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Susceptibility of Certain Solanaceous Plant Varieties to Some Homopterous Insects Infestation

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ABSTRACT

The present investigation aimed to study the effects of some eggplant varieties (Black beauty, white baladi and black baladi) and pepper varieties (Baladi, Red California and Yellow California) on the population density of aphids, leafhoppers and whitefly insect. The obtained results showed pronounced differences in the population density of the afore mentioned insects for the tested varieties. Chemical analysis results showed a positive relationship between protein, carbohydrate contents and aphids, leafhoppers and whitefly insects infestation in all eggplant and pepper varieties, also reverse relationship was recorded between pH values and insects infestation. While, negative relationship between insect infestation and the quantity of yield was obtained. For these results susceptibility of eggplant and pepper varieties must be considered in the integrated pest management program as they play very important role in depressing insect population.

Key words: Eggplant, pepper, insect, aphids, leafhoppers, whitefly

INTRODUCTION

Solanaceous vegetable plants are infested by homopterous insects (aphids, leafhoppers and whitefly insects) which affect of the quality and quantity of yield as results of their direct feeding on plant. In addition, these insects are responsible for natural spread of several virus diseases of economic importance vegetable plants (Nielson, 1968; Moreno *et al.*, 2005; Salehi *et al.*, 2007; Fereres and Moreno, 2009; Moura *et al.*, 2012). The fauna of these insects on most field vegetable crops has been studied in Egypt (Herakly, 1970; El-Zohairy *et al.*, 1989; Fawzy *et al.*, 2007; Abdel-Rahman *et al.*, 2013). Further studies are needed to assess the relation between plant varieties and plant chemical constituents with quantity of yield. So, the resistant varieties could be used as affected factor in the integrated pest management programs (Han *et al.*, 1991; Nossier, 1996).

MATERIALS AND METHODS

The experimental area about 1200 m² was chosen to represent this investigation at Diarb-Nigm district, Sharkia Governorate during 2010 and 2011 seasons. The experimental design used in all growing seasons of eggplant and pepper plants was a complete randomized blocks design with three replicates. The test varieties were distributed randomly in each replicate. Each plot consisted of 10 m wide and 6 m long. The seedling data of eggplant and pepper plants was the 1st week of June and the space between holes 50 cm in 2010 and 2011 seasons. The normal agricultural practices were followed in due time and all plots were kept free of any insecticide treatments. In such experiments, the following three tested eggplant varieties were black beauty, white balady

and black balady, while pepper varieties were balady, red California and yellow California. Sampling started when the age of the plants reached about one month after seedling and continued at weekly intervals through the growing seasons of eggplant (until the mid-October) and pepper plants (until the end of September) during 2011 and 2012 seasons.

The following two procedures of sampling were used:

- Planting samples, three leaves representing at different levels, viz. upper, middle and lower, which were taken from randomly chosen 10 plants of each variety. These leaves were examined in the laboratory using a binocular microscope and the total number of existing nymphs, aptera and alate forms of aphids immature and adult stages of whitefly on both surfaces of the leaves were recorded
- The use of sweeping net, 30 cm diameter and 60 cm deep. Each sample consisted of 100 double strokes were taken from both diagonal directions of the experimental area. Each sample was kept in a tight closed paper bag and transferred to the laboratory for inspection by binocular microscope and the collected leafhoppers were killed by cyanide, stored into species and identified according to the work of Nielson (1968) and El-Zohairy *et al.* (1989). Counts of captured leafhoppers were done for each sample

To confirm the relationship between certain chemical constituents of the different varieties of eggplant and pepper plants and the infestation with aphid, leafhopper and whitefly insects, chemical analysis of different varieties of the afore mentioned solanaceous plants were carried out in Soil Science Laboratory, Faculty of Agriculture, Zagazig University. Plant leaves were taken at random from each replicate when the age of plant varieties reached about 60 days in the season of 2011, to determine the total protein, carbohydrate contents, pH value, phosphorous, calcium and potassium contents according to Dubois *et al.* (1956); Barrows and Simpson (1962); Jackson (1970) and Bremner and Mulvaney (1982).

RESULTS AND DISCUSSION

Survey of some homopterous insects on eggplant and pepper plants

Leafhopper insects

Eggplant (*Solanum melongena*): The data presented in Table 1 show the incidence of five leafhopper species belonging to family Cicadellidae on eggplant at Diarb-Nigm district, Sharkia Governorate. The collected leafhopper species were arranged descendingly according to their abundance as follows: *Empoasca decipiens* (Paoli) *E. decedens* (Paoli), *E. lybica* (de Berg.) *Balclutha hortensis* (Lindb) and *Cicadulina chiniae* (Ghauri).

E. decipiens and *E. decedens* were the most abundant leafhopper species on eggplant.

Pepper plants (*Capsicum frutescens*): The following four leafhopper species were collected on pepper plants during 2010 and 2011 seasons *E. decipiens*, *E. decedens*, *B. hortensis* and *C. chiniae*. *E. decipiens* and *E. decedens* were apparently the most abundant leafhopper species. On the other hand, the rest species were found in low numbers on pepper plants during 2010 and 2011 seasons. These results agree with the findings of Ebadah (2002) and Der *et al.* (2003) who mentioned that the *E. decipiens* infested pepper plants.

Aphids insects: Survey study on eggplant and pepper plants in Diarb-Nigm, district, Sharkia Governorate revealed the presence of the following aphid species *Myzus persicae* (Siilz) and

Table 1: Total No. of leafhoppers, aphids and whitefly species collected from eggplant and pepper plant varieties in Diarb-Nigm district, Sharkia Governorate during 2010 and 2011 seasons

| Insects species | Seasons | Total No. of insects | | | | | |
|---------------------|---------|----------------------|--------------|--------------|------------------|----------------|-------------------|
| | | Eggplant varieties | | | Pepper varieties | | |
| | | Black beauty | White baladi | Black baladi | Baladi | Red california | Yellow california |
| <i>E. decipiens</i> | 2010 | 852 | 703 | 574 | 582 | 467 | 327 |
| | 2011 | 1056 | 839 | 662 | 705 | 544 | 392 |
| <i>E. decedens</i> | 2010 | 511 | 419 | 333 | 396 | 315 | 239 |
| | 2011 | 681 | 511 | 402 | 511 | 372 | 294 |
| <i>E. lybica</i> | 2010 | 257 | 204 | 142 | - | - | - |
| | 2011 | 297 | 230 | 157 | - | - | - |
| <i>B. hortensis</i> | 2010 | 163 | 140 | 127 | 83 | 82 | 71 |
| | 2011 | 187 | 158 | 144 | 97 | 98 | 85 |
| <i>C. chinai</i> | 2010 | 120 | 105 | 92 | 106 | 72 | 61 |
| | 2011 | 154 | 141 | 101 | 117 | 84 | 75 |
| <i>M. persicae</i> | 2010 | 947 | 704 | 491 | 1310 | 1070 | 842 |
| | 2011 | 1213 | 967 | 643 | 1531 | 1246 | 1053 |
| <i>A. gossypii</i> | 2010 | 1746 | 1422 | 1117 | 945 | 741 | 575 |
| | 2011 | 2046 | 1796 | 1464 | 1145 | 884 | 670 |
| <i>B. tabaci</i> | 2010 | 2446 | 1899 | 1507 | 1056 | 865 | 755 |
| | 2011 | 2856 | 2401 | 1772 | 1271 | 1009 | 936 |

Aphis gossypii (Glover) on eggplant s and pepper plants. Echezona and Nganjuchu (2006) incidence that green peach aphid and cotton aphid on the cucumber plants, eggplant s and red pepper plants in the field.

Whitefly *Bemisia tabaci* (Genn.): The total number of the *B. tabaci* infesting eggplants and pepper plants during 2010 and 2011 seasons are shown in Table 1.

It is worth to mention that the total number of *B. tabaci* population on eggplant plants was higher than that recorded on pepper plants in 2010 and 2011 seasons. These results are confirmed with those obtained by Lee *et al.* (2012) who investigated the occurrence of sweet potato whitefly, *Bemisia tabaci* affecting cucumber, eggplant and red pepper from 2010 to 2011.

Seasonal abundance of the dominant homopterous insects on eggplant and pepper plants

Leaf hopper insects, *Empoasca decipiens* (Paoli) and *E. decedens* (Paoli): The weekly numbers of *E. decipiens* and *E. decedens* collected from eggplant and pepper plants in 2010 and 2011 seasons are recorded in Fig. 1-4. Two peaks of population density were recorded for the aforementioned species during 2010 and 2011 seasons on both eggplant and pepper plants. The two peaks occurred at 3rd week of August and September with a total number of 201 and 153 insects/sample for *E. decipiens*, while for *E. decedens* the two peaks occurred at 2nd week of August and September with a total number of 96 and 82 insects/sample on eggplant, while on pepper plants it was 148 and 181 insects/sample (for *E. decipiens*) and 93 and 66 insects/sample (for *E. decedens*) during 2010. On the other hand, One peak was noticed for *E. decipiens* and *E. decedens* on eggplants and pepper plants at the 3rd week of August with a total number of 232

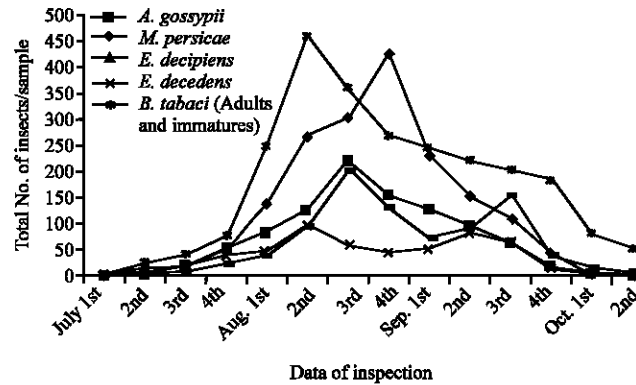


Fig. 1: Seasonal abundance of aphids *A. gossypii* (Glov.), *M. persicae* (Sulzer), leafhoppers *Empoasca decipiens* (Paoli), *E. decedens* (Paoli) and whitefly *Bemisia tabaci* (Genn.) infesting eggplant at Diarb-Nigm district, Sharkia Governorate, Egypt during 2010 season

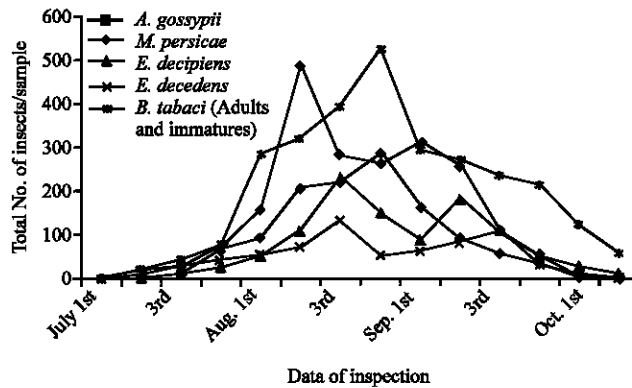


Fig. 2: Seasonal abundance of aphids *A. gossypii* (Glov.), *M. persicae* (Sulzer), leafhoppers *Empoasca decipiens* (Paoli), *E. decedens* (Paoli) and whitefly *Bemisia tabaci* (Genn.) infesting eggplant at Diarb-Nigm district, Sharkia Governorate, Egypt during 2011 season

and 181 insects/sample (for *E. decipiens*) and 132 and 124 insects/sample (for *E. decedens*), while the second peak of *E. decipiens* and *E. decedens* occurred at the 2nd and 3rd week of September with a total number of (183 and 149 and 109 and 89 insects/sample) during 2011 on eggplant and pepper plants, respectively.

Aphid insects; *Myzus persicae* (Sulz) and *Aphis gossypii* (Glover): Samples were taken weekly from eggplant and pepper plants during 2010 and 2011 seasons. The seasonal population abundance of *M. persicae* and *A. gossypii* on eggplant and pepper plants are shown in Fig. 1-4. One peak was noticed for *A. gossypii* on eggplants and pepper plants at the 4th week of August with a total number of 426 and 214 insects/sample during 2010, while in 2011 the peak occurred at the 2nd week of August with a total number of 487 and 214 insects/sample on eggplant and pepper plants. On the other hand, one peak was noticed for *M. persicae* on eggplants and pepper plants during 2010 at the 3rd week of August with a total number of 217 and 275 insects/sample, while

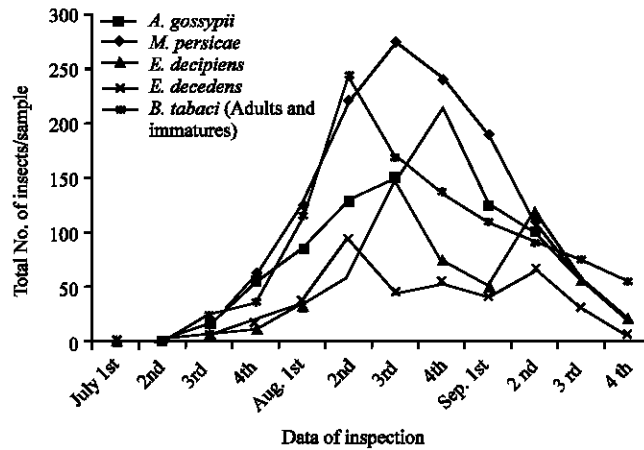


Fig. 3: Seasonal abundance of aphids *A. gossypii* (Glov.), *M. persicae* (Sulzer), leafhoppers *Empoasca decipiens* (Paoli), *E. decedens* (Paoli) and whitefly *Bemisia tabaci* (Genn.) infesting pepper plants at Diarb-Nigm district, Sharkia Governorate, Egypt during 2010 season

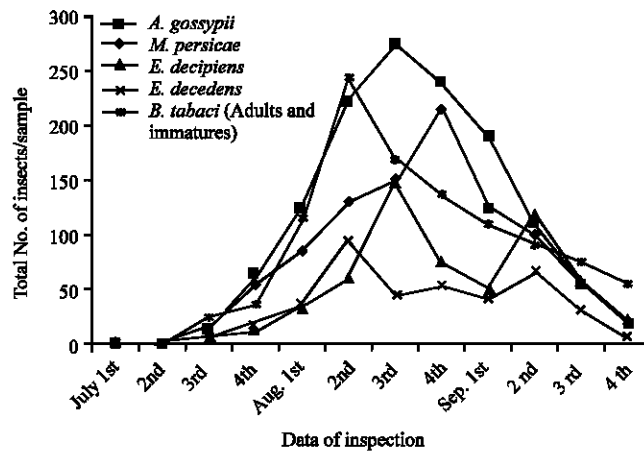


Fig. 4: Seasonal abundance of aphids *A. gossypii* (Glov.), *M. persicae* (Sulzer), leafhoppers *Empoasca decipiens* (Paoli), *E. decedens* (Paoli) and whitefly *Bemisia tabaci* (Genn.) infesting pepper plants at Diarb-Nigm district, Sharkia Governorate, Egypt during 2011 season

in the second season the peak of *M. persicae* occurred at the 4th week of August with a total number of 281 and 321 insects/sample on eggplants and pepper plants, respectively.

Whitefly *Bemisia tabaci* (Genn.): Numbers of *B. tabaci* (immature and adult stages) specimens collected from eggplant and pepper plants during 2010 and 2011 seasons are shown in Fig. 1-4. Data presented in Fig. 1-4 showed that the number of *B. tabaci* individuals fluctuated with generally tendency to increase throughout the successive samples until reaching the peak of population. The population density of *B. tabaci* indicate that one peak recorded at the 2nd week of August peak with a total number of 457 and 244 insects/sample (on eggplant and pepper plants)

during 2010. Similar results were found by Abou-Zaid *et al.* (2012) who recoded that the *B. tabaci* reached its maximum abundance at half of August. While in the second season the peak of *B. tabaci* occurred at the 4th week of August with a total number of 526 and 279 insects/sample on eggplants and pepper plants, respectively.

Regarding the total number of aphid, leafhopper and whitefly insects, it is clear that these insects were more abundant during 2011 than 2010 seasons; the difference in levels of infestation between the seasons might be attributed to the differences in weather factors.

Effect of different eggplant and pepper plants on the population density of certain homopterous insects and the resulted yield quantity

Plant varieties: The influence of certain plant varieties on the occurrence of certain homopterous insects attacking eggplant and pepper plants under the field conditions at Diarb-Nigm district, Sharkia Governorate were studied during the two successive seasons of 2010 and 2011.

Eggplant

Leafhopper insects: As shown from Table 2, the number of *E. decipiens* infested the three eggplant plant varieties was statistically significant during 2010 and 2011 seasons. The most susceptible variety was black beauty followed white balady, whereas black balady variety was the least susceptible recording the respective values (20.29, 16.47 and 13.67 insects sample⁻¹ in 2010 season and 25.14, 19.98 and 15.76 insects sample⁻¹ in 2011 season, respectively.

As seen from Table 2, *E. decedens* infestation on the three tested eggplant varieties were statistically significant during 2010 and 2011 seasons. The most susceptible variety was black beauty (12.17 and 16.22) insects sample⁻¹ in 2010 and 2011 seasons, while the least susceptible variety was black balady (7.92 and 9.57) insects sample⁻¹ in both seasons, respectively.

Aphid insects: Data given in Table 2 revealed that the differences between mean numbers of *M. persicae* on the three tested eggplant varieties were statistically significant during 2010 and 2011 seasons. The most susceptible varieties were black beauty (22.55 and 28.88) insects sample⁻¹. While the least susceptible variety was black balady (11.69 and 15.31) insects sample⁻¹, in both seasons, respectively.

Significant differences could be obtained between *A. gossypii* infestation of different tested eggplant varieties during 2010 and 2011 seasons, Table 2. The most susceptible variety was black beauty (41.57 and 48.69) insects sample⁻¹ in 2010 and 2011 seasons, respectively. While the least susceptible was black balady variety recorded (26.60 and 34.86) insects sample⁻¹ in both seasons, respectively.

Whitefly: As shown from Table 2, the number of *B. tabaci* infested the three tested eggplant varieties was statistically significant during 2010 and 2011 seasons. The most susceptible variety was black beauty followed white balady, whereas black balady variety was the least susceptible recording the respective values (58.24, 45.22 and 35.88) insects sample⁻¹ in 2010 and (68.00, 57.17 and 42.19) insects sample⁻¹ in 2011 season.

Mean yield quantity (kg plot⁻¹): With regard to the influence of eggplant cultivars on eggplant yield, data presented in Table 2 showed that black balady variety yielded the highest mean of 80.66 and 73.50 kg plot⁻¹ in 2010 and 2011 seasons, respectively followed by white balady variety

Table 2: Mean No. of aphids, leafhoppers and whitefly *Bemisia tabaci* infesting different varieties of eggplant plants at Diarb-Nigm district, Sharkia Governorate, Egypt during 2010 and 2011 seasons

| Varieties | Mean No. of insects/sample | | | | | | | | | | Mean of yield (kg plot ⁻¹) | | | | | |
|---------------------|----------------------------|---------|--------------------|---------|--------|---------|--------------------|---------|---------------------|---------|--|---|---------|---------|---------|---------|
| | Aphid insects | | A. <i>gossypii</i> | | Total | | Leafhopper insects | | E. <i>decipiens</i> | | | E. <i>tabaci</i> (Adults and Immatures) | | | | |
| | 2010 | 2011 | 2010 | 2011 | 2010 | 2011 | 2010 | 2011 | 2010 | 2011 | | 2010 | 2011 | | | |
| V1 | 22.550 | 28.880 | 41.570 | 48.690 | 64.12 | 77.570 | 20.290 | 25.140 | 12.170 | 16.220 | 32.46 | 41.360 | 58.240 | 68.000 | 58.000 | 52.330 |
| V2 | 16.760 | 23.020 | 33.860 | 42.760 | 50.62 | 65.780 | 16.470 | 19.980 | 9.980 | 12.170 | 26.45 | 32.150 | 45.220 | 57.170 | 69.330 | 65.330 |
| V3 | 11.690 | 15.310 | 26.600 | 34.860 | 32.29 | 50.170 | 13.670 | 15.760 | 7.920 | 9.570 | 21.59 | 25.330 | 35.880 | 42.190 | 80.660 | 73.500 |
| LSD _{0.05} | 2.410** | 2.240** | 2.130** | 2.574** | 2.27** | 2.407** | 1.660** | 1.607** | 1.440** | 1.465** | 1.55** | 1.536** | 2.165** | 2.066** | 5.212** | 4.289** |

V1: Black beauty, V2: White baladi, V3: Black baladi

cultivars yielded mean of 69.33 and 65.33 kg plot⁻¹ in the two seasons, respectively. Black beauty variety yielded the lowest mean of 58.00 and 52.33 kg plot⁻¹ in 2010 and 2011 seasons, respectively.

Generally, from the obtained results, it could be concluded that black beauty eggplant variety was more susceptible to leafhopper, aphid and whitefly insects' infestation, whereas black balady variety was the least susceptible cultivars. The results agreed with the findings of Abou-Zaid *et al.* (2012) who found that the lowest population abundance of *A. gossypii* and *B. tabaci* on Baladi black variety.

Pepper plants

Leafhopper insects: As shown from Table 3, the number of *E. decipiens* infested the three pepper plant varieties was statistically significant during 2010 and 2011 seasons. The most susceptible variety was balady followed red California, whereas yellow California variety was the least susceptible recording the respective values (16.17, 12.97 and 9.08) insects sample⁻¹ in 2010 season and (18.56, 15.11 and 10.89) insects sample⁻¹ in 2011 season, respectively.

As seen from Table 3, *E. decedens* infestation on the three tested pepper plant varieties were statistically significant during 2010 and 2011 seasons. The most susceptible variety was balady (10.25 and 14.19) insects sample⁻¹ in 2010 and 2011 seasons, while the least susceptible variety was yellow California (6.64 and 8.17) insects sample⁻¹ in both seasons, respectively.

Aphid insects: Data given in Table 3 revealed that the differences between mean numbers of *M. persicae* on the three tested pepper plant varieties were statistically significant during 2010 and 2011 seasons. The most susceptible variety was balady (36.39 and 42.53) insects samples⁻¹ in both seasons, respectively. While the least susceptible variety was yellow California (23.39 and 42.53) insects sample⁻¹.

Significant differences could be obtained between *A. gossypii* infestation of different tested pepper plant varieties during 2010 and 2011 seasons, Table 3. The most susceptible variety was balady (26.25 and 32.06) insects sample⁻¹ in 2010 and 2011 seasons, respectively. While the least susceptible variety was yellow California recorded (15.97 and 18.61) insects sample⁻¹ in both seasons, respectively.

Whitefly: As shown from Table 3, the highest mean number of *B. tabaci* infested the three tested pepper plant varieties were statistically significant during 2010 and 2011 seasons. The most susceptible variety was balady followed red California, whereas yellow California variety was the least susceptible recording the respective values 29.33, 24.03 and 20.97 insects sample⁻¹ in 2010 and 35.31, 28.03 and 26.00 insects sample⁻¹ in 2011 season.

Mean yield quantity (kg plot⁻¹): With regard to the influence of pepper cultivars on pepper yield, data presented in Table 3 showed that yellow California variety yielded the highest mean of 43.66 and 37.33 kg plot⁻¹ in 2010 and 2011 seasons, respectively followed by red California variety cultivars yielded mean of 36.16 and 31.66 kg plot⁻¹ in the two seasons, respectively. While balady variety yielded the lowest mean of 28.33 and 24.50 kg plot⁻¹ in 2010 and 2011 seasons, respectively.

Generally, from the obtained results, it could be concluded that yellow California pepper plant variety and black baladi eggplant variety infested with the least number of leafhopper, aphid and

Table 4: Effect of certain chemical constituents of three varieties of eggplant and pepper plants on the population density of aphids, leafhoppers and whitefly *Bemisia tabaci* during 2011 season

| Varieties | Total protein (%) | Total carbohydrate (%) | pH | P (%) | K (%) | Ca (%) | Total of mean no. of aphids | Total of mean no. of leafhoppers | Total of mean no. of whitefly <i>B. tabaci</i> |
|----------------------|-------------------|------------------------|--------|-------|-------|--------|-----------------------------|----------------------------------|--|
| Plant species | | | | | | | | | |
| Eggplant | | | | | | | | | |
| Black beauty | 10.500 | 37.330 | 5.9 | 0.097 | 1.70 | 1.00 | 77.570 | 41.360 | 68.000 |
| White Baladi | 9.700 | 31.600 | 6.0 | 0.091 | 1.75 | 0.94 | 65.780 | 32.150 | 57.170 |
| Black Baladi | 9.000 | 29.000 | 6.3 | 0.094 | 1.80 | 0.95 | 50.170 | 25.330 | 42.190 |
| LSD _{0.05} | 0.756* | 3.586** | 0.339* | n.s | n.s | n.s | 2.407** | 1.536** | 2.066** |
| Pepper | | | | | | | | | |
| Baladi | 16.300 | 29.700 | 5.7 | 0.330 | 3.30 | 0.97 | 74.590 | 32.750 | 35.310 |
| Red california | 15.600 | 26.600 | 5.9 | 0.320 | 3.50 | 1.00 | 59.170 | 25.440 | 28.030 |
| Yellow california | 15.000 | 24.300 | 6.1 | 0.300 | 3.45 | 0.93 | 47.860 | 19.060 | 26.000 |
| LSD _{0.05} | 0.638** | 2.825* | 0.282* | n.s | n.s | n.s | 1.957** | 1.841** | 1.916** |

whitefly insects and produced the highest quantity of yield. The results agreed with the findings of El-Laithy *et al.* (2013) who mentioned that the infestation of summer pepper cultivars varied with respect to their fruit color, red was regularly more susceptible than yellow to *B. tabaci*. Therefore, it could be recommended to be cultivated successfully in Sharkia Governorate.

Relation between certain chemical constituents of eggplant and pepper plants varieties and leafhopper, aphid and whitefly insects infestation: Samples of different eggplant and pepper plants varieties were chemically analyzed and the obtained results are recorded in Table 4.

A-Total protein, carbohydrate contents "C.C." and pH value: Data in Table 4 show that, the highest mean number of aphids, leafhoppers and whitefly insects recorded on black beauty eggplant variety and balady white pepper variety (77.57 and 74.59 aphids/sample, 41.36 and 32.75 leafhoppers sample⁻¹ and 68.00 and 35.31 whitefly insects) with (10.5 and 16.3 protein, 37.33 and 29.7 C.C. and 5.9 and 5.7 pH) for the two varieties, respectively in 2011 season.

While the least mean number of aphids, leafhoppers and whitefly insects recorded on black balady eggplant variety and yellow California pepper variety 50.17 and 47.86 aphids/sample, 25.33 and 19.06 leafhoppers/sample and 42.19 and 26.00 whitefly insects) with (9.0 and 15.0 protein, 29.0 and 24.3 C.C. and 6.3 and 6.1 pH) for the two varieties, respectively in 2011 season. The results agreed with the findings of Saleh and Al-Shareef (2010) who recorded that the infestation of *B. tabaci* led to decrease the pH value in all vegetable leaves (eggplant, tomato and sweet pepper).

Phosphorous, potassium and calcium: Statistical analysis of obtained data showed that effect of phosphorous, potassium and calcium percentages in eggplant and pepper plants varieties were not significant Hashem (2005), Huberty and Denno (2006) and Hashem *et al.* (2009) pointed out that the chemical constituents of some Solanaceous and cruciferous plant varieties effected on the population density of the leafhopper, aphid and whitefly insects.

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