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Control of *Meligethes aeneus*, *Ceutorhynchus assimilis* and *Dasineura brassicae* in winter oilseed rape (*Brassica napus* L.)

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Abstract

The influence of different class insecticides on the effective control of pollen beetle (*Meligethes aeneus* F.) and pod pests (*Ceutorhynchus assimilis* Payk. and *Dasineura brassicae* Winn.) in winter oilseed rape crops was investigated in field trials carried out during the 2007–2009 period in the central part of Lithuania. All insecticides tested significantly reduced the number of pollen beetle (*M. aeneus* F.) adults, seed pod weevil (*C. assimilis* Payk.) and brassica pod midge (*D. brassicae* Winn.) larvae and pods infested by them. The use of insecticides in the middle of inflorescence emergence (GS 55–57) is not only effective in reducing pollen beetles, but also in reducing pod damage done by pests. Comparison of the efficacy of pyrethroid groups I (Bulldock 025 EC, Kaiso 24 WG, Karate Zeon 5 CS) and II (Mavrik 2 F) showed the insecticides in the second group to be more effective.

Key words: insecticide, neonicotinoid, pyrethroid, organophosphorus, oxidiazines.

Introduction

Oilseed rape (*Brassica napus* L.) is most important in food industry, bio-fuel industry and as a rotation plant in many countries. Currently, oilseed rape is one of the most promising crops in Lithuania. The area sown with oilseed rape is steadily increasing. According to Statistics Department of Lithuania at the end of 2000, in Lithuania oilseed rape was cultivated on 55500 ha and in 2009 the production area amounted to up to 191900 ha. Over the recent years, oilseed rape production area increased 3.5 times.

The number of insects and pests spread in rape fields is determined by environmental, climatic factors and cultivation practices. The list of pests occurring on winter oilseed rape is long. But only a few pests cause serious damage. Pollen beetle (*Meligethes aeneus* F.), seed pod weevil (*Ceutorhynchus assimilis* Payk.) and brassica pod midge (*Dasineura brassicae* Winn.) are most common pests damaging generative rape organs (Huges, Evans, 1999; Dosdall et al., 2001; Alford et al., 2003).

Pollen beetle (*M. aeneus* F.) is an important pest in rape seed crops through Europe (Alford et al., 2003). Adult pollen beetles damage oilseed rape during the green to yellow bud stages (Sedivy, 1993). Pollen beetles can cause severe damage and yield losses (Ruther, Thiemann, 1997). In extreme cases an infestation with pollen beetles can cause yield losses of up to 50% (Kirch, 2006).

Seed pod weevil (*C. assimilis* Payk.) is one of the most important pests of oilseed rape in Europe and other countries (Cárcamo et al., 2009). Weevil damage is inflicted on the crop by adult feeding on developing flower buds causing buds to desiccate and racemes to bear fewer pods, by larval feeding on seeds within pods, and by premature shattering of infected pods (Dosdall et al., 2001). In Europe, this pest of oilseed rape reduces yield of infected pods by about 18% (Alford et al., 2003; Wiliams, 2004; Cook et al., 2006). In other countries, weevil larvae can cause 15–35% yield losses in winter oilseed rape (Buntin, 1999). Seed pod weevil is more damaging to winter rape than to spring rape. An adult usually infests winter rape during the flowering (Ferguson et al., 2000, Williams, 2010). Brassica pod midge (*D. brassicae* Winn.) is also a serious pest of oilseed rape in all Europe (Warner et al., 2000). In Europe, two generations of brassica pod midge in winter oilseed rape have been identified (Kazda, 2002). Damage of the first generation is caused on field edges, while the second generation affects the whole field (Kirch, 2006). As much as 82% of seed weight can be lost from brassica pod midge infested pods (Williams, 2010).

In Europe, pest management still relies on pesticides use. Most pesticides are often applied routinely and prophylactically without regard to pest incidence (Horowitz, Ishaaya, 2004). In modern oilseed rape production crop pests have become increasingly aggressive. For effective control it is necessary to choose the appropriate plant protection tools and follow good pesticide use practices. Research on optimization of plant protection against pests has been done in recent years in foreign countries (France, Great Britain, Sweden, Denmark, Germany, Poland, Czechia, Austria, Switzerland) (Kelm, Kaczmarzyk, 2003; Alford et al., 200; Hansen, 2004; Dechert, Ulber, 2004).

Investigations on weevil (*Ceutorhynchus* spp.) biology and fauna were done in Lithuania during the period 1992–1996 (Tamutis, 1997). The research findings suggest that weevils do not have any commercial significance in winter rape agrocenoses. In recent years, increasing oilseed rape crop concentration, the use of reduced tillage and contrasting winter conditions have facilitated the spread and hibernation of pests. This paper presents the data from the field experiments on the efficacy of various insecticides on pollen beetles (*M. aeneus* F.) and pod pests (*C. assimilis* Payk., *D. brassicae* Winn.) in winter oilseed rape in Lithuania.

Materials and methods

Our experiments were done at the Lithuanian Institute of Agriculture (55º 24′33″ N, 23º 52′00″ E), in the winter oilseed rape crops cv. 'Libea' during the 2007–2009 period. The crops were grown following the approved technologies. Plant growth stages were assessed according to growth stages scale (GS) (Lancashire et al., 1991).

Insecticides were applied on individual flower buds visible but still closed GS 55 (main inflorescence) – 57 (secondary inflorescence) stages. The trials involved four replications with a record plot size of 25 m^2. The information about the insecticides used is presented in Table 1.

Table 1. Characteristics of insecticides used on the field trials

Insecticide	Active ingredients	Chemical class	Mode of action
Bulldock 025 EC	beta-cyfluthrin 25 g l^{-1}	group I pyrethroid	contact
Kaiso 24 WG	lambda-cyhalothrin 50 g kg^{-1}	group I pyrethroid	contact
Karate Zeon 5 CS	lambda-cyhalothrin 50 g l^{-1}	group I pyrethroid	contact
Mavrik 2 F	tau-fluvalinate 240 g l^{-1}	group II pyrethroid	contact
Proteus 110 OD	thiacloprid + deltamethrin 100 g l^{-1} + 10 g l^{-1}	neonicotinoid + pyrethroid	systemic + contact
Pyrinex Supreme	chlorpyrifos + beta-cyfluthrin 250 g l^{-1} + 12 g l^{-1}	organophosphorus + pyrethroid	contact
Pyrinex 25 CS	chlorpyrifos 250 g l^{-1}	organophosphorus	contact
Steward EC	indoxacarb 300 g kg^{-1}	oxidiazines	contact

Pollen beetle (*M. aeneus* F.) assessments in the control treatments and in the insecticide-treated plots were done 1, 4 and 7 days after the spray-application. The assessments of pollen beetles abundance (count of pollen beetle adults) were done on 10 randomly selected plants per plot. The cabbage seed pod weevil (*C. assimilis* Payk.) and brassica pod midge (*D. brassicae* Winn.) larvae were found in nearly all pods that had reached final size (GS 79) and at the beginning of ripening stage (GS 80). The pods were collected following the EPPO standard model (EPPO, 2004). A total of 200 pods were examined per plot (from each of 20 plants, 5 pods from primary raceme and 5 from secondary raceme) for presence or absence of larvae seed pod weevil (*C. assimilis* Payk.). The same pods were scored for presence or absence of brassica pod midge larvae (*D. brassicae* Winn.).

Rape seed was harvested separately from each plot by a harvester "Sampo". The seed moisture was determined. Seed yield per plot was weighed and calculated as yield per hectare (9% moisture counted).

Biological efficacy of insecticides was calculated using Abbott formula (Abbott, 1925). All data were analysed using an analysis of variance (ANOVA) and the Fisher's test was significant. The least significant difference (LSD) was calculated for $p = 0.05$. Analysis of variance was performed using the computer programme *Statistica*, 5.5 version.

Results and discussion

***Pollen beetle* (*Meligethes aeneus* F.).** The abundance of the pollen beetle (*M. aeneus* F.) in the winter oilseed rape at main inflorescence emergence growth stage was high – 22 adults per 10 plants in 2007 (Table 2). In 2007, the weather conditions were warm and wet, and therefore favourable for the spread of blossom beetles on individual flowers and lateral buds of winter oilseed rape. During the other years of the investigation, the pollen beetle abundance was lower, especially in 2009 (Tables 3–4).

Table 2. Efficacy of different class insecticides against *M. aeneus*, *C. assimilis* and *D. brassicae* in 2007 (insecticides used at GS 55)

		Treatment							
		1. Untreated	2. Bulldock 0.225 l ha^{-1}	3. Bulldock 0.3 l ha^{-1}	4. Proteus 0.75 l ha^{-1}	5. Pyrinex Supreme 0.75 l ha^{-1}	6. Pyrinex Supreme 1.0 l ha^{-1}	7. Pyrinex Supreme 1.25 l ha^{-1}	LSD$_{05}$
M. aeneus	Imago per 10 plants 1 DAA	22	0.3*	0.2*	0.6*	0.3*	0.4*	0.2*	2.90
	EF %	–	98.6	99.1	97.3	98.6	98.2	99.1	
	Imago per 10 plants 4 DAA	18.4	1.2*	0.7*	0.8*	0.3*	1.4*	0.4*	1.67
	EF %	–	93.5	96.2	95.7	98.6	92.4	97.8	
	Imago per 10 plants 7 DAA	16.1	8.4*	7.3*	7.9*	10.9*	9.3*	7.4*	1.93
	EF %	–	47.8	54.7	50.9	32.3	42.2	54.0	
C. assimilis	Damaged pods %	5.0	4.0	2.0*	0.0*	5.0	2.0*	2.0*	2.07
	EF %	–	20.0	60.0	100.0	0.0	60.0	60.0	
	Larva unit per 10 pods	0.5	0.4	0.2*	0*	0.5	0.2*	0.2*	0.15
	EF %	–	20.0	60.0	100.0	0.0	60.0	60.0	
D. brassicae	Damaged pods %	9.4	10.3	5.6*	8.0*	6.4*	5.4*	7.0*	1.33
	EF %	–	0.0	40.4	14.9	31.9	42.6	25.5	
	Larva unit per 10 pods	14.8	12.0*	8.6*	7.2*	9.0*	6.4*	7.4*	1.62
	EF %	–	18.9	41.9	51.4	39.2	56.8	50.0	
	Seed yield kg ha^{-1}	1952	2364*	2461*	2544*	2427*	2482*	2462*	116
	In relative values	100.0	121.1	126.1	130.3	124.3	127.1	126.1	
	TSW g	4.48	4.65*	4.66*	4.68*	4.65*	4.67*	4.67*	0.04
	In relative values	100.0	103.7	104.0	104.4	103.7	104.2	104.2	

Note. DAA – days after application, EF % – efficiency of treatment compared to untreated %, TSW – thousand seed weight; * – marked values in rows shows significantly different at $P = 0.05$.

All three types of insecticides, which are assigned to the pyrethroid, neonicotinoid and organophosphate chemical classes, were effective at controlling adult pollen beetles in the year 2007. One day after the application, their efficacy was at 97.3–99.1%, four days after – 92.4–98.6%. One week after the application, the number of the pollen beetles in the treated plots was significantly lower, compared with control and did not reach threshold of this pest (Žemės ūkio augalų kenkėjai, 2002). The efficacy of insecticides that had been tested against the pollen beetle (*M. aeneus* F.) were at the similar level.

As it has been mentioned above, in the year 2008, the population of the pollen beetle was lower than in the year before. One day after the application, the insecticide efficacy ranged 75.8–92.9%. A repeated count four days after the application showed that the maximum dose of organophosphorus class insecticide Pyrinex 25 CS (0.75 l ha^{-1}) exhibited the highest efficacy rate (82.2%) (Table 3). Seven days after the application, the efficacy rate of this insecticide reached the highest value of 73.7%. Four days after the application, the lowest dose of Pyrinex 25 CS insecticide showed very low efficacy (6.7%) in protecting oilseed rape crops against the pollen beetle. When choosing pesticides, it is most important to pay attention to the application time and dosage of the pesticide (Williams, 2004).

Synthetic pyrethroid class insecticides are divided in three groups (Memorandum, 2007). Group I synthetic pyrethroid class insecticide Bulldock 025 EC and group II synthetic pyrethroid class insecticide Mavrik 2 F were used in the field trial in 2008. The efficacy comparison of the group I and II synthetic pyrethroid insecticides revealed that Mavrik 2 F insecticide, classified under the group II of synthetic pyrethroid insecticides, with the efficacy rate at 85.7% was more efficient at lowering the count of rape pollen beetles. However, this rate was not substantially higher than the efficacy rate of Bulldock 025 EC (75.8%), classified under the group I.

Table 3. Efficacy of different class insecticides against *M. aeneus*, *C. assimilis* and *D. brassicae* in 2008 (insecticides used at GS 55)

		Treatment							
		1. Untreated	2. Bulldock 0.3 l ha^{-1}	3. Mavrik 0.2 l ha^{-1}	4. Proteus 0.75 l ha^{-1}	5. Pyrinex 0.188 l ha^{-1}	6. Pyrinex 0.375 l ha^{-1}	7. Pyrinex 0.75 l ha^{-1}	LSD$_{05}$
M. aeneus	Imago per 10 plants 1 DAA	3.3	0.8*	0.5*	0.5*	0.3*	0.8*	0.8*	0.97
	EF %	–	75.8	85.7	85.7	92.9	78.6	78.6	
	Imago per 10 plants 4 DAA	11.3	6.8*	5.8*	3.3*	10.5	2.5*	2.0*	3.86
	EF %	–	40.0	48.9	71.1	6.7	77.8	82.2	
	Imago per 10 plants 7 DAA	24.8	9.5*	10.5*	8.0*	10.3*	14.3*	6.5*	6.34
	EF %	–	61.1	57.6	67.7	58.6	42.4	73.7	
C. assimilis	Damaged pods %	6.5	2.0*	1.3*	0.8*	0.5*	0.8*	0.8*	1.74
	EF %	–	69.2	80.8	88.5	92.3	85.5	88.5	
	Larva unit per 10 pods	0.65	0.02*	0.13*	0.08*	0.05*	0.13*	0.08*	0.21
	EF %	–	69.2	80.8	88.5	92.3	80.7	88.5	
D. brassicae	Damaged pods %	5.3	3.5*	3.5*	2.8*	4.0*	2.0*	4.3*	1.15
	EF %	–	33.3	33.2	47.6	23.8	62.3	19.0	
	Larva unit per 10 pods	4.2	1.3*	1.1*	0.8*	1.4*	0.8*	1.2*	0.43
	EF %	–	68.5	73.2	82.1	67.3	76.2	72.6	
	Seed yield kg ha^{-1}	4742	4844	4819	4974	4773	4780	4773	273
	In relative values	100.0	102.2	101.6	104.9	100.6	100.8	100.6	
	TSW g	4.25	4.33*	4.35*	4.34*	4.36*	4.34*	4.36*	0.02
	In relative values	100.0	101.9	102.2	102.1	102.5	102.1	102.5	

Note. Explanations under Table 2.

The abundance of the pollen beetle was very low in 2009 (Table 4). The highest efficacy performance was achieved after using group II synthetic pyrethroid Mavrik 2 F. The efficacy of this insecticide was 100% one day after the application, while seven days later it approached 81.9%. One day after the application assessment of the efficacy of the group I synthetic pyrethroid class insecticides (Karate Zeon 5 CS, Kaiso 24 WG) showed an efficacy rate of 93.4–96.7%. However, the repeated count seven days after the application showed a significant decrease (60.6–78.7%). Still, the number of adult pollen beetles remained significantly lower compared to control.

The efficacy of Steward EC insecticide, which is classified under oxadiazine chemical class, one day after the application showed the poorest performance, which was just 30.0–47.3%. The repeated counting four days after the application showed that the efficacy had increased to 61.8%, while seven days after the application the efficacy rate amounted to 70.2% (Table 4).

***Cabbage seed weevil* (*Ceutorhynchus assimilis* Payk.)** and brassica pod midge damage rape at the same time and often affect the same pods. At the end of fruit development and in the early ripening stages in 2007, 0.5% of pods were damaged by cabbage seed weevils and 0.5 larva per 10 assessed pods (Table 2) were identified in the control. After applying the insecticides on winter oilseed rape during the inflorescence emergence growth stage, it was estimated that Proteus 110 OD (systemic properties insecticide), was the most effective (biological efficacy 100%) at lowering the number of the damaged pods by the cabbage seed weevil (*C. assimilis* Payk.) and the number of the larvae of this pest. Higher doses of pyrethroid class insecticide Buldock 025 EC (0.3 l ha^{-1}) and organophosphate class insecticide Pyrinex Supreme (1.0 and 1.25 l ha^{-1}) was as efficient as Proteus 110 OD at protecting the rape pods against weevils.

Table 4. Efficacy of different class insecticides against *M. aeneus*, *C. assimilis* and *D. brassicae* in 2009 (insecticides used at GS 57)

		Treatment							
		1. Untreated	2. Mavrik 0.3 l ha^{-1}	3. Karate Zeon 0.1 l ha^{-1}	4. Kaiso 0.1 kg ha^{-1}	5. Kaiso 0.15 kg ha^{-1}	6. Steward 0.063 kg ha^{-1}	7. Steward 0.085 kg ha^{-1}	LSD$_{05}$
M. aeneus	Imago per 10 plants 1 DAA	4.6	0.0*	0.3*	0.2*	0.2*	2.4*	3.1*	1.14
	EF %	–	100.0	93.4	96.7	95.6	47.3	33.0	
	Imago per 10 plants 4 DAA	6.6	2.0*	2.2*	1.8*	1.9*	2.5*	2.5*	1.32
	EF %	–	70.2	66.4	73.3	71.8	61.8	61.8	
	Imago unit per 10 plants 7 DAA	4.7	0.9*	1.1*	1.9*	1.0*	1.5*	1.4*	1.05
	EF %	–	81.9	76.6	60.6	78.7	69.2	70.2	
C. assimilis	Damaged pods %	4.1	2.0*	0.5*	1.8*	1.4*	1.8*	2.0*	2.1
	EF %	–	51.2	87.9	57.6	66.7	57.6	51.2	
	Larva unit per 10 pods	0.4	0.17*	0.03*	0.18*	0.14*	0.18*	0.20*	0.02
	EF %	–	48.8	87.9	57.6	66.7	57.6	51.2	
D. brassicae	Damaged pods %	10.4	2.0*	3.4*	4.6*	3.0*	3.9*	2.1*	1.62
	EF %	–	80.8	67.5	55.4	71.1	62.5	79.8	
	Larva unit per 10 pods	11.0	1.3*	1.4*	3.8*	1.8*	1.9*	0.8*	2.5
	EF %	–	88.2	87.4	66.2	84.0	82.8	92.7	
	Seed yield kg ha $^{-1}$	3872	4017	3882	3957	3965	3978	4007	259
	In relative values	100.0	103.7	100.3	102.2	102.4	102.7	103.5	
	TSW g	4.51	4.59	4.67	4.63	4.59	4.59	4.62	0.19
	In relative values	100.0	101.8	103.5	102.6	101.8	101.7	103.5	

Note. Explanations under Table 2.

All the insecticides that had been tested in the year 2008 were more efficient at lowering the number of the pods damaged by the cabbage seed weevil larvae and the count of cabbage seed weevil larvae, compared to contact action insecticides (Bulldock 025 EC and Mavrik 2 F). The efficacy of organophosphorus class insecticide Pyrinex 25CS for lowering the number of cabbage seed weevil damaged pods ranged from 85.5% to 92.3%. Pyrethroid class insecticides are still used as the most efficient means of the cabbage seed weevil control in Europe and South America. Although the use of organophosphorus class insecticides has exhibited very good results in lowering the damage of this pest lately, the application of organophosphorus insecticides is permitted only in exceptional cases due to their toxic properties (Tansey, 2009).

Similar results of controlling the number of pods damaged by the cabbage seed weevil and the number of larvae in the pods were recorded in the year 2009. The efficacy of the tested insecticides with regard to lowering the number of pods damaged by this pest varied from 51.2% to 87.9%. The highest efficacy rate was reached by using Karate Zeon 5 CS (0.1 l ha^{-1}) insecticide. Similarly, this trend remained for the number of the cabbage seed weevil larvae present in pods.

***Brassica pod midge* (*Dasineura brassicae* Winn.).** At the end of the development of fruits and in the early ripening stages in 2007, 9.4% of pods were damaged by the brassica pod midge and 14.8 larva per 10 assessed pods (Table 2) were found in control plots. In the year 2007, all the tested insecticides, with the exception for the lower dose of Bulldock 025 EC (0.225 l ha^{-1}), lowered the number of the pods damaged by the brassica pod midge significantly, compared to the control; however their efficacy did not exceed 42.6% (biological efficacy varied from 0.0% to 42.6%). Compared to the control, the tested insecticides lowered the average number of pods damaged by the brassica pod midge larvae/10 tested pods significantly. However, only biological efficacy of the higher doses (1.0 and 1.25 l ha^{-1}) of systemic insecticide Proteus 110 OD and Pyrinex Supreme, classified under the organophosphorus class, exceed 50% (biological efficacy 51.4%, 56.8% and 50.0%, respectively).

In the year 2008, the control showed 5.3% of the pods damaged by the brassica pod midge larvae, while an average of 4.2 larvae of this pest were found in 10 pods. All the insecticides tested in 2008 lowered the number of the pods damaged by the brassica pod midge larvae substantially. However, only the efficacy rate of Pyrinex 25 CS (0.375 l ha^{-1}) insecticide reached 62.3%, whereas the efficacy rate of the other tested insecticides varied from 19.0% to 47.6%. All the tested insecticides effectively lowered the number of the larvae of the pest/10 tested pods. However, the highest efficacy rate was recorder having used the systemic nicotinoid class insecticide Proteus 110 OD (biological efficacy at 82.1%). The trials conducted in the Czechia as well showed that the application of neonicotinoid class insecticides had exhibited the most effective performance in lowering the damage of the brassica pod midge (Pavela et al., 2007).

In the year 2009, the average count of the pods damaged by the brassica pod midge larvae was at 10.4%, an average of 11 larvae of this pest was found in 10 pods. Compared to the control, all the tested insecticides lowered the number of the pods damaged by the brassica pod midge larvae and the number of the larvae in ten pods substantially. The usage of a higher dose of systemic insecticide Steward EC (0.085 kg ha^{-1}) exhibited 79.8% efficacy rate at lowering the number of the damaged pods and 92.7% efficacy rate at lowering the number of the larvae in the damaged pods. Similar data were obtained having applied synthetic pyrethroid class group II insecticide Mavrik 2 F (0.3 l ha^{-1}) (biological efficacy at 80.8% and 88.2%, respectively) (Memorandum, 2007).

During the experimental years, the yield of the winter oilseed rape in the control varied from 1952 kg ha^{-1} (in 2007) to 4742 kg ha^{-1} (in 2008). In the year 2007, the yield was extremely low because at the beginning of June the weather was very warm and dry (1st ten-day period's precipitation was 0.3 mm and air temperature was 2.0ºC above the normal).

In the year 2007, all the tested insecticides that had been applied in the inflorescence emergence growth stage (GS 55) increased winter oilseed rape yield (21.1–30.3%) and thousand seed weight (3.7–4.4%) substantially, compared to the control. The application of insecticides increased winter oilseed rape yield by 0.6–4.9% in 2008 and by 0.3–3.7% in 2009; however, compared to the control, this was not an essential increase. In the year 2008, the thousand rape seed weight increased by 1.9–2.5% and all the insecticides applied increased the thousand rape seed weight substantially. Although all the tested insecticides applied in 2009 increased the thousand rape seed weight (1.7–3.5%), the increase was not significant.

Conclusions

1. During the period 2007–2009, the population of the pollen beetle (*M. aeneus* F.) in the control varied from 2.5 (in 2009) to 18.0 (in 2007) adults per 10 plants, where the number was estimated before the application. The number of pods damaged by the cabbage seed weevil (*C. assimilis* Payk.) in the control was at around the same level during all experimental years: 5% in 2007, 6.5% in 2008, and 4.1% in 2009. The population of the brassica pod midge (*D. brassicae* Winn.) was higher, compared to the population of the cabbage seed weevil (*C. assimilis* Payk.), and 9.4% and 10.4% of pods damaged by the larvae of this pest were estimated in 2007 and 2009, respectively.

2. All the insecticides applied in winter oilseed rape during the inflorescence-emergence stage (GS 55–57) in 2007–2009 substantially lowered the pest harmfulness. These data show that

the application of insecticides in the middle of the inflorescence-emergence period (GS 55–57) is not only effective at destroying the pollen beetles but is also efficient at decreasing the pest damage done to pods.

3. The insecticide efficacy time against the pollen beetle (*M. aeneus* F.) correlated with the pest population in 2007 and 2008. When the population of the pollen beetles was very abundant, the tested insecticides protected the crop against the pollen beetles for a shorter time than in 2009.

4. All the insecticides tested lowered the number of pods damaged by the larvae of brassica pod midge (*D. brassicae* Winn.) substantially, but their biological efficacy exceeded 50% rate only in the year 2009.

5. The application of various insecticides on winter oilseed rape (GS 55–57) showed that the systemic insecticide Proteus 110 OD effectively reduced the number of pods damaged by the cabbage seed weevil (*C. assimilis* Payk.) and the larvae of this pest in 2007, and the insecticides Proteus 110 OD and Pyrinex 25 CS exhibited such action in 2008.

6. Comparison of the efficacy of the group I and II pyrethroid class insecticides revealed that the group II pyrethroid tau-fluvalinate was more efficient, compared to the group I pyrethroid class beta-cyfluthrin insecticide.

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Žieminio rapso (*Brassica napus* L.) apsauga nuo rapsinio žiedinuko (*Meligethes aeneus* F.) ir ankštarų kenkėjų (*Ceutorhynchus assimilis* Payk. bei *Dasineura brassicae* Winn.)

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Santrauka

Lauko tyrimai atlikti 2007–2009 m. Lietuvos žemdirbystės institute. Tirta įvairių insekticidų įtaka efektyviai žieminių rapsų apsaugai nuo rapsinio žiedinuko (*M. aeneus* F.) ir ankštarų kenkėjų (*C. assimilis* Payk. bei *D. brassicae* Winn.). Visi tirti insekticidai esmingai mažino rapsinio žiedinuko (*M. aeneus* F.) suaugėlių skaičių, ankštarinio paslėptastraublio (*C. assimilis* Payk.) bei ankštarinio gumbauodžio (*D. brassicae* Winn.) lervų skaičių ir jų pažeistų ankštarų kiekį. Insekticidų panaudojimas butonizacijos tarpsnio viduryje (BBCH 55–57) yra efektyvus ne tik naikinant rapsinius žiedinukus, bet ir mažinant ankštarinių kenkėjų gausumą žieminiuose rapsuose. Palyginus I (Bulldock 025 EC, Kaiso 24 WG, Karate Zeon 5 CS) ir II (Mavrik 2 F) grupės piretroidų klasės insekticidų efektyvumą nustatyta, kad veiksmingesni buvo II grupės insekticidai

Reikšminiai žodžiai: insekticidai, neonikotinoidas, piretroidas, organofosfatas, oksidiazinas.