Resistance of Two Eggplant Cultivars Against the Two-Spotted Spider Mite; *Tetranychus urticae* Koch Infestation, with Notes on its Biology

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ABSTRACT

Field and laboratory studies revealed that the eggplant Black baity cultivar recorded the highly significant susceptible to infestation with *Tetranychus urticae* Koch compared with Baity cultivar.Susceptibility of eggplant cultivars to infestation may be affected by plant leaf morphological structure; length, thickness and density of leaf trichomes. Average number of trichomes /mm^2 leaf was 27.7 and 21.6 for Baity and Black baity cultivars, respectively. The highest mean number of *T. urticae* movable stages on leaves of Black baity cultivar was associated with higher levels of total amino acids and total carbohydrates and with the lowest levels of total phenolic compounds and tannins. Durations of egg, different immature stages, life cycle and life span of *T. urticae* female were the shortest when reared on leaves of Black baity cultivar and the longest on leaves of Baity cultivar. The two eggplant cultivars affected the life table parameters of *T. urticae* .The shortest mean generation time (T) was 12.08 days on Black baity cultivar, and the longest was 13.21days on Baity cultivar .The highest net reproductive rate (R_o) was 32.01 females/female on Black baity cultivar, and the lowest was 21.13 females/female on Baity cultivar.

Key Words: Eggplant, *Tetranychus urticae* ,Susceptibility, Trichomes and Life table.

INTRODUCTION

Eggplant, *Solanum melongena* L., (Solanaceae) is a common and popular vegetable crop grown in the subtropical and tropical countries (Filgueira, 2000).In Egypt,the tetranychid mite ;*Tetranychus urticae* Koch is considered one of the major pests which attack eggplant (Abdallah, 2002 and El-Saiedy & Romeih, 2007). Evaluation of the susceptibility of some eggplant 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 of plant leaves which normally vary according to plant cultivar may affect the population levels of herbivorous pests. There were several studies on the host plant resistance to the infestation with *T. urticae*; (Crooker, 1985,Tomczyk *et al.*, 1987, Ibrahim *et al.*, 2008 , Afifi *et al.*, 2009, Abdallah *et al.*, 2009 and El-Saiedy *et al.*, 2011). Karaat (1991) reported that host plants had a more significant effect on reproductive potential of tetranychids than that on developmental rate. Therefore, the present study was conducted to determine the resistance of two eggplant cultivars; Baity and Black baity to infestation with *T. urticae*, also, the mite biology and life table parameters were carried out on leaves of the two eggplant cultivars.

MATERIALS AND METHODS

Imaging the bottom surface of two eggplant cultivar leaves using the scanning Electron Microscopic technique (SEM) (Joel GM 4200) 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 eggplant leaves were determined as follow: Total phenol content was determined by Folin- Ciocateu method as modified by Singelton and Rossi (1965).Total carbohydrates were extracted from the plant leaves and prepared for assay according to Crompton and Birt (1967). Total amino acids were calorically assayed by ninhydrin reagent according to the method described by Lee and Takabashi (1966) .The amount of Tannins in extracts was determind by Folin- Ciocateu method as modified by Singelton and Rossi (1965). Chemical analysis was carried out during the growing season of the two eggplant cultivars during two periods; peak and late season of infestation. Eggplant leaves were collected and transferred to laboratory and dried under room condition for chemical analysis.

The duration of developmental stages, life cycle, life span, fecundity of *T. urticae* were studied on the leaves of two eggplant cultivars; Baity and Black baity under laboratory conditions of 25±1°C and 70% R.H. Eggplant leaf discs (2 cm diameter) with under surface upward, were placed on cotton bed in Foam dish (20 cm × 15 cm); the cotton bed was kept wet. Ten *T. urticae* adult females collected from the laboratory stock culture were transferred to each disc

for laying eggs. For solitary rearing, newly deposited eggs of the same age were transferred singly, each to a leaf disc. Every dish contained 25 discs. Dishes with discs were kept in an incubator at temperature of 25±1°C and 70% relative humidity. Discs of all treatments were examined twice daily and all biological aspects were recorded until death of mite individuals.

Life tables of *T. urticae* were constructed from the life history and fecundity data. The actual death occurred in egg and immature stages was taken into account when the female survival rate at temperature was determined. Life tables were constructed using the survival data of a specific age class (L x) and the female offspring produced per female in each age class (m x). The net reproductive rate (R_o), the mean generation time (T), the intrinsic rate of increase (r_m), and the finite rate of increase (λ) were estimated according to Birch (1948) using the basic computer program of Abou-Setta *et al.* (1986).

RESULTS AND DISCUSSION

According to the mean number of *Tetranychus urticae* movable stages / leaf existed through the two successive seasons; 2011 and 2012, the obtained results show that the tested eggplant cultivars (Baity and Black baity) significantly ($P > 0.05$) differed in their susceptibility to infestation with *T. urticae* . Black baity cultivar was the highly significant susceptible to infestation ,it recorded the highest infestation numbers (135.54 and 115.03 individuals/ leaf) and the highest infestation percentages (63.25 & 62.3%) during the two successive seasons, respectively; while the lowest infestation numbers and infestation percentages were recorded on Baity cultivar (Table 1). These results were in agreement with those obtained by Ibrahim *et al.*, 2008; Abdallah *et al.*, 2009 and El-Saiedy *et al.*, 2011.

The differences between the two eggplant cultivars in their leaf morphological structure were studied. Leaf trichome consisted of a main branch perpendicular to the leaf surface and the other branches are attached to the main branch in a radiating fashion, parallel or subparellel to the leaf surface with trunk as reported by Patrick *et al.*,(2000) (fig. 1). Trichomes shape, length and density differed in two eggplant cultivars, Baity cultivar has numerous, longer and thicker trichomes than those of Black baity cultivar. The number of trichomes were 27.7 and 21.6 /mm^2 for Baity and Black baity cultivars respectively. Also the length of trichomes were 483.94 and 542.63 mμ for Baity and Black baity respectively , the highest number of trichomes or the trichomes density in the baity cultivar could be the resistance factor that deter both of *T. urticae* feeding and oviposition. Afifi *et al.* (2009) and El-Saiedy *et al.*, (2011) reported that length, thickness and density of leaf trichomes affect strawberry plant resistance to infestation with *T. urticae*.

Obtained results indicated that, positive relationships occurred between mite infestation levels and total amino acids, free total carbohydrates in eggplant cultivars, while negative relationships were found with tannins and nearly shown with total phenolic compounds (Table 2). These results are in agreement with those recorded by; Tomczyk *et al.*, 1987; Leite *et al.*; 2003 Ibrahim *et al.*, 2008; Abdallah *et al.*, 2009 and Afifi *et al.*, 2009 and El-Seidy *et al.*, 2011.

The two different eggplant cultivars affected the durations of developmental stages as well as adult longevity and female fecundity of *T. urticae* (Table 3). Female life cycle averaged 8.72 and 11.62 days, adult longevity averaged 11.08 and 9.63 days when *T. urticae* was reared on leaves of Black baity and Biaty cultivars respectively. Male showed similar trend of female but with slightly shorter periods. Crooker (1985) indicated that the chemical constitution of the leaf might influence fecundity, mortality and development of the immature stages of spider mites, especially the host plant nitrogen content.

The number of deposited eggs per female and daily rate of *T. urticae* averaged 43.26& 7.09 and 28.43&5.0 eggs when reared on leaves of Black baity and Baity respectively. Daily egg production of *T. urticae* reached its peak on the fourth day on Black baity cultivar (9.68 eggs/♀/day), and on the third day on Baity cultivar (6.78 eggs/♀/day); egg production decreased gradually thereafter. In general, there was no distinct m_x peak, egg production was distributed over a relatively long time period on the two tested cultivars.

The two eggplant cultivars affected the life table parameters of *T.urticae* The shortest mean generation time (T) was 12.08 days on Black baity cultivar, and the longest was 13.21days on Baity cultivar .The highest net reproductive rate (R_o) of *T. urticae* was 32.01 female/female on Black baity cultivar, and the lowest was 21.13 female/female on Baity cultivar. The intrinsic rate of natural increase (r_m) of *T. urticae* recorded 0.28 and 0.23 female/female /day when reared on Black baity and Baity cultivars, respectively (table 5) . The r_m value is an important parameter, describing the growth potential of a population under food conditions, as it

Table (1): Susceptibility of two eggplant cultivars to *Tetranychus urticae* infestation during 2011&2012 seasons.

Eggplant cultivars	Mean number of *T. urticae* movable stages / leaf			
	season 2011		season 2012	
	Mean No.	Infestation%	Mean No.	Infestation%
Black baity	135.54[a] ± 7.35	63.25	115.03[a] ± 11.29	62.6
Baity	78.73[b] ± 4.67	36.70	68.76[b] ± 7.26	37.41
LSD 0.05	15.5	-	9.75	-

Table (2): Relationship between phytochemical components of two eggplant cultivar leaves and population of *Tetranychus urticae* adult stages.

Eggplant cultivars	Infestation period	Movable stages *T.urticae*	Phytochemical components			
			Total phenolic (mgGAE/gm dw)	Total amino acids (mg alanine/gm dw)	Total carbohydrates (mg/mg dw)	Tannins (mgGAE/g m dw)
Black baity	Peak	224.75	2.23	88.8	35.05	1.24
	Late season	58.34	2.44	89.3	36	1.38
	Mean	166.41	2.33	89.05	35.52	1.31
Baity	Peak	149.99	2.85	82.14	29.30	1.60
	Late season	15.75	2.89	80.18	30.07	1.68
	Mean	134.24	2.87	81.16	29.68	1.64

Table (3): Duration of developmental stages of *Tetranychus urticae* reared on leaves of two eggplant cultivars at 25 ± 1°c.

T.urticae stages	Sex	Duration in days	
		Eggplant cultivars	
		Black baity	Baity
Egg	♀	3.13 ±0.08	3. 82±0.07
	♂	3.5±0.17	3.87±0.11
Larva	♀	1.34±0.10	2.04±0.07
	♂	1.125±0.11	1.8±0.10
Protonymph	♀	2.21±0.08	2.70±0.12
	♂	1.75±0.16	2.11±0.11
Deutonymph	♀	2.09±0.06	2.75±0.9
	♂	1.37±0.21	2.1±0.12
Total immatures	♀	5.64±0.28	7.49±0.22
	♂	4.37±0.15	6.01±0.10
Life cycle	♀	8.77±0.5	11.31±0.2
	♂	7.74±0.15	9.88±0.4
Adult longevity	♀	11.08±0.9	9.63±0.63
	♂	6.37±0.26	5.87±0.29
Life span	♀	20.54±0.5	21.25±0.6
	♂	14.11±0.2	15.75±0.62

Table (4): Longevity and fecundity of *Tetranychus urticae* female on two eggplant cultivars .

Periods in days	Eggplant cultivars	
	Black baity	Baity
Pre-oviposition	1.18±0.09	1.9±0.9
Oviposition	7.5±0.23	5.2±0.2
Post oviposition	2.4±0.13	2.5±0.13
Adult longevity	11.08±0.9	9.53±0.63
Fecundity		
No. of eggs / female	43.26±2.06	28.43±1.6
Daily rate	7.09±0.1	5.0±0.9

Table (5): Effect of two eggplant cultivars on the life table parameters of *Tetranychus urticae*

Parameters	Eggplant cultivars	
	Black baity	Baity
Generation time in day (T)	12.08	13.21
Net reproductive rate (R_o)	32.01	21.13
Intrinsic rate of natural increase(r_m) per day	0.28	0.23
Finite rate of increase (λ) per day	1.30	1.25
Sex ratio (female/total)	73.00	74.00

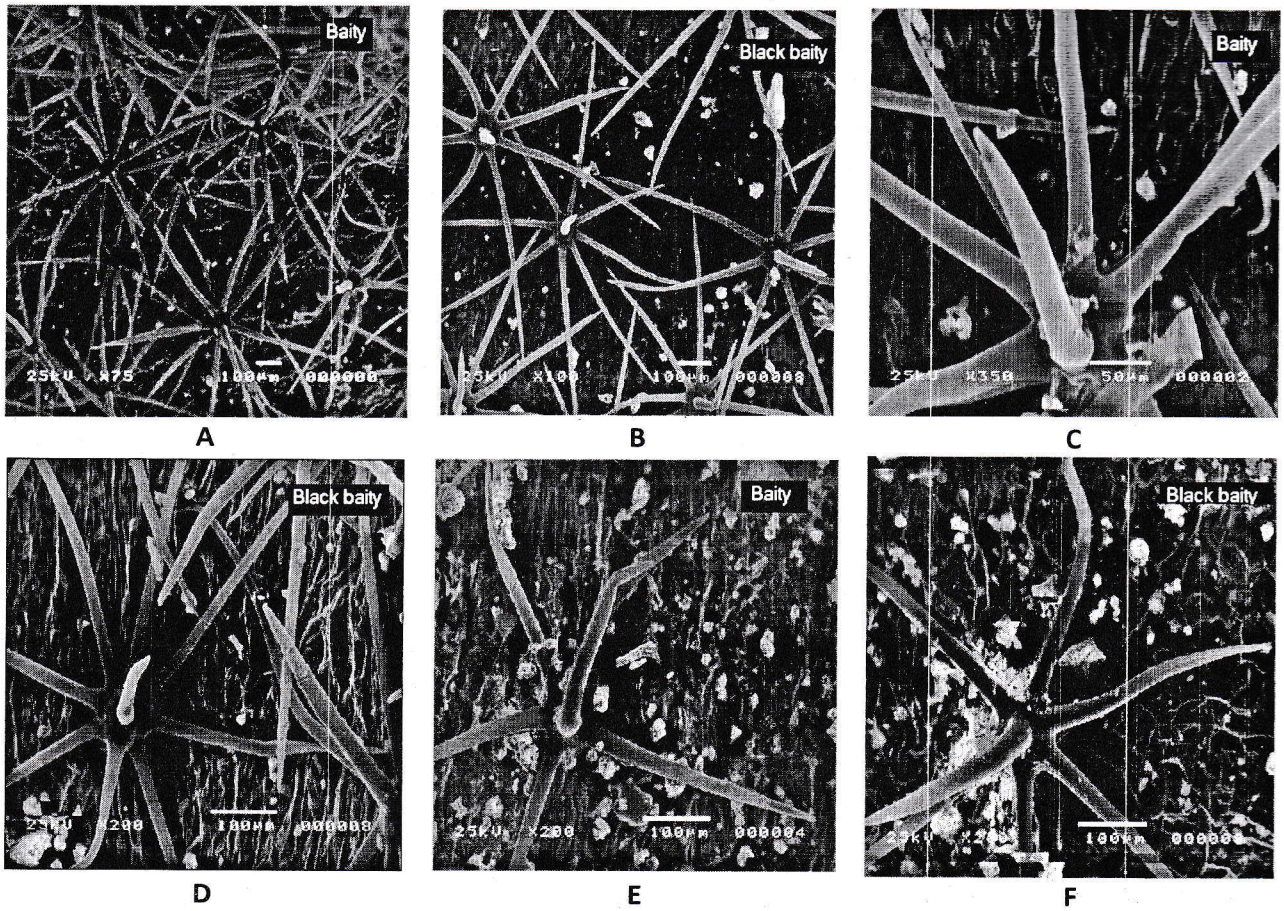

Fig. (1): Scanning electron microscopy of leaves of two eggplant cultivars. A & B: Shape and density of trichomes. C, D, E & F: Trichome shape.

reflects the overall effects of food on development, reproduction and survival characteristic of the populations. These results are in agreement with those recorded by; Southwood, (1978) and Karrat (1991) .Ali and Zaher (2007) and Ali *et al.* (2013).

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