EFFICACY OF INSECTICIDES IN THE CONTROL OF CABBAGE PESTS

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Abstract. *The aim of this study was to assess the efficacy of tau - fluvalinate and lambda - cyhalothrin based insecticides in the control of P. rapae and P. xylostella caterpillars. In the agro-ecological conditions of Vojvodina province (Serbia) (localities Futog and Čurug) the production of cabbage is present every year at vast areas. During 2011, the experiments were performed according to a standard EPPO (PP PP 1/83 (2) 2004) method. The applied preparations are based on tau - fluvalinate (240 g of a.s. /l of the preparation) Mavrik - EW in amount of 0.3 l/ ha, and lambda - cyhalothrin (25 g/l of the preparation) Grom, in the amount 0.4 l/ha. The assessment of pests population abundance was performed before the treatment, two i.e. four and seven days after the treatment. The efficacy of insecticides was determined according to Henderson and Tilton and significance of differences by ANOVA.The average number of P. rapae caterpillars (25 plants/repetition) in Futog site before the treatment was 4.7 - 6.2, after four days it was 0-0.2 and after seven days 0.25-1.25, regardless on the applied insecticides, while the number in the control was 7.7 after four and 10.2 after seven days. Efficacy of insecticides at this site after four days ranged from 96.4 to 100 % and after seven days 89.8 - 97.3 %. At Čurug locality, the number of P. rapae caterpillars before the treatment was 9.7 - 12, while after two and seven days it ranged from 0.5 to 0.75, whereas in the control it was 11.5 after two and 11 after seven days. At this site, two days after the treatment, the efficacy ranged from 93.8 to 95.3 %, and after seven days from 92.7 to 96 %. The average number of P. xylostella caterpillars at locality Futog before the treatment was 13.5 -17.7. Four days after the treatment it was 1.75 - 2.25, and after seven days 1-1.25, while in the control it was 23.0 after four and 27.2 after seven days. At site Čurug before the treatment the average number of P. xylostella caterpillars ranged from 14 to 16.7. Two days after the treatment the average number ranged from 0.75 to 1, and after seven days 0-0.5, regardless on the applied insecticides, while in the control it was 13.0 after two days and 10 after seven days. The efficacy of tested insecticides for controlling P. xylostella caterpillars at Futog site ranged from 87.3 to 92.1 %, after four, and 94.1- 96.2 % after seven days. At Čurug, the efficacy ranged from 92.7 to 95.2 %, after two days and 95.3 to 100 % after seven days.*

By choosing insecticides based on tau-fluvalinate and lambda-cyhalothrin, in addition to satisfactory efficacy in the control of harmful caterpillars of cabbage, the applied amounts of a pyrethroids, compared to organophosphorus insecticides are far smaller i.e. 79 g and 10 g a.s./ha (respectively).

Key words: *Pieris rapae, Plutella xylostella, cabbage, insecticide, efficacy*

INTRODUCTION

Cabbage is one of the oldest cultivated plants, produced in the plains, river valleys, mountain areas, but mostly in the vicinity of large cities and throughout the growing season, and is one of the most important vegetable crops produced in our region. Its production is possible only with intensive agricultural technology and chemical protection, because cabbage is attacked by a large number of harmful insects. Up until recently, the dominant species were *Pieris rapae*, *P. brassicae*, *Mamestra brassicae*, however, in the past decades *P. rapae* then *Plutella xylostella*, *Helicoverpa armigera* (ČAMPRAG, 2004) and *Brevicoryne brassicae* are present in high abundance, while *P. brassicae* and *M. brassicae* are very rare and are almost

extinguished. It is possible to reduce damages by timely application of insecticides and by choosing the once with the most favorable toxicological and ecotoxicological properties, with the goal of preserving human health, beneficial insects and the environment.

Wide and frequent use of insecticides in vegetable crops belonging to the family Brassicaceae, has led to the occurrence of resistance of certain insect pests to several groups of insecticides (BELL AND FENEMORE, 1990), which has recently been associated with failures in the control of these pests on cabbage. INĐIĆ et al. (2003, 2005) studied the efficacy of biological insecticide *Bacillus thuringiensis* subsp. *kurstaki* in the control of harmful caterpillars (*P. rapae*, *P. brasssicae*, *Plutella xylostella*, *H. armigera*, *M. brassicae*) on cabbage, applied individually and in a mix with Cipkord 20 - EC (cypermethrin). Biological product expressed high efficacy applied alone and in the mix with cypermethrin, and efficacy was at the same level of significance with Cipkord 20 - EC.

During 2005, SUDIMAC ET AL. (2006) examined the efficacy of synthetic (cypermethrin and diazinon) and biological (*Bacillus thuringiensis*) insecticides and their mixtures in the control of Cabbage moth (*Mamestra brassicae* L.) and Cotton bollworm (*Helicoverpa armigera* Hub.) caterpillars in cabbage crop. The use of pyrethroids and bioproducts in tank mix is justified in terms of reducing the amount of chemical insecticides to 1/3 or 1/6 of label rate. The advantage of the mixture application is certainly to reduce the amount of synthetic, highly toxic insecticides compared to bioproducts, which are more acceptable in terms of ecotoxicology.

The aim of this work was to determine the efficacy of tau-fluvalinate and lambda - cyhalothrin based insecticides for the control of *P. rapae* and *P. xylostella* caterpillars on cabbage in production conditions of Vojvodina province.

MATERIAL AND METHODS

Experiments were carried out in Futog and Čurug (Vojvodina province, Serbia) according to EPPO standard method for the experimental design and data analysis (Anonymous, 2006) and the efficacy of insecticides for the control of cabbage caterpillars according to Anonymous (2004). The size of main experimental plot was $20m^{2.}$ Trial was set up in four replications, in a randomized block design. Futoški cabbage variety was used in the experiments on both localities, and insecticides Mavrik - EW (tau - fluvalinate 240 g / l) in the amount of 0.3 l / ha and Grom (lambda - cyhalothrin 25 g / l) in the amount of 0.4 l / ha. Insecticides were applied as foliar treatments with 300 l of water per ha. In Futog treatment was carried on 18th August 2011, and in Čurug 31st August 2011, at BBCH 41 stage of development (beginning of head formation). Assessment of the effects in Futog was performed before treatment, four and seven days after the application of insecticides, and in Čurug before treatment, two and seven days after treatment, by counting live caterpillars on 25 plants per replication. The achieved results are expressed as average values for the number of caterpillars, and efficacy was calculated according to HENDERSON AND TILTON (WENZEL,1963).

RESULTS AND DISCUSSIONS

When assessing the effects of insecticides, aside from knowledge on the biology and specificity of varieties, sowing dates and conditions for the growth and development of plants and proper crop rotation should also be considered. Within those measures, proper selection of insecticides is necessary, because the application of insecticides pose a risk for beneficial insects that can also be reduced by using less toxic insecticides.

In this work, the selection of insecticides for the control of harmful cabbage caterpillars was made based on the principle - Grom (lambda - cyhalothrin) as a standard

product, which is registered in Serbia for the control of pests in cabbage crops and Mavrik EW (tau - fluvalinate) a compound of the same chemical group but that is not toxic to bees (TOMLIN, 2006) and with low toxicity for beneficial insects (Carabidae, Staphylinidae, Syrphidae) (www.mauk.co.uk). Selected insecticide should provide effective control of target pests, without the effects on beneficial insects, and tau - fluvalinate fits into the concept of integrated protection and preservation of beneficial flora.

During the experiment in Čurug the presence of the Large white *P. brassicae* was registered (one egg hatch), as well as the several caterpillars (10) of the Cotton bollworm (*H. armigera*). Several Cabbage moth (*M. brassicae*) caterpillars (9) were recorded in Futog. While at both sites a large number of the Small white (*P. rapae*) and the Diamondback moth (*Plutella xylostella*) were present.

In Futog four days after the treatments with Mavrik- EW (0.3 l / ha) and Grom (0.4 l / ha), the number of *P. rapae* caterpillars (0-0.25) was at a significantly lower level compared to the control (7.75) (Table 1). The efficacy of the Mavrik - EW was 96.4 %, and the standard preparation was 100 %. Seven days after the treatments, the number of *P. rapae* caterpillars (0.25 to 1.25) was at a significantly lower level compared to the control (10.25). The efficacy of the tested products ranged from 89.8 to 97.3 %. Four days after the treatment with Mavrik- EW and Grom, the number of *Plutella xylostella* caterpillars (1.75-2.25) was at significantly lower level compared to the control (23.0) (Table 2). The efficacy was 87.3 - 92.1 %, and seven days after treatment with Mavrik- EW and standard preparation, also the number of *Plutella xylostella* caterpillars (1-1.25) was at significantly lower level compared to the control (27.2) the efficacy of insecticides was 94.1-96.2 %.

In Čurug two days after treatment with Mavrik - EW and Grom, the number of *P. rapae* caterpillars (0.5-0.75) was significantly lower compared to the control (11.5) and the efficacy was 93.8-95.3 % (Table 3). Seven days after treatment, the number of *P. rapae* caterpillars (0.5-0.75) was also at significantly lower level compared to the control (11.0), and the efficacy ranged from 92.7 to 96.0 %. Also the number of *Plutella xylostella* caterpillars was at significantly lower level after the application of the insecticides compared to the control, after two and seven days. Two days after treatment efficacy of Mavrik – EW was a 95.2 %, and of Grom 92.7 %. Seven days after the treatment the efficacy of insecticides in controlling *P. xylostella* ranged from 95.3 to 100 % (Table 4). During the tests no phytotoxic effects were recorded on plants of variety Futoški cabbage.

P. xylostella is a species which can develop resistance to a number of insecticides. Two-year tests on resistance in four regions in New Zeland (1999 and 2000) have shown that resistance to synthetic pyrethroids varies both between and within the same region (Walker et al., 2004). Resistance determined for the *P. xylostella* populations in two regions was at a level that could lead to a failure in the control of this pest in field. However, the level of resistance of populations within a region at two sites, which are located only 4 km away, ranged from 3.7 to 29.2 fold. Among butterflies the data on widespread resistance of *P. xylostella* was recorded for pyrethroids (Williamson et al., 1998) with the presence of different mechanisms. *P. xylostella* resistance to synthetic pyrethroids is based on the oxidative detoxification, i.e. activity of monooxygenases (Sun et al., 1990). Takahashi et al. (1992) found that the level of *P. xylostella* resistance to cypermethrin was up to 1096 fold but Joia and Chawla (1995) record even 2880 fold.

Table. 1

The number of *P. rapae* caterpillars and the efficacy of insecticides after 4 and 7 days (Futog, 2011)

Insecticide (l/ha)	before treatment		4 days after treatment			7 days after treatment		
	No. larvae	Sd (±)	No. larvae	Sd (±)	E (%)	No. larvae	Sd (±)	E (%)
Mawrik-EW (0.3)	4.7	2.22	0.25 b	0.49	96.4	0.25 b	0.49	97.3
Grom (0.4)	6.2	2.63	0 b	0	100	1.25 b	1.25	89.8
Untreated control	5.2	1.71	7.75a	1.71		10.25a	1.50	
LSD 0.05			1.84			1,53		

Sd± - standard deviation; E %-efficacy

Table . 2

The number of *P. xylostella* caterpillars and the efficacy of insecticides after 4 and 7 days (Futog, 2011)

Insecticide (l/ha)	before treatment		4 days after treatment			7 days after treatment		
	No. larvae	Sd (±)	No. larvae	Sd (±)	E (%)	No. larvae	Sd (±)	E (%)
Mawrik-EW (0.3)	16.7	1.71	1.75 b	1.50	92.1	1.0 b	0.81	96.2
Grom (0.4)	13.5	2.38	2.25 b	0.96	87.3	1.25 b	0.95	94.1
Untreated	17.7	3.30	23.0 a	1.63		27.25 a	1.71	
LSD 0.05			2.89			2.13		

Sd± - standard deviation; E %-efficacy

Table. 3

The number of *P. rapae* caterpillars and the efficacy of insecticides after 2 and 7 days (Čurug, 2011)

Insecticide (l/ha)	before treatment		2 days after treatment			7 days after treatment		
	No. larvae	Sd (±)	No. larvae	Sd (±)	E (%)	No. larvae	Sd (±)	E (%)
Mawrik-EW (0.3)	9.75	1.70	0.50 b	0.57	95.3	0.75 b	0.95	92.7
Grom (0.4)	12.0	1.41	0.75 b	0.95	93.8	0.50 b	0.99	96.0
Untreated control	10.5	2.52	11.5 a	2.38		11.0 a	1.41	
LSD 0.05			1.80			1.65		

Sd± - standard deviation; E %-efficacy

Table. 4

The number of *P. xylostella* caterpillars and the efficacy of insecticides after 2 and 7 days (Čurug, 2011)

Insecticide (l/ha)	before treatment		2 dayes after treatment			7 dayes after treatment		
	No. larvae	Sd (±)	No. larvae	Sd (±)	E (%)	No. larvae	Sd (±)	E (%)
Mawrik-EW (0.3)	16.8	3.30	0.75 b	0.95	95.2	0 b	0	100
Grom (0.4)	14.8	2.22	1.0 b	0.81	92.7	0.5 b	0.99	95.3
Untreated control	14.0	2.16	13.0 a	2.16		10,0 a	1.82	
LSD 0.05			2.56					

Sd± - standard deviation; E %-efficacy

CONCLUSIONS

Based on performed tests and achieved results on the efficacy of insecticides in the control of harmful caterpillars on cabbage, the following conclusions can be drawn:

• In recent years, in the cabbage production in Vojvodina, the most abundant are caterpillars of *P. rapae* and *Plutella xylostella*, while other harmful species (*P. brassicae*, *M. brassicae*, *M. oleracea*, *H. armigera* and *Brevicoryne brassicae*) are less common.

• Insecticides (tau - fluvalinate and lambda - cyhalothrin) from the chemical groups of synthetic pyrethroids applied at label rates have expressed high efficacy in the control of *P. rapae* and *Plutella xylostella* caterpillars on cabbage at two production sites (Futog and Čurug) in Vojvodina;

• Adhering the principle of good agricultural practices, insecticide should be effective in the control of target pests and not to endanger beneficial insects and as one of these, tau - fluvalinate fits into the concept of integrated protection and preservation of beneficial flora.

ACKNOWLEDGEMENT

The research was carried out within the project III 46008, funded by the Ministry of Education and Science of the Republic of Serbia

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