Population dynamic of *Tetranychus urticae* on cucumber in Erbil region with study of the effects three different miticides on *T. urticae*

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**Abstract.** The current study was carried out to survey the occurrence, identify and control two-spotted spider mite (*TSSM*) *Tetranychus urticae* on cucumber plants within greenhouse in Erbil province. Samples of mite were collected in four locations of cucumber fields. A total of 324 leaves from 108 plants were collected and the mites were removed from the host leaves. Bermectine, Speed and Kanemite were applied as chemical control agents with three different time intervals in field and two different time intervals in laboratory using spray and soaking methods. Results proved that *T. urticae* Koch infested cucumber fields in Erbil province. From inspection of cucumber in greenhouses of four different locations, *T. urticae* were found in all inspected locations and the greatest population was observed in Barhushir area. The highest percent mortality of mites was obtained when Speed was used. Percent mortality was 100% both methods. Meanwhile, the mortality percentages applying Bermectine and Kanemite in soaking method were 38.14% and 41.24% respectively whereas, they showed low mortality of mites which were 80.46% and 77.01% after 48 hours in soaking method respectively. This finding concluded that *Tetranychus urticae* is widespread in Erbil cucumber fields and Speed was the best miticide against it.

**Key words:** two-spotted spider mite , Survey , Bermectine, Speed , Kanemite

**Introduction**

Greenhouse cultivations are rising in recent years around the world and Kurdistan region was not exception from this advancement of Greenhouse cultivations. According to ministry of agriculture statistics (2013) the total number of Greenhouse is 7611 and cucumber is the highest grown crop in Greenhouse about 74%. At the same time the problems of pest are increasing as well. The Greenhouse
crops are affected by many pests that cause extensive yield losses including insects like (aphids, white fly, scale) and other arthropods like spider mites [1,2].

Spiders are the most important mites attacking plants. Most spider mite species are polyphagous. They occur on virtually every major food crops and ornamental plants [3]. T. urticae is the most common mite. It is also known informally by many other names e.g. the Plastic house spider mite, the yellow spider mite. It is the most important pests of cucumber Greenhouse, especially under hot and dry conditions. This species is adapted to various environmental conditions and the Greenhouse is ideal areas for that, which can complete its generation in one week [4]. The use of acaricides has increased substantially over the past half of the 20th century. Since the first serious and widespread outbreaks of spider mites populations, during the 1950s, organophosphorous and other neuroactive insecticides were replaced by specific acaricides i.e. compounds exclusively or primarily effective against mites. Several generations of structurally diverse synthetic acaricides, directed against various biochemical and physiological targets, have been commercialized until now. Besides specific acaricides, a number of insecticides with considerable acaricidal activity (pyrethroids, avermectins, and benzoyleurans) have also been used, while some older neuroactive compounds are still available for the control of phytophagous mites [5,6] and [7].

The effects of pesticides on T. urticae are being widely studied and its resistance to new products is frequently monitored [8]. Failures of chemical control of T. urticae caused by resistance have been reported in several countries for compounds, such as hexythiazox [9], fenpyroximate [10] and Abamectin [11].

On the other hands management of T. urticae is very difficult and pesticides have a substantial role to play in the achievement of this purpose. Superfluity and irregular use of acaricides contributed to the development of resistance to many acaricides, thereby making the chemical control of mite difficult [12, 13]. Due to the effect of pesticides on the environment and human health, it is necessary to devise other control methods and IPM programs to reduce the use of pesticides [14, 15].

Since the studies on T. urticae in Erbil province are unavailable, the major purpose of designing this investigation is to perform a survey on T. urticae in cucumber fields in Erbil in addition to finding the best chemical miticide against it.

Materialis and methods

Mite Sample Collecting and Survey

The survey of mites was performed on a weekly basis in greenhouse during 11-2015 to 6-2016. Samples of mite were collected in five locations of Erbil province from different fields of cucumber. A total of 324 leaves from 108 plants were collected. The leaves taken from each plant were put in paper bag, then placed in a cool box then transported to the laboratory at plant protection department university of Salahaddin. The mites were removed from the host with the help of fine and smooth forceps taking all necessary precautions to avoid damage of the mouthparts of the mites and the host leave
T. urticae Population Dynamics

In order to estimate the population dynamic of two-spotted spider mite on the cucumber, number of plants (according to availability) at weekly visits, for all region, were carried out during the period from November 2015 to Jun 2016. The numbers of both adults and nymphs were counted and recorded.

Chemical Control of Mites

Chemical control of mites was made by laboratory and field experiments. Three types of acaricides Bermectine (active ingredient was abamectin 18% w/v) Speed (active ingredient was chlorphenapyr 24G/L) and Kanemite (active ingredient was Asequinocyl 15% w/v) were used.

Chemical Control in the Field (plastic House)

Seeds were planted in perlites that were filled with peatmos after five days; the seedlings were transplanted to the plastic house. The chemical test was done on Safe hybrid of cucumber. Three rows were arranged at one plastic house. Each row was used for the applications of each miticide. Each plant was tested with 15 replicates including 5 replicates as negative control (SDW). Suspensions of acaricides were prepared by 5ml /10L of Bermectine, 7.5ml /10L of Speed and 10ml /10L of Kanemite. The plastic house temperature was controlled at 28±2. Samples were taken from each plant after one week of infecting plants artificially by the mite (20mites). Three leaves were included from three cucumber plants. The samples were conveyed to the lab to determine the number of mortality of adult stages per cubic centimeter [2]. The data was reported every two days throughout the period study. Percent mortality of TSSM in laboratory and field was calculated by the below formula [16]:

\[
\text{Corrected} = \left(1 - \frac{\text{No. in Co before treatment} \times \text{No. in T after treatment}}{\text{No. in Co after treatment} \times \text{No. in T before treatment}}\right) \times 100
\]

Co: Control   T: Treatment   No.: Number

Results

Results in table (1) show the full work surveillance studies of T. urticae that infested cucumber in five locations from four different areas in Erbil province during the year 2015-2016. The results showed that the highest number of eggs (2272), nymphs (1312) and adults (1122) of T. urticae were found in Barhushtr (in west of Erbil province) followed by Dlopa (in the east of Erbil) with 2133 eggs, 1300 nymphs and 408 adults, while the lowest population number of T. urticae was found in Murtka (in south of Erbil province). The highest population of T. urticae in Barhushtr may be due to less applying of miticides or because cultivating less resistant of cucumber hybrid.

The miticidal action of three different miticides on T. urticae were tested for periods of 24 and 48hrs. It was found that applying Speed after 24hrs of treatment obtained the most effective action using spray method (figure 1), which led to (100%) mortality of mites. While weaker miticidal actions were recorded by Bermectine and Kanemite with mortality percentages 87% and 77% respectively. Whereas,
no significance differences were demonstrated after 48hrs among Bermectine, Speed and Kanemite where the mortality percentages were 100% in all treatments.

Table (1): The monthly total number collected of \( T. urticae \)

| Pest mites | Location |
|------------|----------|
| No. of eggs | No. of immature stages | No. of adults |
| 107 | 51 | 18 | Murtka |
| 2272 | 1312 | 1122 | Barhushtr |
| 1390 | 188 | 298 | Jdida |
| 2133 | 1300 | 408 | Dlopa |
| 425 | 63 | 55 | Brakh |

Moreover, the same results were demonstrated using soaking method, as the highest percent mortality of mites after 24h was Speed miticide with 86.60%. Bermectine and Kanemite killed less than 50% of the mites after 24h with 38.14% and 41.24% respectively (figure 2). Regarding the results after 48hrs, again Speed was best effective miticides killing 100% of the mites in soaking method followed by Bermectine and Kanemite with mortality rate about 80.46% and 77.01% respectively.

![Figure 1](image1.png)

**Figure 1**: Effect of three miticides on mortality percentage of \( T. urticae \) conducted in laboratory (Spray method) and (Soaking method)

Table (2) data analysis verified that there are significant differences \( P < 0.05 \) between Speed and Kanemite in mortality of mites for spray method, while there are no significant differences \( P > 0.05 \) between Bermectine and Kanemite, Bermectine and Speed in the same method.

Table (2): Multiple Comparisons between different miticides conducted in laboratory by spray-method.

| Design | Acaricide | Mean Difference | Std. Error | Sig. |
|--------|-----------|-----------------|------------|------|
| LSD    | Speed     | 0.67            | 0.52       | 0.22 |
|        | Bermektine| 0.5             | 0.52       | 0.35 |
|        | Speed     | 1.17*           | 0.52       | 0.04 |

Symbol: * means significantly different at \( P < 0.05 \)
On the other hand, mortality of mites by soaking method exhibited significant differences between Bermectine with Speed and Speed with Kanemite (Table 3).

Table (3): Multiple Comparisons between different miticides conducted in laboratory by soaking method.

| Acaricide  | Mean Difference | Std. Error | Sig.  |
|------------|-----------------|------------|-------|
| LSD        | Speed           | 3.17*      | 1.16  | 0.02 |
|            | Bermectine      | 0.0        | 1.16  | 1.00 |
|            | Speed           | 3.17*      | 1.16  | 0.02 |
| Speed      | Kanemite        | 0.0        | 1.16  | 1.00 |
| Bermectine | Kanemite        | 3.17*      | 1.16  | 0.02 |

Symbol: * means significantly different at P < 0.05

The result (fig.3) showed that the highest number of mortalities after 24h was in Speed treatment 82.46% followed by Kanemite and Bermectine 24.74% and 18.42% respectively. Also after 48h Speed showed highest mortality 100% followed by Bermectine and Kanemite with the mortality percentages 90.19% and 84.04% respectively. While after 72h the mortality percentages were 100% in Speed followed by Kanemite and Bermectine with 99.60% and 98.67% respectively in treat.

According to table (4) there was significant differences P < 0.05 between all acaricides except Bermectine and Kanemite that showed no significant differences P > 0.05 when miticides was dependent variable.

Also when the time was dependent variable, data showed only significant differences between 24 h. with 48 h. and 24 h. with 72 h. in percent mortality. Whereas there is no significant difference between 48 h. and 72 h. of percent mortality (table 5).

Figure 2: Effect of three miticides on mortality percentage of T. urticae conducted in field (greenhouse).
### Table (4): Multiple comparisons between three different miticides depending on their effect on mite in field, (dependent variable Miticides)

| Miticides | Mean differences | Std. Error | Sig. |
|-----------|-----------------|------------|------|
| Bermectine | Speed           | 13.67*     | 3.92 | 0.02 |
| Kanemite  |                 | 5.67       | 3.92 | 0.16 |
| LSD       | Speed           | 19.33*     | 3.92 | 0.00 |

Symbol: * means significantly different at P < 0.05

### Table (5): Multiple comparisons for chemical control in field, dependent variable time

| Time     | Mean Difference | Std. Error | Sig. |
|----------|-----------------|------------|------|
| 24H      | 48H             | 12.33*     | 4.81 | 0.08 |
| 72H      | 48H             | 12.67*     | 4.81 | 0.06 |
| LSD      | 48H             | 0.33       | 4.81 | 0.94 |

Symbol: * means significantly different at P < 0.05

### Discussion

To our knowledge, this is the first survey on two-spotted spider mite (*Tetranychus urticae*) prevalence and control in cucumber field across Iraqi Kurdistan region. The study proposed that *Tetranychus urticae* was more prevalent in western area of Erbil province rather than the other regions. Regarding acaricidal activity of chemical agents, Speed was the most potent chemical agent for elimination of the mites.

Our results were agree with [17] who evaluated the acaricidal activity of Speed in laboratory and field. In laboratory, it was highly effective against egg, immature and adult stages of TSSM, in a field study had no repellent activity. [18] found chlorphenapyr as effective agent in reducing the tetranychid mites on rose plant. Subsequently, [19] found chlorphenapyr as effective chemical matter against strawberry spider mite in Turkey. Furthermore, in Pakistan, [20] recorded 'Pirate'(chlorphenapyr) as the best acaricide with a good persistency. Similar results were obtained by [21] who estimated the toxic effect of chlorphenapyr on domestic mites in an impregnated filter paper laboratory test.

It has been proved that he miticidal action of acaricides (abamectin) against *Tetanychus urticae* (TSSM) were time dependent [22], which support our finding for acaricidal activity of abamectin. [23] reported that Abamectin exhibited high efficacy on *T. urticae* in laboratory test, 100% mortality was obtained when the recommended dose (9 ppm) was applied. Because of the fact that they recommended that the abamectin could be used as a selective acaricide in integrated mite management programs because of its strong efficacy on pests, its persistence and its limited toxicity on predatory mites. [24] and [25] obtained 100% mortality of TSSM when exposed to the recommended dose of abamectin. Such high effectiveness of abamectin against two-spotted spider mite in strawberry was also observed in several other crops like cotton, cucumber, ornamental plants. Also our results are similar with...
findings by [25], who reported that abamectin reduces the number of *T. urticae* and is highly efficient 3-14 days after application. On the other hand, he showed that the persistence of abamectin efficacy depends on the dose applied. Thus, It was observed that approximately 37% of *T. urticae* population was killed three weeks after application. Based on result Asequinocyl showed less effect than other tested acaricides, this is compatible with [26] they found that acaricide may not be the appropriate choice for long-term control of TSSM unless more frequent applications are conducted. Also it does not have translaminar properties, which was evident based on the low mortality percentages of *T. urticae* nymphs and adults 56 d (42.4% and 9.9%) and 70 d (18.3% and 4.7%) after the plants had been treated. This also was apparent based on the number of live TSSM nymphs (34 and 197) and adults (43 and 49) at 56 d and 70 d, respectively.

References

[1] Castilla, N. and J. Montero. Environmental control and crop production in Mediterranean greenhouses. in *International Workshop on Greenhouse Environmental Control and Crop Production in Semi-Arid Regions* 797. 2008.

[2] Mohammadi, S., A.A. Seraj, and A. Rajabpour, Evaluation of six cucumber greenhouse cultivars for resistance to *Tetranychus turkestanii* (Acari: *Tetranychidae*). *Journal of Crop Protection*, 2015. 4(4): p. 545-556.

[3] Bolland, H.R., J. Gutierrez, and C.H. Flechtmann, *World catalogue of the spider mite family (Acari: Tetranychidae)*1998: Brill.

[4] Düzgüneş, Z. and S. Çobanoğlu, *Tetranychus urticae* Koch ve *Tetranychus cinnabarinus* (Boisduval)(Acarina: *Tetranychidae*)‘un değişik sicaklık ve nem koşullarında biyolojileri ve hayat tabloları. *Bitki Koruma Bülteni*, 1983. 23(4).

[5] Jeppson, L.R., H.H. Keifer, and E.W. Baker, *Mites injurious to economic plants*1975: Univ of California Press.

[6] Dekeyser, M.A., *Acaricide mode of action*. Pest Management Science: formerly Pesticide Science, 2005. 61(2): p. 103-110.

[7] Van Leeuwen, T., et al., *The control of eriophyoid mites: state of the art and future challenges*. Experimental and Applied Acarology, 2010. 51(1-3): p. 205-224.

[8] Castagnoli, M., et al., *Toxicity of some insecticides to *Tetranychus urticae*, Neoseiulus californicus and *Tydeus californicus*. *BioControl*, 2005. 50(4): p. 611-622.

[9] Herron, G., V. Edge, and J. Rophail, *Clofentezine and hexythiazox resistance in *Tetranychus urticae* Koch in Australia*. Experimental & applied acarology, 1993. 17(6): p. 433-440.

[10] Sato, M.E., et al., *Selections for fenpyroximate resistance and susceptibility, and inheritance, cross-resistance and stability of fenpyroximate resistance in *Tetranychus urticae* Koch (Acari: Tetranychidae)*. Applied entomology and zoology, 2004. 39(2): p. 293-302.

[11] Beers, E., H. Riedl, and J. Dunley, *Resistance to abamectin and reversion to susceptibility to fenbutatin oxide in spider mite (Acari: Tetranychidae) populations in the Pacific Northwest*. *Journal of Economic Entomology*, 1998. 91(2): p. 352-360.

[12] Lee, K.P., *The interactive effects of protein quality and macronutrient imbalance on nutrient balancing in an insect herbivore*. Journal of Experimental Biology, 2007. 210(18): p. 3236-3244.

[13] Ganjisaffar, F., Y. Fathipour, and K. Kamali, *Effect of temperature on prey consumption of *Typhlodromus bagdasarjani* (Acari: *Phytoseiidae*) on *Tetranychus urticae* (Acari: Tetranychidae)*. International Journal of Acarology, 2011. 37(6): p. 556-560.
[14] Lorenzen, J.H., et al., Resistant potato selections contain leptine and inhibit development of the Colorado potato beetle (Coleoptera: Chrysomelidae). Journal of Economic Entomology, 2001. 94(5): p. 1260-1267.

[15] Sedaratian, A., Y. Fathipour, and S. Moharramipour, Evaluation of resistance in 14 soybean genotypes to Tetranychus urticae (Acari: Tetranychidae). Journal of Pest Science, 2009. 82(2): p. 163-170.

[16] Henderson, C.F. and E.W. TILTON, Tests with acaricides against the brown wheat mite. Journal of Economic Entomology, 1955. 48(2): p. 157-161.

[17] AHN, Y.-J., et al., Evaluation of effectiveness of AC 303630 and flucycloxuron mixtures against Tetranychus urticae (Acari: Tetranychidae) under laboratory and field conditions. Applied entomology and zoology, 1996. 31(1): p. 67-73.

[18] Kumar, K.D., Incidence and management of mites and thrips of rose under naturally ventilated polyhouse condition, 2007, UAS, Dharwad.

[19] Cakmak, I., H. BAŞPINAR, and N. Madanlar, Control of the carmine spider mite Tetranychus cinnabarinus Boisduval by the predatory mite Phytoseiulus persimilis (Athias-Henriot) in protected strawberries in Aydin, Turkey. Turkish journal of Agriculture and Forestry, 2005. 29(4): p. 259-265.

[20] Mehmood, M.A., et al., Performance of different insecticides against flower thrips (Thysanoptera: Thripidae) on rose cultivar Wiskey mac'. Pakistan Entomologist (Pakistan), 2012.

[21] Hubert, J., et al., A laboratory comparison of the effect of acetone-diluted chlorfenapyr standards with a commercial suspension formulation on four domestic mites (ACARI: Astigmata). International Journal of Acarology, 2013. 39(8): p. 649-652.

[22] Çobanoğlu, S. and S. Alzoubi, Effects of soft soap and abamectin on the two spotted spider mite Tetranychus urticae Koch (Acari: Tetranychidae) and predatory mite Phytoseiulus persimilis AH (Acari: Phytoseiidae) under laboratory conditions. Turkish Journal of Entomology, 2013. 37(1): p. 31-38.

[23] Lagziri, M. and A. El Amrani, Effect of a microbial-based acaricidal product on spotted and predatory spider mites. African Crop Science Journal, 2009. 17(3).

[24] Andrei, E., Compendio de Defensivos Agrícolas, 2005, Andrei Editora Ltda, São Paulo.

[25] Duchovskienė, L., Effects of Abamectin on the two-spotted spider mite (Tetranychus urticae Koch.) in greenhouse cucumbers. Sodininkystė ir daržininkystė, 2007. 26(1): p. 166-175.

[26] Cloyd, R.A., et al., Evaluation of persistence of selected miticides against the twospotted spider mite, Tetranychus urticae. HortScience, 2009. 44(2): p. 476-480.