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Proceeding Paper

Which Color is Better? Efficiency of Color Traps for Monitoring of Black Plum Sawfly †

Igor Shevchuk [1,*] and Olga Shevchuk [2]

[1] Sector of Plant Protection, Institute of Horticulture of National Academy of Agrarian Sciences of Ukraine, Sadova Str., 23, Novosilky, 03027 Kyiv, Ukraine
[2] Laboratory of Phytopathology, Institute of Plant Protection of National Academy of Agrarian Sciences of Ukraine, Vasylkivska st., 33, 03022 Kyiv, Ukraine; phytoppi@ukr.com
* Correspondence: shevig@ukr.net
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Abstract: Black plum sawfly (*Hoplocampa minuta* Christ. (Hymenoptera: Tenthredinidae) is one of the dominant pests of plum in Ukraine, causing significant damage and yield losses. Monitoring based on pheromone and color traps is widespread in integrated protection systems. Data on the dynamics and location of the population of the pest in the agrobiocenosis allow to determine the feasibility, scale and optimal timing of treatments, tactics and means of control. The investigation was carried out in conventionally managed plum orchard of the Institute of Horticulture of National Academy of Agrarian Sciences of Ukraine. Sticky traps of different colors (white, blue, yellow, red and green) were used. The flight period lasted from 17 to 34 days. White traps provided the highest efficiency during the flight period of the plum sawfly. The proportions of insects caught by yellow and blue traps decreased 4 times, and red and green traps 9 times compared to white ones. At the peak of the sawfly's flight the efficiency of white traps increased. The average densities of sawflies during the flight period were: for white traps—89 imago per trap, yellow—10 imago per trap, red—4 imago per trap, blue—10 imago per trap, green—12 imago per trap. The density of the sawfly population depended on meteorological conditions, in particular on the humidity and temperature of the soil and air.

Keywords: plum; black plum sawfly; color traps; monitoring; flight dynamics

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1. Introduction

Black plum sawfly (*Hoplocampa minuta* Christ. (Hymenoptera: Tenthredinidae) is monovoltine, monophagous species. It is reported as one of the most dangerous plum pests in all areas of plum cultivation in Europe [1–4]. According to different authors, fruit damage is up to 36–84% [1,5,6].Especially it is harmful in organic or non-treated orchards where it can damage up to 96% of fruitlets [3–5,7]. In Ukraine it is one of the dominant pests of plum.

Black plum sawfly control strategies mostly are based on pesticide application. One of the key elements for successful pest control is to determine the optimal period for spraying as accurately as possible. Monitoring based on color traps is widespread in integrated protection systems. Data on the dynamics and location of the population of the pest in the agrobiocenosis allow to determine the feasibility, scale and optimal timing of treatments, tactics and means of control [6,8].

The aim of our investigations was to monitor flight activity of black plum sawfly using different color sticky traps.

2. Materials and Methods

The investigation was carried out in conventionally managed plum orchard of the Institute of Horticulture of National Academy of Agrarian Sciences of Ukraine in 2015–2020 on cultivar 'Stanley'.

The sticky traps (20 × 15 cm) were placed at 1.2 m above the ground on plant branches on the south side. Sticky traps of different colors (white, blue, yellow, red and green) were used. For every color 5 traps were placed out. Trap inspection was carried out every two days.

The glue trap efficiency was determined by the formula:

$$E = 100 \cdot \frac{N_1}{\sum N}$$

∑N—the total number of imago;

N_1—the number of imago caught by the certain trap type.

Experimental data were analyzed by one-way ANOVA followed by Duncan's multiple range test ($p = 0.05$).

3. Results and Discussion

According to the results of long-term catches, the flight dynamics of the plum sawfly and the efficiency of colored traps were determined. The beginning of the flight of adults was observed on day 31–42 from the beginning of bud swelling, which occurs in the third decade of April. In 2017, 2018 when flight intensity was low, the flight period of the black plum sawfly lasted 17–19 days. Peak of flight was observed in the first decade of May, when white traps caught 1.5–4.0 specimens per trap. The duration of the flight in 2015 was 28 days, with a peak in the first decade of May and a catch of 3.6–7.0 imagoes per trap. The high level of imago was in 2016 and 2019; the peak of the flight was registered in the second decade of May, when 52–72 imagoes per trap were caught. The duration of the flight period was 25–34 days. In 2020 flight period lasted 23 days with peak in the third decade of April.

During the flight period, which lasted from 17 to 34 days, the average number of captured imago was: on white traps—89, black—2, yellow—10, red—3, blue—4 and green—10 sawfly trap^{-1} (Table 1).

Table 1. Mean cumulative apple sawfly density for different sticky color traps (sawfly trap^{-1}).

Trap Color	2015	2016	2017	2018	2019	2020	Mean
White	26 b[1]	163 b	29 b	33 b	189 d	91 c	89
Yellow	5 a	12 a	2 a	12 a	17 b	3 a	10
Red	1 a	3 a	2 a	5 a	4 a	2 a	4
Blue	2 a	4 a	3 a	6 a	3 a	22 b	10
Green	1 a	6 a	2 a	3 a	35 c	15 b	12

[1] Within each column, means followed by the same letter do not differ at $p = 0.05$.

The number of captured imago was divided into three groups: high level—15.6 ± 5.7; average—8.7 ± 3.4; low—2.2 ± 0,8 sawfly trap^{-1} on one assessment in average for the period of investigation. The density of the sawfly population depended on meteorological conditions, in particular on the humidity and temperature of the soil and air [8]. Thus, a high level of population was observed in 2016 and 2019. Sufficient humidity and temperature regimes contributed to this. The average number of pests was registered in 2020, and low—in 2015, 2017 and 2018. The decrease in population density was influenced by cool and dry weather during the pre-imaging stage and imago flight.

Regardless of the intensity of *H. minuta* flight, white traps caught 57–67% of imago. At the same time, in years with high and medium flight intensity, the efficiency of white traps increased to 67–80%. Imago catching by blue and yellow traps at low levels of flight

intensity increased to 16–18%. The efficiency of red and green traps did not depend on the flight intensity and was low.

White traps provided the highest efficiency during the flight period (Figure 1). In average they caught 53–62% of insects. The proportions of insects caught by yellow and blue traps decreased 4 times, and by red and green traps 9 times, compared with white. At the same time, in the peaks of sawfly flight, the efficiency of white traps increased. The share of imago caught by traps of other colors during this period was low.

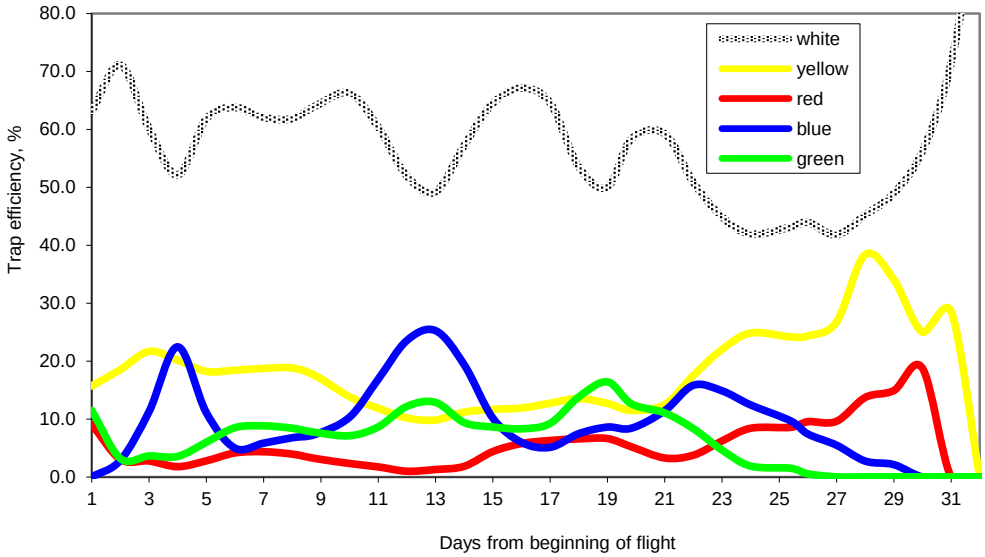

Figure 1. The efficiency of different control traps for assessment of black plum sawfly.

4. Conclusions

According to the results of six years of research, it was found that among white, yellow, red, green and blue traps, the most attractive for imago of black plum sawfly were white traps, which caught an average of 89 sawfly trap^{-1} during the flight. Regardless of the intensity of the sawfly's flight—high, medium or low, white traps caught 53–64% of adults, and at the peak of flight their efficiency increased to 80%.

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