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YELLOW AND BLACK PLUM SAWFLY POPULATION IN THE ORCHARD "MAKSIMIR"

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SUMMARY

The population of plum sawflies (*Hoplocampa flava* L. and *Hoplocampa minuta* Christ.) was studied in the orchard "Maksimir" at the Faculty of Agriculture in Zagreb. White adhesive plates were placed on the plum cultivar 'Čačanska pozna' and monitoring lasted from March 7 to April 25, 2019. The presence of both plum sawflies was established on April 4 at the beginning of the plum blossom, and population abundance was changing during the plum blossom phases. At the beginning of the plum blossom the highest number of yellow plum sawfly was recorded (209 individuals) while the highest number of black plum sawfly was recorded in the full bloom stage (103 individuals). Considering that the population of plum sawflies is regularly high in Croatian plum orchards, it has not been known so far whether the flight dynamics of these two species differ from each other, as it was confirmed by this study. Monitoring results showed the dominance in abundance of yellow plum sawfly in the research orchard, but both species develop in high populations which can cause greater damage to plum production in the investigated orchard.
Key words: catch dynamics, *Hoplocampa flava* L., *Hoplocampa minuta* Christ, plum, population abundance

POPULACIJA ŽUTE I CRNE ŠLJIVINE OSICE U VOĆNJAKU "MAKSIMIR"

SAŽETAK

Populacija šljivinih osica (*Hoplocampa flava* L. i *Hoplocampa minuta* Christ.) istraživana je u voćnjaku "Maksimir" na Agronomskom fakultetu u Zagrebu. Bijele ljepljive ploče postavljene su na sortu šljive 'Čačanska pozna', a praćenje je trajalo od 7. ožujka do 25. travnja 2019. godine. Prisutnost obje vrste

ustanovljena je 4. travnja na početku cvatnje šljive, a brojnost populacije mijenjala se tijekom faza cvatnje šljive. U fazi početka cvatnje šljive ulovljen je najveći broj žute šljivine osice (209 primjeraka), dok je najveći broj crne šljivine osice ulovljen u fazi pune cvatnje (103 primjeraka). S obzirom da je u hrvatskim voćnjacima populacija šljivinih osica redovito visoka, do sada nije bilo poznato razlikuje li se dinamika leta navedenih vrsta, što je potvrđeno ovim istraživanjem. Rezultati praćenja pokazali su izuzetno veliku dominaciju žute šljivine osice u ulovu, no obje vrste razvijaju se u visokoj populaciji koja može uzrokovati veću štetu u proizvodnji šljive u istraživanom voćnjaku.
Ključne riječi: dinamika ulova, *Hoplocampa flava* L., *Hoplocampa minuta* Christ., šljiva, veličina populacije

INTRODUCTION

Yellow (*Hoplocampa flava* (Linnaeus, 1761)) and black (*Hoplocampa minuta* (Christ, 1791)) plum sawflies are considered the most important plum pests. They belong to the order Hymenoptera, suborder Symphyta, family Tenthredinidae and genus *Hoplocampa* (Maceljski, 2002). Yellow plum sawfly (*H. flava*) is yellow-red coloured with dark yellowish wings, while the black plum sawfly (*H. minuta*) is black coloured, has short yellow-brown antenna and transparent wings with brown veins (Kovačević, 1961). Both mature sawflies are 4.5-5 mm long and their wingspan is approx. 12 mm (Maceljski, 2002). Larvae of both sawflies are light yellow, of an elongated body and have three pairs of pectoral legs and seven pairs of abdominal legs. They can reach a size up to 8 mm (Maceljski, 2002). They contain gland that gives off an unpleasant smell (Kovačević, 1961). Life cycle of both plum sawflies is the same. Larvae overwinter in the soil and at the end of winter they make cocoons (Friedrich & Rode, 1996). When the temperature of the soil at a depth of 5-10 cm reaches 10 ˚C, mature forms come out of the soil. At the time of the plum blossom, sawflies fly on the plum and feed on pollen and nectar. After copulation, females lay eggs on the outside of the leaf calyx of semi-open or open flowers. Each female lays 50–70 eggs singly on the flower calyx (OEPP/EPPO, 2004). Duration of the incubation depends on the temperature (approx. 8 days) and the emergence of larvae very often coincides with the end of the plum blossom. Larvae move from the outside of the leaf calyx and infiltrate the ovary over its edge (Maceljski, 2002). It feeds on fruit tissue and seeds, and one larva can damage up to five fruits (Friedrich & Rode, 1996). There could be many larvae in one fruit while they are young, but in that case, they move on to another fruit, so there is always only one plum sawfly larva in the fruit (Kovačević, 1961). Larva completes its development during 20 to 25 days and then, together with the attacked fruits 4 to 5 mm in size, falls on the ground where they make cocoons (OEPP/EPPO, 2004). On various plum cultivars damage can reach up to 50-85% if the plum blossom was poor (Andreev &

Kutnikova, 2010; Rozpara et al., 2010). One larva attack 4 to 5 fruits which is causing a waste of attacked fruits while they are still 5 mm in size and reducing the yield of fruits. Attacked fruits can be recognised by black exit hole (Maceljski, 2002). Since plum sawflies appear regularly in Croatia, their population must be suppressed (Maceljski, 1991). In integrated protection white adhesive plates are used (Wildbolz & Staub, 1984; Igrc Barčić & Maceljski, 2001) to follow insect pest flight activity and to determine the optimal treatment period. Plates should be set up one week before the plum blossom and then checked every three to four days. The weekly catch of 30 black or yellow plum sawflies on one plate is considered an intense attack (Ciglar, 1998). A period of egg hatching coincides with the end of full blossom and with the beginning of the petals falling off. During these periods, the suppression of plum sawflies is forbidden, since the bees are still active, making it difficult to control these pests. Soon after blooming it is recommended to use active substances less harmful to bees. During the petal falling bees no longer appear, and a wider range of active substances can be used. Ciglar & Barić (2002) demonstrated a good efficacy of all insecticides against closely related apple sawfly (*Hoplocampa testudinea* Klug, 1816) in their research. In 2019, the following active substances were registered for this purpose in Croatia: acetaprimid, delthametrin and alpha-cypermethrin (PIS, 2019). For ecologically friendly suppression of plum sawflies entomopathogenic nematodes of species *Steinernema carpocapsae* (Weiser, 1955)*, Steinernema feltiae* (Filipjev, 1934)*, Steinernema kraussei* (Steiner, 1923) and *Heterorhabditis bacteriophora* (Poinar, 1976) can be used (Nježić, 2017), since they are highly specialized and unharmful to other organisms or the environment (Nježić, 2016). Some studies (Jaworska, 1992) on closely related apple sawfly have shown that entomophagous fungi may also contribute to high mortality of plum sawflies in soil. Although plum sawflies are regularly present in Croatian orchards, there is little knowledge about their overall population size and possible differences in flight dynamics, and a lack of such data is noticeable even in foreign research. The aim of this research was to investigate plum sawflies catch dynamics and population abundance by using visual attractants at the “Maksimir” orchard.

MATERIALS AND METHODS

A research of flight dynamics and the population abundance of plum sawflies were conducted during 2019 at experimental station “Maksimir” (45°49’43”N, 16°01’44”E), next to the Faculty of Agriculture. On an area of 1200 m^2 cherries, plums, apples, pears, strawberries, raspberries, blackberries, and other fruits are grown. Domestic and introduced genotypes of fruit species are planted there and the primary purpose of this station is the education of students.

For the monitoring of plum sawflies Bio Plantella white adhesive plates produced by Unichem Agro d.o.o. were used. Dimensions of white adhesive plates were 20x25 cm. They are coated with transparent glue and do not contain active chemical substances for plant protection. One white adhesive plate was set up on the plum cultivar 'Čačanska pozna' on March 7, 2019, i.e. before the blossom. Inspection and replacement of plates were undertaken every seven days until the end of the plum blossom, i.e. March 25, 2019. After regular weekly change of adhesive plates, plum sawfly individuals were identified and counted using Stereo microscope Carl Zeiss V8 in the laboratory of Department of Agricultural Zoology, Faculty of Agriculture according to a standard identification key (Alford, 1984).

Total catches of sawflies were subjected to analysis of variance (ANOVA) to determine differences in individual catches with respect to plum blossom stages. Statistical data processing was performed by using ARM 2019® GDM software (Gylling Data Management, 2019).

RESULTS AND DISCUSSION

During the monitoring period, altogether 266 yellow plum sawfly (*Hoplocampa flava* L.) individuals were caught. The highest catch was recorded in the first week of monitoring since March 28 until April 4 (209 individuals) and a significant catch was recorded a week later, since April 4 until April 11 (52 individuals). In mid-April (April 11 until April 18), only two individuals of yellow plum sawfly were caught, and until the end of monitoring period (April 18 until April 25) only three more individuals were caught (Fig. 1). In the same first week of monitoring, 28 individuals of black plum sawfly were caught, and in the following two weeks (since April 4 until April 18) 103 individuals were caught. After April 18, until the end of the monitoring period, only 6 more individuals were caught (Fig. 1).

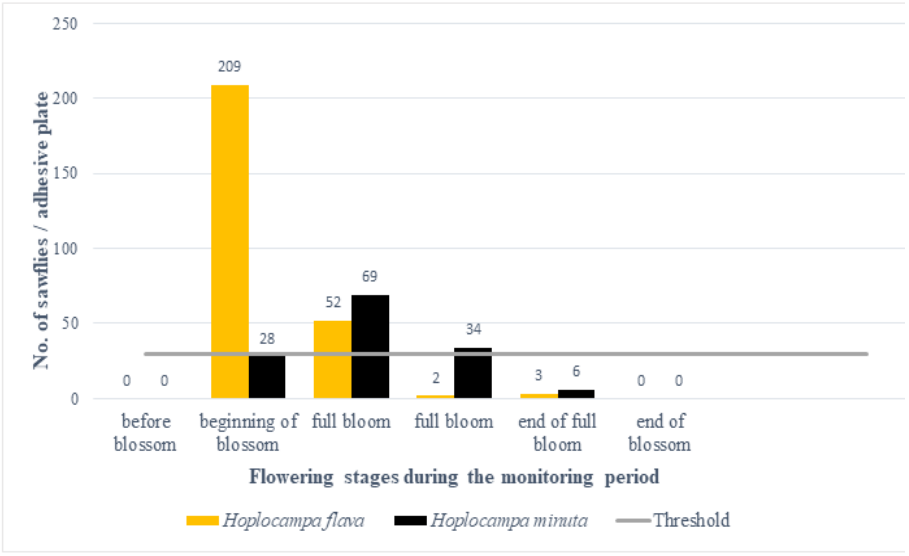

Figure 1 The catch dynamics of *Hoplocampa flava* and *Hoplocampa minuta* in relation to threshold in orchard "Maksimir" in 2019
Grafikon 1. Dinamika ulova vrsta *Hoplocampa flava* i *Hoplocampa minuta* u odnosu na kritičan broj u voćnjaku "Maksimir" 2019. godine

In comparison with yellow plum sawfly, total catch of black plum sawfly was twice lower and during the monitoring period altogether 137 individuals were caught, which is 34% of the total catch (Fig. 2).

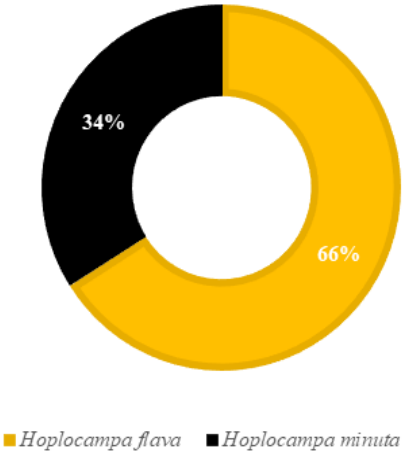

Figure 2 Catch ratio of yellow and black plum sawfly in orchard "Maksimir" in 2019
Grafikon 2. Omjer ulova žute i crne šljivine osice u voćnjaku "Maksimir" u 2019. godini

The population abundance of plum sawflies oscillated at certain plum flowering stages (Fig. 1) and during the whole monitoring period, 403 plum sawfly individuals were caught. Before the beginning of the plum blossom, plum sawflies were not caught, which was expected considering the existing literature data (Maceljski, 2002). They began their activity at the beginning of the plum blossom when the highest number of individuals was recorded (209 yellow and 28 black plum sawflies). Taking into the consideration that the critical weekly number (threshold) of plum sawflies amounts to 30 individuals per adhesive plate (Ciglar, 1998), it is evident that this number was exceeded during the beginning of the blossom when altogether 237 specimens were caught. The same catch trend continued a week later (the first week of full bloom) when 121 individuals of plum sawflies were determined (52 yellow and 69 black plum sawflies) (Fig. 1). After the second examination and at the same stage of full bloom, 36 individuals were determined (2 yellow and 34 black plum sawflies). Therefore, the critical number was exceeded twice at this plum stage (Fig. 1). Tamošiūnas et al. (2014) investigated population dynamics and damage of plum sawflies in plum orchard (cv. 'Stanley') in Lithuania and concluded that when mass flight coincided with plum blossom, a high damage level of 27.8% occurred even at lower population densities. But when mass flight is strongly shifted towards the end of flowering, a low damage of 7.0% can be expected. Based on these results, trap catch data could be reliably used to predict the magnitude of fruit damage level only when mass flight coincides with susceptible flowering phase (Tamošiūnas et al., 2014). During the end of the full bloom a critical number was not determined since nine individuals of plum sawflies (3 yellow and 6 black plum sawflies) were recorded. When the last petals fell from the plum flowers, plum sawflies were not caught so it is reasonable to assume that the black and yellow plum sawfly flight finished simultaneously with the end of plum blossom. The highest number of yellow plum sawfly occurred during the beginning of the plum blossom (209 caught individuals) and one week later, during the full bloom the number fell drastically (52 caught individuals). Their activity in the next week of monitoring was almost negligible. A different trend in flight dynamics was observed with the black plum sawfly whose activity at the beginning of plum blossom was more than 7 times lower than the yellow sawfly. The highest number of black plum sawfly was observed during the full bloom of plum during which a total of 103 specimens of this species were recorded (Fig. 1). After performing the statistical analysis no significant differences in catches regarding the different blossom stages were observed ($p=0,560$).

Based on these data, it can be concluded that the flight dynamics of the two species differs in the study area and that the yellow sawfly reaches the peak of the flight at the beginning of the plum blossom and black sawfly during the full bloom.

Drmić (2015) conducted monitoring of yellow and black plum sawfly populations during the plum blossom in 2003 at the experimental station "Jazbina" (Faculty of Agriculture, Zagreb) by using white adhesive plates. During the monitoring period, a total of 289 individuals were recorded, indicating that sawfly populations during 2013 vegetation season was also high and that it required suppression. However, the relationship of these two species was different with respect to this research. At the experimental station "Jazbina", the catch ratio of black plum sawflies (*H. minuta*) amounted to 66% of the total catch with 192 individuals caught, while the catch of yellow plum sawflies (*H. flava*) amounted to 34% with the total catch of 97 individuals (Drmić, 2015). It can therefore be assumed that microclimatic conditions in that area favoured the dominance of the black plum sawfly.

CONCLUSION

Flight dynamics and the population abundance of the yellow (*Hoplocampa flava*) and black (*Hoplocampa minuta*) plum sawfly were determined during the spring of 2019 by using white adhesive plates for the first time in orchard of experimental station "Maksimir". During this research, which lasted since March 7 until April 25, through different stages of plum blossom, a total number of 403 individual plum sawflies was determined. Yellow plum sawfly was the dominant species with a total catch of 266 individuals (66%). The flight dynamics of yellow and black sawfly also differed since the highest number of yellow sawflies was detected at the beginning of plum blossom while the highest number of black sawflies was observed during the full bloom of plum. At the end of the full bloom the number of black and yellow plum sawflies was drastically decreased, and after the last petals had fell off, their flight finished. The critical number (30 plum sawflies per one adhesive plate) was determined during the beginning of the plum blossom when 237 individuals were caught and during the full bloom when in two examinations the number of plum sawflies amounted to 126 individuals. According to this research, both black and yellow sawflies occur in the critical number in orchard "Maksimir", but the dynamics of their flight differ from one another.

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