Drosophila suzukii in Tuscany (Italy), from cherry crops to vineyards and beyond

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Drosophila suzukii Matsumura, the Spotted Wing Drosophila (SWD), is a small fly native to South- East Asia, belonging to the Drosophilidae family. The female, provided with a strong and sclerotized ovipositor, is able to lay eggs under the skin of unwounded ripening fruits. The larva, feeding on the fresh mesocarp, causes a depressed and soft area in it, and leads the fruit to rapid decomposition. Among the numerous hosts of economic importance, the most common fruits affected by SWD are: blueberry, raspberry, blackberry, strawberry, cherry, apricot, plum, fig, and grapevine.

In the fall of 2008, *D. suzukii* has been reported simultaneously in Spain and Tuscany (Central Italy), then, a year later in Northern Italy and other countries as France and Russia (Cini *et al*., 2012). In the following years, the species has been reported in many European and Italian regions causing a lot of serious damages on various fruit crops. In fact its high biotic potential, as well as the wide range of hosts, makes this fly a very dangerous pest (Cini *et al*., 2012). To better monitor the spreading of SWD in Europe, to study the incidence of its natural enemies, and to develop IPM strategies, in 2012-2014 the Euphresco project "DROSKII" was performed. This project involved five European countries (Italy, Austria, Switzerland, Germany and United Kingdom) and was coordinated by CRA-ABP (Simoni *et al*., 2014). Thereafter, since July 2014 another project Euphresco, "IPMDROS", having Spain as coordinator, and Belgium, Austria, Italy (CRA ABP) and Turkey as partner countries, has been started.

This contribution reports briefly the activities carried out in Tuscany, in 2013-2014 years, to verify the spread and incidence of SWD on different crops of various areas of the region.

Materials and methods

In the years 2013 and 2014, a survey on *D. suzukii* population was carried out in Tuscany mainly in sweet cherry orchards in Lari district (Pisa province), in a biological blueberry crop, apricot orchard and vineyard in Castiglione della Pescaia area (Grosseto province), and in two vineyards, a botanical garden and a small wood in Montalcino area (Siena province). Other samplings were performed in Casentino (Arezzo province), Vada (Leghorn province), Florence and Siena provinces.

Monitoring of *D. suzukii* adults was made by using a device consisting of a red plastic jar (300 ml volume) with a removable lid. Six holes (4 mm diameter) were present on the top edge of the jar to allow flies to enter. The traps were filled with a mix of apple vinegar, red wine and sugar; by using a coated wire, they were hanged to the plant canopies within the shaded side and at the fruit level.

The traps were usually checked and refilled every 7-14 days. All the captured insects, after filtering the content of the trap, were dumped into a glass jar with 70% alcohol. At the facilities of the CRA-ABP (Florence), the flies were then examined under a stereomicroscope to count and identify males and females of *D. suzukii* and other Diptera. As regard *D. suzukii* preimaginal population, samples of fruits were regularly collected from each orchard and transferred to the laboratory: here a part of the sample was examined by stereomicroscope to assess the infestation level, the other part was stored into boxes and maintained at 25°C and 60-70% R.H. to check any emergence of Diptera adults. All Drosophilidae specimens were individually examined to identify males and females of SWD.

In 2013, the monitoring of *D. suzukii* adult population was performed in Lari area by 22 traps on sweet cherry, from the beginning of the ripening period to the end of harvest, in Castiglione della Pescaia area by 25 traps on blueberry, from late May to the end of summer, and by 16 traps on vineyards, from the middle of August to the end of harvest. In 2014, the SWD survey continued in Castiglione della Pescaia area, in the blueberry crop (seven traps) and in a close apricot orchard (three traps) and a vineyard (three traps). In the same year, *D. suzukii* was monitored also in Montalcino area, using six traps in two vineyards, one trap in a botanical garden and one trap in a small wood. The survey began in January and continued until the end of the year.

Results

From the investigation carried out in 2013, it was ascertained that *D. suzukii* was present with a very abundant population in the sweet cherry growing area in Lari. High numbers of SWD adults were trapped both in biologically and conventionally managed orchards. Laboratory observations on fruit samples showed percentages of infestation ranging from 20 to 50%, confirming the establishment of the species as key pest on sweet cherry crops of this district (Gargani *et al*., 2013).

As regard the blueberry crop in Castiglione della Pescaia, the monitoring of 2013 revealed a limited presence of SWD adults in traps and no infestation on sampled fruits. A similar situation was registered in same year in the vineyards of this area with few catches in the ripening period but no cluster infested. During the sampling period, other Diptera Brachycera Cyclorrhapha Acalyptratae were collected in all the traps; the ratio between SWD and these Diptera varied from 9 to 60% according to period and area of monitoring (Gargani *et al*., 2013).

Some traps used for short periods in other ecosystems allowed to ascertain the presence of *D. suzukii* in small orchards of cherry and khaki and in Natural Reserve of Casentino (Arezzo province) and in some urban gardens in the province of Leghorn and Florence. In 2014 SWD catches of SWD were continuously registered throughout the year. In Castiglione della Pescaia, on blueberry, apricot and wine grape, catches had the trend shown in the Figures 1, 2 and 3.

Figure 1
Castiglione della Pescaia (Grosseto), 2014, blueberry crop. Captures of SWD and other Diptera Brachycera adults and sex ratio of SWD

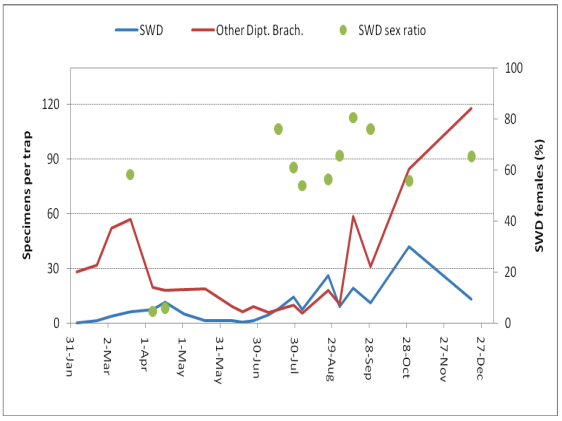


Figure 2
Castiglione della Pescaia (Grosseto), 2014, apricot crop. Captures of SWD and other Diptera Brachycera adults and sex ratio of SWD

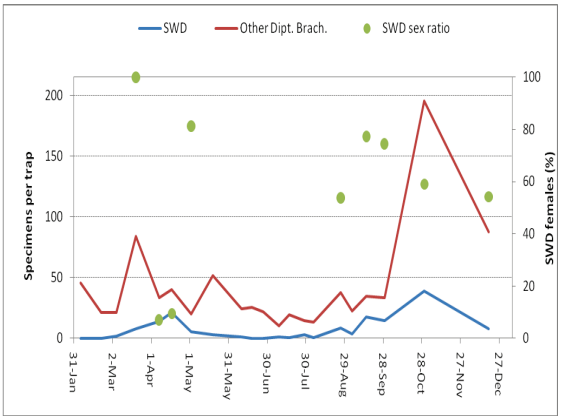
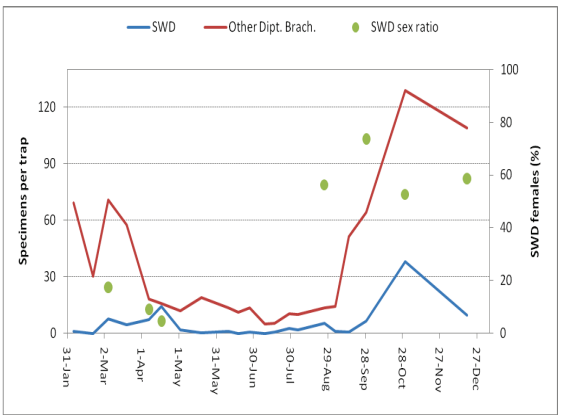


Figure 3
Castiglione della Pescaia (Grosseto), 2014, vineyard Captures of SWD and other Diptera Brachycera adults and sex ratio of SWD

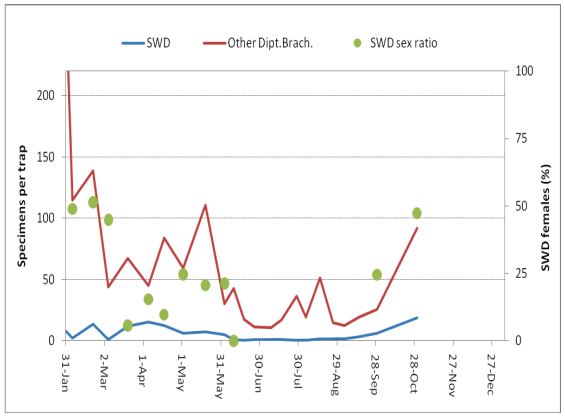


SWD captures showed a similar trend in 2014 in the three agro-ecosystems of Castiglione della Pescaia. After a light presence in the winter months, on the whole, there was an increase in captures in the spring. During the fruit ripening and the harvest periods (late May - first week of August for blueberry, late May - mid-August for apricot, mid-September for grapes) it has been observed a reduction of the captures. A sensible increase in captures was registered at the end of the harvest, with higher effectiveness of traps probably due to non-competition of fruits. The sex ratio of SWD, assessed only when the captures of the insect averaged more than 7 specimens per trap, varied considerably during the sampling period without a clear reason (Figg. 1, 2 and 3).

As regard catches of other Diptera Brachycera Cyclorrhapha Acalyptratae, although higher than those of SWD, the trends were quite similar, with the exception of those registered in vineyard, where from late August the number of catches increased clearly by creating alert among farmers, worried about a dangerous SWD infestation on grapevine. Actually, as showed in Figure 3, most of the adults captured were other Diptera, in particular other Drosophilidae. The presence of preimaginal *D. suzukii* population on grape was also evaluated by sampling and laboratory analysis of clusters by excluding high SWD infestation. On the other sampled fruits collected from ripening period until the end of harvest, only on blueberry were found fruits attacked by *D. suzukii*, at maximum of 6% in the middle of July.

As regard the Montalcino area, the trend of catches registered in the two vineyards monitored are showed in the Figure 4.

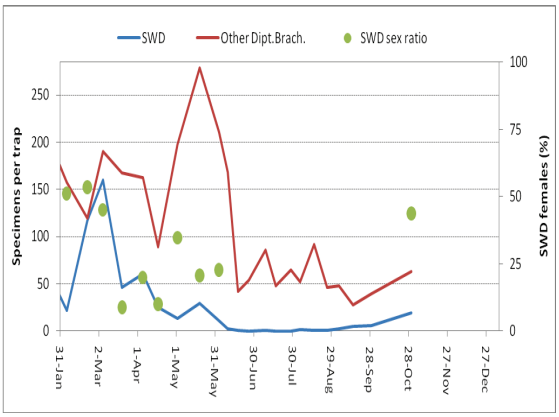
Figure 4
Montalcino (Siena), 2014, vineyard. Captures of SWD and other Diptera Brachycera adults and sex ratio of SWD



Populations of SWD in the vineyards remained always limited during all the year, while the other Diptera showed a quite variable trend during the season. In particular, analogously to the vineyards in Castiglione della Pescaia, there is an increasing population registered in summer. Even if in these vineyards there was a massive presence of Drosophilidae adults flying around clusters, from the lab observations conducted on samples, only in one cluster, a male of *D. suzukii* was found, while a great number of other Drosophilidae was recorded.

In the botanical garden and into the wood in Montalcino area, catches indicated a very different trend compared with that in vineyard (Fig. 5). During the winter there have been numerous catches of *D. suzukii* as well as of other Diptera. From spring onwards SWD populations have been declining, while the other Diptera showed a peak of catches in the spring and, then, a decline in summer.

Figure 5
Montalcino (Siena), 2014, botanical garden and small wood. Captures of SWD and other Diptera Brachycera adults and sex ratio of SWD



Conclusions

SWD has showed a rapid spreading throughout Tuscany as well as in many other Italian and European regions (Vitagliano *et al.*, 2013). In the district of sweet cherry production in Lari, *D. suzukii* has assumed the characteristics of key pest already in 2013 when our surveys allowed to detect a percentage of fruit infestation between 20 to over 50% with 0.2-0.9 larvae per drupe on average (Gargani *et al.*, 2013).

In the investigated area of Castiglione della Pescaia, in 2013 and 2014, on blueberry, known as particularly susceptible crop (Grassi and Pallaoro, 2012), on apricot and grapevine, the number of adult captures was not particularly high and damage on the fruits were limited. This is probably ascribable to the typical microclimate of the coastal region, where low humidity and frequent ventilation create unsuitable conditions for SWD population.

As reported by other Authors (Grassi and Pallaoro, 2014; Briem *et al*., 2014), in 2014, SWD adults were captured throughout the year, including the winter period, characterized by particularly mild temperatures. Furthermore, the highest catches were observed in the periods following the completion of harvest, leading to assume a greater competitiveness of mature fruits compared to the food traps.

A special comment deserves the situation on vineyard. In the last three years, the presence and the potential harmfulness of *D. suzukii* on wine grape has been studied by many Authors. Faced with specific situations, where on some grape varieties significant attacks by SWD have been reported, in general, the researches confirm that wine grape is a minor host for SWD (Ioriatti *et al*., 2015).

Our results are in agreement with these studies: in 2014, the climatic conditions in large parts of Tuscany were characterized by mild temperatures and abundant rainfalls and, during the ripening of grape, high populations of Drosophilidae were noted around the bunches. The catches, however, showed that the number SWD was lower than other drosofiliids; furthermore, rare specimens of *D. suzukii* were detected on the clusters examined in laboratory. During cool and wet harvest periods, high numbers of SWD adults can be observed on damaged berries (Ioriatti *et al*., 2015).

So, by close perspective, it is important to consider that, due to the high reproductive potential of SWD, if the environmental/climatic conditions will be conducive to the development of very abundant populations, the actual and potential damage of this species should be taken in high account. In fact the ongoing climatic change could lead to more frequently cool and rainy summers, like the one occurred in 2014 in many Italian regions, and consequently make the relationship between SWD and vine sour rot more complex and harder to control.

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