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Monitoring of spotted wing drosophila in raspberries and blackberries in Troyan region, Bulgaria

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Abstract

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Drosophila suzukii (Matsumura) is a new serious threat in berry crops. The purpose of the study was to establish its appearance and dynamics of development in one of its preferred nutritional host plants, such as raspberries and blackberries. The surveys were carried out during the period 2016-2017 at the Research Institute of Mountain Stockbreeding and Agriculture in Troyan, in experimental plots with raspberry and the blackberry. The beginning of flying of flies and their population dynamics were followed by the ‚Csalomon' (VARL) trap (Hungary). Traps deployed at the beginning of fruit ripening from June to September. The first caught flies in raspberries and blackberries plantings recorded in June and July, respectively. Registered mean daily temperatures in observed period were 16.6-20.0°C. Gradually the density of *D. suzukii* increased and its number of caught flies decreased during fruit harvesting.

Keywords: Drosophila suzukii; monitoring; raspberry; blackberry

Introduction

Drosophila suzukii (Matsumura) (Diptera, Drosophilidae) is an invasive pest that damages fruit of a large number of cultivated and wild species and represent a limiting factor in the cultivation of berry crops.

Spotted wing drosophila (SWD) is widely spread in many countries in North and South America as well as in Europe (Cini et al., 2012; Asplen et al., 2015). It was first described as an insect pest on cherry in Japan in 1916 (Kanzawa, 1939). In 2008 it was introduced in the USA (California) and Europe (Spain, Italy) (Cini et al., 2012). First record of *D. suzukii* in Bulgaria is registered in sweet cherry orchards in 2014 (Laginova and Ivanova, 2015).

It is a polyphage that attacks a wide range of plants – 90 cultivated crops and wild plants of 23 botanical families. Preferred host plants include strawberry (*Fragaria* x *ananassa*), sweet cherry (*Prunus avium*), raspberry (*Rubus idaeus*), blackberry (*Rubus* spp.), apricot (*Prunus armeniaca*), peach (*Prunus persica*), nectarine (*Prunus persica* var. nucipersica*),* blueberry *(Vaccinium* spp.), plum (*Prunus domestica*), grape (*Vitis vinifera*).

Worldwide, a number of authors, such as Kanzawa (1939), Goodhue et al. (2011), Lee et al. (2011), Walsh et al. (2011), Cini et al. (2012), Kinjo et al. (2014), Asplen et al. (2015), Kenis et al. (2016) designate *D. suzukii* as a key pest for fruit production in North America, Asia and Europe. This species cause serious damages on plum, peach, cherry and persimmon orchards, and blackberry, raspberry, strawberry, blueberry plantings (Bolda et al., 2010; Goodhue et al., 2011; Grassi et al., 2012; De Ros et al., 2013; Minkov et al., 2017). For berry plants in Italy losses of 0.5 million euros were reported in Italy for 2010, and in 2011 – over 1.3 million euros (Rego et al., 2017). The main pathway of introduction of *D.*

suzukii is through the fruit import (Anfora et al., 2012).

This species of *Drosophila* develops from 3 to 15 generations per year depending on climatic conditions (Walsh et al., 2011; Cini et al., 2012). Under conditions of North Italy and France, 9 generations have been registered so far.

It is supposed that in Bulgaria *D. suzukii* can develop up to 7 generations mainly in the most southern parts of the country – Blagoevgrad, Haskovo, Yambol, Stara Zagora and Plovdiv (Karadzhova et al., 2015).

According to Dalton et al. (2011), *D. suzukii* spend the winter as adult. In the spring, flies are activated at a mean daily temperature above 10°C (Kanzawa, 1939). It is the most active in the range of 20-25°C, but at temperatures above 30°C their activity decreases (Kanzawa, 1939).

The main damage is caused by the larvae of SWD that feed on fruit. The damaged fruit in raspberries is wrinkled and moistened. Deformation occurs 1-2 days after the attack. Soft spots appear at the surface of the fruit. In strawberries, the fruits wrinkle and soften, and fungus diseases are observed later.

A specific characteristic of *D. suzukii* is that the female lays eggs in healthy ripening fruits thanks to their serrated ovipositor. The oviositional spots become open window for secondary infection by bacteria and fungi (Walsh et al., 2011). As a result of the damage, the commercial value of such fruits is considerably reduced (Goodhue et al., 2011).

Measures to prevent introduction and spread of SWD included prevention of introduction via host fruits. The monitoring and control must be implemented as a system of events in order to be effective.

Fruits are primarily attacked when they are red colored and have formed some fruit sugar content. If monitoring shows the presence of the insect pest at that period, insecticides have to be applied to protect the fruit. In case of a high population density of the species at an earlier stage, it is desirable to perform pre-treatment. After harvesting, it is advisable to perform additional treatment to reduce the number of adult flies. Often the presence of *D. suzukii* is not noticeable until the fruit is picked up (EPPO, 2011).

Material and Methods

The studies were conducted at the Research Institute of Mountain Stockbreeding and Agriculture in Troyan, one of the areas in Bulgaria, where mainly berry species are grown.

The monitoring of *D. suzukii* was carried out by 'Csalomon' (VARL) insect traps (Hungary). Traps were installed in the experimental plots with raspberry 'Willamet' and 'Shopska Alena' and blackberry 'Hull Thornless' and 'Black Satin' cultivars . The insect traps deployed in the experimental plots at the beginning of fruit ripening. Inspections were done at 5-7 days interval from traps deployment up to end of harvest. Weekly food primers were examined as the liquid was gently sifted through the gauze, collected material was placed in 75% alcohol solution and determined under laboratory conditions. Key marks were for males black spot on wings and for females serrated ovipositor.

Results and Discussion

The appearance of *D. suzukii* in the blackberry and raspberry plantations is related to the fruit ripening. The first adults of SWD in the raspberry plantings were registered in the middle of June 2016 (June 14) and in the beginning of June (June 6) in 2017 (Figure 1 and Figure 2).

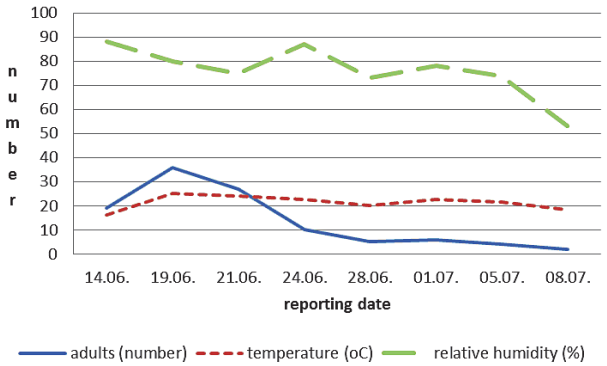

Fig. 1. Population dynamics of *D. suzukii* in raspberries, mean daily temperature and relative humidity in 2016

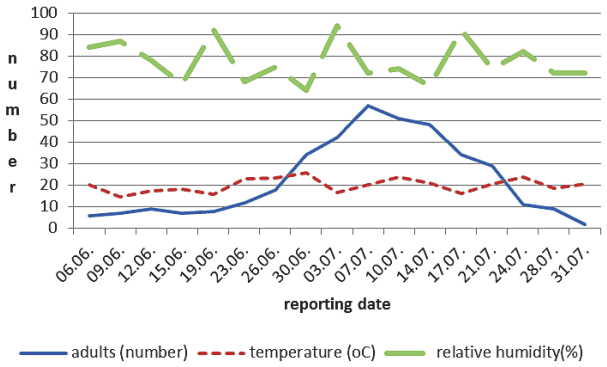

Fig. 2. Population dynamics of *D. suzukii* in raspberries, mean daily temperature and relative humidity in 2017

Appearance of the pest in 2017 is 8 days earlier than in the previous year. The earlier occurrence of flies is explained by the higher temperatures for that period reaching 20°C. As

the temperature increases, a population density increase of *D. suzukii* is observed. The biggest number of caught specimens (37) registered in June 19 and July 7 (57 specimens). The earlier peak in 2016 is explained by the high and means daily temperatures reaching up to 25°C and in July reaching up to 20.2°C. As a consequence of finishing fruit harvest, number of caught specimens decreased significantly, and just single specimens registered in the traps.

Raspberries overripe during 3rd week of July, and *D. suzukii* moved to blackberries. The first caught specimens registered in June 19 2016 and at beginning of June in 2017 (Figure 3 and Figure 4). Mean daily temperature measured were of 16.3-16.6°C.

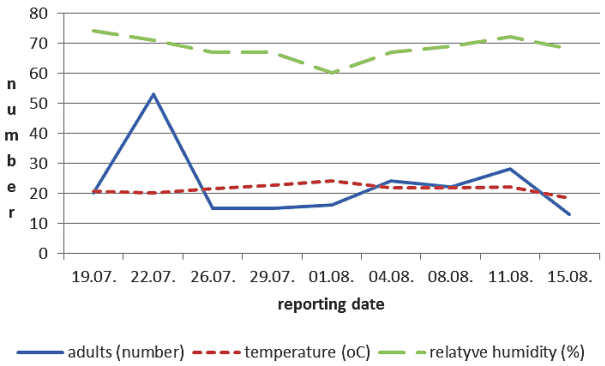

Fig. 3. Population dynamics of *D. suzukii* in blackberries, mean daily temperature and relative humidity in 2016

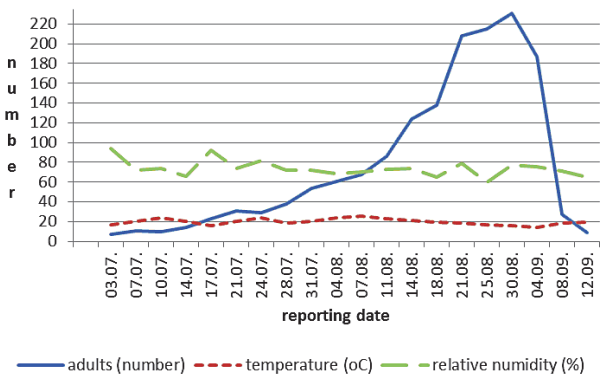

Fig. 4. Population dynamics of *D. suzukii* in blackberries, mean daily temperature and relative humidity in 2017

The earlier appearance of the flies in the blackberry plantations in 2017 could be explained by the warmer weather for the period when the mean daily temperatures reached 25.6°C. Gradually, the density of the species increased and in the middle of July in 2016 a maximum of 55 insects was reported. After that the density of flies decreased and for the second half of August only single species were caught.

The season dynamics is completely different in 2017. Flight of *D. suzukii* was extended. The biggest number of caught specimens recorded at the end of August, 231 insects, at daily mean temperatures of 15.8°C. At the beginning of September flight is extend, and 187 insects were caught, and the daily mean temperatures reached 21.3°C. With the finishing the harvest of fruits, SWD population decreases and move to new nutritional sources.

In 2017, in the experimental raspberry and blackberry plantings, *D. suzukii* caught in a higher number compared to the previous year. Total of 384 insects in raspberries and 1581 insects in blackberries were caught in 2017. In 2016, 109 specimens in raspberries and 206 in blackberries were caught. The higher number of caught *D. suzukii* specimens in traps deplyed in blackberries can be explained as a consequence of the infectious background in the area and the presence of a wide range of host plants in the vicinity (sweet cherry, sour cherry, black currant, plum).

Conclusion

As a result of the research carried out, the following conclusions can be drawn:

The first caught specimens of *D. suzukii* in raspberries observed in the traps during June (June 6-14), and in the blackberries in July (3-19 July), when fruits began to ripen.

A peak in *D. suzukii* caught specimens was recorded during full maturity of raspberries and blackberries as the mean daily temperatures were in the range of 16-25°C.

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