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Evaluation of the resistance of several tomato cultivars to *Bemisia tabaci* (Genn.) (Hem.: Aleyrodidae)

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Abstract
Bemisia tabaci is one of the most important pests of crops and greenhouse products, which is of great importance due to the transmission of viral diseases. In this research, Non-free spawning preference, the length of the prepubertal growth period, and the mortality rate before the maturity of this pest on tomato cultivars including Rio Grand, Ergon, Early Urbana I, and Early Urbana II were investigated under greenhouse conditions. The experiments were designed in a completely randomized block design. The results showed that there is a significant difference at the level of five percent in terms of spawning. The lowest and highest number of eggs per unit of leaf area were observed in Early urbana II and Ergon cultivars, respectively. The results showed that the effect of the host cultivar on the length of the developmental and mortality period of the embryonic and pupal period is not significant, but it is significant on the length of the developmental and mortality period of the nymph period and prepubertal (egg to complete insect). The highest length of the growth period of nymph and prepubertal (egg to complete insect) was recorded on the Early urbana II cultivar and the lowest value of the above parameters was recorded on the Ergon cultivar. The highest losses of the nymph stage and prepubertal (egg to complete insect) were observed on the Early urbana II cultivar and the lowest value of these parameters was observed on the Ergon cultivar. Therefore, the Early urbana II cultivar is more unfavorable to *B. tabaci* than the other cultivars, and it is a desirable attitude to prioritize planting it in the pests management strategy to lessen the damage caused by the *B. tabaci*.

Keywords: Resistance, Bemisia tabaci, Tomato.

Introduction

Bemisia tabaci (Gennadius) (Hemiptera: Aleyrodidae) it is one of the important pests of tomato, which causes a decrease in quantity and quality of production by sucking plant sap (Mound, 1965). Cultivation of pest-resistant plants is one of the ways to fight against this pest. The resistant genotype, with its effect on the morphology, biology and physiology of the pest, causes its population to decrease (Baldin *et al*., 2007)). In recent years, the research conducted in the field of production and use of crop varieties resistant to insects has caused a significant increase in food production in major agricultural areas, for this reason, in most pest management programs, the subject of plant resistance to insects is important (Jounior *et al.*, 2003). The effects of resistance appearing in one cropping season as well as in successive cropping seasons are cumulative over time, and the longer its use, the greater the profit obtained from it. In most cases, insect-

resistant varieties reduce the physical ability and physiological status of the pest, increase the efficiency and host-finding of predators and parasites, and increase the effect of pathogens (Baldin *et al.*, 2007)). There are many factors in the resistant plant that make the host plant species unsuitable for the pest (Samih *et al.*, 2005). Different parts of a plant, leaf age, leaf hairiness are effective in feeding, egg laying, selection and population changes of whiteflies (Bethke & Henneberry, 1984).Lints and fluff can create a physical barrier as well as a suitable microclimate for herbivores (Willmer, 1986). There are several defense mechanisms against pests such as the number, type and chemicals of different glandular trichomes, the thickness of the fruit cuticle in tomato plants (Toscano *et al.*, 2002). Investigations by Setiawati et al. (2009) on the host preference of B.tabaci compared to six tomato cultivars showed that the variety that has a high density of tuberous trichomes causes a decrease in egg laying and feeding of B.tabaci nymphs. Investigations by Butler *et al.* (1988) showed that the low number of B.tabaci on smooth tomato leaves can be attributed to the open canopy of the plant, which causes more light and wind to enter, and higher temperature and lower humidity. The wide genetic diversity of this plant enables targeted breeding programs in resistance to this pest (Toscano *et al.*, 2002). Due to the importance of fresh eating products, especially tomatoes in the food basket of families and the excessive use of pesticides by greenhouse farmers to control B.tabaci , this research focused on this host. In this research, several tomato cultivars grown in different regions of Iran were evaluated from the point of view of their effect on the biological B.tabaci bollworm and their resistance to this pest.

Materials and methods

Cultivation of host plants

In this research, cotton plants were grown in order to maintain the source of insects and tomato cultivars were grown to conduct the experiments of this research. These plants were grown in sufficient quantities during the studies in disposable plastic containers with a diameter of 15 cm and a height of 20 cm, which were filled with suitable soil in greenhouse conditions with a temperature of 25 ± 5 degrees Celsius, a relative humidity of ± 5 60% and the photoperiod was 16 hours of light and 8 hours of darkness. The pots were watered manually once every 2 days, in order to prevent secondary pollution of the plant, distilled water was used for irrigation. To improve the growth of plants, N.P.K nutrient solution was used with irrigation water twice a week. After the establishment of the plants, the pots were moved to cages with dimensions of 80x50x60 cm that were covered with 12 mesh silk cloths (to prevent contamination).

Mass breeding of B.tabaci

Complete insects were collected from the field in order to carry out all the investigations of this research in the research greenhouse as the main source in bulk on the cotton plant in cages with dimensions of 80×50×60 cm covered with 12 mesh silk fabrics. were raised Due to the increase in pest density after 1 to 2 generations, the old pots were replaced with new ones every 15 days.

Egg laying preference of B.tabaci in the No choice test on tomato cultivars

In this experiment, 4 varieties of tomatoes named Ergon, Rio Grand, Early Urbana I, Early Urbana II were evaluated. Selected cultivars of tomato were provided to the insect separately. For this purpose, the water and food solution was poured into glasses and the lid of the glass, which had a hole in the middle for the passage of the plant stem, was placed on it, and then the tomato stem containing 2 main leaves was separated from the plant and placed in the vases. On these glasses, another glass with a net was covered as a glass cage. The two edges of the glasses were connected with plastic adhesive tape, a small hole was placed on the upper glass to place the glass vial of complete insect release. To determine the laying preference, 15 pairs of full-fledged insects of the same age were transferred into the said cages, After 72 hours, the B.tabacis were removed from the upper part of the plant, then the eggs on the leaves were counted. In order to obtain the number of eggs per unit area, the area of the leaves was measured by a leaf area measuring device and the number of eggs per unit area of the leaf was calculated. This experiment was performed in 4 replicates.

The length of the growth period of B.tabaci pre-maturity stages on tomato cultivars

To determine the development period of the pre-puberty stages of B.tabaci, 15 pairs of complete insects of the same age were released into a glass cage (similar to the previous experiment). After 24 hours, the complete insects removed from the upper part of the plant. Binoculars were checked and the hatching time of the eggs was recorded. In this way, the length of the egg growth period was determined for at least 100 eggs. After the eggs hatched and the first instar nymphs settled on the leaf, a map was prepared of the location of the first instar nymphs on the leaf, and based on this map, the length of the pupation period and the beginning of the pupal stage were determined based on the appearance of red eyes. The distance between the appearance of red eyes and the departure of adults was determined and calculated as the length of the pupation period. And thus, the length of the growth period from egg to maturity was measured. 4 replications were considered for each treatment.

Mortality before puberty

During the experiment related to the length of the growth period of pre-puberty stages, determining the percentage of losses of eggs, nymphs and pupae based on counting the number of eggs laid, first-year nymphs and pupae and full insects removed and the difference between the mentioned figures. Done. In this way, based on this experiment, by examining the average percentage of losses of different biological stages of B.tabaci cotton, the effect of cultivar on the loss rate of each biological stage from egg to pupa was determined.

Statistical design and data analysis

Experiments were conducted in a randomized complete block design. Data analysis was done using SPSS software. The averages obtained were compared by Duncan's multiple range test.

Results and Discussion

Egg laying preference of B.tabaci cotton in the No choice test on tomato cultivars

The comparison between tomato cultivars from the point of view of non-free selection of B.tabaci cotton is shown in Table 1. The results showed that there is a significant difference between the selected cultivars in terms of egg laying rate at the five percent level ($F_{3,15}=3.72$, $P=0.04$). The lowest number of eggs was observed in the Early urbana II variety, followed by the Early urbana I variety, and no significant difference was observed between them. The Rio Grand variety is in the middle, and the highest number of eggs was observed in the Ergon variety. This behavior has also been observed in relation to the non-free choice of B.tabaci cotton on tomato cultivars from the point of view of egg laying preference.(Toscana *et al*., 2002; Muigai *et al*., 2002; Setiawati *et al.*, 2009)

Table 1- The average number of eggs per unit of leaf area in different varieties of tomato in the test of no free choice

Cultivar	Number of egg (per cm^2)
Ergon	35.5± 4.6 [b]
Early urbana I	23.5± 2.32 [a]
Early urbana II	22.25± 1.65 [a]
Rio Grand	26.5± 1.65 [ab]

The same letters in each section of the column do not have a statistically significant difference

The length of the growth period of the pre-puberty stages of B.tabaci cotton on tomato cultivars

The comparison between the effect of tomato cultivars from the point of view of the period from egg to complete insect is shown in table 2. In this test, no significant difference was observed between the selected cultivars in terms of the incubation period of the egg and also the length of the pupation period. The average length of egg incubation period on different hosts is consistent. A significant difference was observed between the cultivars in terms of the length of the period of estrus at the level of 1% ($F_{3,15}=6.55$, $P=0.007$). The longest and shortest duration of porgy was recorded in Early urbana II and Ergon cultivars, respectively. A longer molting period can be due to the poor quality of the cultivar for insect nutrition and indicates antibiotic resistance. This behavior has also been observed for the difference of the host effect on the length of the B.tabaci weevil period in the research of Coudriet et al. (1985) as well as Mohanty and Basu (1986), but with the results of the research of Fancelli and Vendramim (2002) that the B.tabaci period is the same. The B.tabaci on different tomato cultivars does not match. This disparity is probably due to the different figures. Also, the results of this study are consistent with the report of Oriani et al. (2011) that there is a significant difference in the completion time of the developmental period from egg to complete insect.

Table 2- The length of the growth period of the pre-puberty stages of B.tabaci on tomato cultivars

Stage	Cultivar			
	Ergon	Rio Grand	Early urbana I	Early urbana II
Egg	6.98±0.25 [a]	7.17±0.09 [a]	7.41±0.29 [a]	7.37±0.11 [a]
Nymph	13.24±0.50 [a]	14±0.18 [ab]	14.55±0.46 [bc]	15.67±0.35 [c]
Pupa	4.04±0.15 [a]	4.16±0.09 [a]	4.07±0.34 [a]	4.09±0.86 [a]
Egg to Adult	24.27±0.49 [b]	25.33±0.27 [ab]	26.04±0.98 [ab]	27.14±0.37 [b]

The same letters in each section of the column do not have a statistically significant difference

Mortality before puberty of B.tabaci cotton on tomato cultivars

The comparison between the effect of tomato cultivars from the point of view of pre-maturity mortality is shown in Table 3. In this test, no significant difference was observed between the selected cultivars in terms of losses in the egg and pupal stages, while in terms of losses in the pupal stage, there was a significant difference at level one. percentage was observed (F3,15=59.75, P=0.00). The highest and lowest porgy losses were observed in Early urbana II and Ergon cultivars, respectively. Also, there was a significant difference between the selected cultivars in terms of pre-maturity losses at the level of 1% (F3, 15=49.02, P=0.00), so that the highest and lowest losses were observed in Early urbana II and Ergon cultivars, respectively. The results of this study are in agreement with the report of Wagner (1995) that there is no significant difference in the percentage of B.tabaci cotton eggs losses on two different cotton cultivars and also with the results of Oriani et al. (2011) that the egg survival percentage is the same on different cultivars. Tomatoes match. In addition, the results of this study agree with the report of Fekrat and Shishebor (2007) that there is no significant difference in pupal stage losses on different hosts. Oriani et al. (2011) reported that the rate of death of B.tabaci nymphs on different hosts is different, which is consistent with the results of the present study. Baldin and Beneduzzi (2010) evaluated the growth and development of eggs to complete insects and mortality of Bemisia tabaci on squash cultivars in laboratory conditions, the highest length of the developmental period in the cultivar Sandy (25.1) and the lowest length of the developmental period (7) 16/) was registered in Novita plus (7/16). The highest rate of porgy mortality was observed in Sandy cultivar (64%) and the lowest in Novita plus cultivar (0%). Their results are consistent with the current research that the cultivar with a shorter growth period has a lower percentage of losses, and conversely, the cultivar with a longer growth period has a higher percentage of losses. Therefore, when a plant variety is more unfavorable for B.tabaci , the growth and development period on that variety is completed for a longer time, it produces fewer generations per year, and on the other hand, the percentage of losses on the unfavorable variety is higher, and over time, the insect population is reduced.

Table 3- Mortality percentage of white B.tabaci cotton pre-maturity stages on tomato cultivars

Stage	Cultivar			
	Ergon	Rio Grand	Early urbana I	Early urbana II
Egg	3.17±0.13 [a]	3.32±0.16 [a]	7.41±0.29 [a]	3.29±0.21 [a]
Nymph	12.02±0.46 [a]	12.61±0.32 [a]	15.8±0.37 [b]	19.17±0.52 [c]
Pupa	3.14±0.21 [a]	3.06±0.17 [a]	3.23±0.40 [a]	3.87±0.20 [a]
Egg to Adult	18.35±0.36 [a]	18.99±0.44 [a]	22.35±0.67 [b]	26.34±0.56 [c]

The same letters in each section of the column do not have a statistically significant difference

Conclusion

According to the obtained results, Early urbana II showed more resistance due to the lower rate of insect spawning on it, as well as the increase in the losses of the porgy stage and the increase in the length of the growth period. On it, it was more than the rest of the cultivars, and the length of the growth period, as well as the amount of losses of the growth stages of the insect on it, was less than the rest of the cultivars.

References

Baldin, E. L. L., Vendramim, J. D., & Lourencao, A. L. (2007). Interaction between resistant tomato genotypes and plant extracts on *Bemisia tabaci* (Genn.) biotype B. *Scientia Agricola*, 64 (5), 476-481.

Baldin, E. L. L., & Beneduzzi, R. A. (2010). Characterization of antibiosis and antixenosis to the whitefly silverleaf *Bemisia tabaci* B biotype (Hemiptera: Aleyrodidae) in several squash varieties. *Journal of Pest Science*, 83 (3), 223-229

Bethke, J. A., & Henneberry J. J. (1984). *Bemisia tabaci: e*ffect of cotton leaf pubescence on abundance. *Southwest Entomology*, 9, 91-94.

Byrne. D. N., & Draeger E. D. A. (1989). Effect of plant maturity on oviposition and nymphal mortality of *Bemisia tabaci* . *Environmental Entomology*, 18, 429-432.

Coudriet, D. L., Prabhaker, N. Kishaba, A. N., & Meyerdirk D. E. (1985). Variation in developmental rate on different hosts and overwintering of the sweetpotato whitefly, *Bemisia tabaci* (Homoptera: Aleyrodidae). *Environmental Entomology*, 14, 516-519.

Fancelli, M., & Vendramim, J. D. (2002). Development of *Bemisia tabaci*(genn) Biotype B on *Lycopersicon* spp. Genotype. *Scientia Agricola*, 59(4), 665-669.

Fekrat, L., & Shishebor, P. (2007). Some biological features of cotton whitefly,*Bemisia tabaci* (Homoptera: Aleyrodidae) on various host plants. *Pakistan Journal of Biological Sciences*, 10(18), 3180-3184.

Jounior, B. A., Toscano , L. C., & Santos ,T. (2003). Non-preference to *Bemisia tabaci* biotype B oviposition in cotton cultivar . *Third International Bemisia workshop.Barcellon*.17-20.

Mohanty, A. I., & Basu, A. N. (1986). Effect of host plants and seasonal factors on intraspecific variations in pupal morphology of whitefly vector ,*Bemisia tabaci* (Genn). *Journal of Entomological Research*, 10, 19-26.

Mound, L. A. (1965). Effects of leaf hair on cotton whitefly population in the Sudan Gezira. *Empire Cotton Growing Review*, 42, 33-40.

Muigai, S. G., Schuster, D. J., Snyder, J. C., Scott, J. W., Bassett, M. J., & McAuslane, H. J. (2002). Mechanisms of resistance in *lycopersicon* gerplasm to the whitefly *Bemisia argentifolii*. *Phytoparasitica*, 30(4), 347-360.

Oriani, M. A. G., Vendramim, J. D., & Vasconcelos C. J. (2011). Biology of *Bemisia tabaci* (Genn) B biotype (Hemiptera, Aleyrodidae) on tomato genotypes. *Scientia Agricola*, 68(1), 37-41.

Samih, M. A., Izadi, H., & Mahdian, K. (2006). Comparative study of the five biological parameters of cotton whitefly *Bemisia tabaci* and silverleaf whitefly *B. argentifolii* reared on cotton under laboratory condition. *Communications in Agricultural and Applied Biological Sciences*, 2, 613-620.

Setiawati, W., Adiarto, B. K., & Gunaeni, N. (2009). Preference and infestation pattern of *Bemisia tabaci* (Genn) on some tomato varities and its effect on gemini virus infestation. *Indonesian Journal of Agriculture*, 2(1), 57-64.

Smith, C. M., Khan, Z. R., & Pathak, M. D. (1994). Evaluation of plants for insect resistance, *In* Smith C. M., Khan Z. R., & Pathak, M. D. [eds], *Techniques for evaluating insect resistance in crop plants* pp. 17-114. CRC Press, Boca Raton, FL.

Toscana, L. C., Boica, A. L., & Maruyama, W. I. (2002). Nonpreference of whitefly for oviposition in tomato genotypes. *Scientia Agricola*, 59, 677-681.

Willmer, P. (1986). Microclimatic effects on insects at the plant surface. In: Juniper, B. & Southwood, R. (eds.), *Insects and the Plant Surface* pp. 65–80. Edward Arnold, London.