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EFFECT OF BOTANICAL INSECTICIDES NEEMAZAL-T/S AND PYRETHRUM APPLIED ALONE AND IN COMBINATION WITH DIFFERENT ORGANIC PRODUCTS ON *THRIPS TABACI* POPULATION DENSITY

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Abstract

The trial was conducted with spring forage pea (*Pisum sativum* L.) from 2011-2013 in the experimental field of the Institute of Forage Crops, Bulgaria. The effect of three insecticides was studied: NeemAzal T/S®, Pyrethrum FS EC (botanical insecticides) and Nurelle D (synthetic insecticide) applied alone and in combination with the growth regulators Polyversum (biological growth regulator and fungicide) and Flordimex 420 (synthetic growth regulator); and an organic foliar fertilizer known as Biofa on *Thrips tabaci* population density. The treatment was conducted once (at budding stage) and twice (at budding and flowering stages). Between the studied biological insecticides against *Thrips tabaci* (Thysanoptera: Thripidae) Pyretrum FS EC was distinguished by its higher protective effect and fast initial activity, while NeemAzal-T/S exhibited slow initial activity and a relatively weak increasing after-effect. Combined use of the bioinsecticides with the organic foliar fertilizer Biofa and growth regulator Polyversum established synergism. The synergistic effect was more pronounced in combinations with Biofa. The highest efficacy among the organic products was found under combined use of Pyrethrum FS EC and Biofa whose protective effect approximated that of Nurele D Chlorsyrine 550 EC. The double treatment of plants (at budding and flowering stages) with Pyrethrum and NeemAzal reduced the density of thrips by 28.9% and 20.1% respectively compared to the single application, without consideration of the method of use. The most efficient combination among organic products was the use of Pyrethrum with Biofa where the density of thrips decreased by 53.7%, followed by Pyrethrum with Polyversum (by 44.0%) and NeemAzal with Biofa (by 39.5%) irrespective of the stage of treatment.

KEY WORDS: Onion Thrips, density, Pyrethrum FS EC, NeemAzal T/S, combinations, efficacy

Introduction

Thrips tabaci L. (Thysanoptera: Thripidae) is a highly polyphagous insect that causes both direct and indirect effects on plant development and health (TRDAN *et al*., 2006; FAIL *et al*., 2013).

The adults and larvae feed on epidermal and subepidermal cells of both meristematic and mature leaf and flower tissues, inhibiting plant growth and development and causing necrotic or light-reflective blotches on the tissue. Furthermore, they indirectly damage plants by transmitting the viruses such as the tomato spotted wilt virus (SAKIMURA, 1963; JENSER *et al*., 2003).

The widespread use of chemical insecticides to control *T. tabaci* has led to increasing resistance against the major classes of synthetic insecticides (MACINTYRE-ALLEN *et al*., 2005). The growing awareness of and demand for insecticides that are not environmentally hazardous has stimulated the study of plant-derived compounds for pest control (BOEKE *et al*., 2004). Such compounds could be used as natural pesticides. Among the sources of botanical pesticides, pyrethrins from pyrethrum plants ((*Chrysanthemum cinerariaefolium*) represent one of the economically most important classes of compounds with broad usage in organic agriculture (CASIDA, 1973). Among botanicals, neem is widely used in integrated pest management in various formulations in several countries around the world today (ISMAN, 2006; TRDAN *et al*., 2007).

Although plant pesticides have been studied in many laboratory tests (CHANDLER, 1951; MORGAN, 2009), very few studies are available that present results from practical use. In addition there is a great lack of comparisons of biological efficacy of pyrethrum and neem products, applied alone and in combination with different organic products, and their impact on the population density of pests.

Therefore the purpose of our study was to compare the biological efficacy of NeemAzal-T/S with that of Pyrethrum, applied alone and in combination with different organic products against *Thrips tabaci* and their impact on its population density in spring forage pea (*Pisum sativum* L.).

Material and Methods

The trial was conducted with spring forage pea (*Pisum sativum* L.) variety Pleven 4 during 2011-2013 at the experimental field of the Institute of Forage Crops, Pleven, Bulgaria (Pleven is located in the middle of the hilly Danubian Plain, at an altitude 100-160 m above sea level as well as at 43.4169998˚ N latitude and at 24.6170006˚ E longitude). The experiment was performed by the split-plot method with a sowing rate of 120 seeds m^{-2} in 4 replications and a plot size of 6.5 m^2. The effect of three insecticides was studied: NeemAzal, Pyrethrum (biological insecticides) and Nurelle D (synthetic insecticide) applied alone and in combination with the growth regulators Polyversum (biological growth regulator and fungicide) and Flordimex (synthetic growth regulator) and an organic foliar fertilizer, known as Biofa, on *Thrips tabaci* population density. The treatment was conducted once (at the stage of budding) and twice (at budding and flowering). The treatment was performed in the morning during the second half of May. Variants of the trial: 1. control (treated with distilled water); 2. Biofa-500 ml/ha (dose); 3. Polyversum-100 g/ha; 4. Flordimex-50 ml/ha; 5. NeemAzal-500 ml/ha; 6. Pyrethrum-50 ml/ha; 7. Nurele D Chlorsyrine-400 ml/ha; 8. NeemAzal-0.5%+Biofa-0.5%; 9. Pyrethrum-0.05%+Biofa-0.5%; 10. NeemAzal-500 ml/ha + Polyversum-100 g/ha; 11. Pyrethrum-50 ml/ha + Polyversum-100 g/ha; 12. Nurelle D -400 ml/ha+ Flordimex-50 ml/ha.

NeemAzal-T/S® is a product from the Indian Neem tree *Azadirachta indica* A. Juss: *Meliaceae*. Active substances: 1% azadirachtin A + 0,5% azadirachtin B,W,G,D and 2,5% neem substance. Producer: Trifolio – M, Germany.

Pyrethrum FS EC is a natural extract of *Chrysanthemum cinerariaefolium*. Components: 32 % extract from pyrethrum (25% pyrethrin) +32 % sesame oil + 36 % adhesives (soft potassium soap). Producer: Andermatt Biocontrol, Switzerland.

Nurelle D (50g a.i. l^{-1} cypermethrin + 500g a.i. l^{-1} chlorpyrifos-ethyl) - pyrethroid insecticide. Producer: Dow AgroSciences- Indiana, USA.

Biofa (brown algae extract) is a natural product obtained through cold extraction and is extremely rich in macro- and microelements. It contains organic matters (9%), alginic acid (4%), natural plant hormones, total nitrogen (0.20%), total phosphorus (P_2O_5) - 8%, soluble potassium (K_2O) - 14%. Producer: Tilco Biochemie GmbH.

Polyversum (spores of fungus *Pythium oligandrum*) is a natural product with a double effect: a fungicide and growth regulator. Producer: Biopreparaty Ltd., Czech Republic.

Flordimex 420 (420 g/l ethephon) is a synthetic growth regulator which stimulates the formation of generative organs. Producer: Bayer CropSciences.

The population density of thrips was recorded eight times in the vegetation period on a plot of 26 m^2 for each variant; the average density is given in Tab. I (the density of thrips was recorded once a week). The method of sweeping with entomological net was used where 5 swings are equal to 1 m^2. The efficacy of the insecticides was calculated according to the formula of ABBOTT (1925) on the first, third, fifth and seventh day after second treatment:

$$E\% = \left(1 - \frac{\text{n in T after treatment}}{\text{n in Co after treatment}}\right) \times 100$$

where: n = Insect population, T = treated, Co = control. The statistical processing of experimental data was conducted using the Statgraphics Plus software program and ANOVA for statistical analysis (ANOVA: Single Factor). This tool performs a simple analysis of variance on data for two or more samples. The analysis provides a test of the hypothesis that each sample is drawn from the same underlying probability distribution against the alternative hypothesis that underlying probability distributions are not the same for all samples. Statgraphics Plus is a tool which makes it possible to study and thoroughly analyse everything related to statistics. This programme contains a toolset for the creation of different variable data, which later can be analyzed under several work methods, and it can select the best data to work on to which, eventually, field-specific graphics can be added, if so desired.

Results and Discussion

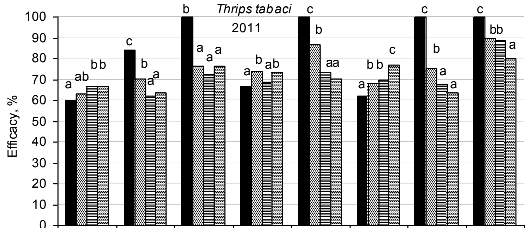
The studied insecticides exhibited different efficacy depending on the way of use (alone or combined) in 2011-2013 (Fig. 1).

Application of Pyrethrum alone showed a higher protective effect and its efficacy ranged from 63.6 to 84.0% during the 7-day reporting period, while for NeemAzal the limit was 60.0-66.9% in 2011. The same trend was retained when Pyrethrum and NeemAzal were combined with the organic products Biofa and Poliversum as an increase of their efficacy by 12.6 and 6.7% respectively (for Pyrethrum) and 6.5 and 5.2% (for NeemAzal) compared to their individual application was observed. The increased biological efficacy was due to pronounced synergism. Pyrethrum was characterized by fast initial activity and in combinations in the first day after treatment by 100.0% efficacy, which remained relatively high, and on the seventh day was 63.6-70.2%. This efficacy reached that of the synthetic insecticide (Nurelle D). NeemAzal, obviously in combination with Biofa and Polyversum, had a less pronounced initial effect (62.2-66.7%) which increased over time and reached 73.5-76.8% one week after treatment. The biological insecticides in combination with the organic foliar fertilizer Biofa had higher toxicity to *T. tabaci* compared to their combinations with Polyversum. It should be noted that the algae extract (Biofa) exhibited an additional effect which is pronounced in strong protective effect on the foliage by a fine coating (microfilm). This coating contributed to better hold of the insecticides on the leaf surface and improved their effect. The most efficient combination among the organic products was a combined application of Pyrethrum and Biofa followed by Pyrethrum + Polyversum and NeemAzal + Biofa.

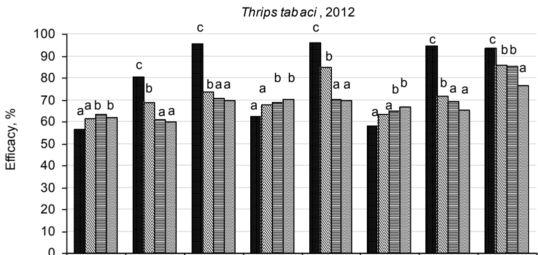
Similar trends were observed during the next two years (2012 and 2013) as Pyrethrum was distinguished with higher toxicity than NeemAzal (Fig. 1). The toxicity of Pyrethrum with foliar fertilizer Biofa approached that of the synthetic insecticide Nurelle D.

The difference in toxic effect of the preparations was probably due to the biological action of their active substances. The active ingredients of pyrethrum extract contain a mixture of pyrethrin I, pyrethrin II, cinerin I, and cinerin II, obtained from dried flowers of the pyrethrum daisy. Pyrethrins I and II account for a major part of the insecticidal activity, and have been used as insecticides since ancient times (PAVELA, 2009). The initial reactions of insects include paralysis followed by death. Most flying insects are highly susceptible to pyrethrins causing them to ‘drop’ almost immediately upon exposure followed by hyperactivity and convulsions (PAVELA, 2009). How pyrethrins act is related to their ability to affect the sodium channel function in the neuronal membranes. Natural pyrethrins are unstable in light compared to synthetic derivatives (pyrethroids). Pyrethrum is the predominant botanical insecticide in use, accounting for 80% of the world botanical insecticide market (ISMAN, 2005).

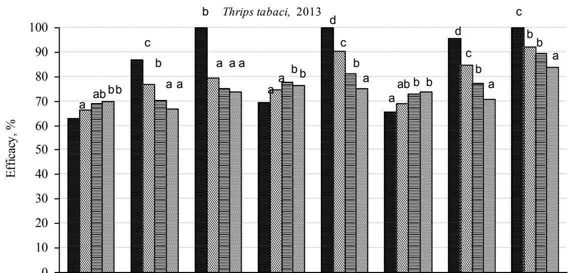
NeemAzal contains biological active substances from the limonoid group and shows significant insecticidal, growth-inhibiting and antifeedant effects (ISMAN, 1994; MORGAN, 2009). It affects feeding behavior of insects causing a reduction in food consumption, reduction in mobility of the pest species and ultimately insect death within a few days (MORDUE & BLACKWELL, 1993). This explains the increasing efficacy of NeemAzal with an increase in the number of days after treatment in the present study. While many sources concerning the insecticide activity of azadirachtin and neem botanical insecticides can be found in literature (KOUL *et al*., 2004; GHATAK *et al*., 2008; PAVELA, 2007, 2009), not many sources are available on the comparative biological efficacy of Pyrethrum and NeemAzal, applied in combination with different organic products against *Thrips tabaci*. Therefore the results presented herein could be precious for science.



	5	6	7	8	9	10	11	12
First day	60,0	84,0	100,0	66,7	100,0	62,2	100,0	100,0
Third day	63,2	70,3	76,3	73,7	86,8	68,4	75,3	89,5
Fifth day	66,7	62,2	72,2	68,9	73,3	70,0	67,8	88,9
Seventh day	66,9	63,6	76,2	73,5	70,2	76,8	63,6	80,1
P=0.05	6.012	5.234	8.031	4.359	5.070	6.107	4.821	7.221



	5	6	7	8	9	10	11	12
First day	56,8	80,6	95,4	62,6	95,9	58,1	94,4	93,5
Third day	61,4	68,9	73,7	67,6	84,7	63,3	71,7	85,9
Fifth day	63,5	61,2	70,6	68,8	70,2	64,9	69,2	85,3
Seventh day	62,1	60,2	69,6	70,4	70,0	66,7	65,5	76,5
P=0.05	5.024	7.317	4.057	6.106	8.342	6.335	6.158	7.439



	5	6	7	8	9	10	11	12
First day	62,8	87,1	100,0	69,5	100,0	65,6	95,5	100,0
Third day	66,2	76,7	79,4	74,5	90,6	69,2	84,5	92,0
Fifth day	69,0	70,3	75,3	77,8	81,1	72,8	77,2	89,5
Seventh day	69,7	66,7	74,0	76,3	75,0	73,6	70,7	84,0
P=0.05	5.956	4.902	6.361	5.205	5.656	7.028	6.080	4.909

Figure 1. Efficacy of insecticides applied alone and in combination with some products against *Thrips tabaci* (days after second treatment). Legend: 5. NeemAzal; 6. Pyrethrum; 7. Nurelle D; 8. NeemAzal+Biofa, 9. Pyrethrum+Biofach; 10. NeemAzal+Polyversum, 11. Pyrethrum+Polyversum; 12 Nurelle D+Flordimex.

High efficacy of botanical extract from *C. cinerariaefolium* for controlling thrips density has been previously reported by STOLL (2000). DODIA *et al*. (2008) and SHIBERU *et al*. (2013) concluded that this extract may possess antifeedant, repellent and insecticidal effects to reduce the damage level caused by *Thrips tabaci*. According to AYALEW (2005), RAY & GURUSUBRAMANIAN (2011) the ethanol extracts of neem seeds also reduced thrips population under field conditions. Similarly in this study, NeemAzal decreased thrips population under field conditions but exhibited a lower mortality rate compared to Pyrethrum.

Population density of *T. tabaci* during the growing season varied widely during the three years of study (P=0.05 = 9.895; 2011-73.5^{a}; 2012-97.0^{b}; 2013-162.8^{c} numbers per 100 sweepings). Both the total amount of rainfall during the growing season of 141.6 mm (April, May and June) and the mean temperature of 16.50C in 2011 inhibited the growth and reproduction of onion thrips. It determined low numbers of 73.5 individuals per 100 sweeping. Higher temperatures in 2012 and 2013 by 2.2 and 1.80C, combined with greater rainfall by 30.2 and 84.4 mm and their relatively more balanced distribution, affected positively the development and reproduction of T. tabaci. The highest thrips number was found at the stages of flowering and at full flowering, the beginning of pod formation. The application of biological and synthetic products influenced the number of thrips (Tab. I).

Used alone, foliar fertilizer and growth regulator, which had no toxic effect, had a mean density of *T. tabaci* in vegetation which approached or slightly exceeded the control from -4.7 to +2.2% on average during the study period. Their action to support both the creation and development of the generative organs of plants and recovery from injuries to some extent compensated for the damage of the pest and helped to improve the productivity of the plants.

As a result of individual treatment at the budding stage with NeemAzal and Pyrethrum, the number of thrips on average for the period 2011-2013 decreased by 24.2 and 30.1%, respectively, with no significant difference between them and also none over the years either (Tab. I). The combination of insecticides with the organic products Biofa and Polyversum significantly reduced the thrips density as differences between their individual applications were statistically significant, with the exception of the combination NeemAzal + Polyversum (29.5% decreased compared with NeemAzal by 24.2%). Better results were obtained by combined use of the bioinsecticides with Biofa compared to Polyversum, and provided better control of *T. tabaci*. The most pronounced protective effect of organic products was observed for variant Pyrethrum + Biofa followed by Pyrethrum + Polyversum as the decrease in the density was on average 45.9 and 37.8% respectively, compared to the control. The reduction of the number of thrips in relevant combinations with NeemAzal was 34.2 and 29.5%.

Significantly more pronounced differences in the protective effect of bioinsecticides were observed under twice treatment (at budding and flowering) as the reduction in pest density at single treatment with Pyrethrum reached 44.3% and had significant differences compared to the reduction at NeemAzal (33.6%) – Tab. I. As a result of combining Pyrethrum with the bioproducts Biofa and Polyversum, the mean number of *T. tabaci* during the vegetation period decreased considerably, on average by 56.4% compared to 41.6% in combinations with NeemAzal. This was due to the stronger toxicity and knock-down effect of the natural extract of *C. cinerariaefolium*. Bioinsecticides which were applied in combination had a stronger effect on the thrips numbers compared to their alone use: statistically significant differences were not found except for the variants with NeemAzal+ Polyversum (37.8% decreased compared with NeemAzal by 33.6%). Only combined use of Pyrethrum and Biofa (62.0% mean reduction) had stable positions and significant differences to the other variants with biological products during the years and the average for the period.

It should be noted that combined use of the insecticides with the organic foliar fertilizer Biofa showed more efficient symbiotic interaction and lower thrips density by 9.5% compared to their combinations with Polyversum. A similar trend about better activity of Pyrethrum in combination with a fertilizer was reported by DJAZULI (2006). Biofa contains extremely macro and microelements, natural plant hormones, etc., enhances the natural immune response of plants and contributes to a natural resistance against the pest (according to the producer: "Trifolio-M", Germany). In the present trial it improved the activity of the insecticides and helped improve protection against thrips as compared with Polyversum.

The stage of the treatment and the way of application aside, Pyrethrum had higher toxic activity and caused higher rates of mortality. The reported mean number of individuals decreased on average by 44.8% compared to 33.9% for NeemAzal. The protective effect of combinations by twice treatment was associated with 28.9% (Pyrethrum) and 20.1% (NeemAzal) lower density compared to their single application, independent of the way of use. The most efficient combination among organic products was use of Pyrethrum with Biofa where the decrease of the thrips density reached an average of 53.7%, followed by Pyrethrum with Polyversum (44.0%), independent of the stage of the treatment. The values about NeemAzal combinations varied within the range of 33.5-39.6%.

Nurelle D reduced thrips density by 52.9%, and in combination with Flordimex by up to 60.5% on average. The activity of synthetic insecticide in comparison with NeemAzal and Pyrethrum was significantly more pronounced with the exception of the combination of Pyrethrum and Biofa which reached or slightly exceeded its protective effect.

The use of plant pesticides has been recommended even more as a suitable alternative of plant protection with minimum negative risks (Isman, 2006; Pavela, 2007). Therefore Pyrethrum and NeemAzal used in combination with Biofa and Pyrethrum are applicable to the conditions of organic farming, providing very high protection against phytophagous thrips.

Conclusions

In studied biological insecticides against *Thrips tabaci,* Pyretrum FS EC was distinguished by a higher protective effect and fast initial activity, while NeemAzal-T/S® exhibited slow initial activity and relatively weak increasing after-action. Under combined use of the bioinsecticides with the organic foliar fertilizer Biofa and growth regulator Polyversum, symbiotic interaction, which was more pronounced in combinations with Biofa, was found. The highest efficacy among organic products had the combined application of Pyrethrum and Biofa whose protective effect approximated that of Nurelle D.

At twice treatment (at budding and flowering stages) of plants with Pyrethrum and NeemAzal the thrips density was reduced by 28.9% and 20.1% respectively compared to their single application independent of the way of use.

The most efficient combination among organic products was the use of Pyrethrum with Biofa where the thrips density decreased by 53.7%, followed by Pyrethrum with Polyversum (44.0%) and NeemAzal with Biofa (39.5%) independent of the stage of the treatment.

Table I. Mean number of *Thrips tabaci* for vegetation period per 100 sweepings.

Variants	Stages of treatment	2011	To C, %	2012	To C, %	2013	To C, %	2011-2013	To C, %
Control (C)	b	77.0 d[a]	-	100.3 gh	-	169.0 de	-	115.4 f	-
	b+f	70.0 gi[b]	-	93.7 fg	-	156.7 g	-	106.8 g	-
	Mean	**73.5**	-	**97.0**	-	**162.9**	-	**111.1**	-
Biofa	b	84.5 d	9.7	97.1 g	-3.2	165.0de	-2.4	115.5 f	0.1
	b+f	65.3 g	-6.7	98.8 g	5.4	170.5 i	8.8	111.5 g	4.4
	Mean	**74.9**	**1.9**	**97.9**	**0.9**	**167.8**	**3.0**	**113.5**	**2.2**
Polyversum	b	79.4 d	3.1	96.8 g	-3.4	179.5 e	6.2	118.6 f	2.8
	b+f	73.4 i	4.9	88.5 ef	-5.5	160.6 g	2.5	107.5 g	0.7
	Mean	**76.4**	**3.9**	**92.7**	**-4.5**	**170.1**	**4.4**	**113.0**	**1.7**
Flordimex	b	75.1 d	-2.5	102.5 h	2.2	158.6 d	-6.2	112.1 f	-2.9
	b+f	67.3 gi	-3.9	84.3 e	-10.1	147.3 f	-6.0	99.6 f	-6.7
	Mean	**71.2**	**-3.1**	**93.4**	**-3.7**	**153.0**	**-6.1**	**105.9**	**-4.7**
NeemAzal	b	58.0 c	-24.7	77.4 f	-22.8	127.0 c	-24.9	87.5 e	-24.2
	b+f	47.0 f	-32.9	64.8 d	-30.8	100.8 e	-35.7	70.9 e	-33.6
	Mean	**52.5**	**-28.6**	**71.1**	**-26.7**	**113.9**	**-30.1**	**79.2**	**-28.7**
Pyrethrum	b	51.4 c	-33.2	76.1 ef	-24.2	114.7 c	-32.1	80.7 de	-30.1
	b+f	37.8 e	-46.0	55.6 c	-40.7	85.2 d	-45.6	59.5 cd	-44.3
	Mean	**44.6**	**-39.3**	**65.8**	**-32.1**	**100.0**	**-38.6**	**70.1**	**-36.9**
Nurelle D	b	38.7 ab	-49.7	59.7 b	-40.4	92.0 ab	-45.6	63.5 b	-45.0
	b+f	24.1 bc	-65.6	38.5 a	-59.0	61.3 b	-60.9	41.3 a	-61.3
	Mean	**31.4**	**-57.3**	**49.1**	**-49.4**	**76.7**	**-52.9**	**52.4**	**-52.9**
NeemAzal+Biofa	b	50.0 bc	-35.1	63.9 bc	-36.3	113.8 c	-32.7	75.9 cd	-34.2
	b+f	36.5 de	-47.9	55.3 c	-41.0	83.3 cd	-46.8	58.4 bc	-45.4
	Mean	**43.3**	**-41.2**	**59.6**	**-38.6**	**98.6**	**-39.5**	**67.1**	**-39.6**
Pyrethrum+Biofa	b	32.8 a	-57.4	59.5 b	-40.7	95.0 b	-43.8	62.4 b	-45.9
	b+f	20.3 ab	-71.0	44.2 b	-52.9	57.2 ab	-63.5	40.6 a	-62.0
	Mean	**26.6**	**-63.9**	**51.8**	**-46.6**	**76.1**	**-53.3**	**51.5**	**-53.7**
NeemAzal+Polyversum	b	55.1 c	-28.4	70.8 de	-29.4	118.2 c	-30.1	81.4 de	-29.5
	b+f	42.5 ef	-39.3	63.6 d	-32.1	93.3 e	-40.5	66.5 de	-37.8
	Mean	**48.8**	**-33.6**	**67.2**	**-30.7**	**105.8**	**-35.1**	**73.9**	**-33.5**
Pyrethrum+Polyversum	b	47.3 bc	-38.6	69.1 cd	-31.1	99.0 b	-41.4	71.8 c	-37.8
	b+f	29.5 cd	-57.9	50.8 c	-45.8	77.5 c	-50.5	52.6 b	-50.8
	Mean	**38.4**	**-47.8**	**59.9**	**-38.2**	**88.3**	**-45.8**	**62.2**	**-44.0**

Variants (Table I - continued)	**Stages of treatment**	**2011**	**To C, %**	**2012**	**To C, %**	**2013**	**To C, %**	**2011-2013**	**To C, %**
Nurelle D.+Flordimex	b	28.9 a	-62.5	53.9 a	-46.3	77.6 a	-54.1	53.5 a	-53.7
	b+f	15.4 a	-78.0	37.3 a	-60.2	50.1 a	-68.0	34.3 a	-67.9
	Mean	**22.2**	**-69.9**	**45.6**	**-53.0**	**63.9**	**-60.8**	**43.9**	**-60.5**
P=0.05	b	**11.789**		**5.318**		**14.552**		**8.213**	
P=0.05	b+f	**7.625**		**5.365**		**7.563**		**7.065**	

Legend: b – stage of budding, b+f – stage of budding and flowering, C (control)-treated with distilled water
[a] Means in each column followed by the same letters are not significantly different ($P > 0.05$) at stage of budding.
[b] Means in each column followed by the same letters are not significantly different ($P > 0.05$) at budding and flowering.

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УТИЦАЈ ИНСЕКТИЦИДА NEEMAZAL-T/S И PYRETHRUM, ПРИМЕЊЕНИХ ПОЈЕДИНАЧНО И У КОМБИНАЦИЈИ СА РАЗЛИЧИТИМ ОРГАНСКИМ ПРОИЗВОДИМА НА ГУСТИНУ ПОПУЛАЦИЈЕ *THRIPS TABACI*

ИВЕЛИНА НИКОЛОВА и НАТАЛИЈА ГЕОРГИЈЕВА

Извод

Испитивања су вршена на сточном грашку (*Pisum sativum* L.) од 2011. до 2013. године на експерименталном пољу Инстиута за крмно биље Бугарске. Испитиван је ефекат три инсектицида на густину популације *Thrips tabaci* (Thysanoptera: Thripidae): NeemAzal®TS, Pyrethrum FS EC и Nurelle D, који су примењивани самостално или у комбинацији са регулатором раста - Polyversum (биолошки регулатор раста и фунгицид) и Flordimex 420 (синтетички регулатор раста); и органско фолијарно ђубриво – Biofa. Третирање је спроведено једном (у фази пупољка) и два пута (у фази пупољка и цветања).

Између испитиваним биолошким инсектицидима против *Thrips tabaci* Pyretrum FS EC је показао да има високу ефикасност и брзу почетну активност, док је NeemAzal-T/S имао спору почетну активност и релативно мало побољшање ефикасности након третирања. Утврђено је да највећи ефекат има комбинована употреба биоинсектицида и органског фолијарног ђубрива Biofa уз употребу и регулатора раста Polyversum. Синергистички ефекат је више изражен у комбинацијама са Biofa.

Највиша ефикасност при употреби органских производа је пронађена код комбиноване употребе Pyrethrum FS EC и Biofa, чији је заштитни ефекат приближан оном код примене Nurele D Chlorsyrine 550 EC. Применом два третмана (у фази пупољка и цветања) са Pyrethrum и NeemAzal смањење густине трипса износи 28,9% и 20,1% у односу на примену једном, независно од начина употребе.

Најефикаснија комбинација је употреба Pyrethrum са Biofa, при чему је густина трипса смањена за 53,7%, затим Pyrethrum са Polyversum (смањење за 44,0%) и NeemAzal са Biofa (смањење за 39,5%), без обзира на период третирања.

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