BIOCHEMICAL PLANT CONSTITUENTS AFFECTING RESISTANCE TO *BEMISIA ARGENTIFOLII* BELLOWS & PERRING (HMEIPTERA: ALYRODIDAE) INFESTATION IN SOYBEAN AND MUNG-BEAN LEAVES

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Abstract

Bemisia argentifolii is a polyphagous insect, and its host selection based on the internal biochemicals of the plant leaf sap. Therefore, this study was designed to correlate between number of the insect eggs and nymphs and certain biochemicals constituents of soybean and mung-bean leaves. Leaf pigments, that including chlorophyll "A" and "B" and carotenes, affected greatly on the insect selection of the oviposition sites in both hosts. As well as, the leaf pigments had a role in settlement of 1st instar nymphs (crawler). Amino acids is important for insect development and eggs load of the females. Meanwhile, phenolics played a negative role in host selections. Increasing phenolocs amount in the plant leaves led to decrease a plant as a host. Plant humidirt also influence the host selection. But in case of *Bemisia argentifolii* , since the eggs and nymphs in physiological contact with plant leaf, the role of humidity in host selection may be low.

KeyWords: Silverleaf whitefly, *Bemisia argentifolii,* plant leaf biochemicals, leaf pigments, chlorophyll "A" and "B", carotenes, amino acid, phenolics, plant humidity.

INTRODUCTION

Since 1986, the silverleaf whitefly (SLWF), *Bemisia argentifolii,* is one of the most important pests world-wide and become a restricted factor on food production and fiber crops. *B. argentifolii* is a pest both in greenhouses and out of doors and being thermophilic pest. Outdoors, the insect is a polyphagous pest and its outbreaks frequently occurred on spring, summer and fall crops such as cotton, soybean, mung-bean, other economic field crops, vegetables and ornamentals (Tengkano *et al.*, 1991; Hirano *et al.*, 1993 Abdel-Baky *et al.*, 2000). Additionally, *B. argentifolii* is a highly aggressive biotype and caused more intensive damage than the biotype previously identified (Abdel-Baky, 2001). It presents higher fecundity, a wider range of hosts, and easily-acquired resistance to insecticide (Costa and Brown, 1990; Prabhaker *et al.*, 1998). Insect behavior on plants indicates that whiteflies could detect whether the plant host is suitable or not only after landing by the internal probing (Verschoor & Lanteren, 1978). So, host plant acceptance or rejection depends on their behavioral responses to plant features (Anderson *et al.*, 1992), which may include morphological, physical and chemical (Berynas & Chapman, 1994). Provenza (2003) reported that the plant-herbivore interactions involve plant structure, plant primary chemistry, plant secondary chemistry and plant biochemical diversity. Mainly some of biochemical determines synchronization of insect life cycle with the type of plant-host and developmental phase, morphological and physical characteristics, which distinguish the plant-host form non plant-host (Chu *et al.*, 1995; Lei and Xu, 1995).

Hence, whiteflies reorganization of their plant hosts has attracted the attention for a long time (Lanteren & Noldus, 1990). Because of the plant leaf odor and color affect on *B. argentifolii* acceptance to their hosts before landing (Pickett *et al.* 1992), plant leaf the chemical cues, that realized by the pest after landing, may be play a more important role during the final acceptance of the host for feeding. Since, *Bemisia* species are phloem feeder, chemical stimuli from leaves offers attractants or no contacts with deterrents, the test probing will switch to exploratory probing. The stylet will probe deeper and deeper until it reaches the phloem and feed (Bernays and Cahpman, 1994). Exploratory probing seems to be a trial and error procedure; it needs time for the insect to find the phloem. This is why the probing speed is fast. The chemical composition of the leaf wax is very complex, evolved with plant secondary substances. It may play an important role in the insect feeding preference behavior (Wenru *et al.* 1992).

The frequent and inadequate use of chemicals has promoted the development of resistance in *B. argentifolii* populations and increasing the application costs (Prabhaker *et al.*, 1998; El-Kady and Devine, 2003; Otoidobiga *et al.* 2003). Development of effective management strategies for the pest requires an understanding of the mechanisms of internal plant component involved in plant selection. Identification of soybean and mung-bean leaf chemical component that help in explanations the host resistance or non-resistance to the insect pest is essential for enhancement and cultivar development (Kindler and Hays, 1999).

Furthermore, adult and immature of *B. argentifolii* are confined to certain parts within a plant, and this determined by both the physical and chemical attributes to which the insect responds. As well as, differences in concentration of nutrients in plant influences host selection (McNeill & Prestige, 1982). Thus, host-plant discrimination seems to be based on internal chemical or physiological plant characteristics. Therefore, the aim of the present study is to determine the role of internal biochemical component that acquired both of soybean and mung-bean leaves a resistance character to *B. argentifolii* infestation.

MATERIALS AND METHODS

1- Field Studies:

Field studies were carried out at the Experimental Research Station, Faculty of Agriculture, Mansoura University inside the compass, to determine the role of plant biochemical contents of both soybean and mung-bean plants on the silverleaf whitefly, *Bemisia argentifolii*, infestation during summer season of 2001 and 2002. Two plant hosts, belonging to family Leguminosae were chosen to show the role of these plants on *B. argentifolii* infestation.

Soybean and Mung-bean cultivars:

Experimental works were carried out with one common cultivar of soybean (Giza-21) and one variety of mung-bean (Kuwmey1) during two successive seasons of 2001 and 2002. Soybean variety was cultivated in June, 17*th* and 23*rd* through 2001 and 2002 growing seasons, respectively. Experimental plots were arranged in a randomized complete blocks design, each of about 120 square meters and with 5 replicates. All agricultural practices were carried out and no insect control measures were practiced.

To evaluate SLWF, *B. argentifolii,* population 15 plants from each soybean variety were chosen randomly (three plants from each corner and three from the center of the area). As well as, three leaves from each plant were selected as follows one from upper, one from middle and the other from the lower level of plant. Samples of soybean leaves were transferred directly to the laboratory, where the eggs and nymphs were counted and recorded.

During 2001 season, samples were taken at weekly intervals, starting from July, 4*th* until the samples became free from whitefly population (September, 19*th*). While during 2002 season, the samples started from June, 25*th* till September, 19*th*.

For counting the whitefly eggs and nymphs on soybean and mung-bean leaves in different varieties, leaf sectors (3 cm^2 each) from leaves margin was used.

II. Laboratory studies:

I. Plant components estimation:

In this set of experiments, chlorophyll "A", "B", carotene, amino acids, phenol, pH (cell sap acidity), and humidity soybean and mung bean leaves were estimated at different time intervals to determine the relationship between these plant components and *Bemisia* argentifolii density under field conditions through 2002 season. These components were estimated as follows:

A - Dyes estimation (leaf pigments or color):

0.2 gm of plant leaves sample was mixed with known volume of diluted acetone 80 or 85 % and left for 24 hours. The color was measured at 662, 644 and 440 nm for chlorophyll "A", "B", and carotene, respectively. Chlorophyll "A", "B" and carotene were measured as follows according to Saric *et al.* (1967) and Comat and Schcile (1942).

Chlorophyll "A"=

$$\frac{(9.7844 \text{ x reading at 644 nm})(0.99 \text{ sample wt.}) \text{ X (completed vol.) X } 100}{1000 \text{ x sample weight}} = \text{mg/100 gm}$$

Chlorophyll "B" =

$$\frac{(21.426 \text{ x reading at 644 nm}) (4.65 \text{ x reading at 662}) \text{ X (completed vol.) X } 100}{\text{Sample weight x } 1000}$$

Carotene =

$$\frac{(4.690 \text{ x reading at 440 nm}) (0.264 \text{ x reading at } 662 + 644) \text{ X (completed vol.) X } 100}{\text{Sample weight x } 1000}$$

= mg/100 gm

B- Amino acid estimation:

One gram of dried plant leaves sample was extracted by heated alcohol at 70°C for three times and alcohol was collected. Then alcohol was evaporated at 55°C till the extract concentrated as a thin film. Residue was dissolved in 10 ml of isopropanol 10 % and 0.5 ml of the formed solution was added to one ml of fresh prepared nonhydrin solution and shacked in water bath for 15 min. The mixture was cooled and completed to 10 ml by adding ethanol. The color developed was measured at wavelength 570 nm according to Askerson (1981) and Jayeramen (1985).

Calculation:

$$= \frac{\text{Reading x factor x 100 Amino acid conc.}}{\text{Sample weight x dilution}} = \text{gm/100 gm}$$

C- Phenol estimation:

Five freshly sample were put in 25 ml methyl alcohol or ethyl alcohol 80 % in dark bottles. The bottles were put in refrigerator at 5°C for 24 hours, the alcohol was purified.

Another 25 ml of alcohol were added and purified with addition of another 25 ml of alcohol. These steps resulted in 75 ml of purified alcohol.

Estimation: One ml of purified alcohol + 0.25 ml of concentrated HCl + 0.5 ml foline were shacked for 3 min. Then, three ml of saturated sodium carbonate were added and the volume complete to 20 ml with distilled water, left for 60 min. The sample was read at 730 nm.

Phenol concentration in sample was calculated according to A.O.A.C. (1970) and Dancil and George (1972) as follow:

$$= \frac{\text{Reading of sample x extracted alcohol Phenol conc. x 100}}{\text{Weight of dried sample x 1000}} = \text{mg/100 gm of dried sample}$$

D- Humidity estimation in plant leaves:

The humidity is one of the factors that play an important role in insects attractiveness to the host plant. So, it was important to determine the water content in the two tested crops at different time intervals. Humidity estimation was determined according to chemical analysis on the base of drying weight, and in some cases for investigation the accuracy in plant stuffs. On the other hand, there are many methods which differ according to the ratio of the humidity in samples, as well as, the purpose of determination. Two main common methods are used as follows:

1- Electric oven method for humidity estimation.

2- Organic solvents methods.

Generally, electric oven was used in this study. The dishes were re-weighed and the loss weight of samples was calculated according to A.O.A.C. (1970) as follows:

$$= \frac{\text{Wetted sample weight - Dried sample weight \% Loss weight}}{\text{Wetted sample weight}}$$

III. The relationship between plant components and whitefly immature stages:

In this set of experiments, the relationship between chlorophyll "A", "B" carotene, amino acids, R.H. in leaves and pH; and whitefly eggs and nymphs were carried out. The simple correlation was determined using COSTAT program to calculate the regression equation parameter (a = intercept, b = slope and R = the correlation).

RESULTS

A- *Bemisia argentifolii* eggs:

Effect of soybean leaves content on SLWF eggs are shown in Table (1) and Fig. (1). Concentration of chlorophyll "A" in soybean leaves had a positive relationship with the number of eggs laid on soybean leaves whereas the regression equation, that expressed on this relationship, is Y = 25.684 + 0.248 X; where: Y = the average number of SLWF eggs, X = the concentration of chlorophyll "A" and R^2 value equal 0.694. On the other hand, chlorophyll "B" concentrations in soybean leaves had affected negatively on the average number of SLWF eggs, whereas the regression equation is Y = 11.72 + (- 9.913) X; where Y = the average number of SLWF eggs, X = the concentration of chlorophyll "B" and R^2 value equal -0.008.

Carotene had a moderate positive effect on the average number of SLWF eggs. The regression equation of carotene compared to the average number of SLWF eggs is Y = 16.253 + 0.163 X and R^2 = 0.568; where Y = the average number of SLWF eggs, X = the concentration of carotene in soybean leaves.

Amino acids content in soybean leaves showed a low positive effect on the average number of SLWF eggs whereas the regression equation is Y = 12.97 + 0.029 X; where : Y = the average number of SLWF eggs, X = the concentration of amino acid in soybean leaves, and R^2 value equal 0.158 (Table 1 & Fig. 2).

As for phenols in soybean leaves, it appears that phenols had significant positive effect on the average number of SLWF eggs. The regression equation is Y = 0.125 + 0.005 X and R^2 = -0.664, whereas Y = the average number of SLWF eggs, X = the concentration of phenols in soybean leaves (Table 1 & Fig. 2).

Table 1. Regression among soybean leaf content and *B. argentifolii* eggs stage during 2002 growing season.

Parameters X : Y	Regression equation parameters a	b	R^2
Chlorophyll A : SLWF eggs	25.68	0.248	0.694*
Chlorophyll B : SLWF eggs	11.72	-9.913	0.008
Carotene : SLWF eggs	16.253	0.163	0.568 *
Amino acids : SLWF eggs	12.973	0.029	0.158
Phenols : SLWF eggs	0.125	0.0046	0.664*
Relative Humidity : SLWF eggs	77.47	-1.229	-0.924***

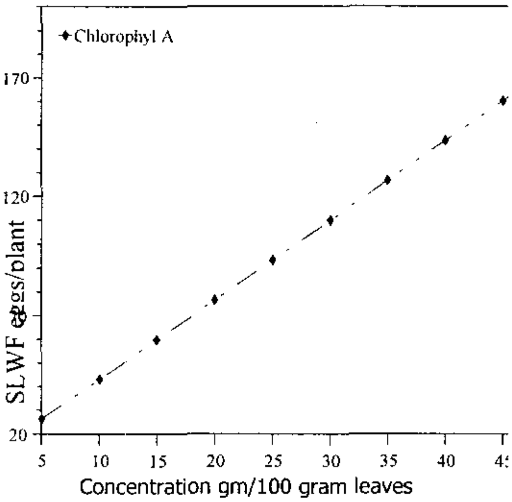

Fig. (1): Functional correlation between the average number of *B. argentifolii* eggs and chlorophyll A, concentration in the soybean leaves during season 2002.

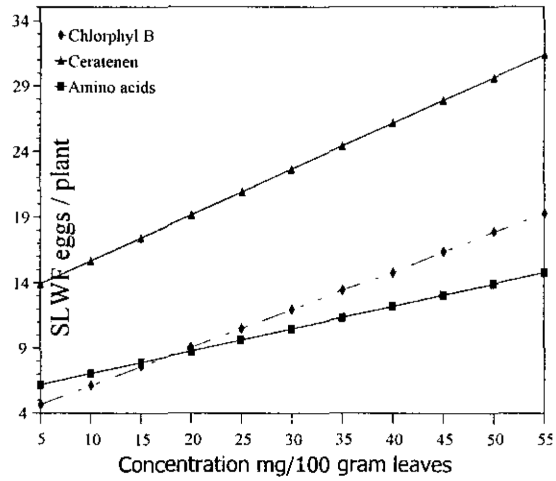

Fig. (2): Functional correlation between the average number of *B. argentifolii* eggs and chlorophyll B, carotene and amino acids contents in the soybean season 2002.

B- *Bemisia argentifolii* nymphs:

Effect of soybean leaves content on SLWF nymphs numbers are shown in Table (2) and Figs. (3 & 4). The correlation coefficient between the concentration of chlorophyll "A" in soybean leaves and the number of nymphs on soybean leaves were highly, whereas the regression equation is Y = 24.21 + 0.055 X; where Y = the average number of SLWF nymphs, X = the concentration of chlorophyll "A", and R^2 value equal 0.801 (Fig. 3).

On the other hand, Chlorophyll "B" had low effect on the average number of SLWF nymphs whereas the regression equation is Y = -0.003 + 11.97 X, where Y = the average number of SLWF nymph, X = the concentration of chlorophyll "B", and R^2 value equal -0.138 (Table 2 & Fig. 4).

Additionally, carotene had positive effects on the average number of SLWF nymphs. The regression equation is Y = 0.033 + 15.54 X and R^2 = 0.602; where Y = the average number of SLWF nymph, X = the concentration of carotene in soybean leaves (Table 2 & Fig. 4).

Amino acids contents in soybean leaves showed a low positive effect on the average number of SLWF nymphs, whereas the regression equation is Y = 0.01 + 12.56 X; where Y = the average number of SLWF nymph, X = the concentration of amino acid concentration in soybean leaves, and R^2 value equal 0.256 (Table 2 & Fig. 4).

As for phenols in soybean leaves, it appears that phenols had slight negative effect on the average number of SLWF nymphs. The regression equation is Y = 0.001 + 0.131 X, and R^2 = -0.483; where Y = the average number of SLWF nymph, X = the concentration of phenols in soybean leaves.

Humidity percentage in soybean leaves revealed high positive correlation with the average number of SLWF nymphs. The linear regression is Y = 0.055 + 24.21 X, and R^2 = 0.801; where Y = the average number of SLWF nymph, X = the humidity percentage in soybean leaves.

Table 2. Regression correlation among soybean leaf content and *Bemisia argentifolii* nymphs during 2002 growing season.

Parameters X : Y	Regression equation parameters a	b	R^2
Chlorophyll A : SLWF nymphs	24.21	0.055	0.801**
Chlorophyll B : SLWF nymphs	-0.003	11.97	-0.138
Carotene : SLWF nymphs	0.033	15.54	0.602*
Amino acids : SLWF nymphs	0.009	12.56	0.256
Phenols : SLWF nymphs	-0.006	0.131	- 0.483
RH : SLWF nymphs	0.055	24.21	0.801**

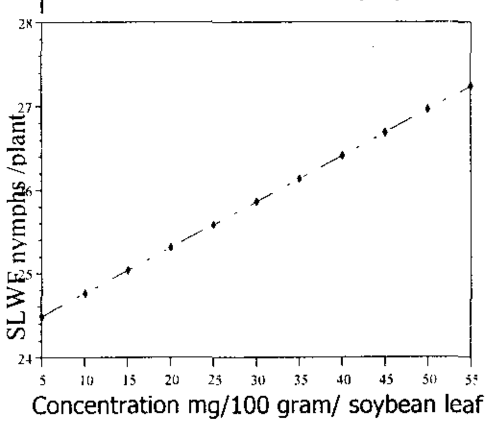

Fig. (3): Functional correlation between the average number of *B. argentifolii* nymphs and chlorophyll A contents in soybean season 2002.

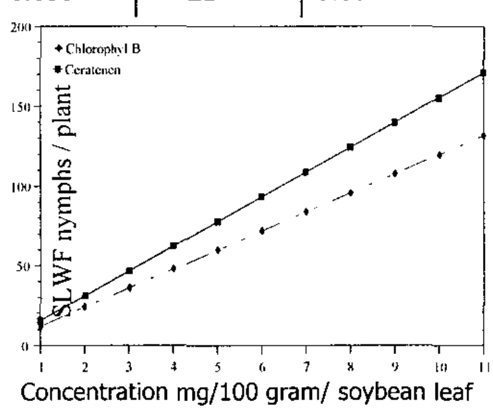

Fig. (4): Functional correlation between the average number of *B. argentifolii* nymphs and chlorophyll B, and carotene contents in soybean season 2002.

II- Mung bean leaves contents:

A- *Bemisia argentifolii* eggs :

Effect of mung bean leaves content on oviposition of the SLWF egg are shown in Table (3) and Fig. (5 & 6). Table (3) and Fig. (5) represent that there were a positive correlation between the concentration of chlorophyll "A" in mung bean leaves and the number of eggs laid on mung bean leaves whereas the regression equation is Y = 9.484 + 3.35 X; where: Y = the average number of SLWF eggs, X = the concentration of chlorophyll "A", and R^2 value equal 0.694.

On the other hand, chlorophyll "B" concentration had a high positive effect on the average number of SLWF eggs, " whereas the regression equation is Y = 3.209 + 0.731 X; where Y = the average number of SLWF eggs, X = the concentration of chlorophyll "B", and R^2 value equal 0.8.96 (Table 3 & Fig. 6).

Carotene had high positive effect on the average number of SLWF eggs. The regression equation is Y = 12.18 + 0.874 X and R^2 = 0.938; where Y = the average number of SLWF eggs, X = the concentration of carotene in mung-bean leaves (Table 3 & Fig. 6).

Amino acids contents in mung-bean leaves showed a moderate positive effect on the average number of SLWF eggs whereas the regression equation is Y = 5.330 + 0.4300 X; where : Y = the average number of SLWF eggs, X = the concentration of amino acid in mung bean leaves, and R^2 value equal 0.506 (Table 3 & Fig. 6).

As for phenols in mung-bean leaves, it appears that phenols had significant positive effect on the average number of SLWF eggs. The regression equation is Y = 39.032 + 2.42 X and R^2 = -0.552, whereas Y = the average number of SLWF eggs, X = the concentration of phenols in mung-bean leaves (Table 3). Regarding the humidity percentage effect, it appears that humidity had slight positive effect on the average number of SLWF eggs. The regression equation is Y = 115.0 + 0.002 X and R^2 = 0.317, whereas Y = the average number of SLWF eggs, X = the humidity percent in mung-bean leaves (Table 3).

Table 3. Regression between Mung-bean leaf content and *Bemisia argentifolii* eggs through 2002 growing season.

Parameters	Regression equation parameters		R^2
X : Y	a	b	
Chlorophyll A : SLWF eggs	9.48	3.35	0.567
Chlorophyll B : SLWF eggs	3.209	0.73	0.896
Carotene : SLWF eggs	12.18	0.874	0.938
Amino acids : SLWF eggs	5.330	0.430	0.506
Phenols : SLWF eggs	39.032	2.42	0.552
RH : SLWF eggs	0.115	0.002	0.317

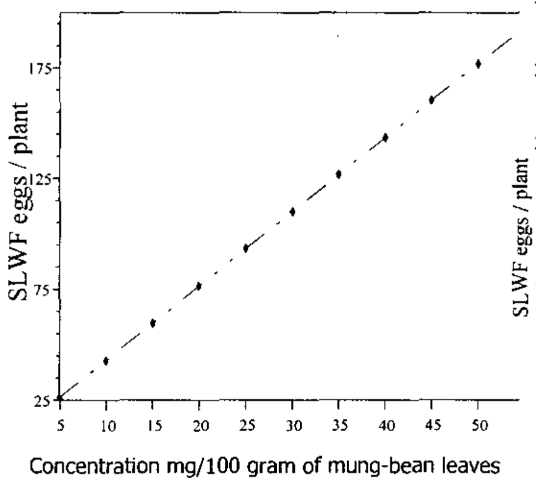

Fig. (5): Functional correlation between the average number of *B. argentifolii* eggs and chlorophyll A concentration in the mung-bean leaves during season 2002.

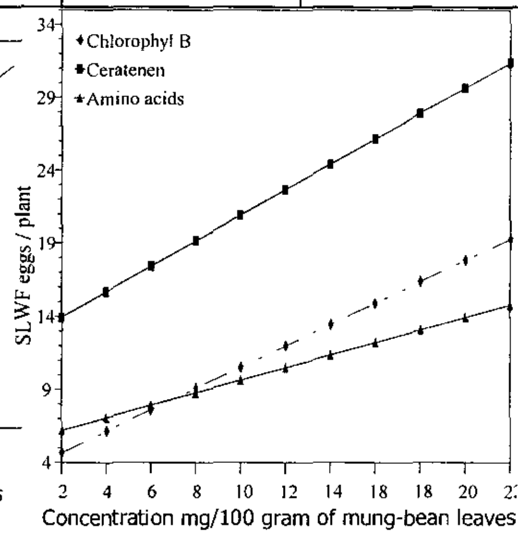

Fig. (6): Functional correlation between the average number of *B. argentifolii* eggs and chlorophyll B, carotene and amino acids contents in the mung-bean leaves during season 2002.

B- *Bemisia argentifolii* nymphs:

Effect of mung bean leaves content on silver leaf whitefly nymphs are shown in Table (4) and Figs. (7 & 8). Concentration of chlorophyll "A" of mung-bean leaves had a positive effectiveness on the average number of SLWF nymphs, whereas the regression equation is Y = 15.76 + 3.87 X; where Y = the average number of SLWF nymph, X = the concentration of chlorophyll "A", and R^2 value equal 0.532.

On the other hand, Chlorophyll "B" had a high positive effect on the average number of SLWF nymphs whereas the regression equation is Y = 4.24 + 0.92 X, where Y = the average number of SLWF nymph, X = the concentration of chlorophyll "B", and R^2 value equal 0.916 (Table 4 and Fig. 8).

Carotene had a positive effect on the average number of silverleaf whitefly nymphs. The regression equation is Y = 13.849 + 1.004 X and R^2 = 0.875; where Y = the average number of SLWF nymph, X = the concentration of carotene in mung-bean leaves (Table 4 and Fig. 8).

Amino acids content in mung-bean leaves showed a low positive effect on the average number of SLWF nymphs, whereas the regression equation is Y = 6.081 + 0.509 X; where Y = the average number of SLWF nymph, X = the concentration of amino acid concentration in mung-bean leaves, and R^2 value equal 0.486 (Table 4 & Fig. 8).

As for phenols in mung-bean leaves, it appears that phenols had a negative effect on the average number of SLWF nymphs. The regression equation is Y = 41.05 + 3.370 X, and R^2 = -0.623; where Y = the average number of SLWF nymph, X = the concentration of phenols in mung bean leaves (Table 4).

Humidity percentage in mung-bean leaves revealed high positive correlation with the average number of silver leaf whitefly nymphs. The linear regression is Y = 0.101 + 0.0068 X, and R^2 = 0.776; where Y = the average number of SLWF nymph, X = the humidity percentage in mung-bean leaves (Table 4).

Table 4. Regression correlation between Mung-bean leaf content and *Bemisia argentifolii* nymphs during 2002 growing season.

Parameters	Regression equation parameters		R^2
X : Y	a	b	
Chlorophyll A : SLWF nymphs	15.76	3.87	0.532
Chlorophyll B : SLWF nymphs	4.24	0.920	0.916
Carotene : SLWF nymphs	13.849	1.004	0.875
Amino acids : SLWF nymphs	6.081	0.509	0.486
Phenols : SLWF nymphs	41.05	3.370	-0.623
RH : SLWF nymphs	0.101	0.006	0.776

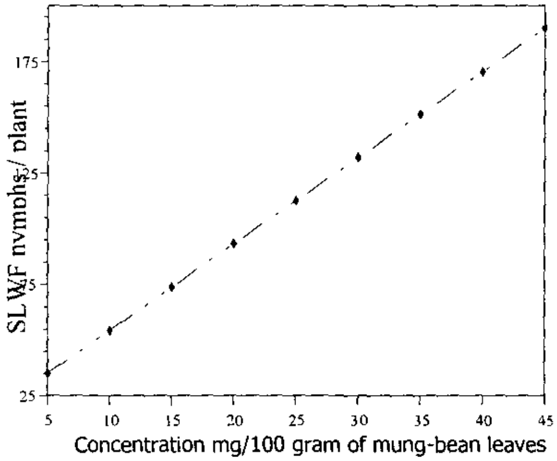

Fig. (7): Functional correlation between the average number of *B. argentifolii* nymphs and chlorophyll A concentration in the mung bean leaves during season 2002.

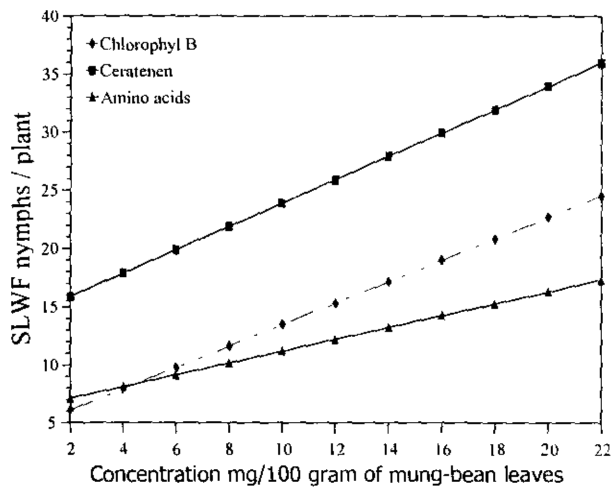

Fig. (8): Functional correlation between the average number of *B. argentifolii* nymphs and chlorophyll B, carotene and amino acids contents in the mung bean leaves during season 2002.

DISCUSSION

Plants and their parts vary considerably in their internal bio-chemicals and the nutritional values for insects (Barbehenn *et al.*, 1999). This may be affect of herbivores insects in food selections (Awmack and Leather, 2002). Selection of an ovipostion site is a critical phase in SLWF life, because the nymphal stages are completely sessile, except the 1st instar (Lanteren & Noldus, 1990). Since *B. argentifolii* females feed and oviposit their eggs on the same leaves, this means those feeding process and oviposition selections go hand in hand. So, ovipostion site selection by SLWF females has a profound effect on their fitness and affect greatly on the nymphal development (Abdel-Baky *et al.*, 2004).

Regarding leaf bio-chemical structure, it could be noticed that soybean and mung-bean differed in their leaf biochemical components which resulted in a significant difference in most cases between plants. Color is a very important factor in SLWF host selection before landing (Mound, 1962; Lentern & Noldus, 1990). Since, the leaf pigments consist of chlorophyll A, B, and carotene which affected greatly on SLWF host selection. Therefore, increasing concentrations of chlorophyll A and B pigments mean that soybean leaf color will be a dark/green and this will affect negatively of the female selection. In the other hand, increasing carotene concentration compared with other pigments studied (chlorophyll A and B), this will turn soybean and mung-bean leaves to be a yellow/green color and then the leaves will be more attractive for SLWF adults to feed and laying its eggs (Mound, 1963). Accordingly, more eggs will be deposited. Also, this means that SLWF females will be able to select their hosts and certain leaves with a plan before landing (Verschoor and Lenteren, 1978) As well as, SLWF adults and immature affected greatly on leaf pigments because they feed on cell sap. So, increasing SLWF infestation will decrease the leaf pigments and then affected plant by reduction the net photosynthetic rate (Lin *et al.*, 1999). Moreover, they indicated that the reduced of photosynthetic rate was associated with reductions in chlorophyll variable fluorescence (Fv/Fm) and fluorescence yield. This finding indicates that SLWF infestation impairs, either directly or indirectly, the photochemical reaction of the photosynthetic system in cotton plants.

Furthermore, Chhabra *et al.* (1993) mentioned that host mechanism of resistance revealed higher percents of reducing and non-reducing sugars, total phenols and free amino acids in the resistant genotypes than in the controls and susceptible genotype. In this respect, Bi *et al.* (2000) reported that applied nitrogen linearly increased densities of SLWF adult and immature Also, the nitrogen treatments linearly enhanced plant foliar photosynthetic rates and altered concentrations of soluble proteins, soluble amino acids and several soluble carbohydrates such as glucose, fructose and sucrose in cotton petiole. They also correlated glucose levels with densities of SLWF adults during the peak population size.

Amino acids are proved to occur in phloem sap (Weibull *et al.*, 1986; Weibull and Melin, 1990; Ahuja, *et al.*, 1999). The most dominant amino acids are glutamate, aspirate and serine. Byrne and Miller (1990) found 15 amino acids in poinsettia sap and 14 in pumpkin. Free amino acids only make up about 5% of the nutrient nitrogen in plants (Mattson, 1980; Murugan and Kumar, 1996; Murgan *et al.*, 1997). Honeydew is considered a reflection of phloem sap constituents. Concentrations of amino acids in whitefly honeydew were found significantly lower than those in phloem sap, indicating that the insect utilized these chemicals in some manner (Byrne and Miller, 1990)

Phenolics amount in a plant changed based on the stage of growth and amount of light experienced by the plant (Bernays and Chapmen, 1994). They pointed out that the tropical plants tend to have high levels of various phenols and flavonoids in young leaves, and the levels falls as the leaves expand. Butter *et al.* (1992)

reported that plant cultivars having higher total phenolic and o-dihydroxyphenolic contents in leaves supported fewer whitefly eggs. Moreover, Chhabra *et al.* (1993) indicated that UL257, UG302 and UG407 excelled in performance. Analysis of the biochemical contents of the green leaves inferred that high concentrations of total phenol, free amino acids and reducing sugars and low levels of non-reducing sugars at the vegetative stage reduced the incidence of insect attack and disease.

In conclusion, this study emphasized the importance of interactions between component of plant biochemical (quality) and whiteflies selection of their plant hosts. In this respect, Rao and Panwar (2001) reported that the resistant varieties of corn had low carotenoid, nitrogen and crude protein contents as compared to the susceptible cultivar.

Evaluation of host plant for feeding and ovipositions by whiteflies in general occurs largely after stylets penetration the leaf tissue, similar to *Trialeurodes vaporariorum* (Noldus *et al.*, 1986). Both morphological and chemical characteristics of the leaf provide specific cues for host evaluation, but final acceptance of a host may come only after whitefly stylet probing.

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المكونات البيوكميائية فى النبات وتأثيرها على الإصابة بالذبابة البيضاء (المسببة لمرض الورقة الفضية) لأوراق فول الصويا وفول المانج

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تعتبـــر الدبابـــة البيضـــاء *Bemisia argentifolii (Alyrodidae: Hemiptera)* (المسببة لمرض الورقة الفضية) حشرة متعددة العوائل النباتية، لهذا فإن إختيارهـــا لعائلهـــا النبـــاتى يتوقف على التركيب البيوكميائى للعصير النباتى. وعلية فإن هذه الدراسة هدفت على ربط العلاقـــة بين مقدار بعض المكونات البيوكميائية للعصير النباتى (كلوروفيل A و كلوروفيـــل B والكـــاريتين، الأحماض الأمينية، الفينولات ورطوبة الأوراق) وتعداد كل من بيض وحوريات الذبابة البيضاء على أوراق فول الصويا وفول المانج.

أشارت النتائج أن الصـــبغات النباتيـــة فـــى الأوراق (كلوروفيـــل A و كلوروفيـــل B والكاريتين) أثرت بدرجة واضحة على إختيار الحشرة لمكان وضع البيض فى كـــلا المحصـــولين بالإضافة إلى تأثيرها على حوريات العمر الأول فى إختيار موقعها على العائل النباتى.

أما الأحماض الأمينية فهى ضرورية وهامة لتطور الحشـــرة ووضـــع البـــيض. بينمـــا الفينولات فعلبت دورا سلبيا فى إختيار الحشرة لعائلها النباتى، فزيادة محتواها يؤدى إلى خفض قيمة النبات كعائل. فى غالبية الحشرات تلعب رطوبة الأوراق دورا هاما فى إختيار الحشرة لعائلها، ولكن فى حالة الذباب الأبيض حيث يوضع البيض منغرسا داخل النسيج الورقى وحوريات الحشرة فى حالة إتصال فسيولوجى دائم بالنبات، فإن رطوبة الورقة تصبح ذات تأثير غير واضح على الأطوار غيـــر الكاملة.