

BIOLOGICAL CONTROL OF TWO-SPOTTED SPIDER MITE IN PEPPER AND MELON CROPS CULTIVATED IN TUNNELS

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Abstract

The paper aims to present the attack characteristics and the results of biological control of two-spotted spider mite on pepper and melon crops cultivated in tunnels. The attack of two-spotted spider mite began in the first decade of June. The degree of attack of two-spotted spider mite on pepper plants was ascending reaching 17.5% in the second decade of September. The degree of attack of two-spotted spider mite in melon was high, reaching 61.3% in the third decade of September. The predator, *Phytoseiulus persimilis* At.-H. (Arachnida: Mesostigmata: Phytoseiidae) was used to control the spider mite in peppers and melons. The variants utilized in our experiment were as it follows: V1 - one release with 50,000 ex./ha; V2 - one release with 100 thousand ex./ha; V3 - one release with 150 thousand ex./ha; V4 - Untreated control. The releases of *Phytoseiulus persimilis* has reduced the two-spotted spider mite degree of attack (DA%) on pepper in late August to 2.3% in V1, 2.1% in V2 and 1.7% in V3. In September the DA% was below 1% in all the three variants. In the untreated control, the pest degree of attack level increased from 9.5% in the first decade of August, up from 17.5% in the 2nd decade of September, and then began to decline. In melons, the releases of *Ph. persimilis* have reduced the attack degree in the third decade of August at 1.8% in V1, 1.9% in V2, 1.5% in V3. In all three variants, the degree of attack in September was less than 1%. In V4 (untreated control), DA% increased from 4.3% in the first decade of August, to 61.3% at the end of September.

Key words: biological control, *Phytoseiulus persimilis*, two-spotted spider mite, pepper, melon.

INTRODUCTION

The two-spotted spider mite - *Tetranychus urticae* Koch is one of the main pests of vegetable crops grown in greenhouses and tunnels (Dalpe, 2002; Zhang, 2003; Calin, 2005; Herrmann et al., 2011).

The pest is polyphagous, that is attacking 1110 host species (Herrmann, 2017), in the field, greenhouse and tunnels. In our country, this pest attacks crops of eggplants, peppers, cucumbers, beans, tomatoes, etc. Pest attack is higher in crops of eggplants and cucumbers and less in other species (Candea, 1984). The spider mites have caused little visible damage to the leaves and induced direct defense responses. According to Merjin et al., 2004 after two-spotted spider mite attack the proteinase inhibitor activity had doubled and the transcription of genes involved in jasmonate-, salicylate-, and ethylene-regulated defenses had been activated. On day four, proteinase inhibitor activity and particularly transcript

levels of salicylate-regulated genes were still maintained. In addition, genes involved in phospholipid metabolism were up-regulated on day one and those in the secondary metabolism on day four. Although transcriptional up-regulation of the enzymes involved in the biosynthesis of monoterpenes and diterpenes already occurred on day one, a significant increase in the emission of volatile terpenoids was delayed until day four.

The emergence of resistance to chemical acaricides, the negative effect of chemicals on useful fauna and pesticide residues determined the usage of predator mites, as *Phytoseiulus persimilis* Athias-Henriot for the control of two-spotted spider mite (Lenteren, 2003 and 2012).

This predator arrived accidentally in Germany from Chile in 1958. Anticipating their effectiveness in pest control in 1960 research began in the UK, Netherlands, Canada, USA etc. in order to determine the influence of this predator in the control of two-spotted spider mite

at various vegetable and flower crops (Rojas, 2010). The obtained results were exceptional and passed to currently reared *Ph. persimilis* (Shih 2001; Bolckmans, 2007) and its use in greenhouses and tunnels for control of two-spotted spider mite.

MATERIALS AND METHODS

During 2015 - 2016 years, experiments in tunnels were performed at Vegetable Research-Development Station Bacau - Romania, in order to study the two-spotted spider mite attack in pepper and melon crops and evaluate the effectiveness of biological control using *Phytoseiulus persimilis* predator. The relevant results from 2016 are presented in this paper.

1. Study of two-spotted spider mite attack in pepper and melon crops in tunnels

The observations were made every 10 days from May to September in Control.

For the attack estimation we used the following indicators:

- Frequency of attack (F%),
- Intensity of attack (I%),
- Degree of attack (DA%).

2. Biological control of pest.

The predatory mite *Phytoseiulus persimilis* At.-H. (*Arachnida, Mesostigmata, Phytoseiidae*) was used for biological control of pest.

The effectiveness of this predator in control of two-spotted spider mite - *Tetranychus urticae* Koch. was studied in pepper collection of cultivars and melon in tunnels. When the degree of attack of mites exceeded in pepper 9.5% the predatory mites were released in the 3 variants. The trial was done in the summer period and early autumn. The average highest day temperature was between 28-32°C with peaks up to 40°C.

The trials of *Ph. persimilis* for the two-spotted spider mite control were at the following release rates:

- V1 – 50,000 mites/ha;
- V2 – 100,000 mites/ha;
- V3 – 150,000 mites/ha;
- V4 - Control.

When the degree of attack of two-spotted spider mites exceeded in melon 4.3% the predatory mites were released in the same 3 variants as mentioned above.

A variant area was 45 square meters.

The effectiveness of the predator releases was determined by decadal observations of the attack on the plant and monitoring the pest population of mite in August and September.

The effectiveness evaluation of *Ph. persimilis* on the two-spotted spider mite was performed by the Sun - Shepard method.

RESULTS AND DISCUSSIONS

1. Study of two-spotted spider mite attack in pepper and melon in tunnels

The dynamic of the degree of attack of two-spotted spider mite on pepper is showed in figure 1.

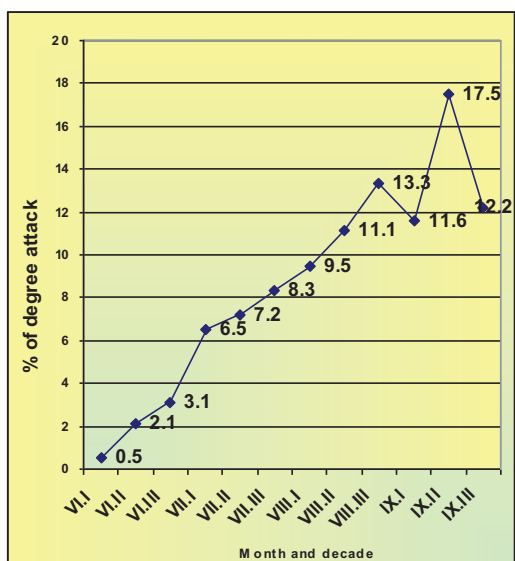


Figure 1. The attack of two-spotted spider mite in pepper

As shown in previous figure, the degree of attack in pepper has an ascendant dynamics. It started in first decade of June and increased to 17.5% in second decade of September. Then attack of pest begins to decrease reaching to 12.2%.

The dynamic of the degree of attack of the two-spotted spider mite on melon is presented in figure 2. The attack started in the first decade of June. The attack level was low until the first decade of August. Then the degree of attack had an ascendant dynamic from 4.3% in the first ten days of August, to 61.3% in the last decade of September. Under these circumstances it was necessary to apply

measures for pest control, harvesting melons being carried out by the end of September.

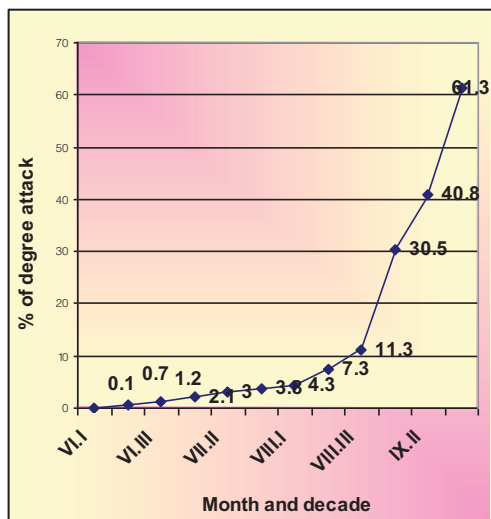


Figure 2. The attack of two-spotted spider mite in melon

2. Biologically control of pest.

The degree of attack (DA%) of two-spotted spider mite decreased in all 3 variants of *Phytoseiulus persimilis* applications - table 1.

Table 1. The degree of attack of two-spotted spider mite on pepper and melon plants

No. variant	DA% in month and decade					
	August			September		
	I	II	III	I	II	III
Pepper						
V1	13.5	9.5	2.3	0.7	0.4	0.1
V2	11.9	9.6	2.1	0.5	0.1	0.1
V3	9.0	6.6	1.7	0.2	0.1	0.1
V4	9.5	11.1	13.3	11.6	17.5	12.2
Melon						
V1	3.4	2.5	1.8	1.7	0.7	0.7
V2	6.1	4.5	1.9	0.8	0.7	0.7
V3	5.9	3.8	1.5	0.8	0.7	0.7
V4	4.3	7.3	11.3	30.5	40.8	61.3

The degree of two-spotted spider mite attack in V1 was reduced from 13.5% (first decade of August) to 9.5% (2nd decade of the month), 2.3% (3rd decade of August and less than 1% in September).

In V2, DA% had the same decreasing trend, which is below 1% in September. The V3,

where the release rate was 150 thousand ex./ha had the lowest values of DA% (6.6% and 1.7% in August and in less than 1% in September, table 1). In control variant (without releases), the degree of two-spotted spider mite attack increased from 9.5% in the first decade of August, up from 17.5% in the 2nd decade of September, then began to decline. The effectiveness of the release was up to 98% in variants with release rate of *Ph. persimilis* at the end of September (Figure 3).

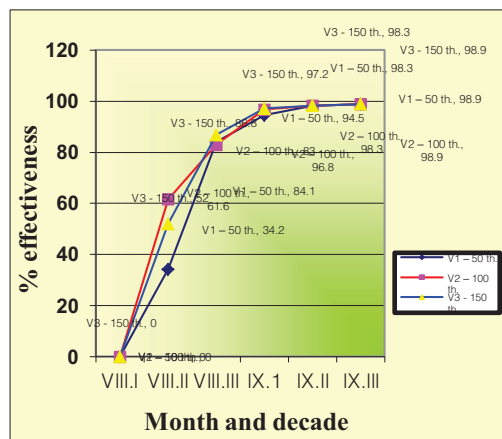


Figure 3. Effectiveness of *Phytoseiulus persimilis* releases in control of two-spotted spider mite on pepper crop

At melon, the pest degree attack was low (3.4% in V1, 6.1% in V2, 5.9% in V3 and 4.3% in control) in first decade of August.

After *Ph. persimilis* releases, the DA% decreased in the second decade of August as follows: V1 - 2.5%, V2 - 4.5%, V3 - 3.8%.

Descendant DA% continued for all three variants, reaching values below 1% in September. In V4 (control without predators release), the degree of attack had a sharp upward trend rising from 4.3% in the first ten days of August, to 61.3% in the last decade of September.

The effectiveness for all three releases rates of *Ph. persimilis* was up to 98% in all variants at the end of September (Figure 4).

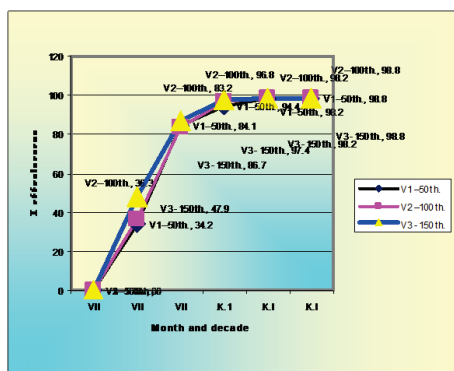


Figure 4. Effectiveness of *Phytoseiulus persimilis* releases in control of two-spotted spider mite on melon crop

CONCLUSIONS

Study of two-spotted spider mite attack on pepper and melon crops in tunnels

The degree of attack in pepper has an ascendant dynamics. It started in first decade of June and increased to 17.5% in second decade of September. Then attack of pest begins to decrease reaching to 12.2%.

In melon the attack started in the first decade of June. The attack level was low until the first decade of August. Then the degree of attack had an ascendant dynamic from 4.3% in the first ten days of August, to 61.3% in the last decade of September.

Biologically control of pest. The degree of two-spotted spider mite attack in V1 was reduced from 13.5% (first decade of August) to 9.5% (2nd decade of the month), 2.3% (3rd decade of August) and less than 1% in September. In V2 DA% had the same decreasing trend, which is below 1% in September. The V3, where the release rate was 150 thousand ex./ha had the lowest values of DA% (6.6% and 1.7% in August and in less than 1% in September). In control variant (without releases), the degree of two-spotted spider mite attack increased from 9.5% in the first decade of August, up from 17.5% in the 2nd decade of September. The effectiveness of the release was up to 98% in variants with release rate of *Ph. persimilis* at the end of September.

At melon, the pest degree attack was low (3.4% in V1, 6.1% in V2, 5.9% in V3 and 4.3% in control) in first decade of August. After *Ph. persimilis* releases, the DA% decreased in the second decade of August as follows: V1 - 2.5%, V2 - 4.5%, V3 - 3.8%. Descendant DA% continued for all three variants, reaching values below 1% in September. In V4 (control without predators release), the degree of attack had a sharp upward trend rising from 4.3% in the first ten days of August, to 61.3% in September.

The effectiveness for all three releases rates of *Ph. persimilis* was up to 98% in all variants at the end of September.

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