RESEARCHES REGARDING THE CHEMICAL AND INTEGRATED CONTROL OF THE GREENHOUSE WHITEFLY, TRIALEURODES VAPORARIORUM WESTWOOD, IN PROTECTED AREAS CULTIVATED WITH TOMATOES

Pop N., Oana Mihaela Pop (Balea), Margareta Berchez
Faculty of Horticulture, University of Agricultural Sciences and Veterinary Medicine, 3-5 Manastur St., 400372 Cluj-Napoca, Romania; popnicolae@gmail.com

Abstract: *The aims of this study was to establish for the control of the greenhouse whitefly Trialeurodes vaporariorum Westwood, the further actions to be taken, using traditional pest control methods and correlating them with the use of unconventional ones (use of coloured sticky boards). The experiments were carried out in 2008 in the greenhouse located in Colonia Borhanci, cultivated with extra-early tomato hybrids: Menhir F1, Cronos F1, Shannon F1. The research shows that the chemical insecticides having a systemical action, Mospilan 20 SG (acetamiprid 200 g/l), Emerite (imidacloprid 240 g/l) where more effective than those products having contact and ingestion actions, Talstar 10 EC (bifetrin 100 g/l), Vertimec 1,8 % EC (abamectin 18 g/l), Decis 2,5 EC (deltametrin 25 g/l) and Faster 10 CE (cipermetrin 100 g/l). Applying a complex strategy to prevent and control of greenhouse whitefly Trialeurodes vaporariorum Westwood it was developed a strategy of integrated control in protected areas. Utilization of sticky traps is an ecological method and the panels can be handled easily.*

Key words: Greenhouse Whitefly *Trialeurodes vaporariorum* Westwood , integrated pest control strategy, chemical pest control, extra-early tomato hybrids

INTRODUCTION

The tomato plant is native to Central and South America, Peru and Ecuador; Lycopersicum esculentum var.cerasiforme was the wild original species used in Mexico since 500 B.C. It is a well known fact that the forced culture of tomato in protected areas in all kinds of greenhouses, allows to obtain a higher quantitative and qualitative yield, but, despite all the advantages which are offered by this constructions e.g. avoiding the climate change; the achievement of out of season crops, double-crop system out of season or prolongation of production cycle etc., that may result in a significant crop loss, up to 25-30 percent per year, or sometimes even more, due to plant pathogens and animal pests.

Though the most frequently used method of diseases and pest control is still the chemical treatments, in the future, by the right use of pesticides, will have to

perform a so-called "integrated battle" for pathogens and pest control, consisting in application of agro-technical, physical, mechanical, chemical, genetic and biological techniques and methods, adapted in such a way as to be compatible and to maintain the pests population at levels that would not cause economical damages, i.e. below the threshold of economical loss. (Bobeş, 1983).

MATERIAL AND METHOD

The researches were carried out near Cluj-Napoca (Colonia Borhanci) in the solar greenhouse cultivated with tomatoes, on an area of 196 m^2 (28 m x 7 m). The analysis studied both the bio-ecology of the greenhouse whitefly, *Trialeurodes vaporariorum* Westwood and the use of some integrated pest control like agrophytotechnical and physical methods, trapping adults with yellow and blue sticky boards and applying chemical insecticides in direct correlation to the pest population dynamics (fig.1).

Fig. 1. Optic yellow and blue boards
(Colonia Borhanci, Cluj – Napoca, 2008, original)

RESULTS AND DISCUSSION

Adults and nymphs of *Trialeurodes vaporariorum* Westwood are found on the underside at tomato leaves and on the shoots, penetrating the phloem and sucking the sap from the tissues. The leaves turn yellow following the attack, they dry and fall down, and the plant suffers significant changes of respiratory processes, of phenoloxidase activity, of catalase, acid phosphatase – which are all expressed by the increase of oxygen consumption, of enzymatic activity and by the subsequent decrease of phosphorus content (Cîndea, 1984).

Following randomized analysis made on diagonal of the solar greenhouse on different heights and floors, from base to top, with an average surface of the leaves of 90 mm^2 found with the use of an "electronic planimeter", the research found the *Trialeurodes vaporariorum* Westwood population density varying between 400-700 individuals.

Presented in table 1 is the average period of a developing cycle of the greenhouse whitefly *Trialeurodes vaporariorum* Westwood as it was analyzed in the solar greenhouse situated in Colonia Borhanci (near Cluj-Napoca) in 2008.

The duration of the egg stage had average value of 9 days in conditions in which the temperature was 20-25°C in the solar greenhouse. When the temperature was lower, between 10-15°C, the incubation of the eggs was longer and when the temperature was higher (25-30°C) the incubation duration was shorter.

We can conclude from this that the egg stage was between 7-11 days. The life cycle duration varies depending on the temperature, as the same results were validated on nymphs aged I, II, III, IV, the table presenting only the constant medium values.

Table 1

Average period of a developing cycle at *Trialeurodes vaporariorum* Westwood (greenhouse Colonia Borhanci Cluj – Napoca, 2008)

Developing stage	Average developing phase (days)
Egg	9
Larvae of age I	4
Larvae of age II	7
Larvae of age III	7
Larvae of age IV	11
TOTAL	**38**

In order to suppress the population of the greenhouse whitefly *Trialeurodes vaporariorum* Westwood, insecticides were chosen from toxicity groups III and IV and the results were differentiated according to the active ingredient of the insecticides.

Table 2

Results regarding the efficiency of several chemical products in controling *Trialeurodes vaporariorum* Westwood after the first treatment(Colonia Borhanci Cluj–Napoca, 4.07. 2008)

Commercial name/active substance	Recommended concentration/ tested concentration	Var.	Mortality registered after			
			3 days	7 days	10 days	21 days
Mospilan 20 SG (acetamiprid 200 g/l) Control	0,012 %	**1**	**36,00**	**78,66**	**94,66**	**100,00**
	0,025 %	**2**	**55,33**	**96,67**	**100,00**	**100,00**
	0,050 %	**3**	**78,66**	**100,00**	**100,00**	**100,00**
Vertimec 1,8% EC (abamectin 18 g/l)	0,05%	**4**	**35,33**	**73,33**	**96,67**	**100,00**
	0,1%	**5**	**56,67**	**94,67**	**100,00**	**100,00**
	0,15%	**6**	**72,67**	**100,00**	**100,00**	**100,00**
Decis 2,5% EC (deltametrin, 25 g/l)	0,02%	**7**	**32,67**	**78,66**	**96,67**	**100,00**
	0,05%	**8**	**65,33**	**88,67**	**100,00**	**100,00**
	0,07%	**9**	**76,66**	**98,00**	**100,00**	**100,00**
Faster 10 CE (cipermetrin 100 g/l)	0,01 %	**10**	**32,00**	**73,33**	**94,67**	**100,00**
	0,02 %	**11**	**32,67**	**98,00**	**100,00**	**100,00**
	0,04 %	**12**	**74,67**	**100,00**	**100,00**	**100,00**
Talstar 10 EC (bifentrin 100 g/l)	0,02%	**13**	**36,00**	**59,33**	**74,67**	**96,67**
	0,04%	**14**	**56,00**	**88,00**	**98,00**	**100,00**
	0,06%	**15**	**76,66**	**92,00**	**100,00**	**100,00**
Emerite (imidacloprid 240g/l)	0,02%	**16**	**32,67**	**74,67**	**100,00**	**100,00**
	0,05%	**17**	**76,66**	**100,00**	**100,00**	**100,00**
	0,07%	**18**	**98,00**	**100,00**	**100,00**	**100,00**

As seen in table 2, the best results of the first treatment given on 4 July, were achieved by the systemic insecticides Mospilan 20 SG (acetamiprid 200 g/l), Emerite (imidacloprid 240 g/l) when compared to the contact and ingestion insecticides like Talstar 10 EC (bifetrin 100 g/l), Vertimec 1,8 % EC (abamectin 18 g/l), Decis 2,5 EC (deltametrin 25 g/l) and Faster 10 CE (cipermetrin 100 g/l).

The result of the second treatment (26 July) regarding the chemical control of greenhouse whitefly *Trialeurodes vaporariorum* Westwood are presented in table 3.

Table 3

Results regarding the efficiency of several chemical products in controling *Trialeurodes vaporariorum* Westwood after the second treatment (Colonia Borhanci Cluj – Napoca, 26 July 2008)

Commercial name/active substance	Recommended concentration/ tested concentration	Var.	Mortality registered after			
			3 days	7 days	10 days	21 days
Mospilan 20 SG (acetamiprid 200 g/l) Control	0,012 %	1	35,33	65,33	96,67	100,00
	0,025 %	2	65,33	96,67	100,00	100,00
	0,050 %	3	88,00	100,00	100,00	100,00
Vertimec 1,8% EC (abamectin 18 g/l)	0,05%	4	47,67	73,33	96,67	100,00
	0,1%	5	65,33	94,67	100,00	100,00
	0,15%	6	81,33	100,00	100,00	100,00
Decis 2,5% EC (deltametrina, 25 g/l)	0,02%	7	32,67	74,67	96,67	100,00
	0,05%	8	55,33	81,33	100,00	100,00
	0,07%	9	78,66	98,00	100,00	100,00
Faster 10 CE (cipermetrin 100 g/l)	0,01 %	10	36,00	59,33	92,00	100,00
	0,02 %	11	55,33	96,67	100,00	100,00
	0,04 %	12	78,66	100,00	100,00	100,00
Talstar 10 EC (bifentrin 100 g/l)	0,02%	13	22,33	52,67	76,66	98,00
	0,04%	14	59,33	81,33	96,67	100,00
	0,06%	15	78,66	96,67	100,00	100,00
Emerite (imidacloprid 240g/l)	0,02%	16	35,33	78,66	100,00	100,00
	0,05%	17	76,66	100,00	100,00	100,00
	0,07%	18	100,00	100,00	100,00	100,00

Mospilan 20 SG (Control) gave a 100 % mortality after 21 days at 0,012 % concentration, after 10 days at 0,025 % concentration and 7 days at a 0,05 % concentration.

Compared to Control, Emerite, a biocid insecticide, resulted in 100 % mortality rate after 7 days at 0,05 % concentration and after 3 days at 0,07 % concentration.

Not differentiating from the first treatment results, insect control products Vertimec 1,8 % EC and Faster 10 EC proved to be highly effective, while Decis 2,5 % and Talstar 10 EC were generally less effective, the last one having the smallest rate of mortality.

In this case, the 100 % mortality rate was achieved at 0,04 % concentration after 21 days from treatment and after 10 days at 0,06 % concentration.

Table 4 summarizes the results of the efficiency of several chemical products after the third treatment (17 August 2008) in controlling the greenhouse whitefly *Trialeurodes vaporariorum* Westwood in the tomato greenhouse located in Cluj-Napoca at the University of Agricultural Sciences an Veterinary Medicine.

The product Mospilan 20 SG (Control) determined a 100 % mortality after 21 days at 0,012 % concentration and after 7 days at 0,05 % and 0,025 % concentration.

Compared to Mospilan 20 SG (Control) the product Emerite produced mortality after 7 days at 0,05 % concentration and at 0,07 % concentration the mortality of greenhouse whitefly appeared 3 days after treatment.

Good results were obtained also with Vertimec 1,8 % EC Faster 10 CE , Decis 2,5 % EC while treatment with Talstar 10 EC gave the lowest mortality rate.

With Talstar 10 EC, 100 % mortality was at 0,04 % concentration at 21 days after treatment and 10 days at 0,06 % concentration.

Table 4

Results regarding the efficiency of several chemical products in controling *Trialeurodes vaporariorum* Westwood after the third treatment (Colonia Borhanci Cluj – Napoca, 17 August 2008)

Commercial name/active substance	Recommended concentration/ tested concentration	Var.	Mortality registered after			
			3 days	7 days	10 days	21 days
Mospilan 20 SG (acetamiprid 200 g/l) Control	0,012 %	**1**	**55,33**	**78,66**	**94,66**	**100,00**
	0,025 %	**2**	**78,66**	**100,00**	**100,00**	**100,00**
	0,050 %	**3**	**98,00**	**100,00**	**100,00**	**100,00**
Vertimec 1,8% EC (abamectin 18 g/l)	0,05%	**4**	**35,33**	**78,66**	**98,00**	**100,00**
	0,1%	**5**	**65,33**	**96,67**	**100,00**	**100,00**
	0,15%	**6**	**98,00**	**100,00**	**100,00**	**100,00**
Decis 2,5% EC (deltametrin 25 g/l)	0,02%	**7**	**32,67**	**78,66**	**96,67**	**100,00**
	0,05%	**8**	**76,66**	**96,67**	**100,00**	**100,00**
	0,07%	**9**	**96,67**	**100,00**	**100,00**	**100,00**
Faster 10 CE (cipermetrin 100 g/l)	0,01 %	**10**	**32,67**	**73,33**	**94,67**	**100,00**
	0,02 %	**11**	**74,67**	**94,67**	**100,00**	**100,00**
	0,04 %	**12**	**96,67**	**100,00**	**100,00**	**100,00**
Talstar 10 EC (bifentrin 100 g/l)	0,02%	**13**	**36,00**	**65,33**	**88,00**	**96,67**
	0,04%	**14**	**65,33**	**88,67**	**98,00**	**100,00**
	0,06%	**15**	**78,66**	**94,67**	**100,00**	**100,00**
Emerite (imidacloprid 240g/l)	0,02%	**16**	**41,67**	**94,67**	**100,00**	**100,00**
	0,05%	**17**	**96,67**	**100,00**	**100,00**	**100,00**
	0,07%	**18**	**100,00**	**100,00**	**100,00**	**100,00**

Defining a strategy for integrated control of greenhouse whitefly *Trialeurodes vaporariorum* Westwood

In order to develop a strategy for the greenhouse witefly control in protected areas cultivated with tomatoes, certain methods that can be included in tomato crop technology were applied:

- **agrotechnical:** the crops rotation (avoiding monoculture); soil fertilization (the application of fertilizers in optimum doses); seed and planting material

(use of tomato hybrids from NUNHEMS Company (Holland): Menhir F1, Cronos F1, Shannon F1.

Regarding the tomato hybrids from Holland, they were extensively observed in the experimental field. The dutch tomato hybrids are more and more required by growers for the protected areas and are appreciates by consumers for their organoleptic qualities.

In 2008 for the solar greenhouse situated in Colonia Borhanci near Cluj-Napoca the extra-early hybrid Cronos F1, Shannon F1, Menhir F1 were used al well from Nunhems Company. All the characteristics of tomato hybrids used in the experiment were taken from Nunhems product catalogue (2006). Seedlings were produced in individual 8/8 cm pots, at the University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca.

In 2008, extra-early tomato hybrids with undetermined growth produced by Nunhems Company (Netherlands): Cronos F1, Shannon F1, Menhir F1 were used al well.

Menhir F1 is an extra-early hybrid with undetermined growth designed for field and greenhouse crops. This hybrid was chosen because of its resistance to the: Tobbaco Mosaic Virus (VMT), *Verticillium albo-atrum* Reike & Berhold, *Verticillium dahliae* Klebahn, *Fusarium oxysporum f.sp. liycopersici* race 0 and race 1 Snyder & Hansen, *Fusarium oxysporum f.sp. radicis lycopersici* Jarvis & Shoemaker. It also has a moderate resistance to: *Meloidogyne incognita* Chitwood, *Meloidogyne arenaria* Chitwood, *Meloidogyne javanica* (Treub) Chitwood.

Cronos F1 has a good resistance to the: Tobbaco Mosaic Virus (VMT), *Verticillium albo-atrum* Reike & Berhold, *Verticillium dahliae* Klebahn, *Fusarium oxysporum f.sp. liycopersici* race 0 and race 1 Snyder & Hansen, while the tomato hybrid Shannon F1 is resistent to all above mentioned deseases plus also to the *Fusarium oxysporum f.sp. radicis lycopersici* Jarvis & Shoemaker.

- the maintenance and the harvesting (destruction of the unwanted weeds around the experimental greenhouse, removal of basal leaves, gathering and destroying the garden scraps);

- **physical** (greenhouse and the soil sanitation, closing the greenhouse during summer and opening it during winter).

CONCLUSIONS

1. The experimental outcomes of our research conducted in 2008 show that the products having a systemical action, Mospilan 20 SG (acetamiprid 200 g/l), Emerite (imidacloprid 240 g/l) where more effective than those insecticides having contact and ingestion actions, Talstar 10 EC (bifetrin 100 g/l), Vertimec 1,8 % EC (abamectin 18 g/l), Decis 2,5 EC (deltametrin 25 g/l) and Faster 10 CE (cipermetrin 100 g/l).

2. The yellow and blue sticky traps (optical panels) can be used with good result in controlling the greenhouse whitefly, *Trialeurodes vaporariorum* Westwood. This is an ecological method and the panels can be handled easily.

3. Our research shows that using traditional pest control methods (application of agro-technical, physical, chemical methods) and corelating them with the use of unconventional ones (use of coloured sticky boards), the

population of the greenhouse whitefly *Trialeurodes vaporariorum* Westwood can be successfully and effectively reduced by a system of "integrated battle", combining all the methods explained above.

REFERENCES

1. Bobeş, I. (1983). Atlas de fitopatologie şi protecţia agroecosistemelor. Ed. Ceres, Bucureşti, 248-260.
2. Busuioc, M. (2006). Entomologie agricolă. Centrul Ed. al UASM, Chişinău, 339-343.
3. Cândea, E. (1984). Dăunătorii legumelor şi combaterea lor. Ed. Ceres, Bucureşti, p. 200.
4. Ciofu, Ruxandra, N. Stan, V. Popescu, Pelaghia Chilom, S.Apahidean, A. Horgoş, V. Berar, K.F. Lauer, N. Atanasiu (2003). Tratat de legumicultură. Ed. Ceres, Bucureşti, p. 603-646.
5. Iacob, N., M. Brîncoveanu (1977). Influenţa unor produse pesticide asupra populaţiilor de zoofagi ai dăunătorilor din sere. Analele ICPP. 12: 237 – 244.
6. Mustaţă, Mariana, Gh. Mustaţă, I. Andriescu, M. Mitroiu (2006). Biologia dăunătorilor animali. Ed. Junimea, Iaşi. P. 99-101.
7. Pop (Balea), Oana Mihaela (2008). Cercetări privind morfologia, bioecologia şi combaterea integrată a musculiţei albe de seră, Trialeurodes vaporariorum Westwood, dăunător al culturilor de tomate în spaţiile protejate, Teza de doctorat.
8. ***CODEX (2004) Bucureşti.