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Blue stem weevil (*Ceutorhynchus sulcicollis*) – a potential threat to oilseed rape production

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Oilseed rape (*Brassica napus*) has numerous insect pests, some of which are stem-miners. Currently, blue stem weevil (*Ceutorhynchus sulcicollis*) is not considered a pest of oilseed rape. In the present study, a total of 60 (30 untreated, 30 insecticide-treated) oilseed rape plants were dissected; and stem-mining larvae were collected, and subsequently allowed to pupate in soil. After pupation, all emerged adult weevils were identified as either blue stem weevil (*C. sulcicollis*) or cabbage stem weevil (*Ceutorhynchus pallidactylus*). We report that under favourable conditions *C. sulcicollis* was capable of reaching pest status, and was significantly more abundant than *C. pallidactylus*, indicating a critical need for future studies regarding *C. sulcicollis*.

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Introduction

Oilseed rape (*Brassica napus* L.) is a valuable food resource for insects. Most of them are not harmful to oilseed rape production, but rather beneficial by pollinating the crop. However, some are considered as pests, and can considerably decrease yield, or even destroy the plants (reviewed in Alford et al. 2003). Blue stem weevil (*Ceutorhynchus sulcicollis* Paykull) is found all over Europe, but rarely recorded on oilseed rape (Alford et al. 2003). Its primary food plants are wild cruciferous plants like *Sisymbrium officinale* L. and *Alliaria petiolata* (M. Bieb.) Cavara & Grande (Morris 2008). The biology of *C. sulcicollis* is poorly described, but as Dieckmann (1972) and Hayn (1970) report, this weevil species is active throughout winter and lays eggs variously in autumn and spring, depending on winter conditions. They oviposit on the underside of leaf petioles, into the stem epidermis; and larvae mine into the stem, causing stem damage, eventually boring out of the stem to pupate under the soil surface. Next generation adults emerge from April onwards, and after a brief period of maturation feeding they aestivate in forest edges, reappearing in September. *Ceutorhynchus sulcicollis* shows similar behaviour to its intragenus relative *Ceutorhynchus picipitarsis* Gyllenhal, which also undergoes summer aestivation until September, and lays eggs through autumn and winter (Barari et al. 2005). In Estonia, Veromann et al. (2006a) had detected only ten

C. sulcicollis specimens in 2005 (using yellow water traps) on winter oilseed rape and zero in their previous studies in 2002–2003 in winter and spring oilseed rape (Veromann et al. 2006b, 2006c). However, Grantina (2012) indicated that the abundance of *C. sulcicollis* in Latvia can differ 11.2-fold between years, and that under certain conditions abundance may increase. The present study provides an overview of *C. sulcicollis* findings in Estonia, from 2020; and we discuss potential causes and implications of our findings.

Material and methods

Thirty randomly chosen winter oilseed rape plants were collected from an untreated oilseed rape field (58.37389° N, 26.33114° E) in Nasja, Tartu County, Estonia, on 4 May 2020, during the stem elongation growth stage (BBCH 30–31; Meier 2001). Plants were transported to the lab, replanted in 5 L pots, and individually covered with fine mesh fabric bags in order to prevent contamination by other insects. Covered plants were maintained in the lab for one month at 20–22 °C, under a 16:8 h light:dark cycle; plants were watered regularly. After one month, plants began to wilt, and we investigated the cause of wilting by dissecting all 30 plants on 1 June 2020. Dissections revealed severe stem damage and an abundance of stem-mining larvae. Since the identification of insect larvae is problematic, collected larvae were pooled into

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a box of moist soil to facilitate pupation. The box was covered with fine mesh fabric, and placed into a climate chamber (Sanyo MLR-351H, Osaka, Japan) at 20°C, 60% relative humidity and 16:8 h light:dark cycle. Soil was kept moist by spraying with water daily. Emerged adult weevils were collected and kept at –20°C until later identification. Species identification was performed via Kirk (1992) and Morris (2008) and confirmed via comparison to voucher specimens from the entomological collection of the Estonian University of life Sciences.

To compare stem damage between untreated- and insecticide [Proteus OD (application rate of 0.6–0.75 l/ha with 200–300 l/ha water) active ingredients deltamethrin 10 g/L and thiacloprid 100 g/L (Bayer CropScience)]-treated plants, 30 randomly chosen winter oilseed rape plants were collected from the same field as the untreated plants, on 2 June 2020, after insecticide application (field was treated on 5 May 2020). Plants were transported to the lab and dissected as described above. To compare the number of weevil larvae found in stems of untreated vs. treated winter oilseed rape plants, Welch's t-test was performed in R v1.2.1335 (R Foundation for Statistical Computing, Vienna, Austria). The total number of emerged weevils per treatment was recorded.

Results and discussion

Stem-mining weevil larvae damaged 29 of the 30 collected untreated winter oilseed rape plants. The number of weevil larvae collected from stems of untreated winter oilseed rape plants was significantly greater than that collected from insecticide-treated plants ($t = 5.67$, $df = 31.2$, $p < 0.0001$); respective averages of 9.33 ± 1.41 and 1.17 ± 0.28 larvae per plant being found. The majority (90%) of the 280 larvae collected from untreated plants successfully completed pupation. Regarding weevil larvae collected from insecticide-treated plants (total of 35 larvae), only two specimens emerged as next generation adults. Of all emerged next generation adults from specimens collected from untreated oilseed rape plants, 204 of them were identified as *C. sulcicollis*, and 47 as *C. pallidactylus*. Of the two adult specimens from larvae collected from treated oilseed rape plants, one was identified as *C. sulcicollis*, and the other as *C. pallidactylus*. Growing conditions between untreated- and treated plants were different, as treated plants were in the field longer. Plants used for dissection were collected from the same field, and the weevils likely oviposited while the plants were still in the field. Collecting larvae from dissected plants can be problematic, and if the plants would have been dissected immediately after collection

(early May), chances for first-instar larval survival and successful pupation would have been low. Larvae collected from treated plants may have been more vulnerable due to different environmental conditions, compared to untreated plants, possibly affecting the survival rate. Seemingly healthy larvae collected from treated plant stems were not able to successfully complete pupation, suggesting a possible effect of insecticide to the larvae, representing a potential reason for very low abundance in previous years.

Currently, *C. sulcicollis* is not considered an important pest of oilseed rape. Our findings support the hypothesis of Grantina (2012), that under favourable conditions they may reach pest status. We suggest that our findings are likely linked to the relatively mild winter conditions of 2019–2020, which may have been favourable for *C. sulcicollis* reproduction and survival. According to the Estonian Weather Service, there have been no winters with a mean temperature as warm as that of 2019–2020 since 1961–1962 (the beginning of systematic weather data collection). In previous years, the mean winter temperature has been approximately –3.3°C, whereas the winter of 2019–2020 had a mean temperature of 2.5°C (Estonian Weather Service 2020). *Ceutorhynchus sulcicollis* is known in Northern Europe, yet literature regarding this insect for international readers is inadequate, indicating the importance of these findings for the broader scientific community. The outcome of this experiment was unexpected and previously not detected in our region. Therefore, supporting data from previous years is non-existent. Our results indicate the need for field studies regarding *C. sulcicollis*, as this species which is currently not considered to be of economic importance may prove to be more widespread and abundant with sufficient monitoring.

Winter oilseed rape, in autumn, forms a group of low-hanging leaves that wither under typical Estonian winter conditions (Ilumäe 2013); and thus, eggs laid during the autumn before winter 2019–2020 may not have survived. Therefore, oilseed rape may not have been a suitable host plant for *C. sulcicollis* during past years in Estonia, because the plant parts suitable for oviposition perished during winter. Weevil larvae collected from untreated vs. treated oilseed rape plants, together with the emergence rates of next generation *C. sulcicollis* adults reared from the same treatments, suggest that treating oilseed rape fields in spring may have reduced the abundance of *C. sulcicollis*. However, further studies considering resistance and lethality of insecticides should be carried out, as there are no studies evaluating the efficacy of insecticides on *C. sulcicollis*.

In order to understand whether population sizes – or distributional area of *C. sulcicollis* have increased, and whether there is indeed a new oilseed rape pest in

northern Europe, further studies are needed. Literature regarding this weevil is scarce and outdated. Our results suggest that, under favourable winter conditions, *C. sulcifollis* populations may increase, thus representing a potential threat to oilseed rape production.

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Silva Sulg is a PhD student focusing on interactions between plants, pests and parasitoids in agricultural landscapes.

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Jonathan Willow (PhD) is a researcher and his primary research is focusing on RNAi and its role in crop protection.

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