

FIELD AND LABORATORY TRIALS TO EVALUATE CERTAIN SINGLE AND TRIPLE CROSSES OF MAIZE HYBRIDS FOR THEIR RELATIVE SUSCEPTIBILITY TO SPIDER MITE *Tetranychus urticae* KOCH INFESTATION IN RELATION TO LEAVES PHYTOCHEMICAL CONSTITUENTS (ACARI: ACTENIDIDA: TETRANYCHIDAE)

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ABSTRACT

Field and laboratory trials were carried out to evaluate six maize hybrids of each single and three-way crosses for their relative susceptibility to spider mite, *Tetranychus urticae* Koch infestation, in relation to leaves phytochemical analysis. Obtained data cleared that the triple hybrids were more infestation than single crosses hybrids during the course of study. The level infestation of single crosses hybrids could be divided into two categories; resistance and moderate infestation, while the triple crosses hybrids could be divided into three categories, moderate, susceptible and highly susceptible to spider mite infestation. Phytochemical components, the total carbohydrates, total protein, nitrogen, phosphorus and potassium were estimated and demonstrated that there were correlation between spider mite level infestation and leaves phytochemical constituents.

Keywords: Maize hybrids, spider mite, phytochemical analysis.

INTRODUCTION

Maize (*Zea mays* L.) occupies an important position among the cereal crops. It is considered one of the important strategic cereal crops in Egypt. It is widely used in bread making in rural areas of the country. It conforms the basis for several food industries such starch, fructose and corn oil, as well as the component of animal feed (maize for silage including green maize and grain maize) there is a new utilization of maize as silage (with or without ears), Taha *et al.*, (1994 a). Recently, the government policy is to mix wheat flour (80 %) with corn flour (20 %) in bread making allover the country in order to reduce the imports of wheat grains. The annual national demand of maize is about 9.0 million tons, which is more than the total national production by about three million tons, these imported annually, therefore, it is advisable to encourage farmers towards planting maize especially in the new reclaimed lands. The cultivated area of maize is about 2 million feddan annually planted in summer season which competition with other summer crops. Spider mite considered one of the main pests infesting field crops and cause sever crop losses in Egypt. Taha *et al.*, (1994 a, b) and Saweries (1993), Baker and Connell (1963) reported that spider mites damage the protective leaf surface and may inject toxic substance into the leaf and interfere with vital possesses. Dahms (1972) identified 16 possible criteria to evaluate pest tolerance in plants among which are the number of motile stages of pest attracted to plant when given a free choice, the length of developmental stages, fecundity or number of eggs laid by female, leaves components and thickness of cuticle epidermis of upper and lower surface of

plant leaves. The aim of the present study is to estimate the relative susceptibility of some local maize single and triple crosses hybrids to spider mite, *Tetranychus urticae* Koch infestation in relation to some phytochemical analysis of leaves constituents

MATERIALS AND METHODS

Field and laboratory studies were carried out to evaluate (6 single and 6 triple crosses) of maize hybrids locally developed by Maize Research Program, Maize Res. Dept. Field Crops Res. Institute (ARC) namely:

1-Single Cross (SC) hybrids: Sc10, Sc125, Sc128, Sc129, Sc155 and Sc162.

2-Three-Way Crosses (TWC) hybrids :TWC 310, TWC 311 , TWC 314 , TWC 327 , TWC 329 and TWC 352

Field experiment:

An area a of 1.2 feddan (50.4 x 100 m=5040 m²) was chosen , prepared for cultivation and divided into equal 12 plots each of 4.2 x100 m .each plot divided into four replicates each of (4.2 x 25 m. = 105 m²). The space between rows 0.7 m (6 rows / plot) between hills 0.3 m (about 330 hills / row) one plant each hill by one side. Experiment was kept free from any pesticides application during the period of investigation. The normal agricultural practices were carried out as recommended. Maize seeds were sewing on May 21, 2011.

Sampling for natural infestation rate estimation

Twenty five days post plantation, samples were collected 10 days intervals till the end of season, samples put in paper bages, transferred to laboratory for examination using stereoscopic binocular microscope 10 leaves per replicate (40 leaves / hybrid), eggs and motile stages of spider mite *Tetranychus urticae* Koch were counted in two sq. inches lower surface of each leaf.

Photochemical analysis of leaves maize hybrids

A sample of each maize hybrids were collected, transferred to laboratory, cleaned, washed with distilled water and dried in an oven at 60 °C for 72 h. then grinded into fine powder. Some specific phytochemical constituents of each maize hybrids leaves dry weight were determined as follows:

- 1- Total carbohydrates were extracted from the plant leaves and prepared to assay according to Aggour *et al.*, (2001).
- 2-Total protein contents were determined using Kjeldatherm according to Knight *et al.*, (1972).
- 3-Total nitrogen was determined by distillation in micro-kjeldahi apparatus (Chapman and Praft, 1961).
- 4- Total potassium was determined using the flame photometer according to (Dewis and Freites, 1970).
- 5- Total phosphorus was calorimetrically determined according (Murphy & Rieibly 1962).

RESULTS AND DISCUSSION

To evaluate the relative susceptibility of six single and six three-way crosses of maize hybrids to spider mite, *Tetranychus urticae* infestation three criteria were taken into consideration, the average number of eggs, motile stage of spider mites infesting each hybrid during the seasons and phytochemical analysis of some leaves constituents. As shown in tables (1, 2, 3 &4) obtained data and statistical analysis revealed that there were highly significant differences between maize hybrids in their relative susceptibility to spider mite, *T. urticae* infestation during the season 2011 at Beni_ Suef Governorate, whereas, the population of spider mites started in few numbers after 25 days of sowing date on all tested single and triple crosses of maize hybrids, with definite trend, whereby the population of eggs and motile stages increased gradually until reached its peak during the last week of July according to each hybrid, after that the number of eggs and motile stages decreased gradually until the end of season. The level infestation of spider mites throughout the season was demonstrated that the six single cross hybrids could be divided according to the obtained data and statistical analysis into two categories; resistance and moderate of leaf infestation. Obtained results as shown in Tables (1&2) revealed that single cross hybrids SC 155 and SC 162 was moderate infestation because of the average number of mites was (4.40 & 4.60) individuals / 2 sq. inch. While the rest single hybrids were resistance to mite infestation, with rating 1.80, 2.15, 2.88 and 3.15 mites / 2 sq. inch, while, the three-way crosses hybrids (TWC) could be divided into according to the obtained data and statistical analysis into three categories; moderate, susceptible and highly susceptible to spider mite, *T. urticae* infestation whereas, TWC 310 and TWC 329 were moderate infestation, which aggregated a total number of eggs and motile stages (1556.5 &1433.0) and (1731.9 & 1638.9) with rating infestation (4.5 &5.1) mites / 2 sq. inch, respectively. The triple crosses TWC 314 and TWC 311 were susceptible to mite infestation; therefore, they received an average numbers during the season (2002.5 and 2476.0) motile stages, with rating infestation 6.25 and 7.73 mites / 2 sq. inch. On the other hand TWC 352 and TWC 327 were highly susceptible to infestation, whereby, they harbored an average numbers of eggs and motile stages (2559.0 &3620.8) and (2785.6 &3845.4) mites during the season, with rating infestation of 11.32 and 12.01 movable stages / 2 sq. inch, Tables (3 &4).

These results coincided with that obtained by Taha *et al.*, (1994a &b) who evaluated certain maize hybrids to spider mite, *T. urticae* and the greater sugar-cane borer *Sesamia cretica* infestation, Azouz (2005) who studied the relative susceptibility of some single and triple crosses of maize plants to spider mite, *T. urticae* infestation.

Phytochemical analysis of leaves for each single and triple of maize hybrids:

The phenomenon of plant resistance to pests is quality that enables the plant to avoid, tolerate or recover from the effect of pests that would cause greater damage to other varieties of the same species under similar conditions. Phytochemical components of the total carbohydrates, total

protein, nitrogen, phosphorus and potassium were estimated. As shown in Tables (5 &6) data and statistical analysis cleared that the total carbohydrates ranged between 9.65 mg / dry weight for resistance single crosses hybrids to 13.82 mg / gm to for intermediate single crosses, while, its range between 13.55 mg/gm dry weight for intermediate tree way crosses hybrids to 15.75 mg/gm for highly susceptible triple crosses whereas, carbohydrates accelerate reproduction of spider mites (Henneberry, 1962a).The quantities of total protein were small compare with that of total carbohydrates, the small amounts of protein were found in leaves of single cross SC10 and the triple hybrid, TWC 310, Tables (5&6). The population of spider mite, *T. urticae* increased as nitrogen and phosphorus increased, while the opposite occurred with potassium, Tables (2,4,5&6).These results coincided with that obtained with El-Sanady (2008), Yokama (1978), Taha and El-Raies (1996) and Zaher and Hanna (1980).

Table (1):-Evaluation six single cross hybrids of maize for their relative susceptibility to spider mite *T. urticae* infestation (No. of eggs) at Beni- Suef Governorate during the season 2011.

Inspection date	Hybrids					
	Average No. of eggs / 80 sq. inches					
	SC10	SC128	SC129	SC125	SC155	SC162
June 15	12.8	13.8	33.0	40.3	59.9	77.3
June 25	15.9	19.2	53.2	58.2	98.1	157.1
July 5	38.5	53.3	80.6	120.7	194.1	216.0
July 15	190.7	207.0	190.1	260.0	303.9	352.9
July 25	212.5	240.0	352.2	284.1	366.8	406.0
Aug. 4	259.7	252.6	338.1	424.0	500.2	531.2
Aug. 14	140.4	154.3	189.8	176.3	340.9	301.2
Aug. 24	72.0	67.5	129.2	161.6	127.9	175.0
Total	942.5	1007.7	1366.2	1525.2	1991.8	2216.7
Mean	117.1	125.9	170.8	190.7	248.9	277.1
L.S.D. (5%)	127.71 (Hybrids)					
L.S.D.(1%)	170.75 (Hybrids)					

Table (2):- Evaluation six single cross hybrids of maize for their relative susceptibility to spider mite *T. urticae* infestation (No. of motile stages) at Beni- Suef Governorate during the season 2011.

Inspection date	Hybrids					
	Average No. of motile stages / 80 sq. inches					
	SC10	SC128	SC129	SC125	SC155	SC162
June 15	8.0	10.6	27.5	28.8	42.2	51.5
June 25	10.6	12.8	38.0	41.6	78.4	92.4
July 5	27.5	31.2	67.2	70.7	128.2	135.0
July 15	112.2	138.0	146.2	162.3	178.8	181.1
July 25	141.8	150.0	207.2	189.4	204.5	290.0
Aug. 4	162.3	168.4	225.4	265.0	392.6	354.1
Aug.14	82.6	81.2	118.6	135.6	238.5	256.3
Aug .24	55.4	48.5	92.3	115.4	105.4	111.8
Total	600.4	690.7	922.4	1008.8	1409.2	1472.2
Mean	75.1	80.1	115.3	126.1	158.8	184.02
L.S.D. (5%)	81.47 (Hybrids)					
L.S.D.(1%)	108.92 (Hybrids)					

Table (3):-Evaluation six three- way cross hybrids of maize for their relative susceptibility to spider mite *T. urticae* infestation (No. of eggs) at Beni- Suef Governorate during the season 2011.

Inspection date	Hybrids					
	Average No. of eggs / 80 sq. inches					
	TWC310	TWC329	TWC314	TWC311	TWC352	TWC327
June 15	14.4	25.0	48.6	35.0	60.0	66.7
June 25	16.8	44.5	66.2	97.4	101.4	120.4
July 5	94.4	101.2	112.8	168.4	231.5	252.5
July 15	168.5	194.3	220.0	285.0	340.0	378.5
July 25	320.0	345.0	350.4	398.5	481.2	499.0
Aug. 4	394.4	408.8	418.5	428.6	614.4	680.8
Aug. 14	312.2	344.5	388.6	395.2	415.1	412.4
Aug. 24	225.8	268.6	292.4	284.2	314.8	375.3
Total	1556.5	1731.9	1897.5	2092.3	2559.0	2785.6
Mean	194.6	216.5	327.2	261.5	319.9	348.2
L.S.D. (5%)	165.32 (Hybrids)					
L.S.D.(1%)	221.02 (Hybrids)					

Table (4):-Evaluation six three- way cross hybrids of maize for their relative susceptibility to spider mite *T. urticae* infestation (No. of motile stages) at Beni- Suef Governorate during the season 2014.

Inspection date	Hybrids					
	Average No. of motile stages / 80 sq. inches					
	TWC310	TWC329	TWC314	TWC311	TWC352	TWC327
June 15	32.2	38.6	29.7	45.4	62.4	72.5
June 25	58.6	92.1	85.4	120.3	123.2	135.4
July 5	102.4	182.6	195.0	269.5	396.8	445.6
July 15	212.4	248.8	272.5	340.0	484.5	510.5
July 25	250.1	305.5	344.2	433.8	682.4	795.9
Aug. 4	288.4	320.2	450.0	514.5	718.1	798.4
Aug. 14	182.3	264.5	351.3	440.1	665.2	652.1
Aug. 24	124.2	186.8	274.4	312.4	482.2	485.0
Total	1433.0	1638.9	2002.5	2476.0	3620.6	3845.4
Mean	179.1	204.9	250.3	309.5	452.6	480.6
L.S.D. (5%)	184.37 (Hybrids)					
L.S.D.(1%)	246.49 (Hybrids)					

Table (5):- Phytochemical analysis of leaves dry weight of six single crosses of maize hybrids.

Ph. analysis Hybrids	Average No. of mites/ 80 Sq. inch.	Concntration of phytochemical components				
		N %	P %	K %	T. carbohydrtes mg/ gm	T. protein mg/ gm
SC10	70.10	1.95	0.50	2.42	9.65	4.25
SC128	80.10	1.99	0.92	2.11	11.74	4.81
SC129	111.30	2.24	0.96	2.01	12.45	5.56
SC125	126.10	2.42	1.20	1.95	14.56	5.62
SC155	157.20	2.81	1.24	1.82	13.56	5.84
SC162	184.02	3.00	1.50	1.80	13.82	6.65
Total	728.82	14.41	6.32	12.11	75.78	32.72
Mean	121.47	2.40	1.05	2.01	12.63	5.45
L.S.D.(5%)		21.19 (Hybrids)				
L.S.D.(1%)		28.53 (Hybrids)				

Table (6):- Phytochemical analysis of leaves dry weight of six three-way crosses of maize hybrids.

Ph. analysis Hybrids	Average No. of mites/ 80 Sq. inch.	Concntration of phytochemical components				
		N %	P %	K %	T. carbohydrtes mg/ gm	T. protein mg/ gm
TWC310	189.10	3.00	1.62	2.85	13.55	5.55
TWC329	204.90	3.15	1.75	2.44	13.78	5.04
TWC314	250.30	3.42	1.84	2.10	14.84	6.00
TWC311	309.50	3.50	1.88	1.92	14.42	5.45
TWC352	452.50	4.12	1.95	1.56	15.62	5.63
TWC327	480.60	4.45	1.98	1.38	15.75	4.80
Total	1886.9	21.61	11.02	10.81	87.96	32.47
Mean	314.48	3.60	1.84	1.80	14.66	5.41
L.S.D.(5%)		60.33 (Hybrids)				
L.S.D.(1%)		81.23 (Hybrids)				

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تجارب حقلية ومعملية لتقييم القابلية النسبية لبعض الهجن الفردية والثلاثية
للإصابة بالعنكبوت الاحمر *Tetranychus urticae* وعلاقتها بالمحتويات
الفيتوكيميائية (Acari :Actinedida: Tetranychidae)

مريم عبدالرحمن السندي
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اجريت تجارب حقلية ومعملية لتقييم قابلية الإصابة لست هجن فردية وستة هجن ثلاثية
للذرة للإصابة بالعنكبوت الاحمر العادى *T.urticae* وعلاقتها بمحتوى الاوراق من العناصر الكبرى
والكربوهيدرات والبروتينات. اوضحت النتائج المتحصل عليها ان الهجن الثلاثية اكثر اصابة من
الهجن الفردية خلال مرحلة الدراسة وعلى ذلك امكن وضع الهجن الفردية فى مستويين للإصابة
متوسطة ومقاومة للإصابة بينما الهجن الثلاثية تم وضعها فى ثلاثة مستويات متوسطة وحساسة
وعالية الحساسية للإصابة بالعنكبوت الاحمر. التحليل الفيتوكيميائية للكربوهيدرات والبروتينات
والعناصر الكبرى النيتروجين والفسفور والبوتاسيوم تم تقديرها حيث وجد ارتباط بين مستوى
الإصابة بالعنكبوت الاحمر وهذه المحتويات حيث تؤدي الكربوهيدرات والبروتينات والنيتروجين الى
زيادة تعداد العنكبوت الاحمر وعلى العكس فان زيادة البوتاسيوم يؤدي الى خفض تعداد العنكبوت
الاحمر ولذلك يوصى باضافة الاسمدة البوتاسية بالمعدلات الموصى بها لاحداث توازن غذائى للنبات
وخفض الإصابة بالافات الناقية الماصة.