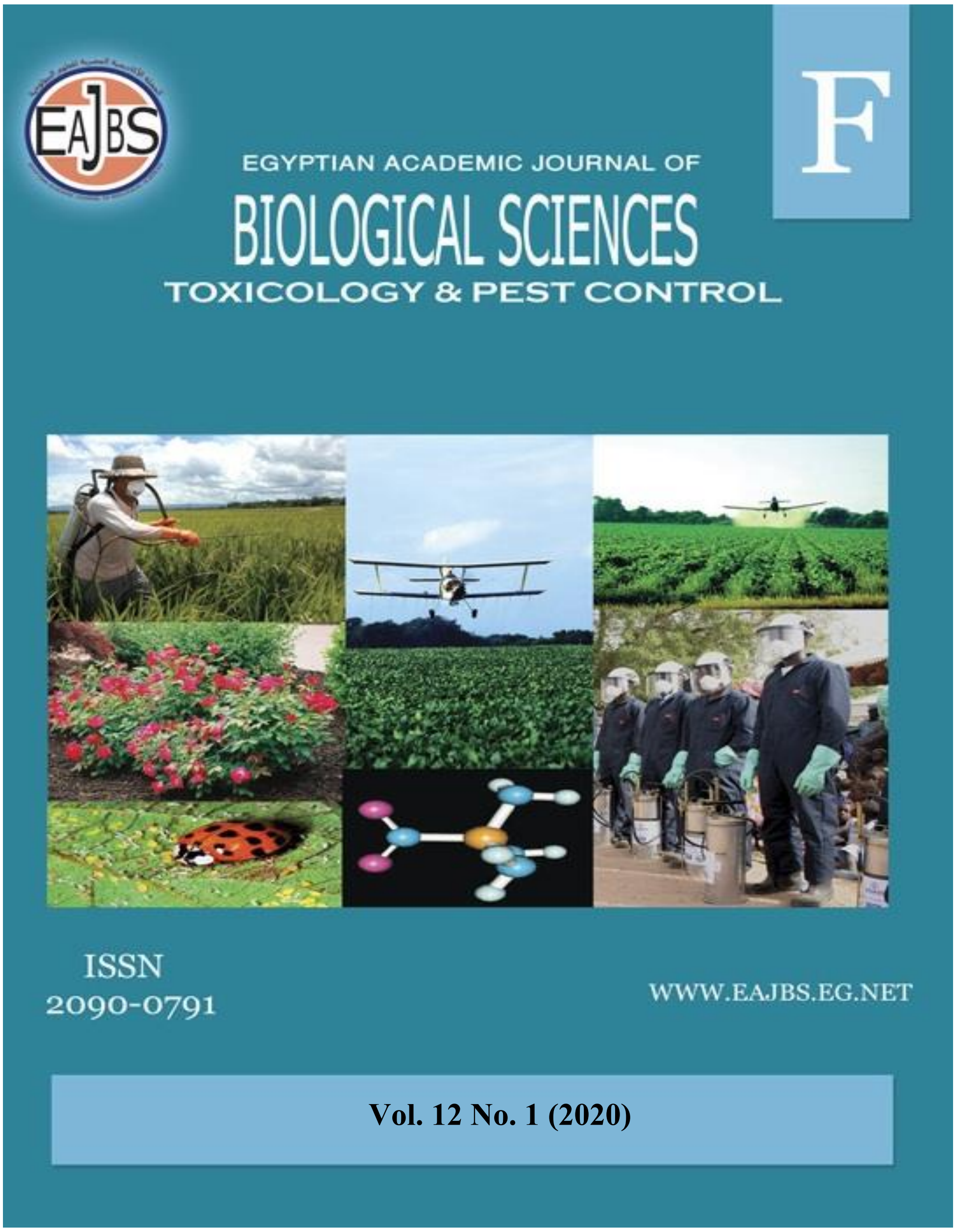

The journal of Toxicology and pest control is one of the series issued twice by the Egyptian Academic Journal of Biological Sciences, and is devoted to publication of original papers related to the interaction between insects and their environment.

The goal of the journal is to advance the scientific understanding of mechanisms of toxicity. Emphasis will be placed on toxic effects observed at relevant exposures, which have direct impact on safety evaluation and risk assessment. The journal therefore welcomes papers on biology ranging from molecular and cell biology, biochemistry and physiology to ecology and environment, also systematics, microbiology, toxicology, hydrobiology, radiobiology and biotechnology.

www.eajbs.eg.net

Citation: *Egypt. Acad. J. Biolog. Sci. (F. Toxicology & Pest control) Vol. 12(1) pp. 217- 226 (2020)*

Egypt. Acad. J. Biolog. Sci., 12(1): 217-226 (2020)

Egyptian Academic Journal of Biological Sciences
F. Toxicology & Pest Control
ISSN: 2090 - 0791
http://eajbsf.journals.ekb.eg/

Efficacy of Certain Insecticides for Controlling the Two Spotted Spider Mite, *Tetranychus urticae* (Koch) and Determination Residues of Abamectin on Some Quality Parameters of Cucumber Fruits

Rehab E.M.E. Salem
Plant Prot. Dept., Fac. Agric., Zagazig Univ., Egypt
E-mail*: yrhab5455@gmail .com

ARTICLE INFO
Article History
Received:17/5/2020
Accepted:30/6/2020
Keywords:
Two-spotted spider mite, *Tetranychus urticae*, acaricide, abamectin, imidaclopride, cucumber, *Cucumis sativus*.

ABSTRACT

Field trials were conducted in El- Salhia, Sharkia governorate, to assess the effectiveness of insecticides (imidaclopride, lambda-cyhalothrin, and abamectin) against the two-spotted spider mite, *Tetranychus urticae,* on cucumber crops. The trial used a randomised complete block design (RCBD) with three treatments: T1: abamectin, T2: lambda-cyhalothrin, T3: imidaclopride, and control, which was repeated three times. At varied harvest intervals of (2h), 1, 3, 5, 7, 9-, 11-, 13-, and 15-days following insecticide applications, residues and abamectin dissipation were measured. The insecticide's persistence, dissipation, half-life value, and safe harvest interval in cucumber were estimated. Additionally, the effects of abamectin residues on various quality indices (total soluble sugars, glucose, acidity, total soluble solids, ascorbic acid, -carotene, dry matter, and protein) were assessed in the last three samples (7 and 15 days after applications). The results revealed that all the treatments reduced the two-spotted spider populations. Furthermore, the results showed that the treatments sprayed with abamectin gave the highest reduction percentage (96.32%), followed by lambda-cyhalothrin (92.22%) and imidaclopride (76.93%). The half-life (t12) values in cucumber fruits were 2.99 days, and the loss percentages of initial deposits in cucumber fruits were 8.96 mg/ kg. In conclusion, we encourage farmers to use abamectin according to the Ministry of Agriculture recommendation in combating *T. urticae*, in integrated pest management, as cucumbers can be safely consumed after 7 days of abamectin treatment.

INTRODUCTION

Cucumber, *Cucumus sativus* L., is one of Egypt's most important vegetable products, used for both domestic and export consumption. Cotton aphid, Aphis gossypii (Glover.); onion thrips, Thrips tabaci L.; whitefly, Bemisia tabaci (Genn.); and two-spotted spidermite, *Tetranychus urticae* Koch are among the insect pests that commonly attack cucumber plants (Karaman *et al*., 2007; Ghallab *et al*., 2011 and Shalaby *et al*., 2013). *T. urticae* has been found to attack over 1200 plant species (Zhang, 2003), with over 150 of them being commercially important (Gupta and Gupta, 1985; Xie *et al.*, 2006; Chhillar *et al.*, 2007).

Tetranychus urticae Koch, 1836, a two-spotted spider mite, is an important pest on many crops, greenhouse, and garden goods (Hoy, 2011). With almost 1200 species, the two-spotted spider mite is the most important member of the Tetranychidae family. *T. urticae* has the ability to produce several generations (12 to 25) and swiftly adapt to new climates. It also has a wide host range, with over 960 kinds of host plants identified (Bolland *et al*., 1998). Because of its short life cycle, haploid-diploid sex determination, and high fecundity, it develops pesticide resistance quickly (Van Leeuwen *et al.,* 2010; Clotuche *et al*., 2011). Adult individuals and nymphs of the spider mite pierce the epidermal cells of the leaf and absorb the contents of the mesophyll cells. At the same time, the damage is also caused to undamaged cells. As a result, the intensity of photosynthesis decreases, the content of chlorophyll changes the colour of the leaves (Park and Lee, 2002& Abdellseid *et al*., 2014). The infested cell can be more damaging to plants when infested with insects pests at the same time such as whitefly and aphids (Kareem *et al*., 2019). Currently, a chemical method is considered the most effective for controlling the spider mite *T. urticae*, especially abamectin a microbial derivative-based acaraicide and other synthetic insecticides such as organophosphorous and pyrethroids in Egypt. The primary component of avermectins generated from Streptomyces avermitilis is abamectin. Insecticide and acaricide component abamectin are utilised in various countries of the world, including America, Europe, and Asia (Clark *et al.,* 1995; Sato *et al.,* 2005).

The undesirable side effects of acaricides can be minimized by monitoring the presence of the residues, their residual effects on some essential biochemical constituents inside cucumber fruits and determining preharvest safety intervals. The purpose of this study was to see how effective the acaricides abamectin, imidaclopride, and lambda-cyhalothrin were against the two-spotted spider mite. Also, abamectin residues in cucumber fruits were determined and the effects of abamectin on some chemical constituents and quality attributes on fruits.

MATERIALS AND METHODS

Laboratory Experiments:

Pesticides Used:

Abamectin: 5′,11,13,22- tetramethyl-2-oxo- (3,7,19-trioxatetracyclo [15.6.1.14,8.020,24] pentacosa-10,14,16,22-tetraene) -6-spiro-2′- (5′,6′- dihydro- 2′H- pyran) -12- yl 2,6-dideoxy-4-O- (2,6-dideoxy- 3- O- methyl- α- L- arabino- hexopyranosyl) -3- O-methyl- α-L-arabino- hexopyranoside.

Lambda-cyhalothrin: reaction product comprising equal quantities of (R) -α-cyano- 3-phenoxybenzyl (1S, 3S)-3- [(Z)- 2- chloro- 3,3,3- trifluoro propenyl]- 2, 2- dimethyl cyclopropane carboxylate and (S)- α- cyano- 3- phenoxybenzyl (1R, 3R) -3 -[(Z)- 2- chloro-3,3,3- trifluoro propenyl]- 2,2-dimethylcyclopropanecarboxylate.

Imidacloprid: R, [(R, S) -α- cyano -3- phenoxy benzyl –(Z) – (1R,3R)- 3- (2- chloro-3,3,3- triflurопropenyl) -2,2- dimethyl- cyclopropane - carboxylate].

Field Experiments:

The study was carried out at El- Salhia, Sharkia governorate, to compare the toxicity of different insecticides abamectin, imidaclopride and lambda-cyhalothrin) against two-spotted spider mites, *T. urticae*, on cucumber. The experiment was set up in a randomised complete block design (RCBD), and the chosen plants were treated with three different insecticides that had been agreed upon beforehand. The plants are left without any contamination, using normal water of application, and commit to repeating three times. Two leaves from the lower canopy, two leaves from the middle canopy, and one leaf from the apex of the branch were randomly distributed among five plants per row from each treatment. When treatment was required, all agronomic techniques were maintained continuously, calibrated, and sprayed according to the schedule with a 15-day interval from the first incidence of the insect pest, i.e., 30 days after planting.

Observations on the count of spider mites were recorded for thirty randomly selected plants before spraying. Three leaves were chosen at random from each plant, and spider mite populations were counted using a binocular microscope. The results were finally reported as mean populations/3 leaves/plant. The first count was taken one day before the first spray, and subsequent counts were taken one, three, five, seven, nine, and fourteen days following each spray. According to Henderson and Tilton's (1955) equation, the percent drop in insect population was computed as follows: R= 100.1 - (Ta.Cb)/Tb.Ca where

R = Reduction percentages in infestation

Cb =Insect number in the treated control plot before insecticidal application

Ta=Insect number in the treated plot after insecticidal application

Ca= Insect number in the untreated control plot after insecticidal application

Tb= Insect number in the untreated control plot before insecticidal application

Determination of Abamectin Residues in Cucumber Fruits:

Sampling Preparation for Residues:

The cucumber crop at the fruiting stage was sprayed with abamectin at recommended rates (100 mL/ Fed.). Control plots were sprayed with water only. After spraying, samples were obtained from each replicate at different times (two hours, one, three, five, seven, nine, eleven, thirteen, and fifteen days). The treated fruits were collected and placed in paper bags and then transported to the laboratory for analysis. A weight of 1 kg was taken from each treatment to study the residues of the abamectin acaricide. Control samples were taken at the same time. The treated samples were subdivided, cutting them into small pieces. All samples were stored in a freezer at−25°C until extraction.

Extraction Procedure:

Extraction:

Abamectin residues were extracted from cucumber fruit samples with QuEChERS extraction. cucumber fruit samples were homogenized. After homogenization, a sub-sample (10 g) was taken to extract. Cucumber fruit samples were placed in a 50 mL falcon centrifuge tube, which was then filled with 20 mL (acetonitrile) and centrifuged for 2-3 minutes. The organic layer was then obtained by centrifuging 2 g sodium chloride (NaCl) for 3 minutes at 3000 rpm (supernatant). 5.5 g anhydrous sodium sulphate was added to 10 mL of the top organic layer in a 50 mL centrifuge tube to remove moisture.

Dispersive SPE Clean-Up Processes:

4 mL of the extract was placed in a 15 mL tube with 0.2 PSA sorbent and 0.6 g anhydrous magnesium sulphate (MgSO4), and the sample tube was vortexed for 30 seconds before centrifugation at 3000 rpm for 5 minutes. 2 mL of the extract was transferred to clean test tubes and centrifuged to dryness at 4000 rpm at -5 °C for 10 minutes before residue analysis.

Determination of Abamectin Residues:

The extract (2 ml) was used for High-performance liquid chromatography (HPLC) analysis. abamectin residues were analyzed with HPLC using a UV-detector at wavelength 200-300 nm. The mobile phase was acetonitrile/water (80/20, v/v) at 0.8 ml min^{-1} on a reversed-phase VP-ODS C18 column (250 × 4.6 mm i.d., 5 mm particle size).

Recovery Test:

Abamectin was added to untreated control samples at three levels (0.05, 0.1 and 1.0 mg/kg). The samples were analyzed under the same conditions. The average recovery was 90% in cucumber fruits

Residual Effects of Abamectin on Some Biochemical Constituents of Cucumber Fruits:

To estimate the impact of abamectin residues on some quality parameters, the last three samples (7 and 15 days after application) were taken to determine some biochemical constituents including total soluble sugars, glucose, acidity, total soluble solids, ascorbic acid, β-carotene, dry matter and protein. Total soluble sugars and glucose were determined according to Dubois *et al.,* (1956). β-carotene was estimated using the method described by Ben-Amotza and Avron, 1983). Acidity, ascorbic acid, protein and dry matter were estimated according to the Association of Official Analytical Chemists methods (AOAC, 1984).

Statistical Analysis:

The data were compiled and tabulated for statistical analysis. Infestation reduction percentages with the spider mite, *T. urticae* at different periods of post-treatment were subjected to analysis of variance (ANOVA) to estimate the statistical significance of treatments using the SPSS 14.00 software (SPSS Inc. Chicago, Il, USA). Also, data of residual effects on some biochemical constituents of cucumber fruits were subjected to analysis of Independent- Sample T-test using the same statistical program.

RESULTS AND DISCUSSION

Efficiency of Abamectin, Imidaclopride and Lambda-Cyhalothrin on the Infestation Reduction Percentages with the 1st of *T. urticae*:

Data in (Table 1) showed the 1st spraying of abamectin, lambda-cyhalothrin and imidaclopride during 2019 growing season. Abamectin caused a high reduction in *T. urticae* populations (96.83%) within 14 days. Lambda-cyhalothrin came in the second position of effectiveness against the population of spider mite, *T. urticae* that reduced of the individuals from 9.8 (control) pre-treatment to reached to 0.04 by 90.44% within 14 days of post-treatment interval compared with imidaclopride that reduced pre-treatment population of the tested insect pest 5.40 by (61.99%) within the same periods of post-treatment interval.

Table 1: Efficiency of abamectin, imidaclopride and lambda-cyhalothrin against the two-spotted spider mite, *T. urticae* infesting cucumber variety during 2019 growing season.

Treatments		Count before Spraying	Reduction at indicated days post-treatment (%)							
			Initial effect1	3	5	7	9	14	Mean of residual effect	Percentage of Population reduction
Abamectin	Treated	4.26	0.22	0.58	0.48	1.12	0.46	0.14	0.50	96.83
	Control	7.00	7.00	20.00	22.40	13.10	13.40	18.60	15.80	
Lambda-cyhalothrin	Treated	7.66	0.60	1.00	0.60	0.94	0.30	0.04	3.48	90.44
	Control	9.80	4.80	2.80	2.20	5.40	6.20	15.00	6.06	
Imidaclopride	Treated	6.24	0.72	0.30	1.68	1.78	0.54	1.36	1.06	61.99
	Control	5.40	5.60	12.00	11.40	11.40	2.20	4.80	7.90	
F- test			**	**	**	**	**	N.S.	**	**

**= High significant N.S.= Not significant

Table (2) 2nd spray with the tested three insecticides during season 2019, all the treatments were marched on the same trend as mentioned with low fitness. The data showed that the treatment with abamectin gave the highest reduction in *T. urticae* population followed by lambda-cyhalothrin, where it caused a reduction in pre-treatment population of spider mite 7.60 by (94.01%), while imidaclopride caused 91.88% population reduction within 14 days of post-treatment interval.

Table 2: Efficiency of abamectin, imidaclopride and lambda-cyhalothrin against the two-spotted spider mite, *T. urticae* infesting cucumber variety during 2019 growing season.

Treatments		Count Before Spraying	Reduction at indicated days post-treatments (%)							
			Initial effect 1	3	5	7	9	14	Mean of residual effect	Percentage of Population reduction
Abamectin	Treated	7.97	0.28	0.40	0.48	0.90	0.32	0.50	2.88	95.82
	Control	7.60	10.46	11.94	12.06	12.06	11.80	12.14	11.74	
Lambda-cyhalothrin	Treated	6.74	0.22	0.44	0.78	1.14	0.72	0.94	0.72	94.01
	Control	7.60	10.46	11.94	12.06	12.03	11.80	12.14	11.74	
Imidaclopride	Treated	6.66	0.54	0.78	1.34	1.26	0.92	0.88	0.96	91.88
	Control	7.60	10.46	11.94	12.06	12.06	11.80	12.14	11.74	
F- test			**	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

**= High significant N.S.= Not significant

(Reddall *et al*., 2004; Duchov-skien, 2007; Lagziri and Elamrani, 2009) found similar results. The great efficacy of abamectin at a low concentration demonstrated that the mite population under study is extremely responsive to this pesticide. Abamectin residue was found to be ineffective on cotton plants by (Landerson *et al.*, 2004; Cloyd *et al.,* 2009). According to the sensitivity of abamectin to UV degradation and the influence of plant age and species on the results (Lasota and Dybas, 1991; Senthil *et al*., 2010; Khajehali *et al*., 2011), such heterogeneity is expected. Abamectin, on the other hand, is absorbed by plants several hours after spraying and hence provides effective *T. urticae* control.

Residues of Abamectin in Cucumber Fruits:

Cucumber fruits were sprayed once with abamectin at the recommended concentration (100 mL/ Fed.). Samples were collected at random from treated lots after 2h. ,1,3,5,7,11,13 and 15 days from application. Results showed that the initial deposit 2h. after treatment with abamectin was 8.96mg/kg.

This value decreased to 3.75, 3.50, 3.00, 2.89, 0.001, ND, ppm after 1, 3, 5 ,7 ,9 ,11 and 15 days. Reduction values in abamectin initial deposit ranged between 58.15 to 100% after 1,3,5,7,9,11 and 13 days after treatments. Table (3). Results revealed that residue half-life (T1/2) value was 3 days in cucumber fruits. The 0.001 mg/kg of abamectin was detected on whole tomato fruits after 9 days of abamectin application. This indicated that only 9 days was enough time to reduce the residues below the maximum residue limits (MRLs) (0.005mg/kg) on cucumber according to EU pesticides database- European Commission. Therefore, cucumber fruits could be marketed with apparent safety for human consumption.

According to (Slvritepe, 2009; Monterio *et al.*, 2015; and Mehdizadeh *et al*., 2017), the residual level of avermectins in paprika was observed in a field experiment from one to seven days and found to be decreased from 18.40 to 7.59 μ/kg. Avermectins in paprika had a half-life of 1.47 days and a quantitation limit of 2 μ/kg. (Gupta *et al*., 2015; Xie *et al.*, 2006) investigated abamectin residues in cabbage at standard and double concentrations of 14.4 and 28.8 g a.i. / ha, respectively, and found that initial abamectin residues in cabbage from the two treatments were 0.495 and 0.773 mg/kg, respectively, and that both treatments reached below the detectable limit (BDL) on the third day.

Table (3): Residues (mg/Kg) of abamectin in cucumber fruits.

Days after spraying	Residues	Dissipation %
Initial	8.96	___
1day	3.75	58.15
3days	3.50	60.94
5 days	3.00	66.52
7 days	2.89	67.75
9 days	0.001	99.99
11 days	ND	100
13 days	ND	100
15 days	ND	100
K	0.36	
$t_{1/2}$	2.99	

K= Degradation rate, $t_{1/2}$= Half- life and UND= undetectable amounts.

Effect of Abamectin Residues on Some Biochemical Constituents of Cucumber Fruits:

Pesticide residues may interfere with biochemical and physiological processes in plants, causing the plant's growth and productivity to be slowed. Furthermore, by changing its quality criteria, they may impair its food quality and possibly prevent its usage as food (Bartholomew *et al*, 1951). As a result, the potential effects of abamectin residues on cucumber chemical components were calculated. Table (4) shows that abamectin residues considerably reduced the levels of all biochemical parameters measured in cucumber fruits (total soluble sugar, glucose, acidity, total soluble solids, ascorbic acid, -carotene, and protein) throughout the experiment with the exception of dry matter. The reduction percentages of the above-mentioned parameters of cucumber fruits with abamectin were 6.67, 37.92, 46.39, 6.10, 25.30, 40.51, 34.92 and 22.71%, respectively. The mean level of dry matter was increased by 13.98%.

Table 4: Effect of abamectin residues on some essential biochemical constituents of cucumber fruits.

Biochemical constituents	Days after spraying	Untreated cucumber fruits	Treated cucumber fruits	Mean reduction (%)
Total soluble sugar (%)	7	9.16±1.95a	6.40±0.95a	
	15	8.97±2.38a	7.24±1.00a	
	Mean	5.55± 1.63a	5.92± 2.23a	6.67
Glucose mg/dL	7	19.22±0.55a	11.92±0.84b	
	15	19.26±0.54a	11.97±0.79b	
	Mean	19.24±1.53a	11.95± 2.22b	37.92
Acidity (%)	7	6.92±0.36a	7.31±1.00a	
	15	7.07±0.24a	7.68±0.27a	
	Mean	13.99±0.33a	7.50±0.25a	46.39
Total soluble solid T.S.S. (%)	7	6.01±0.82a	6.70±0.41a	
	15	6.45±0.63a	6.51±0.54a	
	Mean	6.23±0.72a	6.61±0.39a	6.10
Ascorbic acid mg/dL	7	35.36±7.58a	25.36±2.92a	
	15	35.80±7.98a	27.80±3.73a	
	Mean	35.58±6.99a	26.58±2.89a	25.30
β-carotene (%)	7	11.80±1.89a	7.45±1.16a	
	15	13.08±1.82a	7.47±0.37	
	Mean	12.44±1.20a	7.40±0.58a	40.51
Dry matter (%)	7	12.55±1.76a	16.61±0.26a	
	15	13.54±1.80a	17.36±0.45a	
	Mean	26.09±1.73a	16.98±0.32a	34.92
Protein (%)	7	10.18±0.52a	8.44±0.39a	
	15	12.29±0.39a	8.92±0.55b	
	Mean	11.23±0.45a	8.68±0.44b	22.71

It is commonly known that pesticides have an effect on the chemical makeup of plants after they are applied. Profenofos residues increased protein and ascorbic acid content in potatoes (Habiba *et al*, 1992; Jayasinghe and Mallik, 2010). In addition, these insecticides enhanced T.S.S. and acidity while decreasing tomato glucose, protein, and ascorbic acid content (Ismail *et al.,* 1993). Radwan *et al.* (1995) found that pirimphos-methyl residues in tomato fruit and broad bean seeds had a substantial negative impact on total soluble sugars and ascorbic acid concentration. Pirimphos-methyl exhibited a significant increase in total soluble sugars and acidity percentage of grape berries, whereas there was no effect on T.S.S (Radwan *et al*., 2001). Radwan *et al*., 2004 discovered that pirimphos-methyl treated green pepper fruit had significantly higher total soluble sugars, dry matter percentage, total protein, and -carotene content than untreated fruit. The percentages of total soluble sugars, dry matter, and total protein were all significantly lower after treatment with profenofos. Shalaby (2016a) revealed that residues of thiamethoxam and chlorpyrifos significantly decreased total soluble sugar%, glucose mg/100g, acidity %, total soluble solids %, ascorbic acid mg/100g, protein content%, β-carotene%, protein% and dry matter % of fresh treated okra fruits, and Shalaby (2016b) found that the mean levels of total soluble solids, ascorbic acid, β-carotene, and acidity reduced after 6, 9 and 15 days of profenofos spraying tomato.

It is evident that these biochemical alterations in abamectin-treated cucumber fruits could be attributable to the insecticide's potential to have a local systemic effect (penetrative insecticide). Although abamectin is well known as a nonsystemic insecticide, the penetration of lambda-cyhalothrin through lenticels on the surface of pepper fruits, where it acts on particular biochemical processes, may result in local systemic action. Lambda-cyhalothrin, on the other hand, is a lipophilic molecule that might dissolve in the cell membrane.

Conclusion

In summary, results indicated that all the tested insecticides were effective in reducing *T. urticae* infestation in both the two successive sprays. Abamectin proved most promising and caused a 96.32% reduction in *T. urticae* infestation in comparison with lambda-cyhalothrin which caused 92.22%. imidaclopride was the least effective with infestation reductions of 76.88%.

Results revealed that the initial deposit of abamectin on cucumber fruits was 8.96 mg/kg. A weak degradation of the tested insecticide residues was noticed, one day after spraying with a value of 58.15% dissipation. The initial deposit was slower decreased during the experimental period to reach 0.001 mg/kg after 9 days of abamectin spraying recorded 99.99% reduction in cucumber fruits, while no residues of the tested acaricide were detected on the 11^{th}, 13^{th} and 15^{th} days of spraying. With the exception of dry matter, abamectin residues dramatically reduced the levels of all examined biochemical parameters (total soluble sugar, glucose, acidity, total soluble solids, ascorbic acid, -carotene, and protein) in cucumber fruits throughout the experiment.

REFERENCES

Abdellseid, A.M. and T.A. Abdel Rahman (2014). Residue and dissipation dynamics of abamectin in tomato fruit using QuEChERS methodology. International Conference on Food, Biological and Medical Sciences (FBMS-2014), Bangkok, Thailand.

AOAC (1984). Association of Official Analytical Chemists. Official Methods of Analysis, 19th ed., Washington, D.C.

Bolland, H. R., Gutierrez, J. and Flechtmann, C. H. (1998). World Catalogue of the Spider Mite Family (Acari:Tetranychidae). Brill Publicaion, Leiden, 392 p.

Bartholomew, E.T., Stewart,W.S. and Carman, G.E. (1951). Some physiological effects of pesticides on citrus fruits and leaves. *The Botanical Gazette,* 112 (4): 501-511.

Ben-Amotz, A.B. and M. Avron (1983). On the factors which determine massive β-carotene accumulation in the halo tolerant alge Dunaliella bardawil. *Plant Physiology*, 72: 593-597.

Clark, J. M., Scott, J. G., Campos, F. and Bloomquist, J. R. (1995). Resistance to avermectins extent, mecha-nisms, and management implications. *Annual Review of Entomology,* 40, 1–30.

Chhillar, B.S., R. Gulati and P. Bhatnagar (2007). Agricultural Acarology. Daya Publishing House, Delhi, 355 pp.

Cloyd, R. A., Galle, C. L., Keith, S. R. and Kemp, K. E. (2009). Evaluation of persistence of selected miticides against the two spotted spider mite, Tetranychus urticae. *Horticultural Science,* 44, 476–480.

Clotuche, G., A.C. Mailleux, A.A. Ferna´ndez, J.L. Deneubourg and C. Detrain (2011). The formation of Collective Silk Balls in the Spider Mite, *Tetranychus urticae* Koch. *PLoS ONE*, 6(4): 1804-1817.

Dubois, M., K.A. Giles, J.K. Hamilton, P.A. Robers and F. Smith (1956). Colorimetric method for determination of sugar and related substance. *Analytical Chemistry,* 28: 350- 356.

Duchovskienė, L. (2007). Effects of Abamectin on the two-spotted spider mite, *Tetranychus urticae* Koch. In greenhouse cucumbers. *Sodininkystė irdaržininkystė,* 26, 166–175.

Ghallab, M.M., N.H. Habashi, K.F.I. Aida and M.A. Rizk (2011). Sensitivity of four cucumber cultivars to some piercing sap sucking pests infestation and their impact on yield. *Egypt Journal Agricultural Research,* 89:1363–1371.

Gupta, S.P., S.P. Singh, P. Satyanarayana and N. Kumar (2015). Dissipation and decontamination of imidacloprid and lambda–cyhalothrin residues in brinjal. *International Journal of Plant Protection,* 8 (2): 379–383.

Gupta, V.N. and S.K. Gupta (1985). Mites associated with vegetable crops in West Bengal. Indian ocean., 10: 61–64.

Hoy, M. A. (2011). Agricultural Acarology: Introduction to Integrated Mite Management. CRC Press, Boca Raton. Florida, Vol 7, pp. 7–30.

Habiba, R.A., H.M. Ali and S.M.M. Ismail (1992). Biochemical effects of profenofos residues in potatoes. *Journal of Agricultural and Food Chemistry,* 40: 1852-1855.

Henderson, C.F. and E.W.Tilton (1955). Tests with acaricides against the brow wheat mite. *Journal of Economic Entomology,* 48: 157-161.

Ismail, S.M., H.M. Ali and R.A. Habiba (1993). GC-ECD and GC-M Sanalysis of profenofos residues and biochemical effects in tomatoes and tomato products. *Journal of Agricultural and Food Chemistry,* 41:610-615.

Jayasinghe, G.G. and Mallik, B. (2010). Growth stage based economic injury levels for two spotted spider mite, *Tetranychus urticae* Koch (Acari, Tetranychidae) on Tomato, *Lycopersicon esculentum* Mill. *Tropical Agricultural Research,* 22 (1): 54 – 65.

Karaman, G.E.A., E.A.M. Moftah, S.H.H. Hamouda and M.F.K. Aly (2007). Coexistence of certain sucking insect pests and their associated predators on three vegetable crops in Minia region. *Minia Journal of Agricultural Research and Development*, 27:1025–1040.

Kareem, A.A., G. Port and K. Wolff (2019). Population structure of the glasshouse whitefly, *Trialeurodes vaporariorum* (Hemiptera: Aleyrodidae) shows multiple introductions to the U.K. *Agricultural and Forest Entomology,* 21:139–148.

Khajehali, J., van Nieuwenhuyse, P., Demaeght, P., Tirry, L. and van Leeuwen, T.(2011): Acaricide resistance and resistance mechanisms in *Tetranychus urticae* populations from rose greenhouse in the Netherlands.*Pest Management Science,* 67, 1424–1433.

Landeros, J., L.P. Guevara, M.H. Badii, A.E. Flores and A. Pamanes (2004). Effects of different densities of the two spotted spider mite Tetranychus urticae on CO_2 assimilation, transpiration and stomatal behaviour in rose leaves. *Express Applied A carol.*, 32(3): 187-198. doi: 10.1023/b: appa.0000021788.07667.6b.

Lagziri, M. and Elamrani, A. (2009). Effect of a microbial-based acaricidal product on spotted and predatory spider mites. *African Crop Science Journal*, 17, 119–123.

Lasota, J. A. and Dybas, R. A. (1991). Avermectins, a novel class of compounds: Implications for use in arthro-pod pest control. Annual Review Entomology. 36, 91–117.

Monteiro, V. B., Gondim, M. G., Oliveira, J. E. D. M., Siqueira, H. A. and Sousa, J. M. (2015). Monitoring *Tetranychus urticae* Koch (Acari: Tetranychidae) resistance to abamectin in vineyards in the Lower Mid-dle São Francisco Valley. *Crop Protection*, 69, 90–96.

Mehdizadeh, M., M.T. Alebrahim and M.Roushani (2017). Determination of two sulfonylurea herbicides residues in soil environment using HPLC and phytotoxicity of these herbicides by lentil bioassay. *Bulletin of Environmental Contamination and Toxicology,* 99: 93-99.

Park, Y and J. Lee (2002). Leaf cell and tissue damage of cucumber caused by two-spotted spider mite, *Tetranychus urticae* (Acari: Tetranychidae). *Journal of Economic Entomology,* 95: 952-957.

Radwan, M.A., M.H. Shiboob, A. Abdel-Aal and M.M. Abu-Elamaym (2001). Residues of pirimiphose-methyl and fenitrothion in grapes, their effect on some quality properties and their dissipation during the removal and processing methods. *Journal of Pest Control and Environment Science,* 9 (3): 89-107.

Radwan, M.A., M.H. Shiboob, M.M. Abu-Elamaym and A. Abdel-Aal (2004). Residues of pirimiphos methyl and profenofos on green pepper and eggplant fruits and their effect on some quality properties. *Emirates Journal of Agricultural Science*, 16(1): 32- 42.

Radwan, M.A., M.M. Youssef, A. Abd-El-All, G.L. El-Henawy and A. Marei (1995). Residues levels of pirimiphos-methyl and chlorpyrifos-methyl on tomato and faba bean plants in relation to their impact on some internal quality parameters. *Alexandria Science Exchange* ,16 (3): 389-404.

Reddall, A., V.O. Sadras, L.J. Wilson and P.C. Gregg (2004). Physiological responses of cotton to the two-spotted spider mite, Tutranychus damage. *Crop Sciences,* 44: 835-846.

Sato, M. E., Marcos, Z., Da Silva, A., Dalton, R. and De Souza, M. F. (2005). Abamectin resistance in *Tetranychus urticae* Koch (Acari: Tetranychidae): Selection, cross-resistance and stability of resistance.*Neotropical Entomology*, 34, 991–998.

Senthil, V., P. Ramasamy, C. Elaiyaraja and A.R. Elizabeth (2010). Some phytochemical properties affected by the infection of leaf spot disease of *Cucumis sativus*

(Linnaeus) caused by Penicilliumnotatum. *African Journal of Basic and Applied Science*, 2(3): 64-70.

Shalaby, A. A. (2016 [b]). Residues of Profenofos with Special Reference to Its Removal Trials and Biochemical Effects on Tomato. *Journal of Plant Protection and Pathlogy, Mansoura Univ.*,7 (12) ,845–849

Shalaby, A.A. (2016 [a]). Residues of thiamethoxam and chlorpyrifos on okra in relation to their effects on some internal quality parameters and elements in fruits. *Journal Product & Development*, 21(3): 349-367.

Shalaby, F.F., F.A. Ali, A.A. Hafez and H.M. Saad (2013). Planting date in relation to insect and animal pests attacking cucumber plants under protected cultivation at Giza governorate. *Egyptian Journal of Agricultural Research*, 91(4):1347–1460.

Sivritepe, N., N.A. Kumral, U. Erturk, C. Yerlikaya and A. Kumral (2009). Responses of grapevines to the two-spotted spider mite mediated biotic stress. *Journal of Biological Science*, 9(4): 311-318.

Van Leeuwen, T., Vontas, J., Tsagkarakou, A., Dermauw, W. and Tirry, L. (2010). Acaricide resistance mech-anisms in the two-spotted spider mite, Tetranychus urticae and other important Acari: a review. *Insect Biochemistry and Molecular Biology*, 40, 563–572.

Xie, W.M., K.K. Yong, S.H. Kim, H.R. Chang and K.S. Lee (2006). Determination of abamectin residue in paprika by high-performance liquid chromatography. *Korean Journal of Environmental Agriculture*, 25: 359-364.

Zhang, Z. (2003). Mites of greenhouses. CABI Publishing Oxon, Cambridge, pp 244.

ARABIC SUMMARY

فعاليه بعض المبيدات الحشريه في مكافحة حلم العنكبوت الأحمر، *Tetranychus urticae* وتقدير متبقيات مبيد الابامكتين وتأثيره على بعض معايير جودة ثمار الخيار

رحاب عيداروس محمد السيد سالم
قسم وقاية النبات- كلية الزراعة- جامعة الزقازيق- مصر

أُجريت التجارب الحقلية في منطقة الصالحية بمحافظة الشرقية لتقييم فاعلية بعض المبيدات الحشرية الموصي بها وهم (الايميداكلوبريد، والابامكتين، واللمبدا-سيهالوثرين) تجاه العنكبوت الأحمر ذو البقعتين على محصول الخيار. صممت التجربة بتصميم قطع كاملة العشوائية (3 معاملات) وهي: المعاملة الأولى، مبيد الأبامكتين، والمعاملة الثانية، مبيد اللمبدا-سيهالوثرين، والمعاملة الثالثة، مبيد الايميداكلوبريد، والكنترول وتكرر ثلاث مرات. تم تقديرمتبقي مبيد الأبامكتين (مبيد الأكاروسي الموصى به لمكافحة ذلك العنكبوت) في ثمار الخيار على فترات مختلفة هي: ساعتين، يوم، 3، 5، 7، 9، 11، 13 و15 يوم من المعاملة. أيضاً تم تقدير تأثير متبقيات مبيد الأبامكتين على بعض معايير الجودة (السكريات المذابة الكلية، والجلوكوز، والحموضة، والأجزاء الصلبة المذابة الكلية، وحمض الاسكوربيك، وبيتا- كاروتين، والمواد الجافة، والبروتين). أظهرت النتائج أن كل المعاملات قد أدت إلى انخفاض تعداد حلم العنكبوت الأحمر خلال الرشة الأولى والثانية. علاوة على ذلك، أوضحت النتائج أن المعاملة التى تم رشها بمبيد الابامكتين قد أعطت الأعلى إنخفاض في تعدادات حلم العنكبوت الأحمر (96,32%)، متبوعاً بمبيد اللمبدا- سيهالوثرين بنسبة (92,22%) والايميداكلوبريد (76,93%)، خلال 14 يوم من بعد المعاملة. كما أظهرت النتائج أن نسبة الفقد للمتبقي الأولي في ثمار الخيار كانت 8,96 ملجم/ كجم وفترة نصف العمر ($t_{1/2}$) للمبيد في ثمار الطماطم كانت تقريباً 2,99يوماً. وأظهرت النتائج أيضا إنخفاض في معدل (السكريات المذابة الكلية، والجلوكوز، والحموضة، والأجزاء الصلبة المذابة الكلية، وحمض الاسكوربيك، وبيتا- كاروتين، والمواد الجافة، والبروتين) وبناءً عليه، توصي الدراسة الراهنة المزارعين بإستخدام مبيد الابامكتين لمكافحة حلم العنكبوت الأحمر ذو البقعتين في برنامج المكافحة المتكاملة.