and 2.7 %) in Sudanian watermelon, (9.1, 15.1, 56.7 and 1.6%) Snake watermelon and (7.2, 15.4, 58.1 and 1.5 %) in squash, respectively.

Data show that the two-spotted spider mite population has positive correlation with increasing the three nutrient contents of leaves i.e. crude proteins, carbohydrates and crude fats as well as dense of hairs and vise versa.

Results present in tables 1, 2, 3 and 4, revealed that Sudanian watermelon was markedly infested with the two-spotted spider mite, followed by Snake watermelon and squash. The three studied cucurbits varied in their susceptibility to the two-spotted spider mite, *T. urticae* infestation throughout the two successive growing seasons. This may be related to the morphological characteristic and biochemical contents of the leaves of these three crops. Therefore, it is clear that the morphological characteristic and biochemical contents play a remarkable role on the mite's infestation. In addition, the present study revealed that the concentration of cucurbitacins in the leaves is an important parameter for spider mite resistance in cucurbits. An obvious negative relationship between spider mite survival and cucurbitacins content was noticed. It has been reported that cucurbitacins reduce mite survivorship and fecundity (Gould 1978).

Therefore, population dynamics and the host plant characteristics are important factors to be considered when exploring integrated pest management (IPM) for the two-spotted spider mite, *T. urticae*.

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