Evaluating the toxic efficacy of some bio-insecticides against mature stages of whitefly insect (*Bemisia tabaci*).

Alyaa Abdul-Ridha Hanash

Pure Science College, Wasit University, Iraq

alalqurashy@uowasit.edu.iq

Abstract

This work was conducted to assess the effectiveness of three bio- insecticides (Spinosad, Abamectin and Thiomethoxam) against the mature stages of the whitefly (*Bemisa tabaci*): Aleyrodidera. HomoPtera . The results showed all pesticides it was active in decreasing the population density of adults in first day after spraying, after which its effectiveness it started to decrease after the 3rd and 7th day of spraying, on the other hand, the lowest population density of nymphs was recorded from day 7 onwards after 2nd spray with pesticides. 17.42 adults/10 leaves and 9.82 nymphs/16 cm2 was the lowest population density after 2nd spray of pesticides comparison with the durations before spraying and the 1st spray, which reached rate of population density (55.14 and 25.37) adults 10/leaf and (47.93 and 21.8) nymphs 16/cm2 respectively, Spinosad pesticides were characterized reduced the population density of adult after (1 and 3) days for each of the 1st spray, which reached an average of (2.11, 3.77) insects/10 leaf and (1.66, 2.66) insects/10 leaf for the 2nd spray respectively and for the nymphs at the 2nd spray after (1, 3, and 7) days, which reached an average of (8.66, 4.88, 3.88) nymph/16 cm2 respectively . The present results it shows the effectiveness of the biological agents used (bio-pesticide) and demonstrate that biological insecticides can be used in the management of whitefly by following safety instructions for the use of insecticides and choosing the right time to harvest the plants this is to avoid harm from pesticides as much as possible.

Keywords: Spinosad, Abamectin, Thiomethoxam, Whitefly, *Bemisia tabaci*, Cucumber.

1-Introduction

The whitefly Gennadius (*Bemisia tabaci*) of the order Hemiptera and the Aleyrodidae family are insect pests widespread in most parts of the world. (America, Europe, Africa, Asia, then Australia) has a wide plant hosts range and causes harm and threat to most economic crops due to its direct and indirect damages, as this insect has the ability to transmission of more than 110 plant pathogenic viruses (1,2).This insect infects a wide range of plant families , among the plants most susceptible to infection with this insect are tomatoes, cucumbers, okra, cotton and eggplant(3, 4, 5, 6, 7, 8, 9).

The nature of the damage that this pest causes to plants is by attacking the phloem sap and sucking the sap and secretion of toxic substances, which negatively affects the plant by reducing the synthesis process photosynthesis, plant yellowing, leaf fall. There is also the presence of honeydew on the infected plant parts It becomes a catalyst for the growth of some molds and their negative effects on plant. The insect contributes to the transmission of many pathogenic viruses, including BGMV (Bean golden mosaic virus), TMOV(Tomato mottle virus), (TYLCV) Tomato yellow leaf curl virus .great losses for crop caused by these viruses in terms of quantity and quality of production (3,10).

The cause behind the increased the importance and risk of this whitefly is the speed with which it forms resistant strains for chemical pesticides, it has strains resistant to carbamates and pesticides organophosphates, pyrethrins, and neonicotinoids. This is because it has several different mechanisms for resistance to these pesticides, and the effect may be genetic in the organism in response to selection pressure (11,12).

whityfly affects vegetables, watermelon, cotton ,fruits and citrus .because of the importance of the insect and the damage it causes, many methods have been used to combat it especially chemical pesticides, as they are an effective and quick-acting method. imidacloprid has been widely used to control whitefly and has achieved good results in controlling these. It works to inhibit its development during its annual life cycle and its movement between crops (13).

Due to the side effects of chemical pesticides on the environment and their impact on humans, in addition to that the whitefly is characterized by the rapid formation of strains that are resistant to chemical pesticides (14). researchers have moved towards the need to search for other alternative methods with similar effectiveness achieved by chemical pesticides and at the same time safe for humans and the environment and inexpensive ,biological control played the largest role in achieving these goals (15) . In view of the importance of this insect pest locally and globally, and due to the lack of sufficient studies have been carried out. This study aims to evaluate the effect of bio-pesticides (Spinosad, abamectin and Thiomethoxam) in mature stages of whitefly.

2- Materials and Methods

2-1-Studying the effect of bio-pesticides in the population density of the *B. tabaci* .

This work was conducted in two greenhouses at the Medical Technical Institute / Kut on cucumber plants during the autumn season from September to December / 2020. The land was divided into five lines where cucumber seeds were cultivated. The expanse between one plant and another was 50 cm, after which the plant was left to infect with insect pests (16). After the infestation appeared, and after 30day after planting, and when adult population density is reached 7-15 adults per leaf, the plants were then sprayed with bio- pesticides,at a rate of three replicate of each pesticide, using a 2-liter hand sprayer. The population density was calculated at the day before spraying, as well as After (1, 3, 7) days of spraying, and re-spraying one week after the first spraying(2).

2-1-1-Studying the effect of bio- pesticides in the population density of *B. tabaci* adults

population density of adults on cucumber leaves early in the morning was calculated by counting directly on the underside of the leaf after leaf gentle turn in ten leaves before and after spraying (2).

2-1-2-Studying the effect of bio- pesticides in the population density of *B. tabaci* nymphs

nymphs population density was calculated by calculating the number of nymphs per $4cm^2$ of cucumber leaves, four parts for each leaf and for every ten leaves, the cucumber leaves were transported to the laboratory in a plastic bag, and the nymphs were calculated under dissecting microscope before and after the spraying process.

2-2-Toxic action of bio-pesticides in nymphs and adults of *B. tabaci*

We measured the effectiveness of pesticides (spinosad, abamectin, thiomethoxam) at the field concentration (0.5 ml/l) and at half the field concentration (0.25 ml/l) in whitefly mature stages on cucumber leaves, three plants were sprayed for each concentration (treatment) and three plants were sprayed with water alone (control).Ten leaves were examined under the microscope, and the The relative effectiveness of insecticides in decreasing adult and nymph numbers was calculated. after (1,3,7) day after spraying.

2-3-Statistical analysis

data was analyzed according to Complete Randomized Blocks Design (CRBD) as a factorial experiment using the least Significant difference test (R.L.S.D.) below significant level 0.05.

3- Results and Discussion

3-1-Evaluation of the toxicological efficiency of pesticides in the population density of insect adults.

The results of Table (1) also show the effect of durations in population density, the lowest rate 17.27 insects per leaf one day after spraying , which significantly different from the durations after (3 and 7) days , reached (21.08 and 25.84) 10 insects/leaf for each, respectively. Spraying also had a significant impact, as the rate reached its lowest after the second spray, reached to 17.42 insects 10/leaf, which difference from pre-spray and first spray, reached (55.14 and 25.37) insects 10/leaf for each, respectively. lowest rate reached with spinosad pesticide at first and second spraying and after (1 and 3) days of spraying, reached to (2.11, 3.77, 1.66, 2.66) insects 10/leaf, respectively, difference significantly from the remaining treatments.

Table (1):-Toxic action of bio-pesticides in *B. tabaci* adults

Population density of *Bemisia tabaci* adults: insect/10 leaf								
Pesticide	Pre spraying	Reduction at days after 1st spray			Reduction at days after 2nd spray			Pesticide average
		1	3	7	1	3	7	
AB	55.14	18.88	20.77	25.55	29.88	19.22	28.11	28.22
SP	54.84	2.11	3.77	11	1.66	2.66	5.66	11.67
TH	55.43	37.33	52.66	56.33	13.77	27.44	28.44	38.75
average		19.44	25.73	30.96	15.1	16.44	20.73	
	55.14	25.37			17.42			
RLSD 0.05		5.28						2.72
duration average	After(1) day=17.27	After(3) day=21.08			After(7) day=25.84			
RLSD 0.05 for time duration	1.29							

RLSD (0.05) to interaction between(pesticide*spraying*time)=3.72.

The results are shown in Table (2). There are significant variances in the impact of durations in nymphs population density its lowest after 7 day of spraying bio- pesticide which reached 13.77 nymphs/16 cm^2, which differed significantly from the duration after (1,3), which amounted to (17.36 and 15.21) nymphs/16 cm^2, respectively. The lowest nymphs population density was 9.82 nymphs/16cm^2 after the second spraying, compared to before the spraying and the first spraying it reached (47.93, 21.8) nymphs/16 cm^2 respectively, lowest population density also noted with spinosad insecticide treatment after the second spraying (1, 3, 7) days after spraying , which reached (8.66, 4.88, 3.88) nymphs/16 cm^2 for each, respectively, which differed significantly from the remaining treatments.

Table (2):-Toxic action of bio-pesticides in *B. tabaci* nymphs
RLSD (0.05) to interaction between(pesticide*spraying*time)=5.03

Population density of *Bemisia tabaci* nymphs: insect/16cm^2								
Pesticide	Pre spraying	Reduction at days after 1st spray			Reduction at days after 2nd spray			Pesticide average
		1	3	7	1	3	7	
AB	46.06	24.33	22.44	21.22	9.66	11.77	9.33	20.68
SP	47.81	16	12.22	17.44	8.66	4.88	3.88	15.84
TH	50	23.88	28.33	23.88	21.66	11.66	6.88	23.75
average		21.4	20.99	20.84	13.32	9.43	6.69	
	47.93	21.8			9.82			
RLSD 0.05	5.23							0.93
duration average	After(1) day=17.36		After(3) day=15.21		After(7) day=13.77			
RLSD 0.05 for time duration	1.24							

Suggestions put forward in studies related to the pesticide spinosad were wide-ranging, especially when it came to sucking insect pests such as whiteflies, (17) discovered the biopesticide spinosad most active in decreasing whitefly density.

(18) record in study to evaluate impact of both the pesticide spinosad and the pesticide metarhizium anisopliae, *Beauveria bassiana*, and azadirachtin in whitefly population density *(Bemisia tabaci*) ,the high effectiveness of the pesticide spinosad in combating whiteflies population on tomato, compartion to the rest of the biological factors and that the population density of the insect was reduced in all treatments to an extent it ranges between 50% and 94.61%

In other research to evaluation of the biocides spinosad and azadirachtin on eggs and nymphs and adults of the whitefly (*Bemisia tabaci*) in laboratory and greenhouses (19) arrived to these pesticides have an significant effect and there is a clear reduction in fertility, egg hatching, and emergence. also causes great mortalities in nymphs and adults of the whitefly, and the pesticide Azadirachtin has superior effect on the pesticide spinosad.

(20) mentioned that spinosad pesticide caused heavy mortality in the third nymphal instars for whitefly, first instar was most sensitive.

(21) showed the WG 25 thiomethoxam pesticide most active in decreasing whiteflies population density on eggplant compare to rest pesticides used , accordingly, thiamethoxam gave the highest increase in yield.

Conclusion

from the current finding, it can be concluded that the bio-pesticides (Spinosad , abamectin , Thiomethoxam) and their different concentrations were active in decreasing the population density of *B. tabaci* mature stages under field conditions, The mortality rate is proportional to the concentration. These pesticides have different modes of action, each bio-pesticide causes significant adverse impact in pest society. Such pesticides might provide an alternate method to chemical control and the possibility of using it for works with other agents in an integrated management program for whitefly management.

References

[1] Sadeh, D.; Nitzan, N.; Shachter, A.; Chaimovitsh, D.; Dudai, N.; Ghanim, M. (2017). Whitefly attraction to rosemary (Rosmarinus officinialis L.) is associated with volatile composition and quantity. PLoS One, 12(5): e0177483.

[2] Mahmoud, F. H. ; Mahmoud, M. A. A.; Abd Allah, D. M. and Abdel-Halim , K. Y.(2022). Efficacy of Abamectin and Thiamethoxam Mixture Against *Bemisia Tabaci* in Tomato and Toxicity on Male Albino Rats. Egypt. J. Chem. Vol. 65, No. SI:13, pp. 707 – 715.

[3] Xu, C.; Qiu, B. L.; Cuthbertson, A. G. S.; Zhang, Y. and Ren, S. X. (2012). Adaptability of sweetpotato whitefly *Bemisia tabaci* (Hemipetera: Aleyrodidae) on seven marginal host plants. Int. J. Pest Manage., 58: 297-301.

[4] Anwar, W.; Javed, MA.; Shahid, AA.; Nawaz, K.; Akhter, A.Ur.; Rehman, MZ.; Hameed Iftikhar, S. & Haider, MS. (2019). Chitinase genes from Metarhizium anisopliae for the control of whitefly in cotton. Royal Society Open Science, 6: 190412.

[5] Ahmed, F.; Anwar, W.; Javed, MA.; Basit, R.; Akhter, A.; Ali, S.; Khan, HAA.; Amin, H. & Haider, MH. (2019). Infection mechanism of *Aspergillus* and *Fusarium* species against *Bemisia tabaci.* Mycopath, 17: 69-78.

[6] Salehi, M.; Ghods khah Daryaei, M.; Amanzadeh, B.; Mousavi Koper, S.A. (2021). Antixenosis resistance of oneyear-old poplar seedlings of different clones to poplar clearwing moth, Paranthrene tabaniformis Rott. (Lep: Sessiidae). Caspian Journal of Environmental Sciences, 19: 415-422.

[7] Abbas, KM. & Al-Rahmanny, AHJ. (2022). Toxic effects of various oil concentrations obtained from Rosmarinus officinalis on *Musca domestica* adults (Diptera: Muscidae) in different time periods. Caspian Journal of Environmental Sciences, 20: 401- 405.

[8] Almuhsin Ahmed, IA.; Al-Jboori, MJ. & AlBahadly, ZK. (2022). The double infection diagnosis, fungal and insect on date palm offshoot Phoenix dactylifera with treatment pesticides and practical technique. Caspian Journal of Environmental Sciences, 20: 855- 858

[9] Alwan, SH. (2022). The toxic impact of the extract of the Dieffenbachia picta leaves on the ratio of death in the termites' workers *Microcerotermes diversus* (silvestri) [Isoptera: Termitidae]. Caspian Journal of Environmental Sciences, 20: 217- 220.

[10] Cathrin, P. B. and Ghanim, M. (2014). Recent advances on interactions between the whitefly *Bemisia tabaci* and begomoviruses, with emphasis on tomato yellow leaf curl virus. In Plant Virus-Host Interaction: Molecular Approaches and Viral Evolution; Elsevier: Amsterdam, The Netherlands, 2014: pp. 79–103.

[11] Bass, C.; Denholm, I.; Williamson, M. S. and Nauen, R. (2015). The global status of insect resistance to neonicotinoid insecticides. Pesticide Biochemistry and Physiology, 121: 78–87.

[12] Dangelo, R. A. C.; Michereff-Filho, M.; Campos, M. R.; da Silva, P. S.; and Guedes, R. N. C. (2018). Insecticide resistance and control failure likelihood of the whitefly *Bemisia tabaci* (MEAM1; B biotype): a Neotropical scenario. Annals of Applied Biology, 172(1): 88–99.

[13] Palumbo, J. C.; A. R. Horowitz and Prabhaker, N. (2001). Insecticidal control and resistance management of *Bemisa tabaci.* In S.E. Naranjo and P.C. Ellsworth eds. Special Issue: Challenges and Opportunities for Pest Management of *Bemisia tabaci* in the New Century. Crop Protection, 20(9): 739-765.

[14] Horowitz, A. R.; Kontsedalov, S.; Khasdan, V. and Ishaaya, I. (2005). Biotypes B and Q of *Bemisia tabaci* and their relevance to neonicotinoid and pyriproxyfen resistance. Archives of Insect Biochemistry and Physiology: Published in Collaboration with the Entomological Society of America, 58(4): 216-225.

[15] Zhang, C.; Shao, ZF.; Han, YY.; Wang, XM.; Wang, ZQ.; Musa, PD.; Qiu, BL. & Ali, S. (2018). Effects of Aschersonia aleyrodis on the life table and demographic parameters of *Bemisia tabaci*. Journal of Integrative Agriculture, 17: 389-396.

[16] Haider Alaa Abbas Al-rabiei and Wajih Mudhar Salami (2016). The effect of some isolated fungal suspensions of *tetranychus urticae koch* in her different life stages .Al furat Journal of Agricultural Sciences,8(4) PP 151-8.

[17] Ghosh, S. (2014). Incidence of white fly *Bemisia tabaci* (Genn.) and their sustainable management by using biopesticides. Building Organic Bridges, 2: 623- 626.

[18] Atef, S. A.; Nesreen M. A.; Khaled D. and Abdelhameed M. (2017). An evaluation of some eco-friendly biopesticides against *Bemisia tabaci* on two greenhouse tomato varieties in Egypt. Journal of Plant Protection Research, 57(1): 9–17.

[19] Hail, K. S.; Malak, S. A. and John, L. C. (2018). Responses of the Whitefly *Bemisia tabaci* (Hemiptera: Aleyrodidae) to Biologically Based Insecticides, American Journal of Entomology, 2(3): 28-35.

[20] Kumar, P. and Poehling, H. M. (2014). Effects of azadirachtin, abamectin, and spinosad on sweetpotato whitefly (Homoptera: Aleyrodidae) on tomato plants under laboratory and greenhouse conditions in the humid tropics. Journal of Economic Entomology, 100(2): 411-420.
[21] Kumar, V.; Grewal, G. K. and Dhawan, A. K. (2017). Relative toxicity of newly introduced insecticides against sucking insect pests of transgenic Bt cotton.Pesict Res J, 28: 108-12.

Article submitted 11 August 2023. Accepted at 12 September 2023. Published at 30 September 2023.