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Effectiveness of Spirodiclofen in the Control of European Red Mite (*Panonychus ulmi*) on Apple and Pear Psylla (*Cacopsylla pyri*)

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SUMMARY

The effectiveness of spirodiclofen, an acaricide and insecticide with a novel mode of action, in protecting apple from the European red mite (*Panonychus ulmi*) and pear from pear psylla (*Cacopsylla pyri*) was tested in field trials in four sites in Serbia in 2004, 2005 and 2007. The efficacy of *P. ulmi* control was investigated at Morović (Šid), where the effects of spirodiclofen were compared with those of fenazaquin, clofentezine, fenpyroximate and bifenthrin. Applied in 2004 at a rate of 0.096 g a.i. L^{-1} against the overwintering eggs of *P. ulmi*, spirodiclofen achieved 86% efficacy, while the efficacies of fenazaquin and clofentezine (25 days after treatment) were 84.4% and 27.8%, respectively. In the same season, spirodiclofen displayed high and prolonged efficacy against a summer population of *P. ulmi*: the efficacy of this acaricide applied at concentrations of 0.096 and 0.144 g a.i. L^{-1} was 98% and 96.9%, respectively, while fenpyroximate, clofentezine and bifenthrin achieved 43%, 59.5% and 62% efficacy, respectively (45 days after treatment). This effect of spirodiclofen against the summer population was confirmed in the same site in 2005, when 94.9-95.7% efficacy was achieved (47 days after treatment). The efficacy of spirodiclofen, amitraz and abamectin against eggs and larvae of the first generation of *C. pyri* was examined at a Bela Crkva site in 2004, and in sites at Mandjelos (Sremska Mitrovica) and Bela Crkva in 2005. Applied at a concentration of 0.144 g a.i. L^{-1} at the beginning of hatching, spirodiclofen was found to achieve 83.2-95% efficacy, abamectin 93.5-94.9% and amitraz 78.9-95.6% efficacy (14 days after treatment). Applied in a site at Borkovac (Ruma) in 2007 at a rate of 0.096 g a.i. L^{-1} before hatching of the first generation larvae, spirodiclofen reduced the number of eggs and larvae of *C. pyri* by 72%, 82% and 89% in evaluations 18, 25 and 38 days after treatment, while abamectin and diflubenzuron achieved reductions of 92%, 95% and 91%, and 78%, 71% and 86%, respectively.

Key words: Spirodiclofen; *P. ulmi; C. pyri;* Control

INTRODUCTION

The possibility of resistance development and/or withdrawal of conventional products have required that pest control be based on new biorational insecticides/acaricides, i.e. compounds with novel modes of action, highly effective against key pests but relatively safe for non-target organisms and the environment (Horowitz and Ishaaya, 2004). Spirodiclofen is the first member of a novel class of pest control agents, tetronic acid derivatives, commercialized by Bayer CropScience and put on markets in the European Union, United States and Japan in 2002-2004. Its excellent and long lasting activity against a broad range of phytophagous mites, including European read mite (*Panonychus ulmi*) on apple, has been confirmed in field trials worldwide. Because of its new mode of action - inhibition of lipid synthesis - spirodiclofen effectively controlled mite populations resistant to other acaricides (Nauen et al., 2000; Elbert et al., 2002; Dekeyser, 2005). Besides acaricidal action, spirodiclofen showed insecticidal activity against eggs and larvae of pear psylla (*Cacopsylla pyri*), the most important pest of pears in continental Europe (De Maeyer et al., 2002a). Based on the findings of laboratory and field trials, this compound is considered as a compatible acaricide/insecticide in apple and pear orchards and safe for the environment (Wolf and Schnorbach, 2002; De Maeyer et al., 2002b; Hardman et al., 2003).

Here we present the results of several field trials conducted in Serbia to evaluate the effectiveness of spirodiclofen against *P. ulmi* and *C. pyri* populations, comparing it to other acaricides and insecticides that have been used in practice for a long while. The results of these trials are discussed in terms of improving the management of populations of these pests.

MATERIAL AND METHODS

Efficacy evaluation against *Panonychus ulmi*

Field trials were carried out in apple orchards located at Morović (Šid) in 2004 and 2005. The following acaricides were evaluated: bifenthrin (100 g L^{-1}; Talstar 10-EC, 0.02%; FMC), clofentezine (500 g L^{-1}; Apollo 50-SC, 0.06%; Makhteshim-Agan), fenazaquin (200 g L^{-1}; Demitan 200-SC, 0.05%; Dow AgroSciences), fenpyroximate (50 g L^{-1}; Ortus 5-SC, 0.05%; Nihon Nohyaku) and spirodiclofen (240 g L^{-1}; Envidor, 0.04% and 0.06%; Bayer CropScience). The trial features were: experimental design - randomized block; plot size - 5 trees; replications - 4; type of application - spraying until run-off.

In the trial of acaricide efficacy against the overwintering eggs of *P. ulmi*, motile forms on 25 leaves per plot were counted after treatment (MF*), the means were transformed by √(x+0.5) and separated by *t*-test, and the efficacy was calculated according to Abbott's formula:

$$Ef\,(\%) = \left(1 - \frac{MF^{*}t}{MF^{*}c}\right) \times 100$$

c = control plots, t = treated plots

In the trials of acaricide efficacy against the summer population of *P. ulmi*, motile forms on 25 leaves per plot were counted before treatment (MF) and after treatment (MF*). The means were transformed by √(x+0.5) and separated by *t*-test, and the efficacy was calculated according to Henderson-Tilton formula:

$$Ef\,(\%) = \left(1 - \frac{MF^{*}t}{MF^{*}c} \cdot \frac{MFc}{MFt}\right) \times 100$$

c = control plots, t = treated plots

Efficacy evaluation against *Cacopsylla pyri*

Field trials were carried out in pear orchards located in Bela Crkva in 2004 and 2005, Manđelos (S. Mitrovica) in 2005, and Borkovac (Ruma) in 2007. The following insecticides, applied against the first generation of *C. pyri,* were evaluated: abamectin (18 g L^{-1}; Armada, 0.075%; Willowood Ltd., Hong Kong), amitraz (200 g L^{-1}; Mitac-20, 0.3%; Bayer CropScience), diflubenzuron (480 g L^{-1}; Dimilin SC 48, 0.025%; Crompton) and spirodiclofen (240 g L^{-1}; Envidor, 0.04% and 0.06%; Bayer CropScience). The trials were laid out to include: experimental design - randomized block; plot size - 5 trees; replications - 4; type of application - spraying until run-off.

In Bela Crkva and Manđelos, the insecticides were applied at the beginning of hatching of the first generation larvae. Eggs and larvae (EL) before treatment and larvae (L*) after treatment were counted per shoot on 10 previously marked shoots per plot. The means were transformed by √(x+0.5) and separated by *t*-test, and the efficacy was calculated according to Henderson-Tilton formula:

$$Ef\,(\%) = \left(1 - \frac{L^*t}{L^*c} \cdot \frac{ELc}{ELt}\right) \times 100$$

c = control plots, t = treated plots

At Borkovac, the insecticides were applied before the beginning of hatching of the first generation larvae. After treatment, larvae (L^*) were counted per shoot on 10 previously marked shoots per plot. The means were transformed by $\sqrt{(x+0.5)}$ and separated by *t*-test, and the efficacy was calculated according to Abbott's formula:

$$Ef\,(\%) = \left(1 - \frac{L^*t}{L^*c}\right) \times 100$$

c = control plots, t = treated plots

The larvae were separated in groups of younger (L_{1-3}) and older larvae (L_{4-5}). Pretreatment eggs and white and yellow eggs after treatment were counted, treansformed and separated by *t*-test as well.

RESULTS AND DISCUSSION

Control of *Panonychus ulmi*

The efficacy of spirodiclofen applied at a rate of 0.096 g a.i. L^{-1} against overwintering eggs was compared to clofentezine and fenazaquin effectiveness at the recommended rates (Table 1). In evaluations 12 and 25 days after treatment, spirodiclofen and fenazaquin showed good efficacy, while clofentezine was unsatisfactory in that respect, especially in the second evaluation. Some available data on spirodiclofen effects against *P. ulmi* on apple refer to applications against summer populations. Our results show that this acaricide can be used for treatments at the beginning of vegetation season. Additional field trials are needed to define optimal application rates for this acaricide and test possible combinations with surfactants and spray oils.

Applied at concentrations of 0.096 and 0.144 g a.i. L^{-1}, spirodiclofen was tested against a summer population of *P. ulmi* and compared to bifenthrin, clofentezine and fenpyroximate applied at the recommended rates (Table 2, Table 3). Spirodiclofen managed to retain population abundance at a level many times lower than the initial state and to achieve high (>91%) and long lasting efficacy: 45 and 47 days after treatment its efficacy was still above 94%. A lower efficacy was only recorded in the evaluation three days after threatment in the first year of experiment. A 50% raise in concentration, i.e. from 0.096 to 0.144 g a.i. L^{-1}, did not crucially change the percentage or duration of spirodiclofen effects. This initial effect of spirodiclofen comes as a result of its slower initial activity against spider mite females: after direct treatment, it takes most females several days to die, but fecundity and fertility of the treated individuals are considerably reduced (Wachendorff et al., 2002; Marčić and Ogurlić, 2006, 2007; Cheon et al., 2007; Marčić, 2007). In trials of this acaricide conducted in several European countries, good and long lasting *P. ulmi* control was also achieved on apple after slow initial effect (Elbert et al., 2002). Despite its slower activity, the results of field trials indicate that a single spirodiclofen treatment could be sufficient for keeping summer populations of *P. ulmi* in check when it is applied to low or medium infestations.

Fenpyroximate was also highly efficient but its effect did not last as long. The unsatisfactory and low efficacy of clofentezine and bifenthrin against *P. ulmi* recorded in the same site in both years is probably the result of a resistance that had developed under high selection pressure of these compounds in the preceding years. Even though a case of resistance requires experimental verification in laboratory trials, it is evi-

Table 1. Mean number of motile forms (MF) of *P. ulmi* 12 days and 25 days after treatment (DAT) and efficacy (Ef) of acaricides according to Abbott's formula (Morović; cv. Red chief; April 16 - May 11, 2004)

Tabela 1. Prosečan broj pokretnih formi (MF) *P. ulmi* 12 dana i 25 dana posle tretiranja (DAT) i efikasnost (Ef) akaricida po Abotovoj formuli (Morović; cv. Red chief; 16. april – 11. maj 2004)

Acaricides – Akaricidi	g a.i. L^{-1}/g a.m. L^{-1}	12 DAT		25 DAT	
		MF	**Ef (%)**	MF	**Ef (%)**
Clofentezine/Klofentezin	0.25	4.5 *b*	**67.4**	19.5 *a*	**27.8**
Fenazaquin/Fenazakvin	0.1	1.2 *c*	**91.3**	4.2 *b*	**84.4**
Spirodiclofen/Spirodiklofen	0.096	1.5 *c*	**89.1**	3.8 *b*	**86.0**
Untreated/Kontrola	-	13.8 *a*	-	27.0 *a*	-

The numbers in column followed by the same letter are not significantly different (t-test, P<0.05)
Brojevi u koloni označeni istim slovom ne razlikuju se statistički značajno (t-test, P<0.05)

dent that a replacement of these acaricides with spirodiclofen would be a good solution. Its totally new mode of action (inhibition of lipid synthesis) practically eliminates the risk of cross-resistance with METI-acaricides, mite growth inhibitors or any other acaricide currently in use (Nauen et al., 2000). The IRAC classification of insecticides/acaricides, which is based on their modes of action (IRAC, 2007), lists spirodiclofen in a special group, meaning that it can be an alternative acaricide in strategies of effective resistance management. This compound is considered suitable for IPM systems in apple orchards as a supporting and correcting agent for mite population management (De Maeyer et al., 2002b). The best application timing for spirodiclofen against *P. ulmi* and other spider mites is at the beginning of infestation (Elbert et al., 2002). To improve its

Table 2. Mean number of motile forms (MF) of *P. ulmi* before treatment (BT), three days, 15 days and 45 days after treatment (DAT) and efficacy (Ef) of acaricides according to Henderson-Tilton formula (Morović, cv. Granny Smith, July 19 - September 3, 2004)

Tabela 2. Prosečan broj pokretnih formi (MF) *P. ulmi* pre tretiranja (BT), tri dana, 15 dana i 45 dana posle tretiranja (DAT) i efikasnost (Ef) akaricida po formuli Henderson-Tilton (Morović; cv. Granny Smith; 19. jul – 3. septembar 2004)

Acaricides Akaricidi	g a.i. L^{-1} g a.m. L^{-1}	BT	3 DAT		15 DAT		45 DAT	
		MF	MF	**Ef (%)**	MF	**Ef (%)**	MF	**Ef (%)**
Bifenthrin Bifentrin	0.02	58.8 *b*	22.5 *bc*	**72.2**	48.8 *bc*	**78.2**	188.8 *c*	**62.0**
Clofentezine Klofentezin	0.30	37.2 *a*	28.0 *bc*	**45.4**	44.2 *bc*	**68.8**	127.2 *b*	**59.5**
Fenpyroximate Fenpiroksimat	0.025	19.5 *a*	7.0 *a*	**73.9**	14.2 *a*	**80.9**	94.0 *b*	**43.0**
Spirodiclofen Spirodiklofen	0.096	22.0 *a*	6.5 *a*	**78.5**	7.5 *a*	**91.0**	3.8 *a*	**98.0**
Spirodiclofen Spirodiklofen	0.144	37.8 *a*	11.5 *ab*	**77.9**	5.5 *a*	**96.2**	10.0 *a*	**96.9**
Untreated Kontrola	-	26.5 *a*	36.5 *c*	-	101.0 *c*	-	224.0 *c*	-

The numbers in column followed by the same letter are not significantly different (t-test, P<0.05)
Brojevi u koloni označeni istim slovom ne razlikuju se statistički značajno (t-test, P<0.05)

Table 3. Mean number of motile forms (MF) of *P. ulmi* before treatment (BT), five days, 14 days, 29 days and 47 days after treatment (DAT) and efficacy (Ef) of acaricides according to Henderson-Tilton formula (Morović, cv. Granny Smith, July 27 - September 12, 2005)

Tabela 3. Prosečan broj pokretnih formi (MF) *P. ulmi* pre tretiranja (BT), pet dana, 14 dana, 29 dana i 45 dana posle tretiranja (DAT) i efikasnost (Ef) akaricida po formuli Henderson-Tilton (Morović; cv. Granny Smith; 27. jul – 12. septembar 2005)

Acaricides Akaricidi	g a.i. L^{-1} g a.m. L^{-1}	BT	5 DAT		14 DAT		29 DAT		47 DAT	
		MF	MF	**Ef (%)**	MF	**Ef (%)**	MF	**Ef (%)**	MF	**Ef (%)**
Bifenthrin Bifentrin	0.02	24.0 *a*	14.5 *b*	**74.5**	24.2 *b*	**65.9**	42.5 *bc*	**31.1**	56.8 *c*	**0.0**
Clofentezine Klofentezin	0.30	17.2 *a*	6.2 *b*	**84.8**	22.0 *b*	**56.8**	10.0 *b*	**77.4**	13.2 *b*	**62.6**
Fenpyroximate Fenpiroksimat	0.025	26.5 *a*	0.2 *a*	**99.7**	2.0 *a*	**97.4**	1.8 *a*	**97.4**	27.0 *bc*	**50.3**
Spirodiclofen Spirodiklofen	0.096	31.8 *a*	2.5 *ab*	**96.7**	4.5 *a*	**95.2**	3.0 *a*	**96.3**	2.8 *a*	**95.7**
Spirodiclofen Spirodiklofen	0.144	23.8 *a*	0.8 *a*	**98.6**	1.2 *a*	**98.3**	2.2 *a*	**96.4**	2.5 *a*	**94.9**
Untreated Kontrola	-	23.8 *a*	56.5 *c*	-	70.5 *c*	-	61.2 *c*	-	48.8 *c*	-

The numbers in column followed by the same letter are not significantly different (t-test, P<0.05)
Brojevi u koloni označeni istim slovom ne razlikuju se statistički značajno (t-test, P<0.05)

acaricidal properties, we need a more extensive research of its effects on the structure and dynamics of spider mite populations, and of its possible combinations, especially with surfactants and summer oils.

Control of *Cacopsylla pyri*

In Bela Crkva and Manđelos, the insecticides were applied against the first generation of pear sucker, when most eggs were close to hatching ("yellow eggs") and first larvae were present. The rate of hatching ranged between 0.01 and 0.22. Spirodiclofen efficacy (0.144 g a.i. L^{-1}) was compared to the efficacies of amitraz and abamectin applied at the recommended rates. Spirodiclofen achieved high efficacy in the second and third trial, when hatching was at a beginning (Table 5, Table 6), while the efficacy was lower in the first trial with a higher rate of hatching (Table 4). Amitraz showed a similar effect, but its efficacy in the first evaluation was lower than that of spirodiclofen. The efficacy of abamectin, tested in the second and third trials, was similar to the efficacies achieved by the other two insecticides.

In Borkovac, the insecticides were applied before the hatching of first generation larvae, i.e. while some 50% were yellow eggs, and the numbers of eggs (separated as "white eggs" and "yellow eggs") and larvae (younger L_{1-3} and older L_{4-5}) were evaluated three

Table 4. Mean number of *C. pyri* before treatment (BT), nine days and 14 days after treatment (DAT), and efficacy of insecticides (Ef) according to Henderson-Tilton formula (Bela Crkva, cv. Doyenne du Comise, April 8-22, 2004

Tabela 4. Prosečan broj *C. pyri* pre tretiranja (BT), devet dana i 14 dana posle tretiranja (DAT) i efikasnost insekticida (Ef) po formuli Henderson-Tilton (Bela Crkva, cv. Društvenka, 8-22 april 2004)

Acaricides Akaricidi	g a.i. L^{-1}/g a.m. L^{-1}	BT	12 DAT		25 DAT	
		EL (H)	MF	**Ef (%)**	MF	**Ef (%)**
Amitraz Amitraz	0.6	157.0 *a* (0.22)	38.2 *b*	**63.8**	26.0 *b*	**78.9**
Spirodiclofen Spirodiklofen	0.144	228.2 *a* 0.16)	25.2 *b*	**83.6**	30.0 *b*	**83.2**
Untreated Kontrola	-	148.8 *a* (0.19)	100.0 *a*	-	116.5 *a*	-

The numbers in column followed by the same letter are not significantly different (t-test, P<0.05)
Brojevi u koloni označeni istim slovom ne razlikuju se statistički značajno (t-test, P<0.05)

EL = Mean number of *C. pyri* eggs and larvae before treatment/Prosečan broj jaja i larvi *C. pyri* pre tretiranja
L = Mean number of *C. pyri* larvae after treatment/Prosečan broj larvi *C. pyri* posle tretiranja
H = Rate of hatching (L_{BT}/EL_{BT})/Proporcija piljenja

Table 5. Mean number of *C. pyri* before treatment (BT), five days and 14 days after treatment (DAT) and efficacy of insecticides (Ef) according to Henderson-Tilton formula (Bela Crkva, cv. William ′s, April 20 – May 4, 2005)

Tabela 5. Prosečan broj *C. pyri* pre tretiranja (BT), pet dana i 14 dana posle tretiranja (DAT) i efikasnost insekticida (Ef) po formuli Henderson-Tilton (Bela Crkva, cv. Viljamovka, 20. april – 4. maj 2005)

Acaricides Akaricidi	g a.i. L^{-1}/g a.m. L^{-1}	BT	5 DAT		14 DAT	
		EL (H)	L	**Ef (%)**	L	**Ef (%)**
Abamectin Abamektin	0.0135	258.5 *a* (0.02)	5.0 *b*	**88.3**	11.2 *b*	**94.9**
Amitraz Amitraz	0.6	113.0 *b* (0.01)	2.2 *b*	**85.7**	8.2 *b*	**91.4**
Spirodiclofen Spirodiklofen	0.144	138.0 *ab* (0.03)	2.5 *b*	**86.7**	9.8 *b*	**91.7**
Untreated Kontrola	-	132.5 *ab* (0.02)	18.0 *a*	-	113.5 *a*	-

The numbers in column followed by the same letter are not significantly different (t-test, P<0.05)
Brojevi u koloni označeni istim slovom ne razlikuju se statistički značajno (t-test, P<0.05)

EL = Mean number of *C. pyri* eggs and larvae before treatment/Prosečan broj jaja i larvi *C. pyri* pre tretiranja
L = Mean number of *C. pyri* larvae after treatment/Prosečan broj larvi *C. pyri* posle tretiranja
H = Rate of hatching (L_{BT}/EL_{BT})/Proporcija piljenja

Table 6. Mean number of *C. pyri* before treatment (BT), five days and 14 days after treatment (DAT) and efficacy of insecticides (Ef) according to Henderson-Tilton formula (Manđelos, cv. Passe Crassane, April 21 – May 5, 2005)

Tabela 6. Prosečan broj *C. pyri* pre tretiranja (BT), pet dana i 14 dana posle tretiranja (DAT) i efikasnost insekticida (Ef) po formuli Henderson-Tilton (Manđelos, cv. Krasanka, 21. april – 5. maj 2005)

Acaricides Akaricidi	g a.i. L^{-1}/g a.m. L^{-1}	BT	5 DAT		14 DAT	
		EL (H)	L	**Ef (%)**	L	**Ef (%)**
Abamectin Abamektin	0.0135	192.5 *a* (0.09)	4.5 *b*	**86.8**	3.2 *b*	**93.5**
Amitraz Amitraz	0.6	158.2 *a* (0.11)	4.0 *b*	**85.7**	1.8 *b*	**95.6**
Spirodiclofen Spirodiklofen	0.144	231.2 *a* (0.08)	3.8 *b*	**90.7**	3.0 *b*	**95.0**
Untreated Kontrola	-	172.2 *a* (0.08)	30.5 *a*	-	44.2 *a*	-

The numbers in column followed by the same letter are not significantly different (t-test, P<0.05)
Brojevi u koloni označeni istim slovom ne razlikuju se statistički značajno (t-test, P<0.05)

EL = Mean number of *C. pyri* eggs and larvae before treatment/Prosečan broj jaja i larvi *C. pyri* pre tretiranja
L = Mean number of *C. pyri* larvae after treatment/Prosečan broj larvi *C. pyri* posle tretiranja
H = Rate of hatching (L_{BT}/EL_{BT})/Proporcija piljenja

times (Table 7). Abamectin showed the best effect, as it practically terminated egg laying and achieved 92% and 81.3% efficacy in evaluations 25 and 38 days after treatment. Applied at the rate of 0.096 g a.i. L^{-1}, spirodiclofen significantly reduced the number of eggs and larvae after a weaker initial effect, and achieved 90% and 87.7% efficacy in the second and third evaluations. Diflubenzuron showed the weakest effect.

Figure 1 shows changes in *C. pyri* numbers in the control and treatment plots at Borkovac. Spirodiclofen

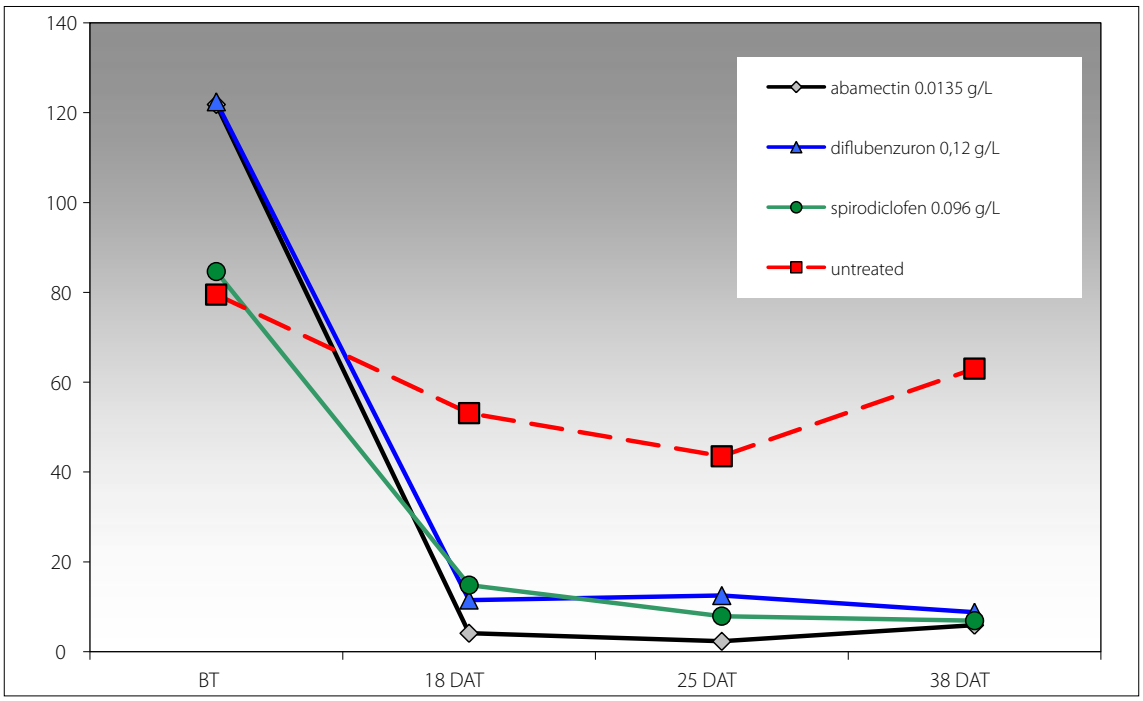

Figure 1. The number of *C. pyri* eggs before treatment (BT) and eggs and larvae 18 days, 25 days and 38 days after treatment (DAT) (Borkovac, March 16 - April 23, 2007)
Slika 1. Broj jaja *C. pyri* pre tretmana (BT) i jaja i larvi 18 dana, 25 dana i 38 dana posle tretmana (DAT) (Borkovac, 16. mart – 23. april 2007)

Table 7. Mean number of *C. pyri* eggs (E) and larvae (L) 18 days, 25 days and 38 days after treatment (DAT) and efficacy of insecticides (Ef) according to Abbott´s formula (Borkovac, cv. William´s, March 16 – April 23, 2007)

Tabela 7. Prosečan broj jaja (E) i larvi (L) *C. pyri* 18 dana, 25 dana i 38 dana posle tretiranja (DAT) i efikasnost insekticida (Ef) po Abbott-ovoj formuli (Borkovac, cv. Viljamovka, 16 mart – 23 april 2007)

	18 DAT					25 DAT						38 DAT				
E	Ew	Ey	**L**	L_{1-3}	L_{4-5}	**E**	Ew	Ey	**L**	L_{1-3}	L_{4-5}	**E**	Ew	Ey	**L**	L_{1-3}	L_{4-5}
Abamectin 0.0135 g a.i. L-1 **Abamektin**																	
2.0 c	0.0 b	2.0 c	**2.1 c**	2.0 c	0.1 b	**0.2 b**	0.2 b	0.0 b	**2.3 b**	1.3 b	1.0 b	**0.0 b**	0.0 b	0.0 b	**5.9 b**	0.1 b	5.8 b
		Ef (%)	**81.1**	78.7	94.1			**Ef (%)**	**92.0**	90.2	93.6			**Ef (%)**	**81.3**	99.3	66.1
Diflubenzuron 0.12 g a.i. L-1 **Diflubenzuron**																	
8.6 b	6.0 ab	2.6 bc	**2.9 c**	2.8 c	0.1 b	**8.3 a**	1.5 b	6.8 a	**4.2 b**	3.9 b	0.3 b	**3.2 b**	1.0 b	2.2 b	**5.6 b**	0.0 b	5.6 b
		Ef (%)	**73,9**	70.2	94.1			**Ef (%)**	**85.5**	70.5	98.1			**Ef (%)**	**82.3**	100.0	67.2
Spirodiclofen 0.096 g a.i. L-1 **Spirodiklofen**																	
9.7 b	2.5 b	7.2 b	**5.2 b**	5.2 b	0.0 b	**5.0 ab**	1.5 b	3.5 ab	**2.9 b**	1.4 b	1.5 b	**3.0 b**	0.0 b	3.0 b	**3.9 b**	0.1 b	3.8 b
		Ef (%)	**53.2**	44.7	100.0			**Ef (%)**	**90.0**	89.4	90.5			**Ef (%)**	**87.7**	99.3	77.8
Untreated **Kontrola**																	
42.0 a	14.8 a	27.2 a	**11.1 a**	9.4 a	1.7 a	**14.6 a**	6.8 a	7.8 a	**28.9 a**	13.2 a	15.7 a	**31.4 a**	14.2 a	17.2 a	**31.6 a**	14.5 a	17.1 a

The numbers in column followed by the same letter are not significantly different (t-test, $P<0.05$)

Brojevi u koloni označeni istim slovom ne razlikuju se statistički značajno (t-test, $P<0.05$)

Ew = White eggs/Bela jaja;

Ey = Yellow eggs/Žuta jaja;

L_{1-3} = Larvae I-III instar/Larve I-III stupnja;

L_{4-5} = Larvae IV-V instar/Larve IV-V stupnja

reduced the number of eggs and larvaes by 72%, 82% and 89% in evaluations 18, 25 and 38 days after treatment, respectively, while abamectin achieved corresponding reductions of 92%, 95% and 91%, and diflubenzuron 78%, 71% and 86%.

The data acquired from our field trials show that control of the first generations of *C. pyri* can be based on spirodiclofen treatment; its application is best timed against mature ("yellow") eggs and initial hatching. Its selectivity for the bug *Anthocoris nemoralis*, the main predator of pear sucker, enables spirodiclofen to be used as a compatible insecticide in pear orchards (De Maeyer et al., 2002b). However, as noted for its acaricidal properties, the effect of spirodiclofen and its combinations with other products against the succeeding generations of pear psylla needs to be tested further in order to improve its activity.

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Efektivnost spirodiklofena u suzbijanju crvene voćne grinje (*Panonychus ulmi*) na jabuci i kruškine buve (*Cacopsylla pyri*)

REZIME

Efektivnost spirodiklofena, akaricida i insekticida novog mehanizma delovanja, u zaštiti jabuke od crvene voćne grinje (*Panonychus ulmi*) i kruške od kruškine buve (*Cacopsylla pyri*), ispitivana je u poljskim ogledima na četiri lokaliteta u Srbiji u 2004, 2005. i 2007. godini. Efikasnost suzbijanja *P. ulmi* ispitivana je u lokalitetu Morović (Šid), gde su efekti spirodiklofena upoređeni sa efektima fenazakvina, klofentezina, fenpiroksimata i bifentrina. Primenjen u 2004. godini u koncentraciji 0.096 g a.i. L^{-1} protiv prezimljujućih jaja *P. ulmi*, spirodiklofen je postigao efikasnost 86%, dok je efikasnost fenazakvina i klofentezina iznosila 84.4% i 27.8% (25 dana nakon tretiranja). U istoj sezoni, spirodiklofen je ostvario visoku i dugotrajnu efikasnost suzbijanja letnje populacije *P. ulmi*: efikasnost ovog akaricida, primenjenog u koncentracijama 0.096 i 0.144 g a.i. L^{-1}, iznosila je 98% i 96.9%, dok su fenpiroksimat, klofentezin i bifentrin ostvarili efikasnost od 43%, 59.5% i 62% (45 dana nakon tretiranja). Ovakav efekat spirodiklofena potvrđen je u istom lokalitetu i u 2005. godini, kada je postignuta efikasnost 94.9-95.7% (47 dana posle tretiranja). Efikasnost spirodiklofena, amitraza i abamektina u suzbijanju jaja i larvi prve generacije *C. pyri* ispitivana je u 2004. godini u lokalitetu Bela Crkva, a u 2005. godini u lokalitetima Manđelos (S. Mitrovica) i Bela Crkva. Primenjen u koncentraciji 0.144 g a.i. L^{-1} na početku piljenja, spirodiklofen je ostvario efikasnost 83.2-95%, dok je efikasnost abamektina iznosila 93.5-94.9%, a efikasnost amitraza 78.9-95.6% (14 dana posle tretiranja). U 2007. godini, primenjen u lokalitetu Borkovac (Ruma) u koncentraciji 0.096 g a.i. L^{-1} pre početka piljenja larvi prve generacije, spirodiklofen je redukovao broj jaja i larvi *C. pyri* za 72%, 82% i 89%, u ocenama 18, 25 i 38 dana posle tretiranja, dok su abamektin i diflubenzuron ostvarili redukciju od 92%, 95% i 91%, odnosno 78%, 71% i 86%.

Ključne reči: Spirodiklofen; *P. ulmi*; *C. pyri*; suzbijanje