NARDI FUNDULEA, ROMANIA
www.incda-fundulea.ro

ROMANIAN AGRICULTURAL RESEARCH, NO. 29, 2012
Print ISSN 1222-4227; Online ISSN 2067-5720

SUSCEPTIBILITY OF CEREAL LEAF BEETLE (*OULEMA MELANOPA* L.) IN WINTER WHEAT TO VARIOUS FOLIAR INSECTICIDES IN WESTERN SERBIA REGION

Snežana Tanasković[1], Milomirka Madić[1], Dragan Đurović[1], Desimir Knežević[2], and Filip Vukajlović[3]

[1]Faculty of Agronomy, Cara Dušana 34, 32000 Čačak, Serbia
E-mail: stanasko@tfc.kg.ac.rs

[2]Faculty of Agriculture, Kopaonička, bb, 38219 Lešak, Serbia

[3]Faculty of Science, Institute of Biology-master student, Radoja Domanovića 12, 34000 Kragujevac, Serbia

ABSTRACT

Outbreaks of the cereal leaf beetle (CLB) *Oulema melanopa* L. in Serbian conditions occur in a cyclic pattern and its high abundance in certain years require chemical control. Areas on chemical control vary from 2 to 28 % of total cereal area. Two groups of insecticides (organophosphate and pyrethroids) and their mixture were tested in field conditions of western Serbia during 2008 and 2009. The products Vantex 60CS, Cimogal, Perfekthion and Gusathion 25WP were tested for the control of number of CLB larvae in winter wheat. Density of populations of larvae in pre-treatment inspections was on average 1.2-1.6 larvae per plant, higher than the accepted economical threshold level (1 larva/plant).

After treatment smallest number of live mobile CLB larvae per plot was registered in plots treated with Vantex 60 SC in both years (0.5 and 3), followed by plots treated with Cimogal and Gusathion 25WP in 2008 (7.5) and Cimogal in 2009 (8.7).

The tested products proved good efficiency in controlling populations of CLB larvae in winter wheat. The most efficient in control of CLB larvae was Vantex 60 SC (98.8% and 96%), followed with Cimogal, with an efficiency of over 87%. Gusathion 25WP manifested a trend to reducing efficiency (87.5 to 72.2%). The lowest efficiency was registered by products Perfekthion (60.3 and 54.5 %), as we expected for a product with long history of use in cereal fields.

Key words: cereal leaf beetle, winter wheat, efficiency, insecticides.

INTRODUCTION

The cereal leaf beetle *Oulema melanopus* L. (*Coleoptera, Chrysomelidae*) is a species that ranges from central Siberia, Sweden, England, Spain and western North Africa to Iran (Olfert et al., 2004). The cereal leaf beetle (CLB) was officially recognised in United States of America in Michigan in 1962 (Castro et al., 1965; Burger, 1990), and is now widely established across much of the United States, except for the southwest, (LeSage et al., 2007) and Canada (LeSage, 2007; Olfert et al., 2004).

CLB was recognised as a cereal pest in Europe since 1737. The European distribution of the species covers roughly all of the humid and sub humid western Palaearctic region, with its area of greatest damage being the area of continental climate. Morphology, life history and biology of CLB in Serbian agro meteorological conditions are well known (Teofilović, 1969; Stamenković, 2004). Adults hibernate gregariously in protected places such as in field debris, in the crevices of tree bark or inside rolled leaves. The adults become active in the spring, when the temperature reaches 10°C and they initially feed on wild grasses. Oviposition begins about 14 days after the emergence of adults. During the next two months each female may lay several hundreds eggs. The larvae pass through four instars, each lasting two to three days. Pupation occurs in the soil, up to five cm beneath the surface. The species are univoltine. Adults initially continue feeding, but become less and less active during summer and early autumn. Feeding of larvae and adults is typically between leaf veins.

Received 24 October 2011; accepted 12 March 2012

CLB is an important pest of wheat, barley and oat, frequently occurring in Europe (Dedryver, 1990; Dimitrijević et al., 2000; Afonina et al., 2001; Gueorguieva and Mateeva, 2001; Igrc-Barčić and Gotlin Culjak, 2001; Meindl at al., 2001; Ulrich et al., 2004; Malschi, 2009). In the territory of Serbia CLB was first recorded in 1938, according to data Agricultural Station Belgrade (Jeremić, 1959; Vukasović et al., 1962). Also, these authors cite that CLB could be found up to 1000 m altitude, in fields on the side of Maljen, Rudnik, Jastrebac, Radan and Zlatar Mountains. This data is supported by earlier investigations (Knecthel and Manolache, 1936) in Romania, were CLB was recorded near Carpathian Mountains, at an altitude of 900-1200 m. In Serbia, CLB sporadically affected cereals (wheat, barely, oat, rye, and triticale) up to the middle of sixties, occurring sporadically, without significant economic damage. But, in the period 1988-1992, it become economically the most important pest in cereals, and up to 28% of cereals area were chemical treated (Stamenković, 2000; Jevtić et al., 2002). Then, during 1992-1998, CLB populations decreased, and only 2-2.5% of wheat area was sprayed. In 2004 CLB was recorded in commercial corn field, without significant damage, but chemical control was recommended in fields for maize seed production (Stamenković, 2004). Unfortunately, in Serbia no trials were conducted based on biological control (Bai et al., 2009) or on promoting parasitism (Evans et al., 2010) of CLB, like in Oregon, or on integrated control like in Romania (Malschi, 2003, 2009). In our conditions chemical control is the main protection method against CLB (Stamenković, 1987, 2000, 2002; Jevtić et al., 2002).

The economic impact of cereal leaf beetles can be significant. Heyer (1977) estimated that a single larva of *Oulema* spp. reduces assimilation by about 10%. Massive attack of larvae reduces total assimilation by up to 80% (Campbell et al, 1989) causing losses of about one tone grain per ha, or 0.5-4% in winter wheat and 3-8% in barley (Grala et al., 2004). Obtained data recommended an economic threshold of one larva per stem (Olfert et al., 2004), but this infestation level often results in unacceptably high levels of defoliation (Buntin et al., 2004). Chemical control of CLB in Serbia is recommended when numbers of young larvae are 1-2 per plant (Čamprag, 1980; Stamenković, 2004) or >10 eegs/plant (Bagi and Bodnár, 2011). In Serbia, many active compounds are registered for suppression of CLB (Sekulić and Jeličić, 2011; Bagi and Bodnár, 2011). The aim of this work was to evaluate biological efficiency of frequently used foliar, organophosphourus and pyrethroids insecticides in western part of Serbia.

MATERIAL AND METHODS

The trial was set up in western Serbia region (Milošević and Milošević, 2010), in the surrounding of Čačak, at the locality Vranići (N 43°56' E 020°19' elevation 282 m) under open field conditions, during 2008-2009. Experimental field had an area of 1.2 ha. The wheat leading variety "Pobeda" (Todorović et al., 2011) was planted in autumn 2007 and was also grown in 2007 subsequent to its planting in 2006. In the same field, wheat was seeded also in autumn 2008. In both years 280 kg per ha seed rate was used.

The trial was set up on May 5th 2008 and May 4th 2009 in the central part of the experimental field with 20 plots. The area of each plot was 5 m^2 (2.5 x 2 m) with 0.5 m between adjacent plots. It was designed in random block system with four replications. One block consisted of four plots with the tested insecticides in one replication and one control-untreated plot.

The four foliar spray treatments included the pyrethroid Vantex 60 CS (0.05%), the organophosphate - Perfekthion (0.2 %) and Gusathion 25WP (0.15 %) and their mixture - Cimogal (0.1 %) (Table 1). CLB numbers were assessed prior to treatments on May 7th, 12th, and 21st and 29th. In inspections on 21st May 2008 and 25th May 2009 we registered oviposition and started to follow up hatching and appearance of CLB larvae in the field. Foliar applications of insecticides were made on Jun 3rd (2008) and 9th (2009), with powered backpack sprayer "Hipol" capacity 6 l.

Table 1. Insecticides used for treatments

Insecticide	Product	Concentration %
Gamma – Cyhalothrin	Vantex 60 CS	0.05
Monocrotophos + cypermethrin	Cimogal	0.1
Dimethoat	Perfekthion	0.2
Azinphos-metyl	Gusathion 25WP	0.15

The plots were surveyed 24 hours after treatment (1 DAT) to check the number of live larvae (Popov et al., 2005) per 50 randomly chosen plants in plot.

Evaluation of effects for applied insecticides was done according to Abbot formula (Abbot, 1925).

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

where, X is efficiency in %; n is insect populations; T is treated; Co is control.

Statistical analysis was done using Statistica10 and GenStat12.1. Data for number larvae after treatment and for biological efficiency were transformed using formula $\sqrt{x+1}$ and $\arcsin\sqrt{\%}$ respectively, to satisfied normality of distribution.

RESULTS AND DISCUSSION

The number of CLB adults fluctuated in visual control in the wheat field from 2 to 15/m^2 in the three controls during May, over both seasons. First eggs were registered on 21st and 25th May respectively. Before treatment, the number of larvae in the experimental field varied between 53 and 113 in 2008, and 59 and 90 in 2009 (Table 2). The calculated number of larvae per plant before treatment was higher in the plots planned to be treated than in the plots that would remain untreated (control). In both research years, before treatment, the smallest average density of larvae per plot and plant was registered in untreated plots.

Table 2. Number of CLB larvae before treatment

Variant	Average CLB larvae number per block											
	2008				2009				plot		plant	
	I	II	III	IV	I	II	III	IV	08	09	08	09
Untreated	65	53	71	59	75	63	77	64	62	69.8	1.2	1.4
Vantex 60 CS	113	56	62	85	90	65	59	90	79	76	1.6	1.5
Cimogal	90	60	80	87	81	69	92	85	79.2	81.8	1.6	1.6
Perfekthion	75	60	87	75	84	72	89	81	74.2	81.5	1.5	1.6
Gusathion WP 25	67	90	60	91	80	85	72	85	77	80.5	1.5	1.6

$LSD_{0.05} = 17.79$ and $LSD_{0.01} = 24.02$

Table 3. Deegres of freedom (df) and estimates of variance components for total number of larvae before and after treatment (transformed data), and biological efficiency of insecticides (B - block, Y- year and T- treatment)

Source of variance	Number of larvae				Biological efficiency	
	Before treatment		After treatment			
	df	variance	df	variance	df	variance
B	3	435.0	3	0.5733	3	60.89
Y	1	129.6^{ns}	1	5.2060***	1	316.26**
T	4	272.1^{ns}	3	19.9339***	3	2385.83***
YxT	4	37.7^{ns}	3	0.5889^{ns}	3	92.76*

^{ns} not significant; *, **, *** significant at $P \leq 0.05$, $P \leq 0.01$ and $P \leq 0.001$ – respectively.

Statistical analysis showed that number of larvae was not statistically different between plots according to LSD test (Table 3).

In inspection at 1 DAT in winter wheat field, the smallest number of mobile larvae was registered in plots with Vantex (0.5 in 2008 and 3 in 2009), followed by Cimogal and Gusathion (Table 4). However, in plots treated with Gusathion we registered in 2009 an increase in numbers of live larvae (Table 4). As we expected the highest number were registered in plots with Perfekthion.

Table 4. Number of CLB larvae 24 hours after treatment (1 DAT)

Variant	Average CLB larvae number per block											
	2008				2009				plot		plant	
	I	II	III	IV	I	II	III	IV	08	09	08	09
Untreated	65	53	71	59	75	63	77	64	62	69.7	1.24	1.4
Vantex	0	1	2	0	2	4	5	0	0.75	2.75	0.0015	0.055
Cimogal	6	8	5	11	8	6	12	9	7.5	8.75	0.15	0.175
Perfekthion	19	23	24	31	29	32	34	31	24.2	31.5	0.484	0.63
Gusathion	8	9	9	4	16	19	29	14	7.5	19.5	0.15	0.39

Table 5. Average values of larvae number 1DAT (transformed data), and biological efficiency (nontransformed data) in 2008 and 2009

Specification		Number of larvae after treatment	Efficiency %
Year	2008	20.40 b	83.61 a
	2009	26.45 a	77.33 b
Insecticides	Vantex	1.75 d	97.46 a
	Cimogal	8.12 c	87.51 b
	Perfekthion	27.88 a	56.89 d
	Gusathion	13.50 b	80.01 c

Means within columns followed by different leters are significantly different (P≤0.05) according to LSD test.

Calculated values for efficiency (Figure 1) of applied insecticides products point out a high efficiency over investigated period for Vantex, >95%. Average efficiency in both years was also good for Cimogal (87.5%) (Table 5). Earlier investigations (Sapko et al., 1990; Stamenković, 2000, 2002; Popov et al., 2005) indicated high biological efficiency of pyrethroids.

Efficiency of Gusathion WP 25 decreased from very satisfactory (87.5%) in 2008, to unsatisfactory (72%) in 2009. It was the first time that we registered a decrease in efficiency for this organophosphate product. As expected, completely unsatisfactory effects were obtained in plots with applications of Perfekthion (Figure 1).

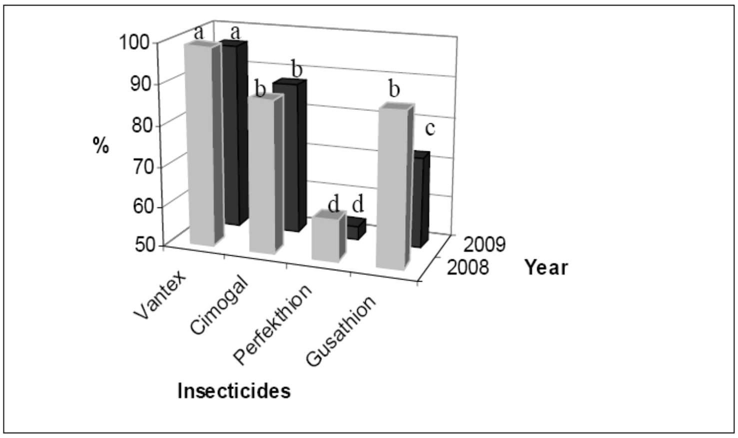

Figure 1. Biological effects of applied insecticides

CONCLUSIONS

In Serbian conditons CLB populations fluctuate over years. In some seasons populations become significantly high and chemical control must be implemented. Several types of insecticedes were tested in open field conditions for control CLB in western Serbia. Applications of pyrethroids and mixtures proved good efficiency (products Vantex 60 CS – with efficiency of 98.82 and 96% and Cimogal with efficiency 87.5%). Also, obtained results indicated the first time a decrese of efficiency value for the product Gusathion WP 25, from 87.8 to 72.2%. As we expected, among tested products the lowest efficiency was shown by Perfekthion, an insecticide with long history of use in crop farming.

Acknowledgements

This paper presents results of the project TR 031092 "Studying the genetic basis of improving the yield and quality of cereals in different agro-ecological conditions", supported by Ministry of Education and Science of Republic of Serbia.

REFERENCES

Abbott, W. S. 1925. *A method of computing the effectiveness of an insecticide*. J. Econ. Entomol., 18: 265-267.

Afonina, V.M., Tshernyshev, W.B., Soboleva-Dokuchaeva, I.I., Timokhov, A.V., Timokhova, O.V. and Seifulina, R.R., 2001. *Arthropod complex of winter wheat crops and its seasonal dynamics.* IOBC wprs Bulletin. 24, 6: 153-163.

Bagi, F. and Bodnár, K., 2011. *Zaštita bilja*. 1-300. Segedinski Univerzitet, Poljoprivredni fakultet, Mađarska.

Bai, B.B., Worth, R.A., Rogg, H.W. and Brown, G.W., 2009. *Cereal Leaf Beetle biological control program in Oregon*, *2008*. 68th Annual Pacific Northwest Insect Management Conference. Proceedings: 22-25.

Buntin, D.G., Flanders, K.L., Slaughter, R.W. and Delamar, D.Z., 2004. *Damage loss assessment and control of the cereal leaf beetle (Coleoptera: Chrysomelidae) in winter wheat.* J. Econ. Entomol., 97: 374-382.

Burger, T., 1990. *Cereal leaf beetle overview*. Cereal leaf beetle seminar, Proceedings: 1-12.

Campbell, J.M., Sarazin, M.J., and Lyons, D.B., 1989. *Canadian beetles (Coleoptera) injurious to crops, ornamentals, stored products, and buildings*. Agriculture Canada, Research Branch, Publication 1826.

Čamprag, D., 1980. *Štetočine pšenice, raži, ječma i ovsa u Jugoslaviji i susednim zemljama (Mađarskoj, Rumuniji i Bugarskoj) i njihovo suzbijanje*. 1-361, "Mala poljoprivredna biblioteka"- Beograd, Poljoprivredni fakultet, Institut za zaštitu bilj - Novi Sad.

Castro, T.R., Ruppel, R. F. and Gomulinski, M. S., 1965. *Natural history of the cereal leaf beetle in Michigan*. Mich. St. Univ. agric. Exp. Station Quart. Bull., 47: 623-653.

Dedryver, C.A., 1990. *The main entomological problems on small grain cereals in France*. 6th. International Symposium Pest and Diseases of Small Grain Cereals and Maize. Halle/Saale: 151-157.

Dimitrijević, B., Stojanović, J. and Milovanović, M., 2000. *Resistance of winter wheat and some other cereals to cereal leaf beetle (Lema melanopus L. Col. Chrysomelidae)*. *6th* Int. Wheat Conference, Budapest, Hungary, Abstracts: 178.

Evans, E.W., Anderson, M.R. and Bowling, P.D., 2010. *Targeted sugar provision promotes parasitism of the cereal leaf beetle Oulema melanopus.* Agricultural and Forest Entomology, 12, 41-47 DOI: 10.1111/j.1461-9563.2009.00448.x

Grala, B., Mrówczyński M., Banaszak H. and Kaniuczak, Z., 2004. *Occurrence of pest species of the genus Oulema (Coleoptera: Chrysomelidae) in cereal fields in northern Poland*. Electronic Journal of Polish Agricultural Universities, Agronomy, Volume 7, Issue 1. Available Online http://www.ejpau.media.pl

Gueorguieva, T. and Mateeva, A., 2001. *Agrobiological and biocenological study of winter oats (A. sativa L.).* IOBC WPRS Bulletin, 24, 6: 129-137.

Heyer, W., 1977. *Biologie und Schadwirkung der Getreidehähnchen Lema (Oulema spp.) in der industriemäßigen Getreideproduktion*. Nachrbl. Pflanzensch. DDR, 31: 167-169.

Igrc-Barčić, J. and Gotlin Culjak, T., 2001. *Insect pests of cereals in Croatia.* IOBC WPRS Bulletin 24, 6: 95-99.

Jeremić, M., 1959. *Dosadašnji rezultati u radu prognozne službe zaštite bilja u NR Srbiji i mogućnosti za njeno organizovanje.* Zaštita bilja, 54: 93-101.

Jevtić, R. S., Stamenković, S. and Jerković, Z., 2002. *Potreba primene folijarnih fungicida i insekticida u zaštiti strnih žita od bolesti i štetočina*. XXXVI Seminar agronoma, Zbrnik referata: 185-193.

Knechtel, W.K. and Manolache, C., 1936. *Observatii biologice asupra gândacului ovazului (Lema melanopa L.) în România*. Anale I.C.A.R., VII: 186-208.

LeSage, L., Dobesberger, E.J. and Majka, C.G., 2007. *Introduced leaf beetles of the Maritime provinces, 2: the cereal leaf beetle Oulema melanopus (Linnaeus) (Coleoptera: Chrysomelidae)*. Proc. Entomol. Soc. Wash., 109(2), 2007: 286–294.

Malschi, D., 2003. *Research on the integrated wheat pests control (Actual strategy of integrated pests management as part of agroecological system for sustainable development of wheat crop, in Transylvania).* Romanian Agricultural Research, 19-20: 67-86.

Malschi, D., 2009. *Integrated pest management in relation to environmental sustainability*. Part I Ecological management of wheat pests Course notes and practical applications. Manual online. Babeş-Bolyai University Cluj-Napoca, Faculty of Environmental Sciences. Bioflux Publishing House, Cluj-Napoca.

Meindl, P., Kromp, B., Bartl, B. and Ioannidou, E., 2001. *Arthropod natural enemies of the cereal leaf beetle (Oulema melanopus L.) in organic winter wheat fields in Vienna, Eastern Austria*. IOBC wprs Bulletin, 24, 6: 79-86.

Milošević, T. and Milošević, N., 2010. *The effect of organic fertilizer, composite NPK and Clinoptilolite on changes in the chemical composition of degraded vertisol in western Serbia.* Carpathian Journal of Earth and Environmental Sciences, 5, 1: 25-32.

Olfert, O., Weiss, R.M., Woods, S., Philip, H., and Dosdall, L., 2004. *Potential distribution and relative abundance of an invasive cereal crop pest, Oulema melanopus L. (Coleoptera: Chrysomelidae)*. Canada, Can. Entomol., 36: 277-287.

Popov, P., Malschi, D., Vilau, F. and Stoica, V., 2005. *Insect pest management of Lema melanopa in Romania.* Romanian Agricultural Research, 22: 47-52.

Sapko, G. Ya., Martynenko, N. I. and Dobrobol'skaya, S. I., 1990. *Experience in Lema melanopus control*. Journal Zashchita Rastenii, 10: 21.

Sekulić, J. and Jeličić, S., 2011. *Sredstva za zaštitu bilja u prometu u Srbiji*. Biljni lekar, 37(2-3): 113-380.

Stamenković, S., 1987. *Iskustva u zaštiti strnih žita od žitne pijavice* (*Lema melanopus L.*) *u Vojvodini 1887.* Jugoslovensko savetovanje o primeni pesticida, Zbornik radova, Sveska, 9: 143-152.

Stamenković, S., 2000. *Žitna pijavica i dalje značajna štetočina strnih žita*. Biljni lekar, 2-3 (28): 112-115.

Stamenković, S., 2002. Pojava i značaj *žitne pijavice u 2001. godini.* Biljni lekar, 2 (30): 111-114.

Stamenković, S., 2004. *Pojava i štetnost žitne pijavice*. Biljni lekar, 2 (32): 124-131.

Teofilović, Ž., 1969. *Prilog proučavanju morfologije i razvića žitne pijavice (Lema melanopus L.) i uticaj ekoloških činilaca na njene životne aktivnosti*. Zbornik radova Zavoda za strna žita, 4: 29-124.

Todorović, G., Protić, R. and Protić, N., 2011. *Variation of wheat grain yield depending on variety and seed size*. Romanian Agricultural Research, 28: 25-28.

Ulrich, W., Czarnecki, A., and Kruszyński, T., 2004. *Occurrence of pest species of the genus Oulema (Coleoptera: Chrysomelidae) in cereal fields in Northern Poland*. Electronic Journal of Polish Agricultural Universities, Agronomy, Volume 7, Issue 1. Available Online http://www.ejpau.media.pl

Vukasović, P., Čamprag, D. and Stojanović, T., 1962. *Štetočine ratarskih kultura (skripta).* Poljoprivredni fakultet, Novi Sad: 1-85.