THE EFFECT OF PROTECTIVE SEED MIXTURE ON DAMAGE OF STEMS OF WINTER OILSEED RAPE (*BRASSICA NAPUS* L.) BY RAPESEED STEM WEEVIL (*CEUTORHYNCHUS NAPI*) AND CABBAGE STEM WEEVIL (*CEUTORHYNCHUS PALLIDACTYLUS*)

P. Štranc[1], D. Bečka[1], J. Vašák[1], J. Štranc[2], D. Štranc[2]

[1]*Czech University of Life Sciences, Faculty of Agrobiology, Food and Natural Resources, Prague, Czech Republic*
[2]*ZEPOR[+], Agricultural Advising and Connoisseurship, Žatec, Czech Republic*

Decrease of pesticide of inputs in winter rapeseed protection is a permanent topical problem. The aim of our research was to test in pilot conditions the possibility of the use of the so-called marginal effect during invasion of stem weevil into the stand of winter rapeseed, i.e. using seedings composed of winter turnip rape, early variety of winter rapeseed and spring rapeseed. It can be seen from the results that the use of protective sowing against stem weevils (turnip and cabbage stem weevil) is possible into certain degree. However, we remark that for correct insecticide treatment of protective sowing or margins (framing), permanent monitoring of pests is necessary and simultaneously with it to observe the development of weather, particularly temperatures suitable for their mass flight. For higher efficiency of treatment of the stand edge by insecticides we recommend their more frequent application with respect to stem weevil as well as to pollen beetle and pests of siliques. We consider practical use of protective sowing for protection of winter rapeseed against stem pests in wider range full of problems. Regarding the necessity of very accurate determination of the date of their mass flight as well as subsequent adequate chemical protection that should be done in a very short period of time.

winter oilseed rape; protection; protective sowing; rapeseed stem weevil; cabbage stem weevil

INTRODUCTION

Semi-pilot trials with seeding of winter rapeseed by seed mixture attractive for pests (Štranc et al., 2006) were conducted on the plots of Agricultural farm Velké Přílepy – the Centre Tursko (the former district Prague-west) with seeding of winter rapeseed by seed mixture attractive for pests (Štranc et al., 2006).

The aim of these experiments in pilot trials was to test the use of the so-called marginal effect during invasion of spring pests into the winter rapeseed stand, i.e. using seedings composed of winter turnip (*Brassica campestris* L. convar. *campestris* – the variety Rex 50%), early variety of winter rapeseed (the variety Presto 25%) and spring variety (the variety Star 25%). In the fact it is an ability of this seeding to catch invasion pest of rapeseed to such a degree that in the stand behind the seeding limit values of their occurrence were not exceeded, it means all-area chemical protection was not necessary. That should be reduced to the edge of an area with seeding. A part of the plot with winter rapeseed was sown with protective sowing with seed mixture of width about 9 m, the second part of the plot was sown in a standard way by rapeseed, without seeding (control). The similar problem was solved by many authors (Büchi, 1995; Nilsson, 1969; Nerad, Vašák, 2000a, b; Vošlajer et al., 2003; Štranc, 2006).

This article is dealing only with rapeseed stem weevil (*Ceutorhynchus napi*) and cabbage stem weevil (*Ceutorhynchus pallidactylus*). The authors studied in the trial the length of feeding channel in stems of cabbage family plants caused by these cabbage stem weevils.

The advantages resulting from the above-mentioned way of rapeseed protection using seedings are economic, because there are savings in application of insecticides as well as ecological, as this will much reduce contamination of environment by insecticides and with time there is also natural reduction of pest in untreated stand.

MATERIAL AND METHODS

The trial with protective sowing of winter rape were established in catastre of the village Tursko, the district Prague-west, in altitude 289 to 308 m above sea level. The territory is a part of the Kladno Plateau or its eastern part, respectively. The area of plots in different years was as follows: 10 ha (2000/2001), 39 ha (2001/2002), 21 ha (2002/2003). The soil type was Chernozem Luvisol on loess, medium to strongly humic, humus of medium to very high quality. As to the soil texture is concerned it is the soil medium heavy. The interest area is situated in the region A2 – warm, arid, with average annual temperature 8–10 ºC and annual sum of precipitation 450–550 mm.

The trials were carried out with winter rapeseed varieties Pronto (in the years 2000–2002) and Embleme (in the year 2002/2003), at the row spacing 12.5 cm and sowing rate about 60 seeds per 1 m^2 – in the year 2000/2001 and

Variants of the trial and evaluation points (identical in all experimental years)

Variant	Specification of variant	Evaluation sites – distance from margin			
1	Untreated all (seeding by mixture)	seeding	25 m	50 m	100 m
2	Untreated all (without seeding)	margin	25 m	50 m	100 m
3	Seeding treated (seeding by mixture)	seeding	25 m	50 m	100 m
4	Treated margin (without seeding)	margin	25 m	50 m	100 m
5	All treated (seeding by mixture)	seeding	25 m	50 m	100 m
6	All treated (without seeding)	margin	25 m	50 m	100 m

Average monthly air temperature (ºC) and monthly sum of precipitation (mm) – Červený Újezd

Period	Normal		2000		2001		2002		2003	
Month	Temperature	Precipitation	Temperature	Precipitation	Temperature	Precipitation	Temperature	Precipitation	Temperature	Precipitation
I	–2.2	27	–1.54	25.4	–1.01	17.0	–2.06	33.1	–2.2	23.2
II	–1.4	26	3.09	21.0	3.96	52.6	1.28	12.9	–4.5	4.6
III	2.6	30	3.98	118.5	4.10	22.3	3.59	54.5	4.3	5.1
IV	7.4	43	10.59	13.2	7.61	20.1	7.07	53.2	7.0	20.7
V	12.4	60	15.45	59.6	14.86	70.6	14.45	52.9	14.7	70.1
VI	15.9	68	17.58	45.8	17.39	93.5	14.39	58.5	19.1	22.5
VII	17.4	76	15.87	56.2	18.20	80.3	18.25	93.5	19.0	76.9
VIII	16.8	68	18.82	42.6	19.20	161.2	18.97	107.5	20.6	12.7
IX	13.7	46	13.78	22.5	12.86	52.8	11.73	70.0	14.0	16.6
X	8.2	39	10.68	56.9	7.26	39.0	11.73	23.8	5.2	21.3
XI	2.5	34	5.21	31.6	3.78	86.2	2.37	37.3	4.1	9.9
XII	–0.8	32	0.45	11.0	–2.31	50.3	–2.30	35.8	–0.4	23.5
IV–IX	13.9	361	15.35	239.9	15.02	478.5	14.14	435.6	14.1	219.5
Year	7.7	549	9.5	504.3	8.83	745.9	8.29	633.0	8.41	307.1

* – data were taken from meteorological station Červený Újezd

about 50 seeds per 1 m^2 – in the years 2001–2003. Insecticides were applied by trailed sprinkler HardiTwin with air support. Protection against stem weevils was performed by the preparation Nurelle D in the dose of 0.6 ha/l in the following dates: 2001 – on 3rd April; 2002 – on 28th March; 2003 – on 14th February (it rained up to 2 hours after application).

During June, in the sites of sampling, always after unrooting of 50 plants of winter rapeseed we were finding the degree of infestation by rapeseed stem weevil and cabbage stem weevil. We studied the number of infested plants and length of feeding channel (in cm).

RESULTS AND DISCUSSION

In the years 2001 and 2002 the stands of winter rapeseed were in a very good conditions after over-wintering, or in good condition with a density about 40 rows/m^2, or 28 rows/m^2, respectively. On the other hand, in 2003 the stand of winter rapeseed (the Embleme variety) after over-wintering was in bad condition with a density 8–11 rows/m^2.

Compared to the rapeseed stand seed mixture (after over-wintering in 2001) had higher density (approximately 65 rows/m^2) and representation of different components was as follows: winter turnip Rex 60%, winter rapeseed Prestol 25% and spring rapeseed Star 15%. The stand of protective sowing rapeseed was thicker but in a good condition. In the years 2002 and 2003 the condition of seeding was significantly different, because the stand of protective sowing was in bad or in very bad condition with a density 8–12 rows/m^2 or 3–7 rows/m^2, whereas winter turnip rapeseed Rex out of 95% or 99%, respectively, was almost the only component of seeding.

In the years 2002 and 2003, in seeding of winter rapeseed on the edge of the plot very low density was achieved, i.e. 3–5 rows/m^2 or 1–3 rows/m^2, respectively. Low density of the stand on the studied margin, or protective sowing, was caused by strong soil compaction on the edge of the plot – headland, where the stand was in a bad condition before winter due to it the stand has not overwintered.

It is evident from Tables 1, 5 and 6 or Figs 4, 5 and 6 that damage caused by rapeseed stem weevil and cabbage stem weevil was decreasing with proceeding depth of the stand. In the years 2002 and 2003 in some cases damage to plants on protective sowing or plants on the edge of stand, respectively, was slightly lower, what apparently caused their low density in these places, and hence, a less intensive attraction of the given pests.

It follows from Table 2 and Fig. 1 that in untreated variant with protective sowing statistically significant difference in all studied years between the length of feed

Table 1. The number of infested plants of rape by stem weevils and length of feed channel, Tursko, 2001

Variant		Distance from the margin	Length of feed channel (cm)							
			0	0 to 10	10 to 20	20 to 30	30 to 50	50 to 70	70 <	avg. length
1	All untreated (seeding by mixture)	margin	0	1	2	10	16	6	15	49.7
		25 m	0	6	9	3	18	11	3	37.2
		50 m	5	6	14	6	11	4	4	27.8
		100 m	5	8	9	5	21	2	0	25.7
2	All untreated (without seeding)	margin	2	3	7	8	19	5	6	37.2
		25 m	5	8	7	9	10	6	5	30.6
		50 m	5	7	10	2	21	3	2	30.3
		100 m	5	8	9	5	21	2	0	25.7
3	Treated seeding (seeding by mixture)	margin	28	17	4	1	0	0	0	3.4
		25 m	8	7	9	1	16	7	2	28.3
		50 m	7	25	9	6	1	2	0	11.4
		100 m	6	12	7	6	9	8	2	26.3
4	Treated margin (without seeding)	margin	25	16	3	2	3	1	0	7.1
		25 m	7	6	7	7	14	9	0	28.2
		50 m	8	7	6	11	13	4	1	24.8
		100 m	7	6	8	9	16	3	1	25.5
5	All untreated (seeding by mixture)	margin	29	15	2	3	1	0	0	4.4
		25 m	28	19	3	0	0	0	0	2.8
		50 m	35	11	3	0	1	0	0	2.8
		100 m	33	15	2	0	0	0	0	2.1
6	All untreated (without seeding)	margin	26	15	4	2	2	1	0	6.5
		25 m	27	18	2	1	1	1	0	4.9
		50 m	27	14	4	2	1	2	0	6.8
		100 m	32	12	3	2	1	0	0	3.9

Table 2. More detailed evaluation of the analysis of the length of feed channel in different distances from protective sowing in the variant "All untreated" (protective sowing with mixture) in the years 2001–2003

Method: 95.0 percent Tukey HSD			Homogeneous groups
Variant	Count	Mean	
4 (100 m)	3	26.0	A
3 (50 m)	3	30.7667	A
2 (25 m)	3	38.6	AB
1 (seeding)	3	46.6333	B

Minimum statistical difference = 12.9492
P = 0.004

Table 3. More detailed evaluation of analysis of variance of the length of feed channel in different distances from protective sowing in the variant "Untreated all (without protective sowing) in the years 2001–2003

Method: 95.0 percent Tukey HSD			Homogeneous groups
Variant	Count	Mean	
4 (100 m)	3	21.9	A
3 (50 m)	3	33.6667	AB
1 (margin)	3	40.0667	B
2 (25 m)	3	40.1	B

Minimum statistical difference = 15.4499
P = 0.017

Table 4. More detailed evaluation of analysis of deviance of feed channel in different distances from seeding in the variant "Treated seeding (seeding by mixture)" in the years 2001–2003

Method: 95.0 percent Tukey HSD			Homogeneous groups
Variant	Count	Mean	
3 (50 m)	3	12.3	A
1 (seeding)	3	13.0	A
4 (100 m)	3	16.8333	A
2 (25 m)	3	19.2	A

Minimum statistical difference = 25.8719
P = 0.808

channels and in the distance of 50 and 100 m. On the other hand, in untreated variant, without protective sowing, there is a statistically significant difference between the length of channels in 100 m from the other sites of sampling (margin, 25 m – Table 3 and Fig. 2), what manifests greater attractiveness of seeding for stem pests. Our results are in discrepancy with the knowledge of Nerad and Vašák (2000b), who reported that protective sowing has no effect on the incidence of stem weevils.

In all other variants in the studied years 2001–2003 statistically significant difference is not evident in the length of feed channels between different sampling sites

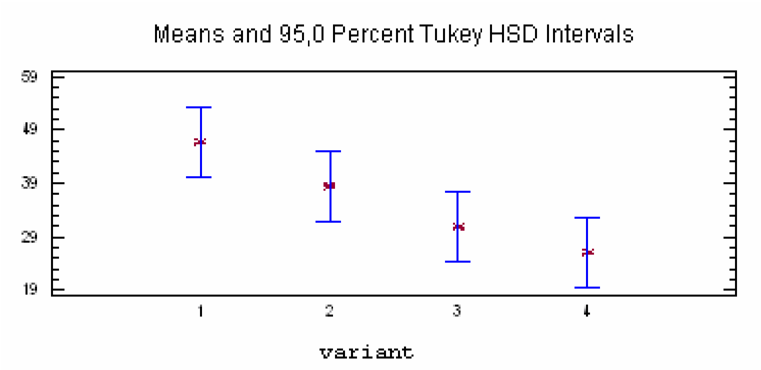

Fig. 1. Length of feed channel in different distances from protective sowing in the variant "All untreated (seeding by mixture)" in the years 2001–2003

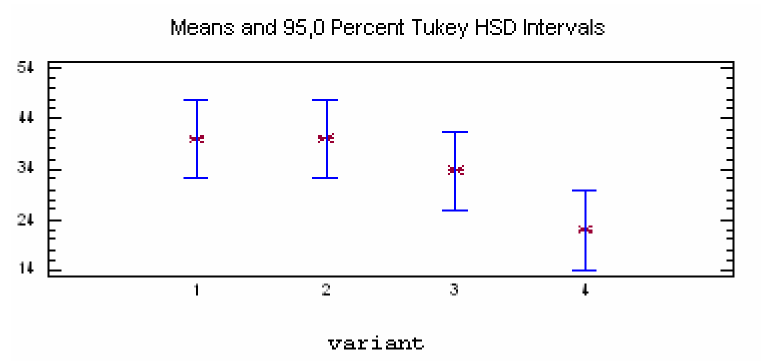

Fig. 2. Length of feed channel in different distances from protective sowing in the variant "All untreated (without seeding)" in the years 2001–2003

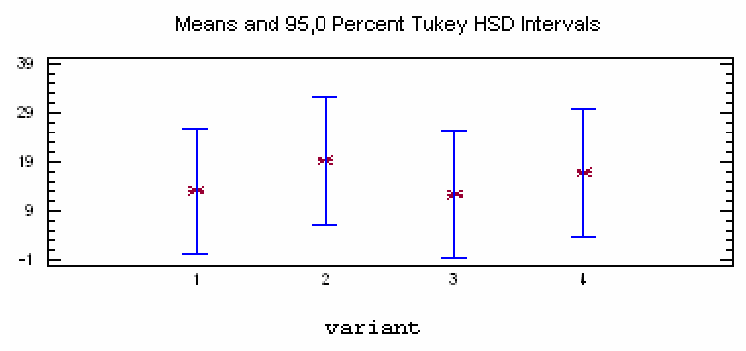

Fig. 3. Length of feed channel in different distances from protective sowing in the variant "Treated seeding (seeding by mixture)" in the years 2001–2003

and a certain tendency can be only estimated, similar to the case of the variant "Treated protective sowing (protective sowing by mixture)" (Table 4 and Fig. 3).

A great representation of plants with big length of feed channel (the most frequently in the length of 30 to 50 cm) is evident from the values presented in Table 1, i.e. in untreated edge of the stand or in protective sowing, eventually.

Then it follows from Fig. 4 that efficiency of the used insecticide was very good on treated free margin or protective sowing, eventually. The preparation was evidently applied after mass flight of pests, what predicates of relatively high proportion of damage to plants in the distances 25, 50 and 100 m from the edge of the stand.

The highest efficiency of insecticide was recorded in the case of treatment of the whole stand when a prevailing part of adults was reached in the time of their copulation and maturation feeding before oviposition.

Similar results like in the year 2001 were obtained in 2002. The date of application against stem weevils was determined more exactly. Higher efficiency of the variant using the protective sowing in protection against these pests was also proved in 2002 (Table 5 and Fig. 5). Higher efficiency of protective sowing or turnip rapeseed (variety Rex) respectively, consisted in greater attractiveness and migration of pests to the seeding where they were subsequently controlled by insecticide. The stands with whole-area application of insecticide were the least damaged in this year as well.

In 2003, despite the previous years we did not record nor from far such a great difference between treated and untreated variants. As mentioned above, in 2003 insecticide was applied not only later but it was washed out by rain (up to two hours from sprinkling), what reduced efficiency of treatment against stem weevils (Fig. 6). The results obtained show a necessity to carry out early and precise protection (Š e d i v ý , 2000) and many others.

It follows from the results that despite the given negative facts, in the experimental year 2003 we recorded the least damage of plants just in the variant with treated protective sowing.

N e r a d and V a š á k (2000a) presented that stem weevils strongly infest plants on the protective sowing and in the stand, as well. It follows from our results that it is necessary to study the number of infested plants but also intensity of damage that is falling with increasing depth of the stand.

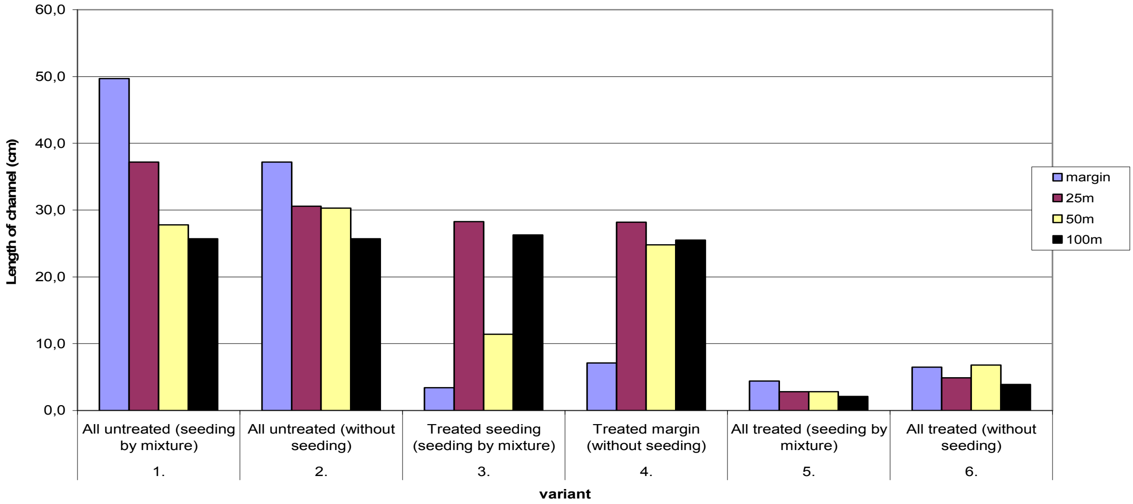

Fig. 4. Length of feed channel, Tursko 2001

Table 5. The number of infested rapeseed plants by stem weevils and length of feed channel, Tursko 2002

Variant		Distance from the margin	Length of feed channel (cm)							
			0	0 to 10	10 to 20	20 to 30	30 to 50	50 to 70	70 <	avg. length
1	All untreated (seeding by mixture)	margin	0	2	3	5	14	14	12	50.8
		25 m	2	3	9	10	11	9	6	37.2
		50 m	3	5	6	7	13	12	4	37.0
		100 m	4	7	5	12	12	7	3	31.0
2	All untreated (without seeding)	margin	0	2	6	5	19	4	14	46.9
		25 m	0	0	1	5	25	11	8	48.8
		50 m	0	6	5	12	15	7	5	36.5
		100 m	4	10	17	6	10	3	0	20.7
3	Treated seeding (seeding by mixture)	margin	17	11	2	8	8	4	0	16.9
		25 m	24	10	11	3	2	0	0	7.4
		50 m	30	8	6	6	0	0	0	5.6
		100 m	33	13	3	1	0	0	0	2.7
4	Treated margin (without seeding)	margin	9	17	8	7	7	2	0	15.6
		25 m	1	6	7	14	11	6	5	33.7
		50 m	3	9	12	10	5	7	4	28.3
		100 m	4	4	2	3	1	0	0	4.4
5	All untreated (seeding by mixture)	margin	28	19	3	0	0	0	0	2.8
		25 m	35	11	3	0	1	0	0	2.8
		50 m	33	15	2	0	0	0	0	2.1
		100 m	36	14	0	0	0	0	0	1.4
6	All untreated (without seeding)	margin	31	14	3	2	0	0	0	3.3
		25 m	29	18	2	1	0	0	0	2.9
		50 m	43	4	2	1	0	0	0	1.5
		100 m	38	9	2	1	0	0	0	2.0

CONCLUSIONS

– It was proved that protection against pests can be significantly biologised. One of the solutions we concentrated on is protective sowing of winter rapeseed (9 m in width) by over-wintering seed mixture composed of winter turnip rape – 50%, early variety of winter rapeseed – 25% and spring rapeseed – 25%. The given mixture reduces damage by stem weevils, but realization is rather problematic.

– N e r a d , V a š á k (2000a) and N e r a d (2001) reported that stem weevils (rapeseed stem weevil, cab-

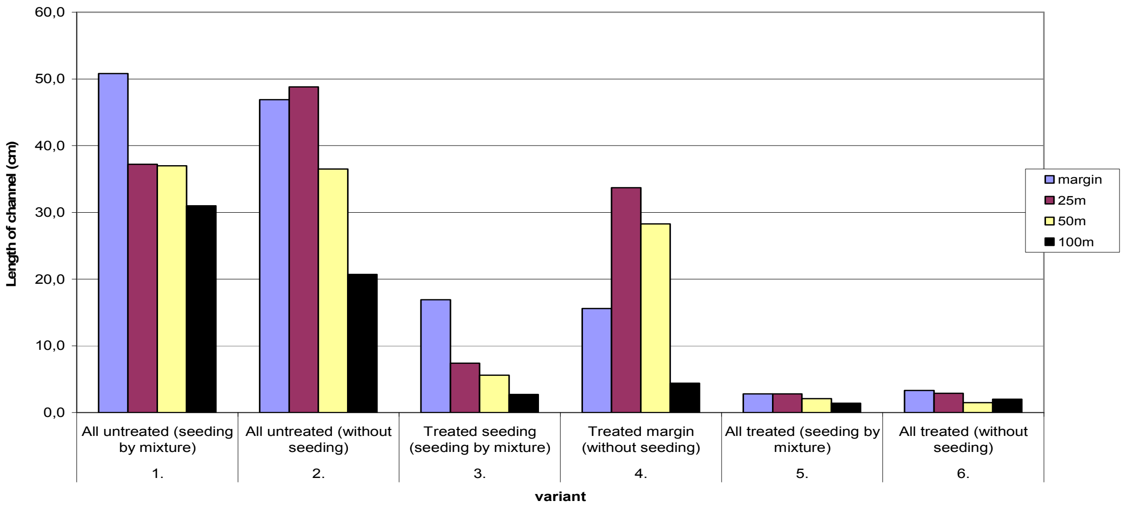

Fig. 5. Length of feed channel, Tursko 2002

Table 6. The number of infested rapeseed plants by stem weevils and length of the feed channel, Tursko 2003

Variant		Distance from the margin	Length of feed channel (cm)							
			0	0 to 10	10 to 20	20 to 30	30 to 50	50 to 70	70 <	avg. length
1	All untreated (seeding by mixture)	margin	1	4	3	13	14	9	6	39.4
		25 m	0	2	4	14	16	6	8	41.4
		50 m	2	6	13	12	7	5	5	27.5
		100 m	3	7	18	12	7	3	0	21.3
2	All untreated (without seeding)	margin	3	2	12	7	12	8	6	36.1
		25 m	1	3	9	3	17	11	6	40.9
		50 m	2	3	12	7	13	11	2	34.2
		100 m	11	5	14	10	7	2	1	19.3
3	Treated seeding (seeding by mixture)	margin	9	10	12	9	7	2	1	18.7
		25 m	10	14	6	7	5	4	4	21.9
		50 m	6	16	13	4	5	3	3	19.9
		100 m	6	9	14	12	3	4	2	21.5
4	Treated margin (without seeding)	margin	5	8	14	12	7	3	1	21.8
		25 m	0	4	14	16	9	2	5	30.2
		50 m	3	8	13	14	6	2	4	25.3
		100 m	5	9	11	14	9	2	0	20.8
5	All untreated (seeding by mixture)	margin	6	6	8	7	12	5	6	31.7
		25 m	5	5	12	6	11	3	8	32.3
		50 m	7	6	6	13	9	8	1	27.3
		100 m	12	6	11	5	13	2	1	20.8
6	All untreated (without seeding)	margin	1	4	8	9	14	13	1	35.7
		25 m	8	4	10	11	9	5	3	26.9
		50 m	5	3	12	14	11	2	3	26.9
		100 m	7	6	10	13	9	4	1	23.7

bage stem weevil) strongly infest plants on protective sowing and the stand as well. Furthermore, it follows from our results that it is necessary to study not only the number of infested plants but also intensity of their infestation that is falling with increasing intensity depth of the stand (length of feed channel is shortening). It is also evident from the results found that the use of protective sowing to protection of winter rapeseed against stem weevils (rapeseed stem weevil, cabbage stem weevil) is possible to a certain degree,

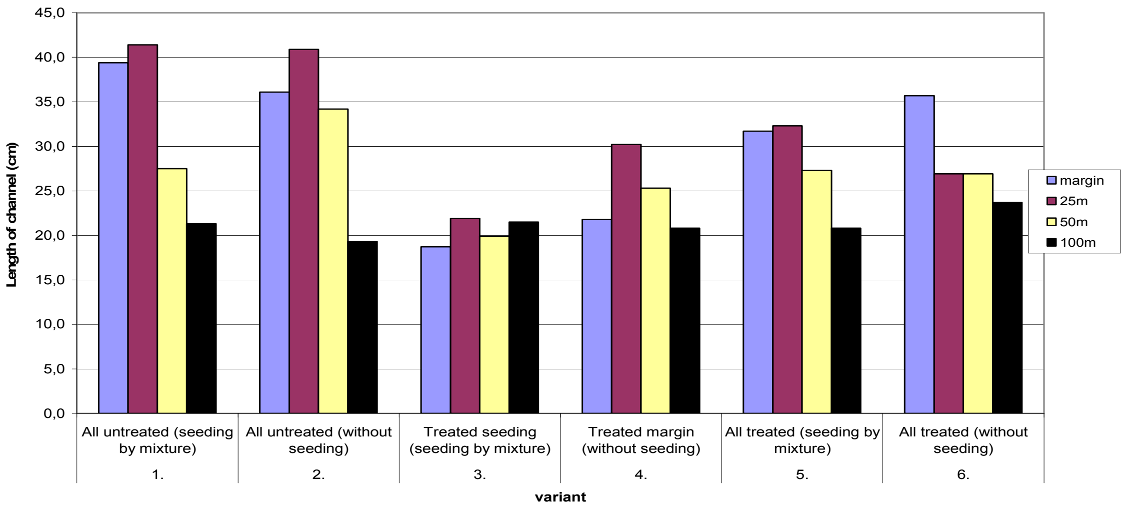

Fig. 6. Length of feed channel, Tursko 2003

though their first mass invasions intervene deeper in the stand than it is usual, e.g. pollen beetle or pests of siliques, eventually.

– Biologically tested more acceptable protection against pests has had a great handicap in recent years, because areas of oil crops of the cabbage family are growing. On many places rapeseed is reaching several years critical 12.5% in the crop rotation. Hence, crop rotation as well as isolation distance from last year's of rapeseed stands are not kept, what brings extremely strong pressure of harmful agents that thus becomes unsustainable. Protective sowing will not keep so strong pressure of pests below the threshold of economic harmfulness. We have to mention that especially strong pressure of pests particularly in lower altitudes where rapeseed should not be cultivated.
– The above-mentioned seed mixture can be used with success for bio-indication of the incidence of spring pests instead of yellow Möricke dishes or sticky plates.

REFERENCES

BÜCHI, R.: Combination of trap plants (*Brassica rapa* var. *silvestris*) and insecticide use to control rape pests. Bulletin-IOBC-WPRS, *18*, 1995: 102–121.

NERAD, D.: Biologizace ochrany řepky ozimé (Biologisation of winter oilseed rape protection). [Dissertation.] CUA Prague, 2001.

NERAD, D. – VAŠÁK, J.: Ochranné obsevy – cesta k usměrněné ochraně proti řepkovým škůdcům (Protective sowing – the way to directed protection against oilseed rape pests). Příloha časopisu Farmář, 2000a, č. 6.

NERAD, D. – VAŠÁK, J.: Ochranné obsevy – možnost pro omezení pesticidů v ozimé řepce (Protective sowing – the possibility for reduction of pesticides in winter oilseed rape). Nový venkov, 2000b, č. 1.

NILSSON, C.: Integrated control of pests in oil plants – trap crops for pollen beetles in spring rape. Agriculture – pests, diseases and weeds. In: Proc. 37th Swedish Crop Protection Conf., Uppsala, Sweden, 1996: 105–112.

ŠEDIVÝ, J.: Škůdci ozimé řepky (Winter oilseed rape pests), 2000: 199–223. In: VAŠÁK, J. et al.: Řepka (Oilseed rape). Praha, Agrospoj 2000. 322 pp.

ŠTRANC, P.: Biologizace ochrany řepky ozimé (Biologisation of winter oilseed rape). [Dissertation.] CUP Prague, 2006. 200 pp.

ŠTRANC, P. – BEČKA, D. – VAŠÁK, J. – NERAD, D.: Využití ochranných obsevů proti stonkovým krytonoscům u řepky ozimé (The use of protective sowing against stem weevils in winter oilseed rape). In: Prosperující olejniny, CUP Prague, 2006: 41–45.

VOŠLAJER, Z. – JUROCH, J. – MUŠKA, F. – ZBUZEK, B.: Základní prvky ochrany plodin v dubnovém období (Basic elements of crop protection in April period). Rostlinolékař, 2003 (2): 3–9.

Received for publication on July 3, 2007
Accepted for publication on September 19, 2007

ŠTRANC, P. – BEČKA, D. – VAŠÁK, J. – ŠTRANC, J. – ŠTRANC, D. (Česká zemědělská univerzita, Fakulta agrobiologie, potravinových a přírodních zdrojů, katedra rostlinné výroby, Praha, Česká republika; ZEPOR+, zemědělské poradenství a soudní znalectví, s. r. o., Žatec, Česká republika):

Vliv ochranné obsevové směsi na poškození stonků řepky ozimé (*Brassica napus* L.) krytonoscem řepkovým (*Ceutorhynchus napi*) a krytonoscem čtyřzubým (*Ceutorhynchus pallidactylus*).

Scientia Agric. Bohem., *39*, 2008: 16–23.

Snížení pesticidních vstupů při ochraně ozimé řepky je stálým aktuálním problémem. Cílem našeho pokusu bylo v poloprovozních podmínkách ověřit možnost využití tzv. okrajového efektu při náletu stonkových krytonosců do porostu ozimé řepky, a to pomocí obsevů složených z ozimé řepice, rané odrůdy ozimé řepky a jarní řepky.

Ze zjištěných výsledků je patrné, že využití ochranných obsevů proti stonkovým krytonoscům (řepkovému a čtyřzubému) je do jisté míry možné. Poznamenáváme však, že pro správné insekticidní ošetření obsevu, popř. okraje (tzv. rámování), je třeba provádět neustálý monitoring škůdců a současně pozorně sledovat vývoj počasí, zejména teplot vhodných pro jejich hromadný přelet. Pro vyšší efektivnost rámování porostu insekticidy doporučujeme jejich častější aplikaci s ohledem nejen na stonkové krytonosce, ale i na blýskáčka a šešulové škůdce.

Praktické využití obsevů k ochraně ozimé řepky proti stonkovým škůdcům v širším měřítku však považujeme za problematické, a to jak s ohledem na nutnost velmi přesného stanovení termínu jejich hromadného přeletu, tak i vzhledem k následné adekvátní chemické ochraně, kterou je třeba realizovat ve velmi krátkém časovém intervalu.

řepka ozimá; ochrana; ochranný obsev; krytonosec řepkový; krytonosec čtyřzubý

Contact Address:

Ing. Přemysl Š t r a n c , Ph.D., Česká zemědělská univerzita v Praze, Fakulta agrobiologie, potravinových a přírodních zdrojů, katedra rostlinné výroby, Kamýcká 957, 165 21 Praha 6-Suchdol, Česká republika, tel.: +420 224 382 531, fax: +420 224 382 535, e-mail: stranc@af.czu.cz