Beni-Suef University

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Studies on Two Spotted Spider Mite *Tetranychus urticae* Koch on Squash Plant *Cucurbita pepo* at Fayoum Governorate

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SUMMARY

Squash plants consider one of the most important vegetable crops for local consumption and it is good source of several minerals like iron, zinc, phosphorus, and potassium and also it contains anti-oxidant, vitamin C and vitamin A. squash subject to infestation with several pests which cause great damage for plant growth and affect yield, therefore the study conducted for two seasons (2017 and 2018) on squash varieties (Eskandarani, Hytech and Milet) to investigation the following points:

1) Survey and seasonal abundance of, *T. urticae* and other related sucking insect.

2) Studying the relation between the population of *T. urticae* and other insects on the three varieties with environmental conditions (temperature-humidity).

3) Evaluation the susceptibility of three squash varieties to *T. urticae* infestation during two seasons 2017 and 2018.

4) Using Scanning Electron Microscopy to take a picture for trichomes on squash leaves of three varieties and evaluate different phytochemical components of the squash leaves of three varieties to explain the susceptibility of three squash varieties to *T. urticae* infestation.

5) Study effect *T. urticae* nutrition on the anatomical and histological characteristics of squash leaves by using Light and Transmission Microscopy.

6) Biological study of the *T. urticae* at different temperatures.

7) Using plant extracts against *T. urticae*.

1. Ecological studies:

1.1. Survey and population dynamics of pests on three squash varieties (Eskandarani, Hytech and Milet):

In Eskandarani variety:

1. ***T. urticae***:

The population of *T. urticae* commenced from 18th March in 2017 and 2018, the highest population of *T. urticae* was recorded on 10th June (166.8) individual / leaf in 2017 while the maximum population was recorded in 22th April (103.4) individual / leaf. It was found that significant positive correlation found between the population dynamic and temperature(r=0.865** and 0.589**) in 2017and 2018 respectively. While the correlation was significantly negative with humidity (r=-0.747**) in 2017 and insignificant negative in (r=-0.539) in 2018.

2. *A. gossypii*:

Population started from 18th March in 2017 and 2018and reached to its peak in8th April (458.8) individual / leaf in 2017and 27th May (84.6) individual / leaf in 2018. It was found that there was significantly negative between the population dynamic and temperature (r= -0.649*) in 2017 but (r= 0.843**) highly significant positive in 2018. While the correlation was highly significantly positive with humidity (r=0.700**) in 2017 and insignificant negative in(r= -0.450) in 2018.

3. *T. tabaci*:

The population started from18th March in both seasons 2017and 2018. The highest population was recorded on 29thApril (13.2) individual / leaf in 2017 while the maximum population was recorded in 15th April (884) individual / leaf during 2018. It was found that there was insignificant negative correlation found between the population dynamic and temperature

(r=-0.305 and -0.269) in 2017 and 2018 respectively. While the correlation was insignificant positive with humidity (r=0.251) in 2017 and insignificant negative in(r=-0.190) in 2018.

4. Whitefly, *B tabaci*:

Nymphs population started from 25th March in2017 and 2018 and reached to its peak in 29th April (140.8) individual / leaf in 2017and 15th April (515) individual / leaf in 2018.It was found that there was insignificantly positive between the population dynamic and temperature (r = 0.096 and r = 0.062) in 2017and 2018, respectively. While the correlation was highly insignificantly negative with humidity (r=-0.377 and r= -0.341) in in 2017and 2018respectively.

5. *L. sativae*:

Population started from18th March in both seasons 2017and 2018 and reached to its peak in29th April (5.6) individual / leaf in 2017and 15th April (176.8) individual / leaf in 2018. The relationship between weather factor and population showed that there was insignificantly positive between the population dynamic and temperature (r = 0.118) in 2017 and insignificantly negative (r = -0.304) in 2018. While the correlation was insignificantly negative with humidity (r=-0.227) in 2017 and insignificantly positive (r= 0.105) in 2018.

6. *J. lybica*:

Population started from 6th May in2017 and 8th April in 2018. Reached to its peak in13th May (1.4) individual / leaf in 2017and 29th April (4.2) individual / leaf in 2018. It was found that there was insignificantly positive between the population dynamic and temperature (r = 0.118 and r = 0.432) in 2017and 2018respectively. While the correlation was highly

insignificantly negative with humidity (r=-0.464 and r= -0.330) in in 2017and 2018respectively.

In Hytech variety:

1. *T. urticae*:

Population commenced from 18th March in 2017 and 25th March in 2018, the highest population was recorded on 20th May (138.8) individual / leaf in 2017 while the maximum population was recorded in 27th May (40.2) individual / leaf during 2018. The results indicated that there was highly significant positive correlation found between the population dynamic and temperature(r=0.837** and 0.864**) in 2017and 2018 respectively. While the correlation was insignificantly negative with humidity (r=-0.786** and -0.658) in 2017 and 2018.

2. *A. gossypii*:

Population started from 18th March in 2017 and 2018 and reached to its peak in1st April (343.4) individual / leaf in 2017and 6th May (125) individual / leaf in 2018. The results showed that there was significantly negative between the population dynamic and temperature (r= -0.604*) in 2017 but (r= 0.671*) highly significant positive in 2018. While the correlation was significantly positive with humidity (r=0.621*) in 2017 and insignificant negative in(r= -0.524) in 2018.

3. *T. tabaci*:

Population started from18th March in both seasons 2017and 2018. The highest population was recorded on 29thApril (56.8 and 151.8) individual / leaf in 2017 and 2018 respectively. Our results showed that there was insignificant negative correlation found between the population dynamic and temperature(r=-0.241 and -0.291) in 2017and 2018 respectively. While the

correlation was insignificant positive with humidity (r=0.059) in 2017 and insignificant negative in(r=-0.182) in 2018.

4. Whitefly, *B. tabaci*:

Nymphs population started from 25th March in 2017 and 18th March in 2018 and reached to its peak in13th May (126) individual / leaf in 2017and 15th April (481.4) individual / leaf in 2018.results showed that there was insignificantly positive between the population dynamic and temperature (r = 0.337 and r = 0.065) in 2017and 2018respectively. While the correlation was insignificantly negative with humidity (r=-0.426 and r= -0.293) in in 2017and 2018respectively.

5. *L. sativae*:

Population started from18th March in 2017and 8th April in 2018 and reached to its peak in 6th May (9.8) individual / leaf in 2017and 15th April (3) individual / leaf in 2018. Results indicated that there was insignificantly positive between the population dynamic and temperature (r = 0.088) in 2017 and insignificantly negative (r = -0.372) in 2018. While the correlation was insignificantly negative with humidity (r=-0.110) in 2017 and insignificantly positive (r= 0.105) in 2018.

6. *J. lybica*:

Population started from 6th May in 2017 and 15th April in 2018. Reached to its peak in10th June (2.6 and 5) individual / leaf in 2017 and 2018 respectively. Results showed that there was highly significant positive between the population dynamic and temperature (r = 0.732**) in 2017 and significantly positive (0.651*) in 2018. While the correlation was significantly negative with humidity (r-0.585*) in 2017and insignificantly negative (-0.202) in 2018.

In Milet variety:

1. *T. urticae*:

Population commenced from 18th March in 2017 and 2018, the highest population was recorded on 13th May (89.8) individual / leaf in 2017 and 22th April (35.6) individual / leaf in 2018. Results showed that there was highly significant positive correlation found between the population dynamic and temperature (r=0.760**) in 2017 and significant positive correlation (0.465) in 2018. While the correlation was insignificantly negative with humidity (r=-0.769 and -0.448) in 2017 and 2018 respectively.

2. *A.* gossypii:

Population started from 18th March in 2017 and 2018 and reached to its peak in8th April (387.8) individual / leaf in 2017and 29th April (99.8) individual / leaf in 2018.results showed that there was significantly negative between the population dynamic and temperature (r= -0.613*) in 2017 but highly significant positive (r= 0.843**) in 2018. While the correlation was significantly positive with humidity (r=0.631*) in 2017 and insignificant negative in(r= -0.304) in 2018.

3. *T. tabaci*:

Population started from18th March in both seasons 2017and 2018. The highest population was recorded on 25th March (46.2) individual / leaf in 2017 and in 15th April (79.4) individual / leaf in 2018. Results showed that there was significant negative correlation found between the population dynamic and temperature (r=-0.606*) in 2017 and insignificantly positive (r=0.200) in 2018. While the correlation was significantly positive with humidity (r=0.566*) in 2017 and significantly negative in(r= -0.575*) in 2018.

4. Whitefly, *B. tabaci*:

Population started from 25th March in2017 and 2018 and reached to its peak in6th May (131.4) individual / leaf in 2017and 15th April (451.4) individual / leaf in 2018.The results showed that there was insignificantly positive between the population dynamic and temperature (r = 0.301 and r = 0.010) in 2017and 2018respectively. While the correlation was highly insignificantly negative with humidity (r=-0.273 and r= -0.366) in 2017and 2018respectively.

5. *L sativae*:

Population started from18th March in both seasons 2017and 2018. Reached to its peak in 29th April (5) individual / leaf in 2017and 8th April (1.4) individual / leaf in 2018. The relationship between weather factor and population of *L. sativae* indicated that the simple correlation values (r) showed that there was insignificantly negative between the population dynamic and temperature (r = -0.051 and -0.230) in 2017and 2018respectively. Correlation was insignificantly negative with humidity (r=-0.191) in 2017 and insignificantly positive (r= 0.102) in 2018.

6. *J. lybica*:

Population started from 6th May in 2017 and 1st April in 2018. Reached to its peak in13th May (2.4) individual / leaf in 2017and 22th April (11.6) individual / leaf in 2018.the relationship between weather factor and population of *J.lybica* indicated that the simple correlation values (r) showed that there was significantly positive between the population dynamic and temperature (r = 0.613*) in 2017 and was insignificantly positive (r = 0.432) in 2018. While the correlation was insignificantly negative with humidity (r=-0.525 and r= -0.282) in in 2017and 2018 respectively.

1.2. Susceptibility of different squash varieties to *T. urticae* infestation:

Infestation by *T. urticae* was significantly different among the three different squash cultivars. Eskandarani was the most susceptible harbored, While Hytech cultivar was intermediate and the lowest average number of mite infestations was recorded in case of Milet cultivar. This can be traced back to two factors trichomes and phytochemical components of squash leaves. The Eskandarani variety had the lowest number of trichomes (3232.05) (number/ cm^2) and it was highly susceptible to *T. urticae*, while Milet variety had the highest number of trichomes (4017.93) (number/ cm^2) and it was the lowest susceptible to *T. urticae*. As for the phytochemical components of squash leaves, Eskandarani variety was the most infested variety may refer this to the chemical composition of the squash leaves which contains highest contents of Total protein, Total lipids and Total carbohydrates than two other varieties. Also had the lowest contents of Chlorophyll (a and b), total phenol, total flavonoids and total carotenoids than other tested varieties. Finally it was found that positive relationship was found between mite infestations and squash leaf contents i. e., total carbohydrates, total protein and total lipids in squash leaves, while a negative one found with alkaloids and total phenolic compounds, total flavonoids and total carotenoids and chlorophyll (a and b).

The feeding of the mite caused many anatomical and histological changes in the leaves of squash, where it was examined by light microscope and noticed that the average thickness of the mesophyll tissue increased and became undifferentiated, and there are large spaces in the palisade tissue and the palisade tissue lost its compact regular columnar shape, and the average thickness of the upper and lower epidermis decreased in all three varieties. By using an electron microscope in the Eskandarani variety, abnormal

changes were observed in the contents of cells as, degradation of the cell wall, as well as decomposition of mitochondria and deformation of grana disks in chloroplasts and the nucleus lost its spherical shape and shrank. The same changes were observed for the other two cultivars, but to a lesser degree in severity.

2. Biological studies:

Effect of different temperatures on biology of *T. urticae* fed on three squash varieties:

Temperature plays an important role on all different biological aspects of *T. urticae*. Where they successfully completed their development and reproduced at all tested temperatures (20, 25, 30 ºC). Also developmental time, oviposition period, adult longevity and life span decreased with increasing temperatures, while daily oviposition rate and fecundity increased with increasing temperatures. It was noticed that the higher the temperature, the shorter the duration of each stage of growth. Therefore 30ºC is the ideal degree in which all stages of growth are shortened.

3. Effect of some plant extracts on *T. urticae*:

The effect of using three oil plants extracts, namely, Triple Power, Palmetto and Lemongrass, on the adults and eggs of *T. urticae*, was studied by using the spray method.

3.1. The effect of three oil plant extracts on adult individuals of *T. urticae*:

Triple Power recorded the highest toxicity than the rest of the extracts, as the LC_{50} value was 1.31, followed by palmito where LC_{50} was recorded 2.01, while Lemongrass LC_{50} was 4.29%. Also LC_{90} for Triple power was 4.46% followed by Palmito 7.47% and lemon grass17.11%.

3.2.The effect of three oil plant extracts on *T. urticae* eggs:

Triple Power recorded the highest toxicity than the rest of the extracts, as the LC_{50} value was 0.61% and in Palmito LC_{50} was recorded 0.96%, while Lemon grass LC_{50} was1.08%. Also LC_{90} for Triple power was 12.81% followed by Palmito 13.12% and lemon grass16.57%.