IDENTIFICATION AND CONTROL OF RAPE STEM WEEVIL *CEUTORHYNCHUS* SPP. IN WINTER OILSEED RAPE IN LATVIA

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Abstract

Research on identification of *Ceutorhynchus* spp. on winter oilseed rape in Latvia was done during the vegetation season of 2009 and 2010. Field trials were located in the Research and Study Farm "Peterlauki", Jelgava municipality, Latvia (56°32'17.38N, 23°43'17.65E). Four species of brassica stem weevils were identified: cabbage stem weevil *Ceutorhynchus pallidactylus* Marsh., syn. *C. quadridens* Pan., rape winter stem weevil *C. picitarsis* Gyll., blue stem weevil *C. sulcicollis* Pay., and *C. typhae* Herb. One of the most common species in winter oilseed rape was cabbage stem weevil *C. pallidactylus.*

Use of a sweep net for identification of particular species cannot be applied, as in practice no specimens have been collected by this method. One of the most appropriate methods for identification of *Ceutorhynchus* spp. on winter oilseed rape has been yellow sticky traps and water traps that have been used to collect the greatest number of specimens (24) during the vegetation season.

First pests appear during the 2nd decade of April, when the plant reaches 33 BBCH. Pest control using systemic insecticide Proteus 110 OD (tiakloprid 100 g L^{-1}, deltametrin 10 g L^{-1}) with a dose of 0.75 L ha^{-1} was applied when the plant reached 39-44 BBHC. Despite the high population density (2 to 10 insects on 40 plants), significant ($p<0.05$) decrease in pest damage by 43-51%, when compared to untreated area, was recorded during vegetation seasons of 2009 and 2010. Pest control with a systemic insecticide when the plant is in the stem elongation phase provided a significant ($p<0.05$) yield increase of 0.5 to 0.7 t ha^{-1}.
Key words: weevil, *Ceutorhynchus* spp., winter oilseed rape.

Introduction

Cultivated areas of winter and spring rapeseed in Latvia have reached 100 thousand ha. It is forecasted that the areas will continue to increase. Oilseed rape takes a solid place in the crop rotations of arable farms throughout Europe, and almost in all cases its cultivation is connected with intensive application of plant protection products. This is a result of increase in disease and weed pressure, and also distribution of pests.

Cabbage stems weevil *Ceutorhynchus pallidactylus* Marsh., syn. *Ceutorhynchus quadridens* Pan., and rape stem weevil *Ceutorhynchus napi* Gyll. (Toshova et al., 2009; Williams, 2004) have been mentioned as one of the most harmful pests in Europe and Northern America. Less damage is caused by rape winter stem weevil *Ceutorhynchus picitarsis* Gyll., blue stem weevil *Ceutorhynchus sulcicollis* Pay., and *Ceutorhynchus typhae* Herb. (Alford, 2003; Veromann et al., 2006). *Ceutorhynchus* spp. are the most important pests for oilseed rape in Germany, where they can cause severe yield losses (Büch and Katzur, 2005; Aljmli, 2007). Weevils are comparably small bugs with the length of 1.3 to 7 mm (2-3 mm in most cases) and are commonly found throughout the world (Toshova et al., 2009). More than one third of *Ceuthorhynchus* are monophagous or oligophagous on *Brassicaceae* species (Toshova et al., 2009; Evans, 2007). Some of *Ceuthorhynchus* species can be mentioned as especially harmful for crucifers, as their larvae and imago target specific plant parts. Larvae of *C. picitarsis* (Gyllenhal, 1837) damage leaf stems; larvae of *C. pallidactylus* (Marsham, 1802), *C. typhae* (Herbst, 1795) and *C. sulcicollis* (Paykull, 1800) damage plant stalks, and *C. obstrictus* (Marsham, 1802) damage rapeseed in pods (Toshova et al., 2009). Weevil imago feed on oilseed rape leafs, stalks, buds and flowers (Toshova et al., 2009). Crucifer stem weevil is univoltine. Adults exit from hibernation in March/April and migrate to oilseed rape fields. Most harmful invasion time of brassica stem weevil starts with the beginning of stem elongation and lasts until appearance of flower buds (BBCH 30 – 50) (Aljmli, 2007), when imago can be observed. In the later plant development stages damage is caused by emerged larvae, who tunnel inside the stalks and leaf stems to feed. Feeding goes on until the 2nd decade of June, when openings are created in stalks and the larvae drop out on the soil. Due to the pest damage plants have smaller size, wither away and die (Kelm and Klukowski, 2000). The necessity of controlling this particular pest depends on a specific situation (Hiiesaar et al., 2003).

Imago of brassica stem weevil on oilseed rape can be identified by using a sweep net, shake cone, water traps, sticky traps and performing insect counts on the plants (Free and Williams, 1978; Free and Williams, 1979; Tarang et al., 2004; Walszak et al., 1998). In Czech Republic, Austria, Germany and Poland pest emergence and control of pest population is determined by using yellow water traps, and treatment is recommended when the threshold number has been exceeded for over 3 days (Biocontrol-based..., 2010). Water traps have been used to sample all coleopterous pests of oilseed rape (Alford, 2003; Walczak et al., 1998). Sticky traps are more often used for flying insects and have been extensively used to monitor several different species of pests on oilseed rape (Alford, 2003). Sweep netting has been used for sampling of many kinds of oilseed rape pest.

This method is most efficient when the crop canopy is dry and when there is little or no wind (Alford, 2003).

The aim of the research was to identify the best timing for collection of brassica stem weevil and to determine the most efficient control measures in winter oilseed rape in Latvia. Collected data will help to set the most efficient timing for control measures of brassica stem weevil on winter oilseed rape.

Materials and Methods

Field trials were located in the Research and Study Farm "Peterlauki", Jelgava municipality, Latvia (56°32'17.38N, 23°43'17.65E), using winter oilseed rape *Brassica napus* variety 'Adder'. Sowing was done on 15 August in 2008 and 12 August in 2009. Agrotechnics: previous crop – black fallow, ploughing and cultivation were done twice in autumn. Field trial was set up in two variants (control and treatment), six randomized replications. Plot size was $5 \times 10 = 50$ m^2, isolation bands – 0.01 ha^{-1}. When count of *Ceutorhynchus palidactylus* average reached 1 imago on 40 plants, treatment with Proteus 110 OD (tiakloprid 100 g L^{-1}, deltametrin 10 g L^{-1}) was done on 6 May.

Counting of brassica stem weevil was done by using four methods:

recording of stem weevil – average on 40 plants in plot;

yellow glue trap – yellow glue trap (10 × 25 cm) in every plot;

yellow water trap – yellow water trap (Ø 30 cm, 10 cm high) in every plot;

sweep net – where every sample was obtained with the help of 150 insect net sweeps (25 sweeps per every plot) of the winter oilseed rape stand.

Samples were taken starting with the 2nd decade of April (33 BBHC) until the 1st decade of June (71 BBHC) in 5-day intervals – 20.04., 25.04., 01.05., 05.05., 10.05., 15.05., 20.05., 25.05., 01.06., 05.06., 10.06., 15.06. in 2009, and 20.04., 28.04., 06.05., 11.05., 17.05., 21.05., 27.05., 02.06., 09.06. in 2010.

Plant volume invaded by brassica stem weevil (P, %) was calculated by using the following Formula (1):

$$P = (n \times 100) / N, \qquad (1)$$

where: n = number of insects;
N = total number of sampled stems
(Интегрированные системы защиты..., 2005).

Correlation analyses were used to determine the dependence between the factorial (X), which is the number of insects, and the resultative attribute (Y), which is yield. To evaluate the collected data, the estimated value was compared to the critical value. Obtained results were analysed with the necessary probability level ($p<0.05$) and actual number of samples.

Weather data received from the Jelgava HMS of Latvian Environment, Geology and Meteorological Agency were compared to the long-term average data.

The weather in vegetation season of April 2009 was mild and dry. Second and third decade of April was without rain. In April, the average daily air temperature was higher than the common norm. This was the 2nd driest April in Latvia during 86 years. Also in May the weather was mild and dry. In May, the average daily air temperature was higher than the common norm, and the average precipitation was not sufficient for development of winter oilseed rape. In June and July, the air temperature and precipitation were sufficient for development of winter oilseed rape.

In 2010, the average air temperature in May was + 1.3 °C higher than perennial mean. In the third decade of May, the air temperature was on - 0.2 °C lower than perennial mean. Precipitation level was 51.31% of the norm in the second decade of May. In June, the average daily air temperature was higher than the norm. Precipitation was below the long-term average. In July, the average daily temperature was higher than perennial norm (+ 4.4 °C), and precipitation was 319% of perennial norm. This was the hottest July in Latvia during 95 years. In the second and third ten day period of July there were rainstorms.

High average air temperature and low participation level in May of 2009 and 2010 was favourable for the spread of pests and caused problems for pest control.

Results and Discussion

Four brassica stem weevil species have been identified in Latvia: cabbage stem weevil *C. pallidactylus* Marsh., syn. *C. quadridens* Pan., rape winter stem weevil *C. picitarsis* Gyll., blue stem weevil *C. sulcicollis* Pay., and *C. typhae* Herb. First imago of the different species mentioned above has been observed in different plant development stages. Imago is observed when the air temperature exceeds + 6 °C. They feed both on wild and cultivated cruciferous plants. Females make an ovipositor bite either in leaf stem or stalk and lay 1-2 eggs. In approximately 10 days the larvae emerge. Larvae feed and damage leaf stems and stalks for the next three to five weeks. Afterwards they leave the plant and pupate in the soil. Only one generation of brassica stem weevils is possible in Latvian climatic conditions. By the end of the summer imago develops from the pupa and feeds and damages crucifer leafs. In late August insects head to overwintering sites in field margins and forest edges (Alford, 2003; Toshova et al., 2009; Hiiesaar et al., 2003).

In vegetation season of 2009, first imago of brassica stem weevils were identified on April 20 (BBHC 35) on yellow sticky traps. On the plants and in the yellow water traps the first insects were counted only 5 days later – April 25, BBHC 39 (Table 1).

Table 1

Efficiency of different identification methods of brassica stem weevils on winter oilseed rape in vegetation season of 2009

Sampling dates	Phenological growth stages (BBCH)	Number of insects			
		On single plant	Average per one		150 sweeps of insect net
			yellow sticky trap	yellow water trap	
15 April	33	0	0	0	0
20 April	35	0	3	0	0
25 April	39	2	22	2	0
01 May	44	3	4	0	0
05 May	51	2	3	0	0
10 May	57	1	2	0	0
15 May	60	0	3	1	0
20 May	67	1	3	0	0
25 May	69	2	0	1	0
01June	70	3	0	1	0
05 June	71	2	0	0	0
10 June	72	1	0	1	0
15 June	74	1	0	0	0

In vegetation season of 2010, the first imago of brassica stem weevil in the trial field was observed one week later by help of the yellow water trap in the end of April (28 April), and after a week in early May (06 May) it was recorded on the plants. Late appearance of the pest can be explained by the low average air temperature and frequent precipitation in the last decade of April (Table 2).

Table 2

Efficiency of different identification methods of brassica stem weevils on winter oilseed rape in vegetation season of 2010

Sampling dates	Phenological growth stages (BBCH)	Number of insects			
		On single plant	Average per one		200 sweeps of insect net
			yellow sticky trap	yellow water trap	
20 April	33	0	0	0	0
28 April	35	0	0	3	0
06 May	39	1	0	25	0
11 May	44	3	1	16	0
17 May	51	2	1	3	0
21 May	67	1	4	0	0
27 May	69	0	2	0	0
02 June	70	0	4	0	0
09 June	71	0	0	0	0

By using the sweep netting, no brassica stem weevils were collected during vegetation seasons in both years – 2009 and 2010. In order to control the population of brassica stem weevil, systemic insecticide Proteus 110 OD was used by applying a dose of 0.75 L ha^{-1}.

In 2009, the first control measures of brassica stem weevils were made 10 days after observation of the first insects on 30 April- BBHC 44. The 10 imago were counted on 40 plants, which may be considered as a very heavy infestation – according to the critical thresholds developed by A. Priedītis the control measures should be taken when there is one imago counted on 40 plants (Priedītis, 1999). The control was done according to the insect counts on the yellow sticky traps and yellow water traps. In 2010, control measures using insecticides were done one week later than in 06 August in 2009. - BBCH 39, when one to two insects were counted on 40 plants. Control measures could not be implemented any earlier as there was minor, but frequent precipitation. With the decrease of precipitation and increase of the average air temperature at the end of 1st decade of May, massive emergence of brassica stem weevils was observed in the 2nd decade of May (11 may) when

8 insects per 25 plants were counted. This measurement is close to the critical threshold set in Poland – 6 insects on 25 plants (Garbe et al., 1996; Alford, 2003). The high population density in the trial field may be explained by the close distance to oilseed rape field in the previous season (~50 m), where some of the insects overwintered.

According to the amount of insect-invaded plants it can be noted that there has been an increase of pests by 48% in 2010 if compared to 2009 (untreated variant). This can be explained by the absence of proper crop rotation in the trial field (Fig. 1). Most of the Latvian farmers cultivating oilseed rape face the same problem.

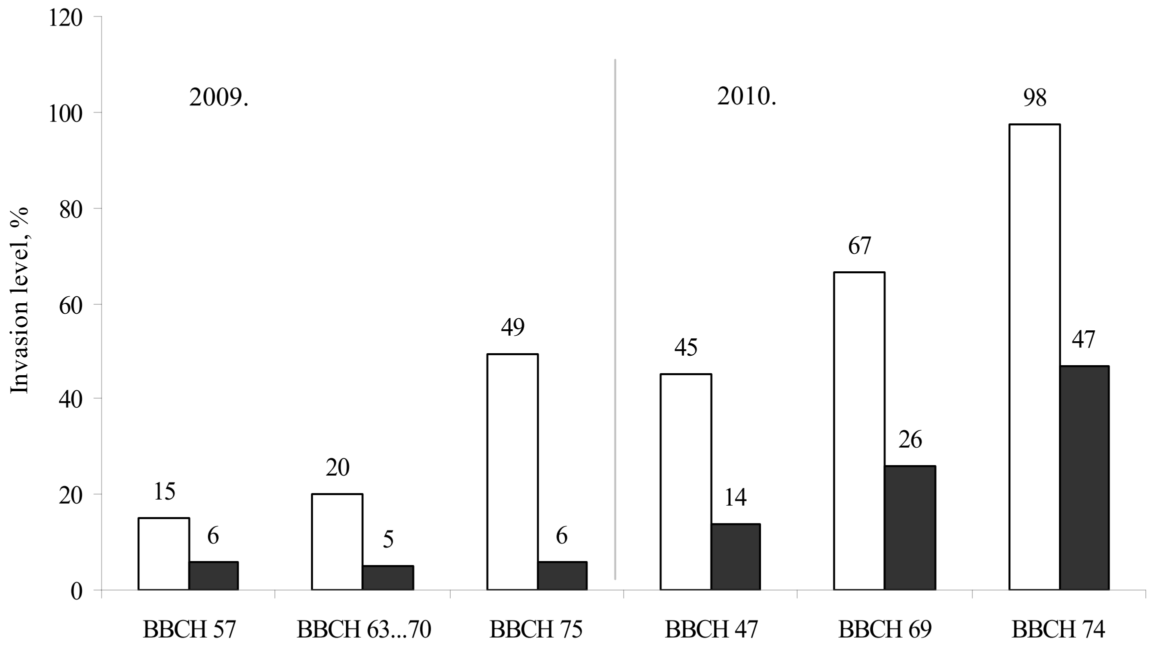

Figure 1. *Brassica* stem weevil invaded plants (%) on winter oilseed rape in in vegetation seasons of 2009 and 2010.

□ Control ■ Proteus 110 OD in dosage 0.75 L ha^{-1}

2009 vegetation season LSD 95% - 45.47
2010 vegetation season LSD 95% - 24.6

Despite the high density of brassica stem weevil on winter oilseed rape it has been possible to significantly ($p<0.05$) decrease the pest damage in 2009 and 2010 – by 43 – 51% (BBHC 74 development of the pods), when compared to the untreated area. Systemic insecticide Proteus 110 OD impacted the hatched larvae by slowing down their feeding and further development.

Pest control of brassica stem weevil with a systemic insecticide Proteus 110 OD provided a significant ($p<0.05$) yield increase of 0.5 to 0.7 t ha^{-1} or ~ 19% if compared to control (Table 3).

Table 3

Influence of brassica stem weevil on the yield of winter oilseed rape in vegetation season of 2009 and 2010

Variants	2009		2010	
	Yield,	Compared to control,	Yield,	Compared to control,
	t ha^{-1}	%	t ha^{-1}	%
Control	2.6	100	3.2	100
Proteus 110 OD	3.1	119	3.8	119
$LSD_{0.05}$	0.31		0.26	
r_{yx}	-0.99		-0.99	

Conclusions

1. Four species of brassica stem weevils have been identified on oilseed rape (*C. pallidactylus, C. picitarsis*, *C. sulcicollis*, *C.typhae*). *C. pallidactylus* is the most common species found on oilseed rape.
2. In Latvia sweep netting cannot be used for counting of brassica stem weevils, as no insects have been captured by this method.
3. Pest control of brassica stem weevil with a systemic insecticide Proteus 110 OD on winter oilseed rape (BBHC 39-44) provided a significant ($p<0.05$) yield increase of 0.5 to 0.7 t ha^{-1} (~19%) when compared to untreated areas.
4. Suitable methods for counting of brassica stem weevils in winter oilseed rape were use of yellow sticky traps and water traps.

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