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Susceptibility of three okra local varieties to infection with cotton mealybug, *Phenacoccus solenopsis*

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Abstract
The results of the field study showed the sensitivity of three okra varieties (Hasnawy, Ghazaly and Btera) to the cotton mealybug**,** *Phenacoccus solenopsis* from the average numerical density of *P. solenopsis*, the variety Hasnawy recorded the highest severity of infection, which amounted to 15.01 nymphs and adults/leaf, followed by the variety Btera with an average of 10.59 nymphs and adults /leaf, while the variety Ghazaly recorded the least severe infection, and it is the least sensitive variety among the three varieties, with an average of 7.72 nymphs and adults/ leaf. This is because Ghazaly contains the lowest content of chlorophyll and moisture percentage of 16.33 mg /g and 80.41%, respectively, while the Hasnawy and Btera varieties contained 35 and 32 mg /g respectively for chlorophyll. In contrast, the moisture percentage was 82.42 and 81.64% respectively. in additions the leaf area of the variety Ghazaly is smaller compare with other varieties used in this study.

Keywords: Mealybug, chlorophyll, moisture, sensitivity, leaf area

INTRODUCTION

Okra crop *Abelmoschus esculentus* (L) is considered one of the most important vegetable plants spread in most countries. Due to its high nutritional value, it represents one of the most widely consumed plants in the world. It belongs to the Malvaceae family, which is classified as one of the well-known plant families containing 40 species and more than 900 species of plants [1]). Okra pods (okra fruits) play an important role in the human food demand, as they are rich in some nutrients such as calcium, potassium, magnesium, and phosphorus and are a source of carbohydrates, protein, dietary fiber, vitamins A, B1, and C, and mineral salts. As for the seeds are rich in unsaturated fatty acids such as linoleic acid, and therefore, they play a vital role in human nutrition [2, and 3].

Iqbal et al. [4] mentioned that despite the fact that okra is a crop that is tolerant to harsh conditions, the lack of readiness of the elements in the soil and bushes, and poor agricultural practices, there is still an imminent danger in achieving optimal yield, and this danger is due to insect pests that affect the okra crop.

The mealybug Phenacoccus solenopsis Tinsley is one of the pests that destroy this crop. which was recently recorded as an insect introduced to Iraq. It belongs to the order Hemiptera and the family Pseudococcidae, Also the genus Phenacoccus belongs to more than 180 species with a broad spectrum of plant families that reach 154 species of plants from 53 families consisting of 20 field and horticultural crops. As for economic families, they prefer some plant families, including Malvaceae, belong to the okra plant, in addition to cotton and ornamental plants [5,6, and 7]. P. Solenopsis sucks the plant sap from the underside of the leaves, branches, stems and fruiting bodies also causes general weakness of the plant and falling leaves as well as damaging the plants through its work on the transfer of pathogens to the plant in addition to that it secretes a honeydew that causes the growth of sooty mold and other Secondary infections that reduce photosynthesis and reduce the marketing of plant products, the plant may become

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stunted, the leaves will curl and eventually the yield will be significantly reduced [8]. The aims of this study are to sensitivity test some varieties of okra approved for cultivation in Iraq by the mealybug Phenacoccus solenopsis, by calculating the population density of the insect on the okra varieties and the study of the effect of some plant traits morphological and biochemical on *P. solenopsis*.

Testing the susceptibility of infection with the cotton mealybug P. solenopsis to three local varieties of okra crop

The sensitivity of the three varieties of okra crop (Hasnawy, Ghazaly, and Btera) was tested, and the seeds were obtained from the Al-Nahrain Agricultural Office in Al-Najaf Governorate. The field (30 m2) was selected in the village of Abu Shareesh in Al-Muthanna Governorate and prepared for cultivation by conducting all necessary agricultural operations. It was divided into three replicates, each replicate, including three experimental units, each experimental unit consists of 10 okra plants, and the distance between one experimental unit and another is 20 cm. Okra seeds were sown on 21/3/2023, and the distance between one seedling and another was 15 cm. The experiment was conducted according to the randomized complete block design (RCBD). The insect was transferred from the infected fields of Al-Younis orchards in Al-Muthanna governorate to the field on date 25/5/2023. The infection was carried out manually by transferring an infected plant from the okra plant infected with the cotton mealybug insect to a healthy okra plant. The sampling process continued every week for four weeks.

Determination of chlorophyll

The total chlorophyll of the okra crop (Hasnawy, Ghazaly and Btera) was determined according to the technique of Harborn (9). (0.5 g) of leaf tissue was crushed with 10 ml of acetone at a concentration of 85%. The solution was filtered using filter paper (Wathmann No.1). Then the crushing process was repeated to extract the remaining chlorophyll until the color of the tissue became white, after that the total volume of the filtrate liquid was completed with acetone to reach 20 ml (10). Absorption was measured with wavelengths 645-663 nm by using a spectrophotometer, and then the concentration of chlorophyll was calculated by using the following equation:

Total chlorophyll = 20.2 XD (645) + 8.02 XD (663) (V I am running a few minutes late; my previous meeting is running over. W x 1000)
D645 = absorption value at 645 nm wavelength
D663 = absorption value at 663 nm wavelength
V = final volume of filtrate (20 mL)
W = leaves weight (0.5) g

Determination the total moisture content in the leaves

The fresh weight of 10 leaves measured from each okra crop (Hasnawy, Ghazaly and Btera). Then leaves were dried using an oven. The samples were completely dried, and the moisture content in the leaves was measured.

The thickness of leaf's layers

The anatomical study was carried out in the fresh leaves of okra crop (Hasnawy, Ghazaly, and Btera) collected from the field and used the method of cutting by hand cutting for preparing slices according to previously been described by Al-Khazraji and Aziz (12) with some modifications according to which has previously been described by Al-Gburi et al (13).

Measurement of total leaf area:

Random samples were taken from three local varieties of the okra crop. Each variety was represented by five fully developed leaves from each replicate, i.e. the total leaves for each variety were 15 leaves and the leaf area was calculated using the Image J program, as shown in the following steps: 1- Photographs of all leaf samples were taken with a tape measure or ruler 2- The images were transferred to a computer after installing the ImageJ program. 3- From the menu bar in the program, choose File and open the stored images file 4- Select Analyze and then measure the leaf area. (14).

Statistical analysis

Results were statistically analyzed by using An ANOVA analysis. The averages were compared using the lowest significant difference LSD at a probability level of 0.05 by using software GenStat12.

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RESULTS AND DISCUSSION

Susceptibility test of the cotton mealybug *Phenacoccus solenopsis* infestation on three local okra varieties: Hasnawy, Ghazaly and Btera

The results showed, as shown in (Table1), that there was a significant difference in the average numerical density of adults and nymphs of P. solenopsis among the varieties included in the study (Hasnawy, Ghazaly and Btera), which recorded an average numerical density of 15.01, 7.72, and 10.59 nymphs and adults/leaf. respectively. The least significant difference was 2.02 at the probability level of 0.05. There were significant differences among the varieties included in the experiment due to the structural, morphological and chemical differences between the okra varieties, such as the carbohydrate content of the leaves and the amount of nitrogen, and the softness of its tissues, which enables the insect to penetrate and easily infect (15). The content of the leaves of phosphorus and potassium, as it is directly related to the occurrence or resistance of infection because its gives the plant tissues rigidity and strength as a result of its entry into the formation of cells of the scleral tissue that supports the structure of the plant (16). Also, sucking insects are commonly attracted to succulent plants rich in chlorophyll (17, and 18).

Table 1: Number density of the average number of P. solenopsis insect on the leaves of three local cultivars of the okra crop: Hasnawy, Ghazaly and Btera.

Varieties	**Numerical density of the average insect number (nymph and adult/leaf)**				
	first week	second week	third week	fourth week	an average Numerical density/week
Hasnawy	8.5	12.4	17	22	15.01
Ghazaly	4.2	6.6	8.7	11.3	7.72
Btera	5.7	8.8	11.9	15.8	10.59
L.S.Do.05	2.02				

Leaf moisture in the three okra varieties

It is clear to us that there are significant differences in the average percentage of moisture for the leaves of all the varieties included in the study (Figure 1), where Hasnawy recorded the highest water content was 82.42%, followed by the Btera variety with an average water content of 81.64%, while the lowest average content it was recorded by the Ghazaly variety was 80.41%, and the least significant difference was 0.21 at a probability level of 0.05. We conclude from the results that the average humidity of the leaves of okra varieties has an effect on the numerical density of the insect on the okra crop. Increasing the water content of the plant works to increase the metabolism of the plant and the softness of its tissues [19], which makes the plant more susceptible to infection by the cotton mealy bug, and the average correlation coefficient for the relationship between the percentage of moisture and the numerical density of the insect was 0.96, which is a strong positive correlation (Table 4).

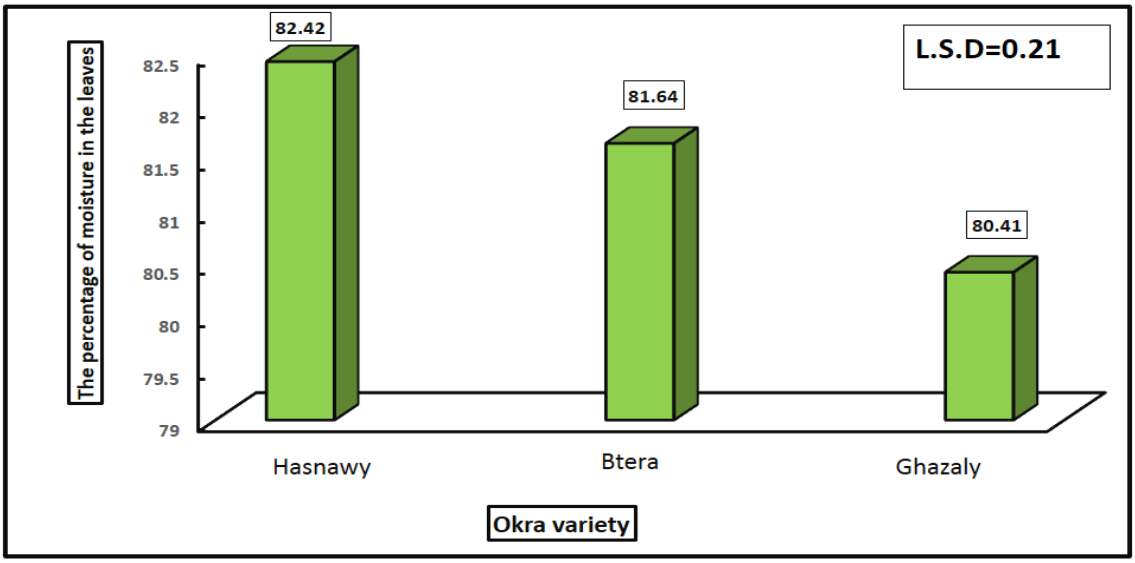

Figure 1: Percentage of moisture in the leaves of okra local varieties: Hasnawy, Ghazaly and Btera

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Total chlorophyll content

The results shown in Figure (2) indicated that there was a significant difference in the leaf content of total chlorophyll between the three okra varieties included in the experiment, where the Hasnawy variety recorded the highest chlorophyll content was 35 mg / g, while the variety Btera recorded an average of 32.41 mg/g. The variety Ghazaly has The lowest content of chlorophyll in the leaves was 16.33 mg/g. The study of the biochemical characteristic (total chlorophyll content) of okra crop varieties showed a strong positive correlation, and the correlation coefficient was 0.86 between the number of *P. solenopsis* insects and the total chlorophyll content in leaves (Table 4). This is because a plant that contains a high amount of chlorophyll creates a high amount of nitrogenous compounds and carbohydrates, which are among the factors most needed by plant-eating insects (20, and 17). In this regard, Al-Sudani [21] mentioned that the infestation of the *Lantana camara* plant with the cotton mealy bug was at a higher rate than that of *Hibiscus rosa* plant. The reason may be the high chlorophyll content of the *Lantana camara* plant, reaching 80.75 mg/g, while the chlorophyll percentage of the *Hibiscus rosa* plant was 58.50 mg/g.

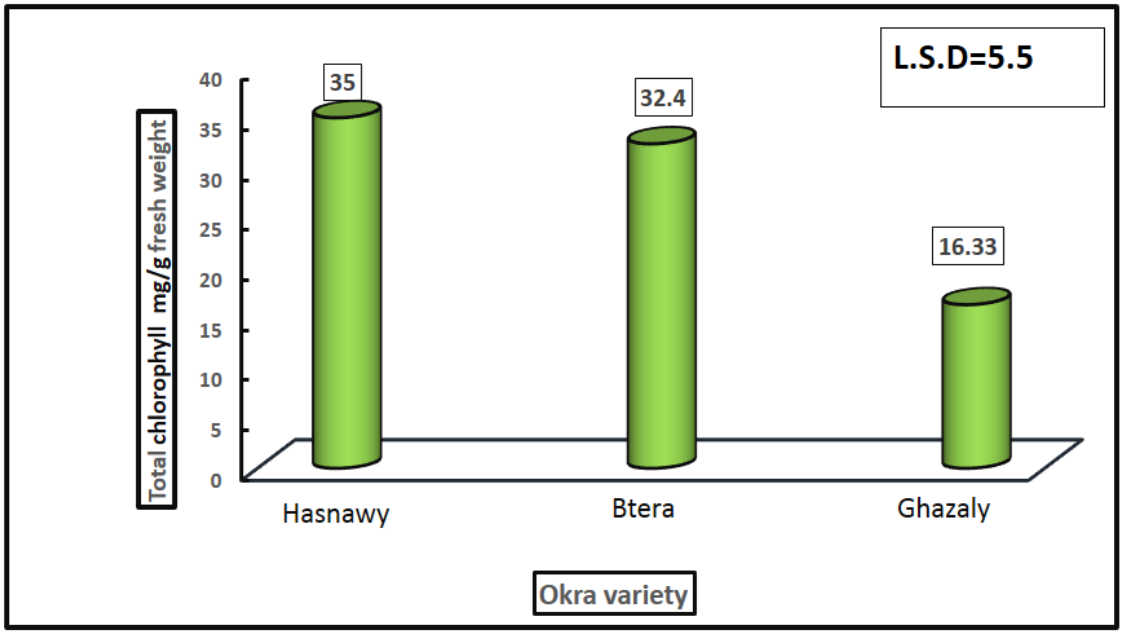

Figure 2: Total chlorophyll of three varieties of okra, Hasnawy, Ghazaly and Btera

Thickness of leaf's layers among the three okra varieties

The results of the anatomical characteristics of the leaves of the three varieties in Table (2) showed that there was a variation in the rates of epidermal and cortex thickness (Figure 3), which were measured before the infection occurred. Where the Ghazaly was significantly superior in the thickness of the epidermal layer compared to other varieties, which amounted to 17.88 µm, while the variety Btera amounted to 15.85 µm, and the variety Hasnawy recorded the smallest epidermal thickness among the three varieties was 12.36 µm.

The average correlation coefficient for the relationship between epidermal thickness of leaves and the numerical density of the insect *P. solenopsis* was -1, and it is a complete negative correlation (Table 4). As for the thickness of the cortex, Ghazaly recorded an average thickness 374.3 µm, while Hasnawy and Btera recorded 305.4 and 349.8 µm, respectively. The results showed that there were significant differences between all varieties, as the correlation coefficient for the relationship between the thickness of the cortex and the numerical density of the insect *P. solenopsis* was- 0.99 , and it is a complete negative correlation, (Table 4).

This variation is due to the genetic variation of the varieties, which is directly reflected in the morphological and histological structure of the vegetative parts of okra [22], which leads to a difference in the sensitivity of the varieties to insect pests, including *P. solenopsis*. One of the defense mechanisms against insects in okra is the morphological structures such as the number and thickness of cells, as the number of insects increases on the thin leaves and decreases on the thick leaves of the plant [23]. Plant varieties with thick cuticle leaves are less favorable for insect infestation [23]. Therefore, tissue thickness can determine the degree of resistance in some crop varieties.

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Table (2) Thickness of epidermis and cortex of leaves of three okra cultivars: Hasnawy, Ghazaly and Btera

Varieties	Epidermis thickness micrometer	Cortex thickness micrometer
Hasnawy	12.36	305.4
Ghazaly	17.88	374.3
Btera	15.85	349.8
L.S.Do.05	2.72	11.84

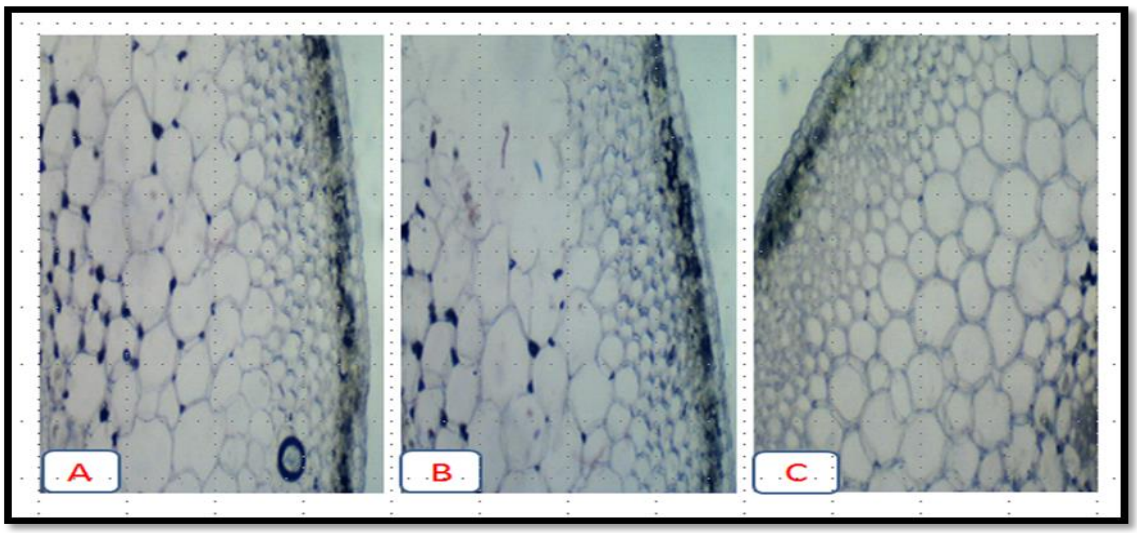

Figure 3: Cross-section of leaves of okra varieties: Hasnawy (A), Ghazaly (B), and a Btera (C) 4X.

Leaf area of three local varieties of okra crop: Hasnawy, Ghazaly and Btera

The results of the leaf area of three local okra variety: Hasnawy, Ghazaly and Btera (Table 3) showed that there was a variation in the leaf area that were measured before the infection occurred, where Hasnawy was significantly superior in the average leaf area compared to other varieties , which amounted to 473.3 cm ² As for the variety Btera amounted to 430 cm2, while Ghazaly recorded the smallest average leaf area among the three varieties, amounting to 382.3 cm², the average correlation coefficient for the relationship between area leaf and the numerical density of the insect was 0.98, and it is a complete positive correlation, (Table.4). The leaf area plays a major role in the severity of crop infestation, and this may be attributed to the dense distribution of the presence of the insect on the leaf with a large area, in contrast to leaves with a small area [24].

Table 3: Leaf area for three varieties of Okra: Hasnawy, Ghazaly and Btera

Varieties	**leaf area (cm²)**
Hasnawy	473.3
Ghazaly	382.3
Btera	430
L.S.Do.05	7.78

Table 4: Correlation coefficient for some phenotypic and physiological traits in comparison with the numerical density of *P. solenopsis*

Adjective	correlation coefficient	link strength
Epidermis thickness	**_1.00**	Strong negative correlation
Leaf area	**0.98**	Strong t positive correlation
Cortex thickness	**-0.99**	Strong negative correlation
Moisture percentage	**0.96**	Strong positive correlation
Amount of chlorophyll	**0.86**	Strong positive correlation

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CONCLUSION

The results showed in the study offer clear evidence for the population density of the mealybug Phenacoccus solenopsis varied among the local okra varieties, Hasnawy, Ghazaly and Btera with different. Depending on the mealybug populations and the analysis of the biochemical of the varieties, Ghazaly was classified as a less sensitive variety against mealybug.

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REFERENCES

[1] Yasin, M., F. Anwar, H. Noorani, S. Muhammad, A. Mahmood, T. Javed and Abu-Harirah, H. A. 2022. Evaluating non-composted red cotton tree (Bombax ceiba) sawdust mixtures for raising okra (Abelmoschus esculentus (L.) Moench) in pots. Agronomy, 13(1), 97.
[2] https://doi.org/10.3390/agronomy13010097
[3] Elkhalifa, A. E. O.E., M. Al-Shammari, J.C. Adnan, K. Alcantara, N.E. Mehmood and Ashraf, S. A. 2021. Development and characterization of novel biopolymer derived from abelmoschus esculentus l. Extract and its antidiabetic potential. Molecules, 26(12), 3609. https://doi.org/10.3390/molecules26123609
[4] Xiong, B.W.Wu.Z., R. Zhang, C. Liu, A. Yang and Xian, Z. 2021. Preparation, characterization, antioxidant and anti-inflammatory activities of acid-soluble pectin from okra (Abelmoschus esculentus L.). International Journal of Biological Macromolecules, 181, 824-834. https://doi.org/10.1016/j.ijbiomac.2021.03.202
[5] Iqbal, J.M., M. Al Hasan, Ashfaq and Nadeem, M. 2011. Association of chemical components of okra with its resistance against Amrasca biguttula biguttula (Ishida). Pakistan Journal of Zoology, 43(6).
[6] Arif, M. I.R., Muhammad and Abdul, G. 2009. Host plants of cotton mealybug (Phenacoccus solenopsis): a new menace to cotton agroecosystem of Punjab, Pakistan. International Journal of Agriculture and Biology, 11(2), 163-167. http://www.fspublishers.org/
[7] Fand, B. B. and S.S., Suroshe. 2015. The invasive mealybug Phenacoccus solenopsis Tinsley, a threat to tropical and subtropical agricultural and horticultural production systems–a review. Crop protection, 69, 34-43. https://doi.org/10.1016/j.cropro.2014.12.001
[8] Ben-Dov, Y.D.R., Miller and Gibson, A. P. 2017. Scale Net. Available at:
[9] http://www.scale.info/catalogue/Phenococcus%20solenopsis/ (Accessed June2017).
[10]https://doi.org/10.26842/binhm.7.2018.15.1.0093
[11] Shah, T. N., A. M. Ahmed and Memon, N. 2015. Population dynamics of cotton mealybug, Phenacoccus solepnosis Tinsely in three talukas of district Sanghar (Sindh). Journal of Entomology and Zoology Studies, 3(5), 162-167.
[12]Al-Sahhaf, F. H. R. 1989. Feeding applied intentions. Ministry of Higher Education and Scientific Research. Baghdad University. House of Wisdom - Iraq.
[13]Lorenzen, C. J. 1967, December. Vertical distribution of chlorophyll and phaeo-pigments: Baja California. In Deep Sea Research and Oceanographic Abstracts (Vol. 14, No. 6, pp. 735-745). Elsevier. https://doi.org/10.1016/S0011-7471(67)80010-X
[14]Horwitz, W. 1982. Evaluation of analytical methods used for regulation. Journal of the Association of Official Analytical Chemists, 65(3), 525-530. https://doi.org/10.1093/jaoac/65.3.525
[15]Al-Khazraji, T. A. and F. M. Aziz. 1990. Practical in plant anatomy and microscopic preparations. Press of the Iraqi Ministry of Higher Education. University of Al Mosul. Iraq. 324 pages.

[16]Al-Gburi, B. K. H., F. H. Al-Sahaf, F. A. Al-Fadhal, A. E., Mohammed and Monte Diaz de Guereñu, J. P. D. 2019. Effect of different control methods on Cuscuta campestris, and growth and productivity of eggplant (Solanum melongena). Plant Archives, 19(Sup. 1), 461-469. https://orcid.org/0000-0001-9940-4256
[17]Stawarczyk, M and k .Stawarczyk. 2015. Use of the ImageJ program to assess the damage of plants by snails. Chemistry-Didactics-Ecology-Metrology, 20(NR 1-2), 67-73.
[18]El-Fakharany, S. K. M. 2020. Cotton mealybug Phenacoccus solenopsis (Hemiptera: Pseudococcidae) population density in eggplant and okra plantations and effect of some insecticides. Egyptian J. Plant Protection Res. Institute, 3(1), 377-388.
[19]16. Steinkraus, D.; J. Zawislak, G. Lorenz, B. Layton and Leonard, R. 2005. Spider mites on cotton in the Mid-south. University of Arkansas, Division of Agriculture Department of Entomology, Research Reports, 8 p.
[20] Amaliotis,D., I. Therios and M. Karatissiou. 2004. Effect of nitrogen fertilization on growth, leaf nutrient concentration and photosynthesis in three peach cultivars. ISHS, Acta Hort., 449: 36–42.

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[21] Farouk, S., A. B. Almutairi, Y. O. Alharbi and Al-Bassam, W. I. 2021. Acaricidal efficacy of jasmine and lavender essential oil or mustard fixed oil against two-spotted spider mite and their impact on growth and yield of eggplants. Biology, 10(5), 410.
[22] https://doi.org/10.3390/biology10050410
[23] Singh, V and A. K., Sood. 2017. Plant Nutrition: A tool for the management of hemipteran insect-pests-A review. Agricultural Reviews, 38(4), 260-270./10.18805 ag.R-1637
[24] Shadchina, T. M., and V. V., Dmitrieva. 1995. Leaf chlorophyll content as a possible diagnostic mean for the evaluation of plant nitrogen uptake from the soil. Journal of Plant Nutrition, 18(7), 1427-1437. https://doi.org/10.1080/01904169509364992
[25] Al-Sudani, A. H. A. 2018. Diagnostic and ecological study of two types of mealybugs with some methods of controlling them in Basra Governorate. Master Thesis, Department of Plant Protection / College of Agriculture / University of Basra. 83 pages.
[26] Maciel, F. M., C. M. Salles, C. A. Retamal, V. M. Gomes and Machado, O. L. 2011. Identification and partial characterization of two cysteine proteases from castor bean leaves (Ricinus communis L.) activated by wounding and methyl jasmonate stress. Acta physiologiae plantarum, 33, 1867-1875.
[27] Smith, C. M. (Ed.). 2005. Plant resistance to arthropods: molecular and conventional approaches. Dordrecht: Springer Netherlands. log in with your Springer account
[28] Jabbar, A. S. and F. J.M. Al Bahadli . 2014. Effect of tomato leaf borer Tuta absoluta (Meyrick) on some cultivars and species of the Solanaceae family, with reference to its control. Basra Journal of Science, vol. 32, p. 2b, p. 1 - 20 pages. https://search.emarefa.net/detail/BIM-542607