

Phenology of cabbage stem flea beetle (*Psylliodes chrysocephala* L) in oilseed rape

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SUMMARY

The cabbage stem flea beetle (*Psylliodes chrysocephala* (L.)) is an important pest of winter oilseed rape in Serbia. Beetles colonize oilseed rape in early October and are active in the field until first frost and wintertime. In autumn, adults can be seen laying eggs in the soil around plants. Larvae of *P. chrysocephala* developed intensively on leaf petioles in November, reaching their highest numbers at the end of the month. No infested plants were found in a conventional field, while 14.5% of all dissected leaf petioles were infested on an integrated field. On unprotected plants in an organic field, 76.0% of the plants were infested with larvae at the growth-stage BBCH 18-19, with 31.1% infested leaves on average. As a result, the number of plants was reduced by 51%, i.e. from 43.0/m² recorded in the autumn to 22.0/m² in the following spring. A new generation of *P. chrysocephala* beetles emerged from the soil in the first half of June and rapidly escaped the fields from almost dry plants. Our results showed that a part of the population stayed in aestivation and emerged in the following crop during the next season. On the following 5 March, 0.5 beetles/m² were found in emergence cages in the organic field, while 0.81 beetles/m² were found in the former trap crop.

Keywords: Cabbage stem flea beetle; Oilseed rape; Phenology

INTRODUCTION

The cabbage stem flea beetle (*Psylliodes chrysocephala* (L.)) is the most widespread borer species of the winter oilseed rape in northern regions of Europe with coastal climate. The species is also found in the Middle East, Asia, North Africa, Canada and the United States. In Europe, it is one of the 6 most important pests of oilseed rape (Alford et al., 2003; Williams, 2010), and one of the major pests of winter oilseed rape in Serbia

(Kereši et al., 2007; Milovanović, 2007; Sivčev et al., 2012). However, its importance has decreased after insecticide seed dressing proved an effective control. Also, the application of insecticides for turnip sawfly *Athalia colibri* (Christ) control is effectively reducing its numbers.

The biology of *P. chrysocephala* has been studied extensively in countries in which oilseed rape is grown on large areas (Bonnemaison & Jourdeuil, 1954; Buhl, 1959; Ferguson et al., 2006; Williams et al., 2004).

As it has not been studied in detail in Serbia, the objective of this present survey was to present data on the phenology of *P. chrysocephala* in commercial oilseed rape fields.

METHODS AND MATERIALS

The experiment was conducted in three winter oilseed rape (OSR) fields, 1 ha each, located near the village Stari Žednik in northern Serbia, (N45° 57.280', E19° 37.554').

Oilseed rape seeds cv. Excalibur were sown on 17 September 2010 in three fields representing different management options (conventional, integrated and organic). In the field managed conventionally, the planted seeds were coated with a mixture of the pesticides thiamethoxam + fludioxonil + mefenoxam, while a foliar spray, Chlorpyrifos + Cypermetrin (500 g/ha + 50 g/ha), was applied on 25 March 2011, and N=148.4 kg ha⁻¹, P=80.4 kg ha⁻¹, K=80.4 kg ha⁻¹ K of mineral fertilizers were also applied. In the OSR field in which integrated management was used, the planted seeds were coated with the same mixture of pesticides, the foliar spray was Cypermetrin (100 g/ha), and a half dose of mineral fertilizers (N =80 kg ha⁻¹, P=39 kg ha⁻¹, K=39 kg ha⁻¹) was applied. In the organic field (under conversion), seeds were not dressed with any pesticides, Spinosad (96 g/ha) was applied as a foliar spray on 6 April 2011, and no mineral fertilizers were applied. A trap crop strip of turnip rape (*Brassica chinensis* x *Brassica rapa*), 3 m wide, was planted around the field. Fungicides and limacides were not applied in any of the fields.

Autumn and spring immigration of *P. chrysocephala* adults to OSR fields was monitored by yellow water traps (YWT). Four traps were placed in the middle of each field on 2 October 2010 (BBCH 12-13). The distance between neighboring traps was 50 m, beginning at 50 m from the edge. By the end of November (BBCH 18-19), the traps were checked 4 times and the captured adults counted (10 October, 1 November, 10 November, 30 November 2010). Trapping was discontinued in December and the traps were removed after the first snow. Four yellow traps were set up again from 20 January 2011. From mid-March, insects were collected at intervals of 7 days until oilseed harvest. The YWTs were mounted on holders, so the traps were always above the oilseed rape crop. A 5% sodium benzoate solution was used as conservation fluid in YWTs and refilled as needed.

In the fall of 2010, randomly selected plants were sampled and dissected in the laboratory on 10 November 2010 (BBCH 17-18) and 30 November 2010 (BBCH

18-19). Each time, 80 plants per field (10 plants per 8 sampling points) were collected. In order to determine the presence/abundance of larvae each leaf petiole and root were dissected. In the spring of 2011 oilseed rape plants were collected and dissected three times, on 12 April 2011 (BBCH 55-57), on 19 April during the full flowering of oilseed rape (BBCH 63-65), and at the end of flowering on 3 May (BBCH 69 -71), and larvae were counted.

Emergence cages (www.ecotech-bonn.de/de/produkte/oekologie/bodenphotoelektor.html) with epigeic pitfall traps added to each cage were used to determine the number of beetles in a newly emerged generation. Eight cages were placed in the middle of each field and adult sampling began at the end of flowering on 27 April 2011 (BBCH 68). One day before oilseed rape harvest (21 June 2011), the cages were removed. Insects were trapped at 7-14 day intervals. Due to high temperatures, ethylene glycol was used in photoelector top vessels, as well as in epigeic pitfall traps inside cages, instead of the 5% solution of sodium benzoate.

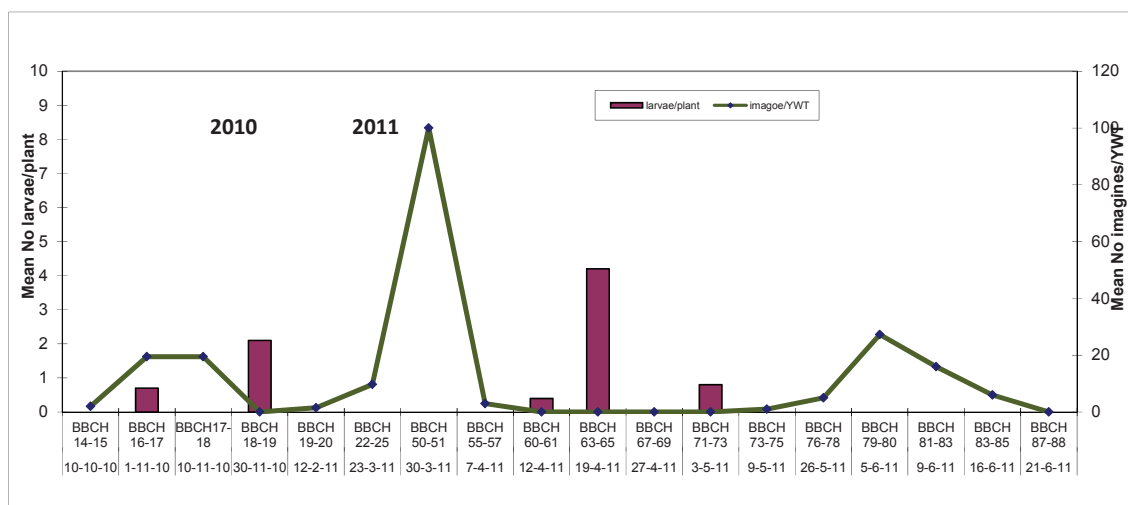
RESULTS

Visual inspection for flea beetle adults from the initial stages of oilseed rape development BBCH 10-11 up to BBCH 18-19, resulted in finding two species of flea beetles - *Phyllotreta nemorum* L. and *Psylliodes chrysocephala*. The former was found sporadically and in small numbers in all three fields during autumn. *Psylliodes chrysocephala* was present in much greater numbers and consistently in yellow water traps during autumn. Immigration flight of *P. chrysocephala* into the oilseed rape crop began in October and gradually increased in numbers (Figure 1). Maximum flight, as shown in YWT, occurred in November when daily temperatures reached as much as + 20 ° C.

The feeding activity of *P. chrysocephala* was low at the growth stages of cotyledons and the first leaf developed, when plants are most vulnerable to feeding beetles. At the cotyledon growth stage (BBCH 9-10) damage was detected on a few plants. Feeding was most intense in November (Figures 2 and 3). However, the oilseed rape plants were well developed (BBCH 16-18) during that period, so that leaf damage was less evident. The average number of flea beetles captured in YWT over the sampling period 2 Oct.-30 Nov. 2010 showed an increase in flight activity with a reduction in intensity of management (conventional field<integrated field<organic field) (Table 1)

Table 1. Mean number of *P. chrysocephala* captured per YWT during autumn 2010 and % of damaged plants and leaves (sampling period 2 October - 30 November)

Field	Mean number (\pm s.e.) of <i>P. chrysocephala</i> beetles per YWT	% of damaged leaves (BBCH 18-19)	% of damaged plants
Conventional	5.5(\pm 4.5)	0.0	0.0
Integrated	26(\pm 2)	14.5	44.0
Organic	40(\pm 24)	31.1	76.0

**Figure 1.** Flight of *P. chrysocephala* beetles detected by YWTs and number of larvae in oilseed rape plants, October 2010- June 2011

During November, adults were noticed on the ground around oilseed rape plants, which indicated egg laying. The first sampling and dissection of leaf petals were done on 10 November 2010 (BBCH 17-18). Dissection data showed that larvae were at the beginning of development (L1) and that sampling and dissection were performed too early. The second sampling and dissection were conducted on 30 November 2010. The results of dissection revealed that 76% of the plants in the organic field were infested, while 31% of leaf petioles contained *P. chrysocephala* larvae (Figure 1). In the integrated field, 44% of the plants and 14.5% of all dissected leaf petioles were infested. In the conventional field, no infested plants were recorded. Due to damaged leaves, plants were not able to successfully overwinter. In the organic field, which was most infested, the number of plants in the spring was reduced by 51%, from 43.0/m² to 22.0/m², while a reduction did not occur in the conventionally managed and integrated fields, where the numbers varied from 30.3/m² to 30.5/m², and 31.2/m² to 35.0/m², respectively.

**Figure 2.** Feeding tunnels of *P. chrysocephala* larvae in oilseed rape leaf petioles, 30 November 2010

After a December-January winter break, adults flying activity was continued in February and throughout the following spring. Maximum flight activity was on 30 March 2011, when oilseed rape was at the growth stage of inflorescence emergence BBCH 50-51. Although the beetles were numerous (Figure 1), feeding damage was hardly visible because plants were already well-developed. During April and May adult activity was not recorded. However, during that period larval feeding activity was detected in stems and in the first three lower leaf petals. Dissection of the main stem and leaf stalks on 12 April, 19 April and 3 May (BBCH 60-73) revealed the presence of *P. chrysocephala* larvae in the main stem. Adults of a new generation were found in photoelector cages from 26 May (BBCH 77-78) until 21 June 2011 (BBCH 87-88) (Figure 4). Newly emerged beetles fed intensively on husks and upper parts of the main raceme (Figure 5). The trap crop of turnip rape attracted a considerable number of beetles and the largest number of adults emerged from its soil. This indicates that turnip rape

can be used as a trap crop for management of this pest. In July no emergence or flight of beetles was recorded. Photoelector cages were left in the field throughout a fallow and further on during the following year, when an emergence of as much as 0.5 beetles/m² was recorded in the most infested organic field on 5 March 2012, while 0.81 beetles /m² were found in the trap crop.



Figure 3. Feeding scars on oilseed rape and turnip rape leaves, October 2010

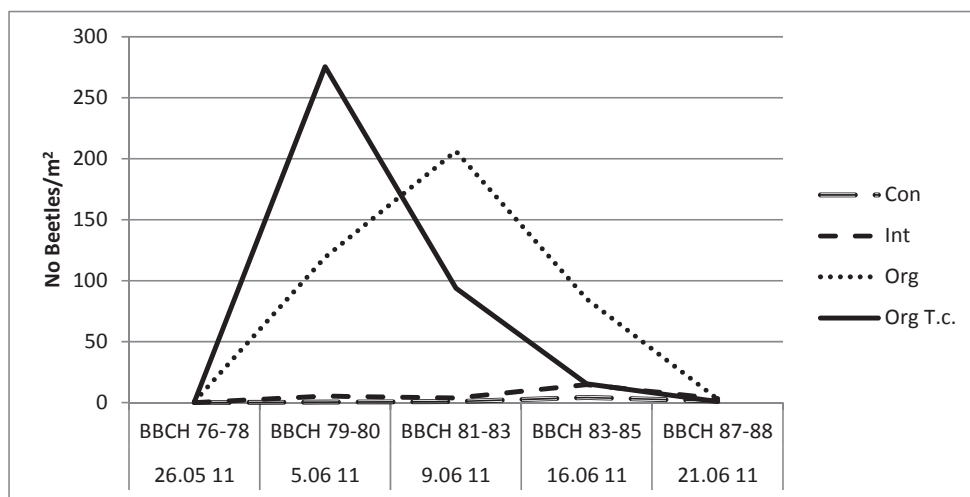


Figure 4. Emergence of a new generation of *P. chrysocephala* beetles

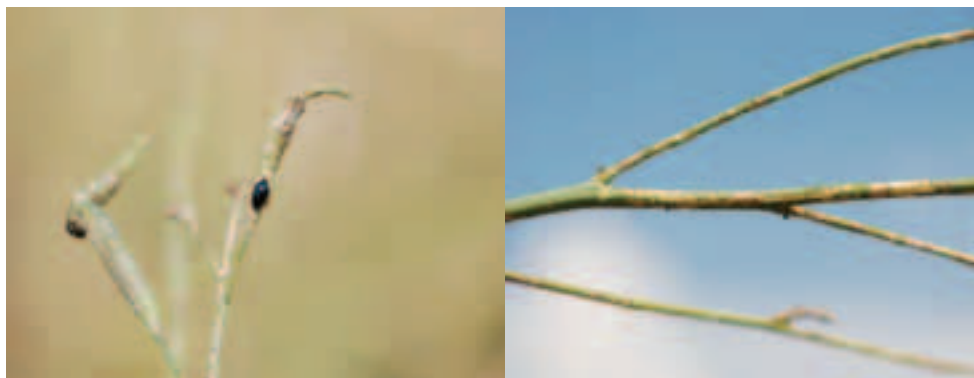


Figure 5. New generation of *P. chrysocephala* feeding on oilseed rape husks and branches, June 2011

DISCUSSION

The cabbage stem flea beetle *P. chrysocephala* is an oilseed rape pest whose importance has decreased with the introduction of effective seed treatments with insecticides. In our research, we detected damage from cabbage stem flea beetle only in the organic field for which seeds were not treated with insecticides. It should be noted that plants infested with this pest suffered more during wintertime due to frost and resulting stalk rot. In the oilseed rape fields using conventional and integrated management practices and seeds treated with neonicotinoids, damage was either small or not observed at all. The survival of larvae on these fields was very low, which resulted in a very low number of new generation beetles. Therefore, it is clear that commercial oilseed rape production, which is using seeds treated with insecticides, are not an important source of re-infestation. This also indicates that the species survives on other host plants and migrate from there to oilseed rape in the fall. Therefore, seed coating with insecticides, as well as a reduction in alternative plant hosts, are important for control of *P. chrysocephala*.

Reduction in the number of OSR plants during winter can be considerable, as it was in our fields sown with unprotected seeds, reaching 50%. Due to such large-scale damage, control of *P. chrysocephala* should be a standard measure. Before the practice of coating seeds with insecticides was introduced in commercial production, destruction of entire crops had been reported (Maceljski et al., 1980).

Beetles of a new generation that emerge in June feed intensively and are able to damage OSR plants. In the first half of June OSR plants are in the ripening stage when pods rapidly mature and develop black and hard seeds. Pest feeding over the period therefore results in yield loss. The beetles then quickly fly away from the oilseed rape crop and can no longer be seen on its already dry plants. They find sheltered places in surrounding headland or groves where to creep into cracks. In summer, the beetles are in a state of aestivation (Bonnemaison & Jourdeuil, 1954). In the fall, after spending about two months in diapause, they become active again. Then they search for oilseed rape plants or other plants of the family *Brassicaceae* where females will feed again and lay eggs in the soil around plants. *P. chrysocephala* has one generation per year (Alford et al., 2003; Williams 2010). Our results showed that a part of the population stays in aestivation and emerges in the spring of the following year. In emergence cages left in the fields, 0.5 beetles/m² were found in the organic field on 5 March of the following year, while 0.81 beetles/m² were found in the former trap crop.

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Fenologija crvenoglavog buvača (*Psylliodes chrysocephala* L.) u uljanoj repici

REZIME

Crvenoglavi buvač (*Psylliodes chrysocephala* L.) je važna štetočina ozime uljane repice u Srbiji. Naseljava uljanu repicu početkom oktobra i aktivan je u polju sve do pojave mraza i zime. Tokom jeseni adulti se mogu videti kako polažu jaja u zemljište u blizini biljaka. Larve *P. chrysocephala* se tokom novembra intenzivno razvijaju u lisnim peteljka i najviše ih ima krajem ovog meseca. Na netretiranim biljkama disekcijom je utvrđeno 76.0 % napadnutih biljaka sa u proseku 31.1 % napadnutih listova u razvojnom stadijumu BBCH 18-19. Rezultat ovalikog napada je bilo smanjenje broja biljaka za 51%, od 43,0/m² koliko ih je bilo u jesen na 22,0/m² u proleće naredne godine. Nova generacija adulta *P. chrysocephala* izleće iz zemljišta tokom prve polovine juna i brzo napušta polje sa skoro suvim biljkama uljane repice. Naši rezultati su pokazali da deo populacije ostaje u dijavauzi i eklodira u narednom usevu tokom proleća naredne godine. Mi smo u fotoeklektor kavezima, koji su ostavljeni u polju i tokom naredne godine, 5. marta 2012. u organskom polju registrovali 0.5 imaga/m², dok je u lovnom pojasu zabeleženo 0.81 imaga/m².

Ključne reči: Crvenoglavi buvač; Uljana repica; Fenologija