Susceptibility of Certain Maize Varieties to *Tetranychus urticae* Koch Infestation in Relation to Leaf Chemical Contents

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ABSTRACT

Field studies were carried out to evaluate six single cross maize hybrids namely; Giza 129, Giza 10 & Giza 125 (white maize varieties) and Giza 168, Giza 162 & Giza 166 (yellow maize varieties) for their relative susceptibility to the two-spotted spider mite, *Tetranychus urticae* Koch infestation, during 2008 and 2009 growing seasons at Sharkia Governorate, Egypt. Giza 125 and Giza 162 proved to be the most susceptible hybrids to spider mite infestation in white and yellow maize varieties, respectively, while Giza 129 and Giza 166 were the most tolerant in the two varieties, respectively. In both tested seasons, mite population reached its peak on maize during the fourth and the third weeks of July, respectively, for all tested hybrids. A significant positive correlation was found between mite infestation and both nitrogen and protein contents in maize leaves.

Key Words: Susceptibility, *Zea mays*, *Tetranychus urticae*, Population, Maize hybrids, Chemical contents.

INTRODUCTION

Maize (*Zea mays* L.) occupies an important position among cereal crops in Egypt. Although it was planted principally for animal feed, yet it is also important as stable food crop for birds and contributes in human feed as a maize oil and partially in bread.

Maize plants are infested with several pests, of which *T. urticae* is considered important (Abd-El-Shaheed *et al.* 1975, Abo-Korah, 1983 and Zaher *et al.* 1980). Bacon *et al.*, 1962 found a 47% reduction in maize yield resulting from damage by *T. urticae*. Mite infestation differs according to maize varieties (Sawiris, 1992). This difference may be attributed to plant leaf morphology or its chemical contents.

Many studies are focused on new tolerant plant varieties that received the lowest infestation of mites and consequently increased the crop yield (Ahmed, 1994 and El-Sanady *et al.*, 2008). Additionally, the relation between chemical contents of leaves and mite infestation was discussed by several authors (Zaher *et al.*, 1980, Trindade and Chiavegato, 1999; Hoffland *et al.*, 2000 and Hole & Salunkhe, 2005) to create unfavorable conditions for spider mite development, thus reduce their injuriousness on plants.

Therefore, the aim of the present work was to evaluate six single cross maize hybrids belonging to two maize varieties (white and yellow) for their relative susceptibility to *T. urticae* infestation during two successive growing maize seasons; 2008 and 2009. In addition, the population dynamic of the mite throughout the two seasons was studied. The relationship between mite infestation and maize leaves chemical contents was investigated.

MATERIALS AND METHODS

1- Field trials:

An area of about quarter feddan (1 feddan= 4200m^2) at Zagazig district, Sharkia Governorate, Egypt was divided into 24 plots, four of which as replicates were cultivated with one of the six maize hybrids. Maize seeds were sown in rows 7 m. long and 80 cm. in between at a distance of 25 cm. between hills at nearly end of May, during 2008 and 2009 growing maize seasons, (Table 1).

Table (1): Tested maize hybrids (*Zea mays* L.)

Maize varieties	Hybrids
White	Giza 10
	Giza 125
	Giza 129
Yellow	Giza 162
	Giza 166
	Giza 168

All plots received normal agricultural processes without using pesticides. Throughout the two growing seasons, weekly samples, each of five 5 leaves / plot (20 leaves per each hybrid) from 22nd June to 25th August were examined for *T. urticae* moving stages. Two square inches around mid rib of leaf were examined. Each hybrid was represented by 20 leaves × 10 sampling dates.

2- Phytochemical analysis of maize leaf varieties:

Leaf samples of the six maize hybrids cultivated in 2009 season, were picked up during the

vegetation period, cleaned, washed with distilled water, and dried in an oven at 70° C for 48 hr., then grinded into fine powder. The total carbohydrate and total protein were estimated according to the methods of Miller (1959) and Chapman & Pratt (1961), respectively. Nitrogen, phosphorus and potassium were also determined as the methods described by Black (1965); Murphy & Riely (1962) and Dewis & Freites (1970), respectively.

3. Statistical analysis:

Data were analyzed by one-way analysis of variance (ANOVA) to test the significant differences between mean values and correlation coefficient between the spider mite population and chemical contents of maize leaves using Costat software (Anonymous, 1990).

RESULTS AND DISCUSSION

1- Susceptibility of maize varieties to *T. urticae* infestation

Data given in Table (2) indicate that the tested maize varieties significantly differed in their susceptibility to *T. urticae* infestation according to the mean number of movable mite stages / 100 square inches existed throughout 2008 and 2009 seasons on samples collected from each hybrid.

Table (2): Susceptibility of maize varieties to *T. urticae* infestation during 2008 and 2009 seasons

Varieties	Hybrids	Mean no. of moving stages during season / 100 square inches	
		2008	2009
White	Giza125	3884.62 ± 40.71[a]	4981.60 ± 183.5[a]
	Giza 10	2512.28 ± 150.26[b]	2705.08 ± 69.91[b]
	Giza 129	780.42 ± 07.07[c]	717.60 ± 42.84[c]
	$LSD_{0.05}$	287.85	269.20
Yellow	Giza162	4800.12 ± 84.22[a]	5128.8 ± 77.94[a]
	Giza168	1660.42 ± 37.28[b]	1936.28± 126.07[b]
	Giza166	1244.48 ± 70.26[c]	1436.00 ± 46.49[c]
	$LSD_{0.05}$	213.98	223.24

In white maize hybrids, the single cross hybrid, Giza 125 was the most highly significant susceptible to infestation recording 3884.62 ± 40.71 and 4981.60 ± 183.51 moving mite stages during the two successive seasons 2008 and 2009, respectively, followed by the moderately infested hybrid Giza 10 receiving 2512.28 ± 150.26 and 2705.08 ± 69.91 movable mite individuals, respectively. Single cross hybrid, Giza 129 was the most tolerant one that gave the lowest significant difference in the number of mite infestations (780.42 ± 7.07 and 717.60±42.84), respectively.

Whereas yellow maize hybrids ranged between 4800.12±84.22 and 5128.80±77.94 movable mite individuals for the most susceptible hybrids, Giza 162 in the two maize growing seasons 2008 and 2009, respectively, to 1244.48±70.26 and 1436.00±49.49 movable mite individuals, respectively, for Giza 166 which considered the most tolerant one.

2- Population dynamic of *T. urticae* on maize varieties during 2008 and 2009 growing seasons

As shown in Figs. (1&2), *T. urticae* occurred during the two seasons from 22nd June to 25th August. During the first season, the infestation of mite moving stages occurred in few numbers after 25 days of sowing date on all tested varieties. A definite trend in population dynamic was observed, the population increased slowly until about July 1st, then it sharply increased until reached its peak during the fourth week of July. This result was observed by all tested maize hybrids with different degrees. Subsequently, the number of mites decreased gradually until the end of the season.

The same trend was obtained during the second season with the exception of that all the tested hybrids reached its peak during the third week of July.

Generally, it was appearent .that all the tested hybrids exhibited higher numbers of *T. urticae* in the second season than in the first one, Figs. (1 & 2).

Based on the seasonal mean of the population in the white maize hybrids, Giza 125 was the most susceptible one that infested with 188.00 and 250.47 individuals (mean number of moving mite stages/10 square inches) in 2008 and 2009 seasons, respectively. On the contrary, Giza 129 hybrid was the most tolerant one recording 35.00 and 36.40 individuals, during the two growing seasons, respectively (Figs. 1, A & 2, A).

In case of yellow maize hybrids, Giza 166 showed highest tolerance than other hybrids followed by Giza168 and Giza 162 that infested by (62.00 & 69.00), (77.00 & 84 07) and (242.00 & 262.60) mite movable stages in both maize seasons, respectively, (Figs. 1, B & 2, B).

Margoli and Kennedy (1984); Taha (1992), Magouz *et al.*, (2006) and El-Sanady *et al.*, (2008)

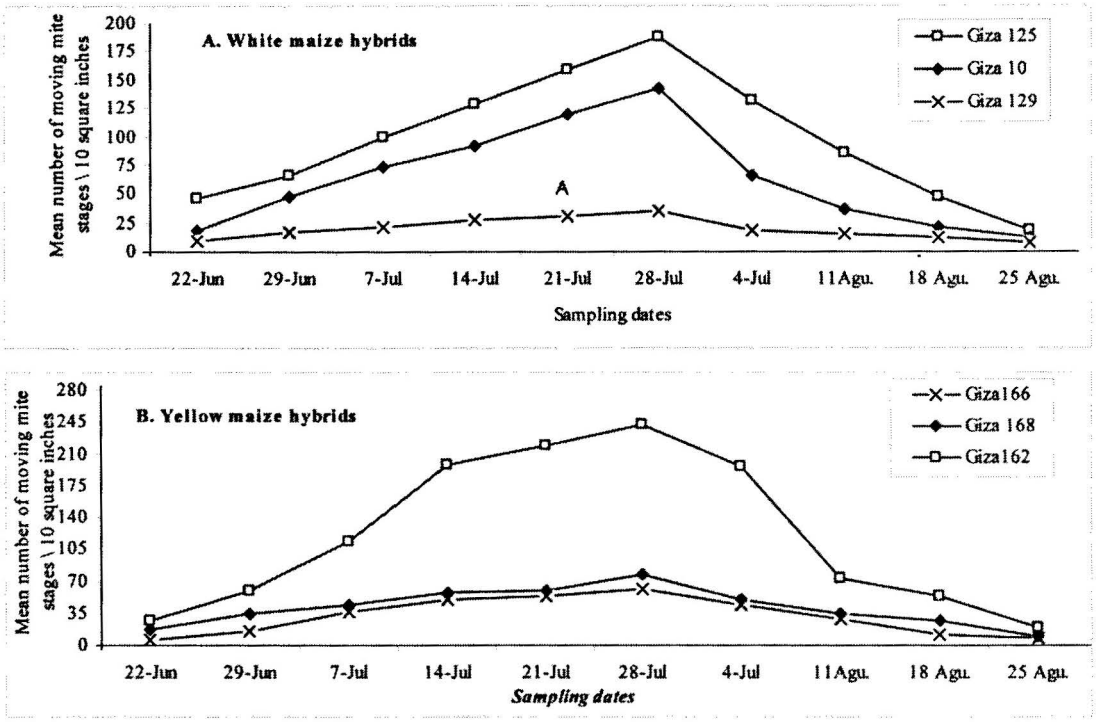


Fig. (1, A-B): Population dynamics of *T. urticae* infestation on white and yellow maize varieties at Sharkia Governorate during the 2008 growing season.

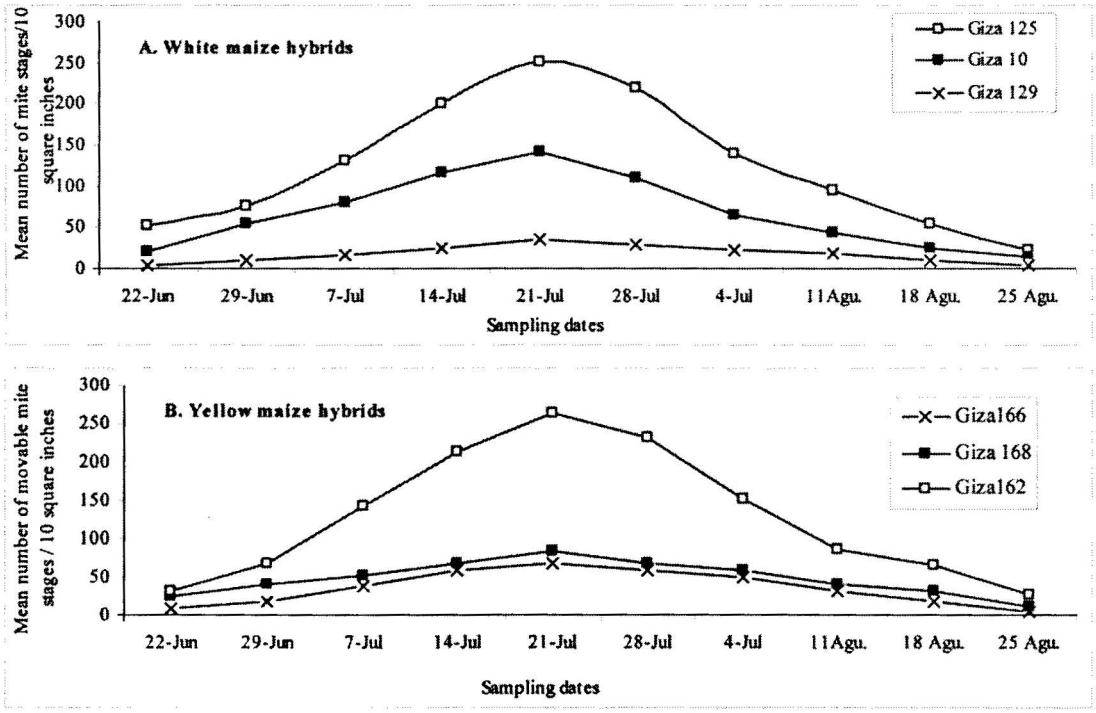


Fig. (2, A-B): Population dynamics of *T. urticae* infestation on white and yellow maize varieties at Sharkia Governorate during the 2009 growing season.

recorded the same conclusion when studied the population fluctuation of *T. urticae* on maize and soybean varieties.

3- Relationship between mite infestation and chemical contents of maize leaves

Total carbohydrates, total protein, nitrogen, phosphorus and potassium were estimated in maize leaves during 2009 growing season.

As shown in Fig. (3, B&C) , data and statistical analysis cleared that the total protein and nitrogen contents in the white hybrids, ranged between 44.66±3.92 and 3.63 ± 0.31 mg/gm dry weight for the most significant susceptible hybrid, Giza 125 to 29.00±2.81 and 2.63±0.63 mg/gm dry wt. for the highly significant tolerant hybrid, Giza 129, respectively. As for yellow hybrids, the values for total protein and nitrogen content ranged between 37.66±2.33 and 3.13±0.20 mg / gm dry wt. for the highly significant susceptible hybrid, Giza 162 to 31.00±5.03 and 2.43±0.17 mg / gm dry wt. for the most tolerance hybrid, Giza 166, respectively.

The same trend was recorded in the case of phosphorus content among the yellow maize hybrid Giza 166 where it was the most susceptible giving 3.30±0.15 mg/gm dry wt., while Giza 166 appeared to be the lowest infested one giving 1.41±0.07 mg/gm dry wt., Fig. (3, D).

On the other hand, the quantities of the total carbohydrates and potassium in maize leaves were slightly compared to the total protein and nitrogen. The higher amounts of both total carbohydrates and potassium were presented in Giza 168 and Giza 162 hybrids that gave 11.30±0.35 mg/gm dry wt., and 99.00±4.58 mEq / gm dry wt., respectively.

While the lower amounts recorded were 9.36 ± 0.18 mg / gm dry wt. and 70.66 ± 3.71 mEq / gm dry wt. for Giza 166 and Giza 10 hybrids, respectively (Fig. 3, A-E).

Positive correlation was obtained only between mite infestation and both nitrogen and total protein contents in maize leaves (Table, 3).

The most susceptible single cross hybrids, Giza125 and 162 gave positive significant correlation with total protein and nitrogen comparing with other white and yellow maize hybrids, respectively. The statisticale analysis showed a negative insignificant correlation between number of moving mite stages and total carbohydrates in maize leaves

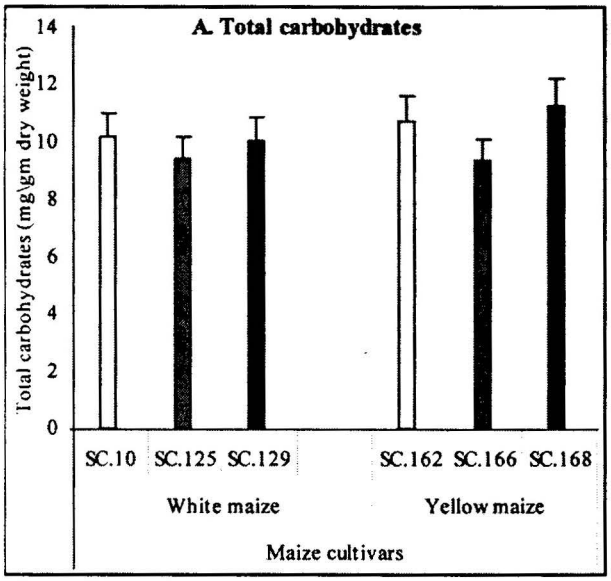
Table (3): Correlation coefficient between the population of *T. urticae* and phytochemical contents of maize leaves during 2009 growing season.

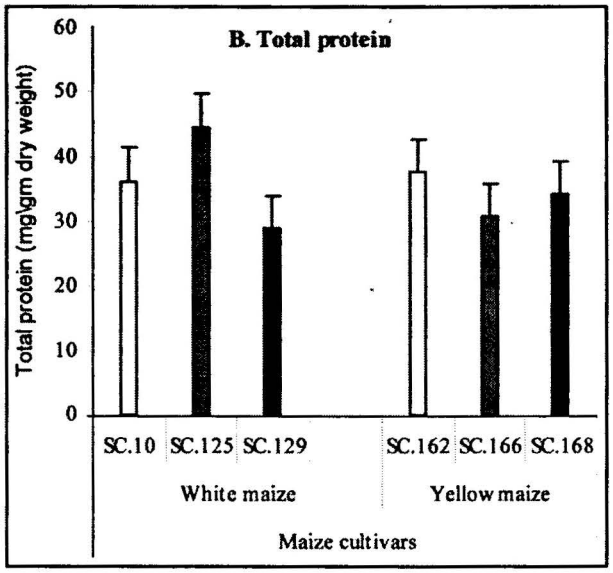
Maize hybrids	Total Carbohyd.	Total protein	N	P	K
Giza 10	- 0.383	0.987	0.976	- 0.077	- 0.943
Giza 125	- 0.614	0.997*	0.994*	- 0.387	- 0.954
Giza 129	- 0.141	0.864	0.985	- 0.512	- 0.984
Giza 162	- 0.727	0.989*	0.975*	0.838	0.188
Giza 166	- 0.428	0.920	0.853	0.550	0.676
Giza 168	- 0.094	0.949	0.876	0.603	0.856

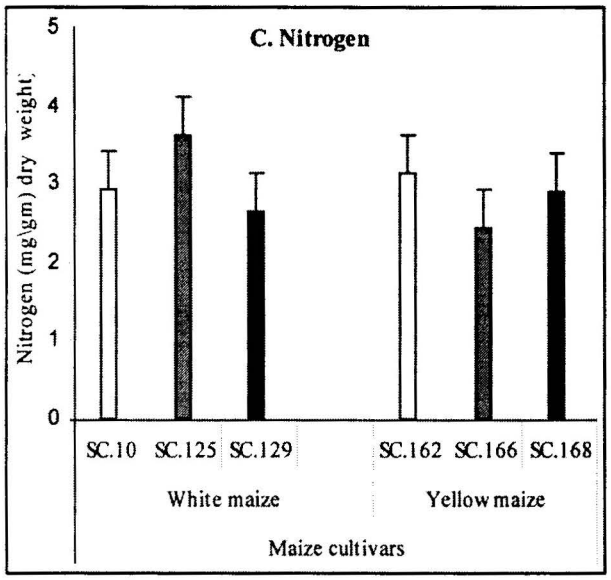
Similar results were obtained by Sawires (1992) when testing spider mite infestation and chemical contents of maize leaves. Ahmed (1994) suggested that resistance may be attributed to low protein and amino acid contents of leaves, which provided less nutritive diet for *T. urticae*. The resistance cultivars of rose, which recorded lowest spider mite population, had lower amounts of nitrogen and higher amounts of carbohydrates than the more susceptible cultivars (Hole & Salunkhe, 2005).

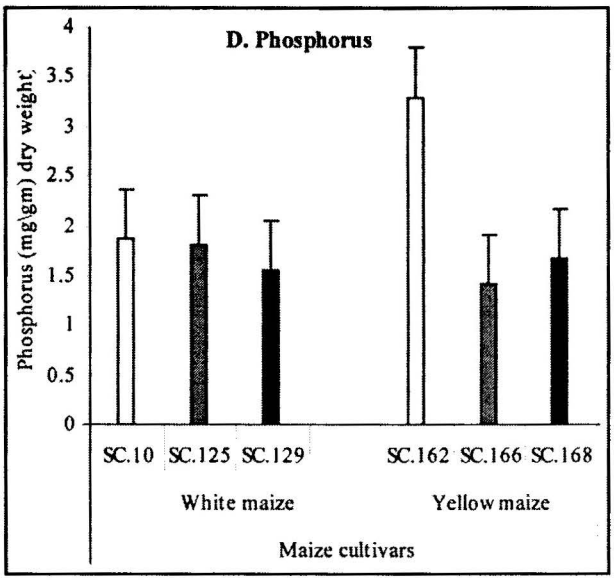
Tulisalo (1972) reported that, fecundity of *T. urticae* was independent of variations in type and levels of carbohydrates because of different pathways for carbohydrate metabolism exist. In addition, Zaher *et al.*, (1980) found insignificant positive correlation between infestation of soybean with *T. urticae* and leaf nitrogen contents. In contrary, Magouz *et al.*, (2006) and El-Sanady *et al.* (2008) reported a negative correlation between the population density of moving mite stages and nitrogen contents in soybean leaves.

The obvious correlation between spider mite infestation and both nitrogen and total protein contents in leaves may be explained by Hoffland *et al.*, (2000) who found that, the protein concentration in tomato leaves is positively correlated with nitrogen availability. In comparing plant species as a host for mites, it was found that nitrogen levels in leaf tissues are positively correlated with rates of mite development and fecundity Hanna *et al.*, (1982). Maia & Busoli (1992) observed a reduction in the duration of pre-oviposition period and increase in oviposition period as the nitrogen contents increased. Furthermore, Trindade and Chiavegato (1999) observed that nitrogen and phosphorus deficiency or potassium excess caused reduction in the reproduction rate of *T. urticae*. In conclusion, white and yellow maize varieties, Giza 125 and Giza162, respectively, were the most susceptible single cross hybrids to *T. urticae*









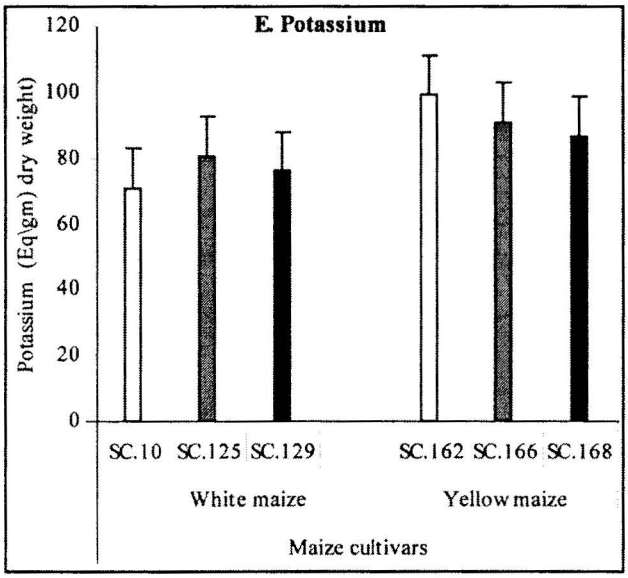


Fig. (3, A-E): Phytochemical analysis of dried leaves of white and yellow maize varieties during 2009 season.

infestation. Also, a positive significant correlation occurred between spider mite infestation and both nitrogen and total protein contents in maize leaves.

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