

Control strategies for *Drosophila suzukii* management in fruit crops in Germany

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The Spotted Wing *Drosophila* (SWD) with its highly broad host spectrum is one of the most serious pests in Germany in fruit crops since its first record in 2011. The most susceptible crops are all stone fruits particularly cherries and almost all berry crops particularly raspberries and blackberries. Infestation levels can reach up to 100 % without any regulation or control measures. Even if control measures were applied, losses can reach an economical level, where harvest must be ceased. Depending on population development and climate, infestation pressure varies between different periods during one season or between different years. For most threatened crops in Southern Germany potential control periods of SWD are from May (strawberries and cherries) until October (raspberries, blackberries). Hence, growers cultivating different crops have to face a huge challenge in plant protection. For short term control, different insecticides are registered. In stone fruits, only annual authorizations for emergency uses are allowed (article 53 EU-regulation 1107/2009). In 2017, spinosad (SpinTor) and lambda-cyhalothrine (Karate Zeon) could be used in all stone fruits. In sweet and sour cherries as well as plums cyantraniliprole (DuPont Exirel) could be applied additionally. In all berries, spinosad is registered according to a regular authorization against SWD. Furthermore, the application of Karate Zeon is possible in raspberries, blackberries, currants and blueberries. DuPont Exirel can be used only in currants and blueberries according to an article 53-authorization. Pros and cons of chemical control have to be taken into account. This includes varying efficacies against certain SWD stages, different maximum residue levels and following pre-harvest periods. Additionally rain fastness as well as side effects on honey bees or predatory mites vary between the different insecticides. Therefore, other measures are necessary to decrease the population and infestation pressure of SWD in fruit crops. The general recommendations to growers focus on preventive measures as well as cultivating techniques such as netting, regular monitoring of SWD, consequent pruning, regular mulching, short harvesting intervals, complete harvest, consequent sanitation measures and quick refrigerating and processing of fruits. All these control and preventive measures increase cost for fruit production which can be a risk for the economic feasibility of farms. This requires an economically as well as environmentally sustainable control strategy against this serious invasive pest.

Field demonstration of control techniques of *Drosophila suzukii* in China

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From year 2015 to 2017, four pilot sites (two for cherry and two for bayberry) were selected as demonstration areas for controlling *Drosophila suzukii*. The techniques demonstrated were monitoring of *D. suzukii* in orchards including seasonal fluctuation and peak periods, techniques of attract-and-kill adult flies and removal of dropped fruits. In addition, two field experi-

ments were conducted with the aim to test the efficiency of different wine lures trap, different colour trap and chemical control on population of *D. suzukii* in orchards. The following conclusions can be given based on the field demonstrations: (1) Using the sugar and vinegar liquid is effective for the control of *D. suzukii*. Farmers can use simple traps for monitoring, predicting, controlling and trapping fruit flies. (2) The rotted fruit can attract the vinegar flies, so it can be added to the sweet and sour wine solution to increase the control effect. (3) The tests with colour traps for *D. suzukii* in red bayberry orchard show that blue and yellow are more effective than green and red, but this result needs further verification. (4) Attraction by different wine lures for *D. suzukii* in red bayberry orchard show that there was no significant difference between the different ratios of white wine and vinegar. (5) The larvae can pupate in the fruit and soil, so the removal of dropped fruits on the ground can effectively reduce the number of fruit flies in the orchard. (6) It is suggested to suppress the population of *D. suzukii* around the orchards. (7) The field test with the chemical compound of ethyl polybacteria show that chemicals can reduce the populations of *D. suzukii* in the orchard, but in general chemical sprays should not be used except really necessary. (8) Spray treatments of chemical pesticides can be applied at the population peak of the flies or after harvest, and it is necessary to improve spray methods in order to lower environmental pollution, including to minimize spray amounts and frequency so as to protect natural enemies.

Evaluation of soft fruit genetic resources for resistance to the Spotted Wing *Drosophila* (*Drosophila suzukii*)

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The Spotted Wing *Drosophila* (SWD) is an invasive insect which infests in particular thin-skinned berries as strawberries, raspberries, blackberries, blueberries, gooseberries and currants. Females of *Drosophila suzukii* attack fresh, ripe fruit by using their saw-like ovipositor to lay eggs under the fruits skin. The infestation occurs shortly before the harvest and the subsequent larval development makes the fruit unusable for marketing. A sustainable control of SWD can be only assured by the cultivation of resistant or at least less susceptible soft fruit cultivars. The aim of the project is the detection of genotypic differences in the susceptibility against the SWD in genetic resources of raspberry and strawberry. Resistant or less susceptible cultivars can then be used for breeding or recommended to growers in infested areas. In total, 19 summer-fruiting and 9 autumn-fruiting raspberry cultivars were evaluated for susceptibility against SWD in laboratory experiments with ten replicates per cultivar. For the infestation assay, 10 *D. suzukii* females and 5 males of an age between 4–6 days were released into a 125 ml plastic beaker with an aerated lid containing three fruits. The incubation temperature was 23°C with a relative humidity of 65% and a light:dark regime of 16:8 h. After 24 h flies were removed and larvae were counted 5 days after infestation. There were significant different infestation rates between the cultivars evaluated. The summer-fruiting cultivars 'Cascade Delight' and 'Reflamba' showed the highest infestation rates with an average of 4.8 larvae per fruit and female. The lowest infestation rate were determined for the cultivars 'Dorman Red' and 'Glen Ample' with an average of 1.2 and 1.8 larvae per fruit and female, respectively. The autumn-fruiting cultivars 'Polana'