Effect of the Whitefly *Bemisia tabaci* (Gennadius) Infestation on Amino Acids, Phenol Content and pH Value in Some Vegetable Plants in Greenhouses

Samia M. Saleh [1] and Layla A. Al-Shareef [2]
[1]Faculty of Agriculture, Alexandria University, Egypt.
[2]Faculty of science for girls, King Abdul Aziz university, Jeddah , Saudi Arabia

Received on: 27 /7/2010 ***Accepted: 26 /10/2010***

ABSTRACT

Some biochemical changes (amino acids , phenol content and pH value) were determined in leaves of six vegetable plant species (cantaloupe, cucumber, zucchini, eggplant, tomato and sweet pepper) infested with *Bemisia tabaci* (Gennadius) in greenhouse. It can be concluded that the highest values of amino acids content were in the cantaloupe and eggplant, but the lowest were in zucchini and sweet pepper. Amino acids content of all infested plants was less than that of non infested plants during all seasons. The infestation led to significant increase in phenol content of all infested plants. Regard to the pH value, the lower plant leaves recorded the highest followed by middle and upper leaves. The infestation of *B. tabaci* led to decrease the pH value in all vegetable leaves except for cucumber.

Key words: Bemisia tabaci, amino acids, phenol content, pH value, vegetable plants, greenhouses.

INTRODUCTION

Whitefly *Bemisia tabaci* (Gennadius) is considered as an agricultural pest that spread rapidly, where it infests vegetables, fruit, ornamental plants and weeds (Morales and Cermeli, 2001). It can be found in greenhouses and open fields where their numbers have increased, especially after the expansion of agricultural in greenhouses (Shaheen *et al.*, 2005 and Chu *et al.*, 2007). The whitefly in all stages (the immature and adult), can cause a direct damage to the plants by sucking the plant sap, which contains carbohydrate, amino acids, phenols and many other important nutrients, and this leads to reduce plants vitality, reduction in productivity and deformation of the leaves, fruit and flowers (Byrne & Bellows, 1991; Lin *et al.*, 1999 and Saleh & AL-Shareef, 2005). It also damages the plant indirectly by secreting the honeydew (Byrne *et al.*, 2003), which is covered with sooty muld fungi, and subsequently interfere with the process of photosynthesis and respiration, which in turn inhibits the plant growth or produces fruit unsuitable for feeding (Buntin *et al.*, 1993 and Bi *et al.*, 2001), and beside that whitefly can transmit viral diseases (Moralrs & Jones, 2004).

There are several chemical changes occur in the leaves of plants as a result of infestation with *B. tabaci*, some are changing in the content of amino acids, phenols, pH value and some mineral elements (Leite *et al.*, 2004). Hong & Rumei (1993) proved that the secreted honeydew of *B. tabaci* and *T. vaporariorum* contains many mineral elements, carbohydrates and almost 18 kinds of amino acids. Laurentin *et al.* (2003) found that the highest population density of the whitefly occurred on the leaves of sesame plants with pH 5.7 - 5.99. Fancelli *et al.* (2005) noted that pH value plays an important role for *B. tabaci* 's preference when laying eggs on the plant.

The current study aims to measure the chemical changes (content of amino acids and phenols, the value of pH) in the leaves of six plants (cantaloupe, cucumber, zucchini, eggplant, tomato and sweet pepper) infested with *B. tabaci* during four seasons compared with the non infested plant leaves under greenhouse conditions

MATERIAL AND METHODS

1. Greenhouse plantation:

This study was conducted at the Agricultural Research Station in Huda Al Sham, located 120 km north east of Jeddah. Two greenhouses were used (size 24 × 10 m^2), and each has been divided in to three sections using a cloth barriers (which helps the ventilation and preventing the whitefly from passing through it). In the first greenhouse three plant types of family Cucurbitaceae which were cantaloupe (*Cucumis melo* L.) , cucumber (*Cucumis sativus* L.), and zucchini (*Cucurbita pepo* L.) were planted. In the other greenhouse, plants of family Solanaceae which were eggplant (*Solanum melongena* L.), tomato (*Lycopersicum esculentum* Mill) and sweet pepper (*Capsicum annum* L) were planted. In each greenhouse, crops were planted in12 longitudinal lines, each 3 lines presented a replicate on an area of 8 × 10 m^2 (four replicates for each plant type).

2. Estimation of chemical changes in plant leaves:

We carried out each experiment on four random leaves which taken from each of non-infested and

infested plants by *B. tabaci* after about six weeks of transplanting. The experiment were repeated over four seasons.

2-1. Estimation of total amino acids:

Extracting the plants and estimating amino acids were done according to the method of Chapman and Pratt (1961) using a spectral absorption apparatus (spectrophotometer) at a wavelength 570 nm.

2-2. Estimation of phenol:

It was done according to Wieslaw Olesz *et al.* (1988). The phenol content in the plant extract was estimated by using a spectrophotometer.

3. Estimation of pH value:

Plants were divided into three sections (top, middle and low). Four samples were collected from each of the three sections of the six plant types (non-infested and infested by *B. tabaci*) according to Berlinger *et al.* (1938). The plant extract was prepared according to Chapman and Pratt (1961). PH value in the extract was measured by using a pH meter, and it was repeated in the different agricultural seasons.

4. Statistical analysis:

The data were subjected to statistical analysis according to Watson & Croft (1993).

RESULTS AND DISCUSSION

1. Amino acids:

The results of statistical analysis showed that there were a highly significante differences in the mean content of amino acids resulted from *B. tabaci* infestation and the different types of plants, as well as the different agricultural seasons.

Table (1) shows that the content of amino acids in non-infested plants were significantly more than in the infested plants by *B. tabaci*, and they were in descending order starting with non-infested plants in winter (0.955) and autumn (0.940) which were not differ significantly from each other, but significantly more than the non-infested plants in spring (0.902) and summer (0.902), which in turn did not differ from infested plants in winter (0.872). The least significant values were of the infested plants in each of spring (0.781), summer (0.781) and autumn (0.751) and they did not differ significantly from each other.

Table (1) also demonstrates the comparison between the non infested and infested plants in all seasons. The highest mean content of amino acids were in cantaloupe (0.911) followed by eggplant (0.879), tomato (0.876) and cucumber (0.852), but eggplant did not differ significantly from cantaloupe. While amino acids in zucchini (0.806) and sweet pepper (0.839) did not differ significantly from cucumber.

The reduction of amino acids in the infested plants is as a result of direct sucking of the plant sap by *B. tabaci*. Many scientists pointed out to the direct damage of *B. tabaci* because that reduces the content of nutrients causing early kill to the leaves tissue. Pollard (1955) recorded symptoms of the occurrence of whitefly *B. tabaci* on cotton leaves as chlorotic spots resulted from the larvae's saliva that feed on the sap and thus remove the starch, chlorophyll and the essential plant nutrition, as a result the leaves fall and consequently stop the growth rate of plant. This also has been confirmed by Byrne and Miller (1990) where they proved that the amount of amino acids is consumed with plant sap and had been discovered in the honeydew produced by *B. tabaci*, and they were the same amino acid of the plant sap, but the amount in the plant sap was greater than in the honeydew, the researchers also confirmed that this amino acids resulted from the absorption of sap and not from protein breakdown or nitrogen fixation in the honeydew. This indicates that the rest of the amino acids that did not exist in the honeydew were used in some components of the body of the insect like energy and protein synthesis. Abdel-Baky *et al.* (2005) reported that these amino acids are necessary for insect growth and laying eggs. Medina-Ortega & Cañas (2007) clarified that the content of amino acids in poinsettia plant was used to determine the behavior and activity of the whitefly, and therefore reducing the content of amino acids in the agricultural fertilizer reduces the number of whitefly *B. tabaci* and thus can be used as a safe method to reduce *B. tabaci* and consequently reduce the use of pesticides.

Also, Table (1) shows that the content of amino acids in each of non-infested and infested plant types varied in different agricultural seasons. Many scientists emphasized the occurrence of these amino acids in the plant sap. (Mittler, 1957; Miles *et al.*, 1982 and Weibull & Melin, 1990) also the number and content of amino acids vary from one plant to another (Weibull *et al.*, 1986 and Winter *et al.*, 1992).

2- Phenol:

The statistical analysis indicated that there was a highly significant differences in the mean percentage of phenol due to the infestation by *B. tabaci*, different types of plants and agricultural seasons.

Table (2) shows that significant increase in phenol percentage appeared as a result of the presence of *B. tabaci* on the six types of plants (cantaloupe, cucumber, zucchini, eggplant, tomato and sweet pepper) in the four seasons (autumn, winter, spring and summer). In summer and spring seasons, the mean percentage of phenols in the infested plants (5.708 and 5.663) did not differ significantly, but they were significantly more than the infested plants during the winter season (5.519), which significantly more than the infested plants in autumn (4.999), on the other hand the mean percentage of phenol from the leaves of non-

infested plants in summer (4.523) was significantly more than in the leaves of non-infested plants in spring (4.332) and winter (4.295) did not differ significantly from each other but significantly more than non-infested plants in autumn season (3.985). Also the table clarifies that for all non-infested and infested plants during all seasons, the sweet pepper was the most significant in the mean percentage of phenols (6.705), but eggplant (4.135) and cantaloupe (3.448) were the least significantly.

It could be conclouded that the infestation by *B. tabaci* increases the mean percentage of phenol in plant leaves during all seasons, and this indicates that this is a defensive method in plants against this insect. Hartley and Keene (1984) proved that many plants cell walls contain different compounds, including the phenols. Also both Feeny (1968) and Chan & Waiss (1978) emphasized that tannin compounds increase in the plants as a method to resistance against arthropods.

Table 1: Mean content of total amino acids in non infested and infested plant leaves with *B. tabaci* in all seasons.

Seasons	Infestation	Type of plant						Mean
		Cantaloupe	Cucumber	Zucchini	Eggplant	tomato	Sweet pepper	
Autumn	Non infested	1.111 Aa	0.909 BCc	0.728 Cd	0.963 Abc	1.047 Aab	0.884 Ac	0.940 A
	Infested	0.702 Eb	0.739 Dcb	0.710 Cb	0.844 Ca	0.646 Db	0.862 Aa	0.751 C
Winter	Non infested	0.908 CDcd	1.090 Aa	0.863ABd	1.056Aab	0.985 ABbc	0.827 ABd	0.955 A
	Infested	0.851 Dbc	0.829 CDbc	0.845 ABbc	0.923 BCab	0.968 ABa	0.817 ABc	0.82 B
Spring	Non infested	0.936 CDa	0.958 Ba	0.905 Aab	0.82 5BCb	0.909 BCab	0.877 Aab	0.902 B
	Infested	0.734 Eb	0.814 CDab	0.851 ABa	0.594 Dc	0.864 Ca	0.830 Abab	0.781 C
Summer	Non infested	1.065 ABa	0.818 CD cd	0.778 BCd	0.992 ABab	0.902 Bbc	0.857 ABcd	0.902 B
	Infested	0.979 BCa	0.660 Ed	0.768 BCc	0.839 BCb	0.684 Dd	0.756 Bcd	0.781 B
Mean		0.911 a	0.852 bc	0.806 d	0.879 ab	0.876 b	0.839 cd	

Different letters mean that there are significant differences between the mean values
Capital letters are present in the vertical comparison
Small letters are present in the horizontal comparison

Table 2: Mean percentages of phenol in non infested and infested plant leaves with *B.tabaci* in all seasons.

Seasons	Infestation	Type of plant						Mean
		cantaloupe	Cucumber	zucchini	Eggplant	Tomato	Sweet pepper	
Autumn	Non infested	2.625 Gc	3.690 Eb	5.143 DEa	4.133 ED b	2.885 Ec	5.435 Da	3.985 F
	Infested	3.060 Df	4.595 Bd	7.173 Aa	5.068 Bc	3.588 De	6.510 Bb	4.999 C
Winter	Non infested	3.948 Cd	2.860 Fe	4.953 DEb	3.898 Dc	4.135 Ce	5.975 Ca	4.295 E
	Infested	4.940 Ad	3.985 De	5.955 C b	4.915 Cd	5.435 Bc	7.883 Aa	5.519 B
Spring	Non infested	3.385 Dd	4.440 Bc	5.080 DE b	2.025 Fe	5.128 Bb	5.933 Ca	4.332 E
	Infested	4.205 Bd	5.590 Ac	6.613 Bb	2.735 Ee	6.893 Ab	7.945 Aa	5.663 A
Summer	Non infested	2.525 Ee	4.133 Cd	4.675 Ec	4.610 CEcd	5.220 Bb	5.975 Ca	4.523 D
	Infested	2.900 Ed	5.435 Ac	5.430 D c	5.700 Ac	6.798 Ab	7.983 Aa	5.708 A
Mean		3.448 f	4.341d	5.628 b	4.135 e	5.010 c	6.705 a	4.878

Different letters mean that there are significant differences between the mean values
Capital letters are present in the vertical comparison
Small letters are present in the horizontal comparison

Sheta (1991) proved that the phenols in infested potato tubers were significantly greater than non-infested plants. Also Abdel-Moniem *et al.* (2005) explained that the fourth node of rose stem was lightly infested by *B. tabaci*, because of the phenol release which reduces the abundance of whitefly. The increasing of phenol release increases the special ability of plant vegetables to resist infestation by *B. tabaci*. The concentration of total phenol varies from one plant to another, leading to differentiate sensitivity against insect infestation. The increase rate of phenol was great in plants that were lightly infested than in the moderate and severely infested plant in which the concentration of phenol was low, thus phenol reduces the presence of the insect.

3- pH value:

pH value plays an important role in the leaves of plants, and its value differs accordingly to the different types of plants during different seasons of the year. The present study showed that pH value has an important role in the whitefly *B. tabaci* preference to plant leaf for feeding and laying eggs

The statistical analysis showed that there were significant differences in the mean pH value due to the difference of the plant types, leaf's location in the same plant, as well as the seasonal differences among which the study was conducted.

Table (3) shows that pH value in the bottom leaves of the plant in summer season (7.090) and spring (7.029) did not differ significantly, but significantly more than the bottom leaves in winter (6.971) and autumn (6.989), which did not differ significantly from each other and from spring, but they were significantly more than the middle leaves in summer (6.721), which in turn was significantly more than the middle leaves in winter (6.598) and autumn (6.598) and in turn, they were significantly more than the middle leaves in spring (6.440). This value was significantly more than the top leaves in summer (6.315), winter (6.333) and autumn (6.306), which they did not differ significantly from each other, but significantly more than the top leaves in spring (5.856).

When comparing the mean pH values in the different tested plants during all seasons, it was found that, cucumber (7.024) was significantly more than cantaloupe (6.916), which in turn was significantly more than zucchini (6.585), and the latter was significantly more than tomato (6.410), that in turn was significantly more than each of eggplant (6.343) and sweet pepper (6.339). The latter did not differ from other in the mean pH value. This means that the pH value varied according to the tested plant types.

Table 3: Mean of PH values in three different locations of plant leaves in all seasons.

Seasons	Locations	Type of plant						Mean
		cantaloupe	cucumber	Zucchini	Eggplant	Tomato	sweet pepper	
Autumn	Top	6.175 Eb	7.225 BCa	6.375 GHb	6.200 Eb	6.200 EFGb	5.713 Ec	6.306F
	Middle	6.763 Cb	7.325 Ba	6.463 EFG c	6.400 Cc	6.400 Dec	6.175 Dd	6.598 D
	Bottom	7.588 Aa	7.263 BCb	6.825 BCcd	6.638 Bd	6.638 BCd	6.981 Bc	6.989 B
Winter	Top	7.025 Ba	7.088Ca	6.263 Hb	6.125 DEb	6.125 FGb	5.375 Ec	6.333 F
	Middle	7.050 Bb	7.350 Ba	6.500 DEFGc	6.257 CDd	6.275 EFd	6.138 Dd	6.598 D
	Bottom	7.575 A a	7.225 BCb	6.725 BC c	6.700 Bc	6.700BCc	6.900 BCc	6.971 B
Spring	Top	5.838 Fbc	5.525 Fd	6.063 Ia	6.025 Eab	6.025 GHab	5.663 Ecd	5.856 G
	Middle	6.413 Dbc	6.638 Cab	6.413 FGHbc	6.200 CDEc	6.200 EFGc	6.775 Ca	6.440 E
	Bottom	6.900 BCb	7.063 Cb	6.638 CDEc	7.088 Ab	7.088 Ab	7.400 Aa	7.029 AB
Summer	Top	6.888 BCa	6.763 Db	6.700 BCD b	6.025 Ec	5.888Hc	5.575 Ed	6.315 F
	Middle	7.189 Bab	7.250 BCa	6.913 Bb	6.100 DEd	6.563 CDc	6.313 Dd	6.721 C
	Buttom	7.588 Aa	7.575 Aa	7.150 Ab	6.338 Cd	6.825 Bc	7.063 Bb	7.090 A
Mean		6.916 b	7.024 a	6.585 c	6.343 e	6.410 d	6.339 e	6.600

Different letters mean that there are significant differences between the mean values
Capital letters are present in the vertical comparison
Small letters are present in the horizontal comparison

Table (4) shows that as for all noninfested and infested plants, the mean pH value was significantly higher in the bottom leaves (7.020), followed by middle (6.586) and then the top (6.202). The results from this table also proved that for each plant separately, there was significant progression in the mean pH values starts with the bottom leaves, followed by the middle and then the top in each of the non-infested and infested plants with the exception of the infested eggplant, where both the middle (6.031) and top leaves (6.019) did not differ significantly from each other, but less significantly than the bottom (6.463). As well as, in the infested cucumber plant where middle (7.338) and bottom (7.369) leaves do not differ from each other, but significantly more than the top leaves (6.738). That means the bottom leaves always contain the plant sap and pH value that are appropriate for *B. tabaci*, which help in the growth of immature stages (eggs and larvae), also the lower leaves contain the favorable pH value for *B. tabaci*.

pH value is one of the most fundamental components of the plant sap, its importance had been identified in plant life for a long time (Fife & Frampton, 1936 and Delrot, 1987). Husain *et al.* (1936) confirmed that *B. tabaci* always choose the young leaves to lay their eggs, depending on the pH difference in the young leaves which is higher than the fully grown leaves, and this considered one of the key factors to explain the whitefly abundance on the young leaves rather than fully grown leaves. The results of this study showed that pH value varies according to the different types of plants. Fancelli *et al.* (2005) corroborated with these results where they proved that pH value plays an important role in the process of laying eggs of *B. tabaci* on eight different varieties of tomatoes.

Results from the current study also show that the favorable pH value in the plant sap that *B. tabaci* feeds on, ranged between 6.150 to 7.638. These results correspond with the results of Berlinger (1983) where he proved that the favorable pH value for *B. tabaci* in plant sap ranged between 6 - 7.25.

Ilyas *et al.* (1991) reported that there is a positive correlation between pH and population density of *B. tabaci*. On the other hand Laurentin *et al.* (2003) proved the opposite of these results where they stated that the highest population density of *B. tabaci* on the sesame leaves was at pH 5.99 - 5.

Table 4: Mean of PH values in three different locations of non infested and infested plant leaves with *B. tabaci*.

Type of plant	Infestation	Locations			Mean
		Top	Middle	Bottom	
Cantaloupe	Non infested	6.563 Bc	7.044 Bb	7.638 Aa	7.081A
	Infested	6.400 Cc	6.663 CDb	7.188 Ca	6.750 B
Cucumber	Non infested	6.563 Bc	6.944 Bb	7.194 Ca	6.900 B
	Infested	6.738 Ab	7.338 Aa	7.369 Ba	7.148 A
Zucchini	Non infested	6.456 BCc	6.731 Cb	6.969 Da	6.719 B
	Infested	6.244 Dc	6.413 Eb	6.700 Ea	6.4521 D
Egg plant	Non infested	6.169 DEc	6.456 Eb	6.919 Da	6.515 CD
	Infested	6.019 EFb	6.031 Fb	6.463 Fa	6.171 E
Tomato	Non infested	6.150 DEFc	6.569 DEb	7.063 Ca	6.594 C
	Infested	5.969 Fc	6.150 Fb	6.563 EFa	7.227 E
Sweet pepper	Non infested	5.663 Gc	6.575 DEb	7.150 Ca	6.463 D
	Infested	5.500 Hc	6.125 Fb	7.022 Ca	6.216 E
Mean		6.202 c	6.586 b	7.020 a	6.600

Different letters mean that there are significant differences between the mean values
Capital letters are present in the vertical comparison
Small letters are present in the horizontal comparison

REFERENCES

Abdel-Baky, N. F., A. M. Abou EL-Naga, M. E. EL-Nagar, and G. A. M. Heikal. **2005.** Biochemical plant constituents affecting resistance to *Bemisia argentifolii* Bellows & Perring (Hemiptera : Aleyrodidae) infestation in Soybean and Mung bean leaves. J. Agric Res., **83**(3): 987-1005.

Abdel-Moniem, A. S. H., N. A. Farag, and M. H. Abbass. **2005.** Vertical distribution of some piercing sucking insects on some roselle varieties in Egypt and the role of amino acids concentration in infestation. Archives of Phytopathology and Plant Protection, **38**(4): 245-255.

Berlinger, M. J., Z. Mag l, and A. Benzioni. **1983.** The importance of pH food selection by the tobacco whitefly. Phytoparasitica. **11**(3-4): 151-160.

Bi, J. L., N. C. Toscano, and G. R. Ballmer. **2001.** Seasonal Population dynamics of the Greenhouse Whitefly *Trialeurodes vaporariorum* on Oxnard area. Department of Entomology, University of California, Riverside, CA 92521.

Buntin, G. D., D. A. Gilbertz, and B. D. Oetting. **1993.** Chlorophyll loss and gas exchange in tomato leaves after feeding injury by *Bemisia tabaci* (Homoptera: Aleyrodidae). J. Econ. Entomol, **86**(2): 517-522.

Byrne, D. N. and T. S. Jr. Bellows. **1991.** Whitefly biology. Ann. Rev. Entomol, **36**: 431-457.

Byrne, D. N. and W. B. Miller. 1990. Carbohydrate and amino acid composition of phloem sap and honeydew produced by *Bemisia tabaci.* J. Insect Phys., **36**(6): 433-439.

Byrne, F. J., S. Castle, N. Prabhaker, and N. C. Toscano. 2003. Biochemical study of resistance to imidacloprid in biotype *Bemisia tabaci* from Gutaimala. Pest Management Science, **59** (3): 342-352.

Chan, B. G. and A. C. Waiss. **1978.** Condensed tannin on antibiotic chemical from *Gossypium hirsutum.* J. Insect physiol., **24**: 113-118.

Chapman, H. D. and P.F. Pratt. **1961.** Method of analysis for soil, plants and waters. University of California, division of Agricultural Sciences. 309 pp.

Chu, C. C., E. Barnes, E. T. Natwick, T. Y. Chen, D. Ritter, and T. J. Henneberry. **2007.** Trap catches of the sweetpotato whitefly (Homoptera:Aleyrodidae) in the Imperial Valley, California, from 1996 to 2002. Insect Science, **14**(2): 165-170.

Delrot, S. **1987.** Phloem loading, apoplastic or symplastic. Plant physiol. Biochem., 25: 667.

Fancelli, M., D. Vendramim, T. S. Frighetto, and A. L. LourenÇã. **2005.** Exsudato glandular de genótipos de tomateiro e desenvolvimento de *Bemisia tabaci*(Genn.) (Sternorryncha: Aleyrodidae) Biótipo B. Neotropical Entomology, **34**(4): 659-665.

Feeny, P.P. **1968.** Effect of Okra leaf tannin on larval growth of the winter moth. *Operophtere prumata.* J. Insect Phys. **14**: 804-817.

Fife, J. M. and V. L. Frampton. 1936. The pH gradient extending from the phloem into the parenchyma of the sugar beet and its relation to the feeding behavior of *Eutettix tenellus.* J. Agric. Res., **53**: 581-593.

Hartely, R. D. and A. S. Keene. **1984.** Aromatic aldehyde constituents of graminacceous cell walls. Phytochemistry, 23: 1305.

Hong, L. and X. Rumei. 1993. Studies on honeydew excretion by greenhouse whitefly, *Trialeurodes vaporariorum* (Westw.) on its host plant, *Cucumis sativus.* J. Appl. Ent.,**115**: 43-51.

Husain, M. A., A. N. Puri, and K. N. Trehan. **1936.** Cell sap acidity and the incidence of whitefly (*Bemisia gossypiperda)* on cottons. Current Science, **4**: 486-487.

Ilyas, M., S. N. Puri, and N. B. Rote. **1991.** Effect of some morphophysiological characters of leaf on incidence of cotton whitefly. J. Maharashtra Agriculture Universities, **16**(3): 386-388.

Laurentin, H., C. Pereira, and M. Sanabria. **2003.** Phytochemical characterization of six sesame (*Sesamum indicum* L.) genotypes and their relationships with resistance against the sweetpotato whitefly *Bemisia tabaci* (Gennadius). American Society of Agronomy, **95**: 1577-1582.

Leite, G. L. D., M. Picanço, G. N. Jham, and M. D. Moreira. **2004.** Scientific communication natural factors influencing whitefly attack in tomato. Arq. Inst. Biol., São Paulo., **71**(2): 245-248.

Lin, T. B., A. Schwartz, and Y. Saranga. **1999.** Photosynthesis and productivity of cotton under silver leaf whitefly stress. Crop. Sci., **39**: 174-184.

Medina-Ortega, K. J. and L. A. Cañas. 2007. The amino acid composition of poinsettia cultivars: Effects on whitefly preference and performance. Entomo. Soc. Amer. Ann. Meeting, San Diego, CA, December 9-13.

Miles, P. W., D. Aspinall, and L. Rosenberg. **1982.** Performance of the cabbage aphid, *Breuicoryne brassicae* (L.), on water-stressed rape plants, in relation to changes in their chemical composition. Austr. J. Zool., **30**: 337-345.

Mittler, T. M. **1957.** Studies on the feeding nutrition of *Tuberolachnus salignus* (Gmelin) (Homoptera: Aphididae). 1. The uptake of phloem sap. J. Exp. Biol., 334-341.

Morales, P. and M. Cermeli. **2001.** Evaluation of the preference of the sweet potato whitefly *Bemisia tabaci* (Gennadius) (Homoptera: Aleyrodidae) in five agriculture crops. Entomotropica, **16**(2): 73-87.

Morales, F. J. and P. G. Jones. **2004.** The ecology and epidemiology of whitefly transmitted viruses in Latin America. Virus Research, 100(1):57-65.

Pollard, D. G. **1955.** Feeding habits of the cotton whitefly, *Bemisia tabaci* (Genn). (Homoptera: Aleyrodidae). Annals of applied biology, **43**: 664-671.

Saleh, S. M. M. & L. A. H. AL- Shareef. **2005.** Effect of *Bemisia tabaci* (Gennadius) on tomato varieties minerals. Alex. Sci. Exchange J., **26**(3). 263-270.

Shaheen, F. A. H., A. A. A. Said, A. M. Hamid, and S. E. Ei-zahi. **2005.** Some complementary approaches to control aphids and whitefly in cotton fields with conservation on their associated controlling predators. The third International Conference on IPM Role in Integrated Crop Management and Impacts on Environment and Agricultural Products. 26-29 November 2005, Giza, Egypt.

Sheta, S. M. I. **1991.** Studies on some vegetable insect pests. Master thesis, Fac. Agric., Alexandria Univ.

Watson, B. and H. Croft. **1993.** Statistical for management and economics. Allyn and Bacon printed in U. S. A.

Weibull, J. and G. Melin. **1990.** Free amino acid content of phloem sap from Brassica plants in relation to performance of *lipaphis erysimi* (Hemiptera: Aphididae). Ann. Appl. Bio., **116**: 417-423.

Weibull, J., D. Brishammar, and J. Pettersson. **1986.** Amino acid analysis of phloem sap from oats and barley: a combination of aphids stylet excision and high performance liquid chromatography. Entomol. Exp. Appl., **42**: 27-30.

Winter, H. , G. Lohaus, and H. W. Heldt. **1992.** Phloem transport of amino acids in relation to their cytosolic levels in barley leaves. Plant Physiol., 99: 996-1004.

Wieslaw Olesz, C.Y.L., W. J. Antoni, and R. P. Keith. **1988.** Identification of some phenolic compounds in apples. J. Agric. food chem., **36**: 430-432.

الملخص العربى

تأثير الإصابة بالذبابة البيضاء *Bemisia tabaci* (Gennadius) على محتوى الأحماض الأمينية ، الفينولات والأس الهيدروجيني في بعض نباتات الخضر في البيوت المحمية

سامية محمد محمد صالح[1] ، ليلي عودة الشريف[2]

[1]كلية الزراعة- جامعة الاسكندرية

[2]كلية العلوم للبنات- جامعة الملك عبد العزيز

تم في هذا البحث دراسة بعض التغيرات الكيميائية (محتوى الأحماض الأمينية ، الفينولات وقيمة الأس الهيدروجيني) في أوراق ستة أنواع مختلفة من نباتات الخضر (الكنتالوب ، الخيار، الكوسا ، الباذنجان ، الطماطم والفلفل الحلو) الناتجة عن الإصابة بالذبابة البيضاء *Bemisia tabaci* (Gennadius) في البيت المحمي. ولقد تبين من نتائج هذه الدراسة أن أعلى قيمة لمحتوى الأحماض الأمينية والفينولات كانت في نباتي الكنتالوب والباذنجان وأقلها في نبات الكوسا والفلفل الحلو. كما أن محتوى الأحماض الأمينية في جميع النباتات المصابة كانت أقل معنوياً عن مثيلاتها في النباتات غير المصابة خلال جميع المواسم الزراعية. كما أدت الإصابة الدبابة البيضاء إلى زيادة معنوية في محتوى الفينولات في جميع النباتات. وقد كانت قيمة الأس الهيدروجيني هي الأعلى معنوياً في الأوراق السفلى من النباتات يليها معنوياً أوراق المنطقة الوسطى ثم العليا. إن الإصابة بالذبابة البيضاء أدت إلى انخفاض قيمة الأس الهيدروجيني في أوراق جميع النباتات ما عدا نبات الخيار.