The results can be useful for both organic and conventional fruit and grapevine production and will be available at www.isip.de.

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The occurrence and management of *Drosophila suzukii* in Hubei Province, China

Yong-Cheng Dong[1], Nan Jiang[1], Chang-Dong Chen[2], Ping Li[3], Pu-Yun Yang[3], Chang-Ying Niu[1]
[1] Hubei Insect Resources Utilization and Sustainable Pest Management Key Laboratory, College of Plant Science and Technology, Huazhong Agricultural University, Wuhan, 430070, China
[2] Shiyan Station of Plant Protection and Quarantine, Shiyan, 442000, China
[3] Pest Control Division, National Agricultural Technology Extension and Service Center, Ministry of Agriculture, Beijing, 100125, China E-Mail: niuchangying88@163.com (CYN)

Spotted wing drosophila (*Drosophila suzukii* Matsumura) is an economically important pest damaging to soft skinned berries and stone fruits over the world. In the past years, the population remained relatively low in the main production areas of cherries in Hubei province, China. However there were still several cases of outbreak reported, yet the main cause is still elusive. We monitored the population dynamics using sugar/vinegar liquid traps in cherry orchards and analyzed the relationship of population dynamics with climatic factors. The population dynamics showed very similar tendency between early and middle varieties which have approximately two weeks delay of fruit maturation without exhibiting an obvious correlation with the fruit maturation. The overall dynamics showed two peaks throughout the experimental season, which coincided with the phenology of cherry and neighbouring strawberry, suggesting a potential shift across host plants. The correlation analysis indicated that temperature is the main factor positively affecting the mean number of captured flies whilst precipitation strongly negatively influenced them. The results suggest that the *D. suzukii* population fluctuation was significantly associated with host phenology and climate. Over past years, demonstration blocks were established nationwide under the support of the National Agro-Tech Extension and Service Centre. The various control strategies were integrated to fight against *D. suzukii* including (a) attracting and killing strategies – sugar/vinegar liquid together with sticky traps with different shapes and colors, (b) cultural control – habitats/orchards sanitation, deep plowing or rotary tillage, (c) recommended chemical spray in the case of outbreaks. In addition, strategic research such as gene mining and candidate selection targeting reproductive processes to facilitate SIT were carried out in the laboratory to support the pest control. Those inputs aim to provide the theoretical basis and develop effective and sustainable suppression approaches against *D. suzukii* in the long run.

Assessment of mortality factors for *Drosophila suzukii* in Switzerland

Tim Haye, Pierre Girod, Marc Kenis, Tessa Ramburn, Leslie Mann, Gaëlle Beureux, Oceane Liehrmann
CABI Switzerland, Rue des Grillons 1, 2800 Delémont, Switzerland

A life table study for *Drosophila suzukii* was conducted under semi-natural condition at a forest site in Delémont, Switzerland. The aim of the study was to examine mortality factors of all developmental stages, such as natural mortality, predation and parasitism. Fruits infested with eggs, L1/L2, and L3 were exposed over a short period of time using potted blueberry plants (*Vaccinium corymbosum*). Groups of pupae were exposed on the ground underneath the bushes. These were then collected for examination and rearing in the laboratory, to quantify mortality factors in the different developmental stages. For each exposure period, controls consisted of non-attacked fruits and fruits attacked by *D. suzukii* kept in screened cages. To estimate the generational mortality of *D. suzukii* in Switzerland, life tables were constructed using the data from the exposure experiments and following the methods described by Bellows et al. (1992). For the egg and L1/L2 stages, mortality was not much different if they were caged or not (respectively 36.05% and 31.25% for the egg stage and 60.64% and 62.43% for the L1 stage). For the L3's, exposed larvae were more attacked (76.12%) than the caged ones (63.75%). The same tendency was observed for pupae in the soil (25.63% for the non-caged and 18.67% for the caged ones). Based on these mortality rates, the total generational mortality was 95.57%, which provided a realistic R0 of 4.7. This mortality cannot be explained by parasitoids because none of them emerged from the larvae and pupae exposed. Mortality was only caused by two parameters here: predation or abiotic mortality. Mortality in the larval and pupal stage could be increased by introducing classical biological control agents from Asia, such as larval parasitoids in the genus *Ganaspis*, or using native pupal parasitoids (e.g. *Trichopria drosophilae*) for inundative biological control. To drop the population growth below 1 (= declining populations), 30% larval parasitism would be necessary (R0 = 0.92), whereas increasing pupal parasitism to 30% would had a much lower effect on the fly populations (R0 = 2.8).

Natural Enemies of *Drosophila suzukii* in Yunnan Province

Wu Hao, Fang Yuan, Chun Xiao, Chen Guohua
College of Plant Protection, Yunnan Agricultural University, Kunming 650201, PRC E-Mail: x.chun@163.com; chenghkm@126.com

Drosophila suzukii is one of the most important pests of many fruit crops. It has a wide variety of natural host plants. Current control measures for *D. suzukii* depend on pesticides to great extent. Biological control using parasitoids plays an important role in population regulation of *D. suzukii*. The objective of our study was investigating the parasitic natural enemy species of *D. suzukii* and studying their biological characteristics in Yunnan Province. More than 45 plant species were collected from 23 sampling sites in Yunnan province, among them there were 15 host plant species of *D. suzukii*. There were four parasitic wasp species in Yunnan province, namely *Ganaspis brasiliensis*, *Leptopilina japonica*, *Trichopria drosophilae*, and *Pachycrepoideus vindemmiae*, which emerged from five host plants. The species, populations and parasitism rates by the parasitic wasps varied with different sites and host plant species as well as with the same plant species at different sites. The highest rate of natural parasitism was 38.5 % in a *Myrica rubra* ochard. *G. brasiliensis* occurred in four generations in a year, the female population was higher than male (sex ratio ♀:♂= 2:1). This parasitoid parasitized 2nd larval instar of *D. suzukii*. Its average lifetime was about 49 days and the duration from egg to adult emergence was about 29 days. The peak period of oviposition was from the 7th to the 22nd day after emergence of females.

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Prospects for biocontrol of *Drosophila suzukii* by invertebrates in Germany

Camilla Englert, Eva-Maria Dumath, Annette Herz
Julius Kühn-Institut, Institute for Biological Control, Heinrichstraße 243, 64287 Darmstadt, Germany

Ongoing research aims to identify native parasitoids of Drosophilidae in Germany and tries to assess their ability for natural control as well as their suitability for being used as biological control agents in pest management of *Drosophila suzukii*. Due to the lack of adapted and specific native antagonists of *D. suzukii*, collection of parasitoids attacking native *Drosophila* species took place in different regions in Germany during 2015 and 2016. Over several months naturally infested fruit were collected from plants and soil. We captured seven different *Drosophila* parasitoid species. First experiments illustrated that the pupal parasitoids *Trichopria drosophilae*, *Spalangia erythromera* and *Pachycrepoideus vindemmiae* successfully parasitize *D. suzukii*. The two larval parasitoids *Leptopilina heterotoma* and *Asobara rufescens* were not successful in parasitizing the new host species. Lifetime fecundity, progeny production and sex ratio of the progeny during the life period of female parasitoids were investigated in two German populations of *T. drosophilae*. Females and males of both strains lived on average more than 30 days. The number of eggs produced over the whole lifespan was higher in the Central German population (85.5 ± 2.7 eggs/female) than in the South German population (80.7 ± 3.4 eggs/female). Compared to this the female offspring was slightly superior in South German population (61%) than in Central German population (46%). Progeny development usually lasted about three weeks in both strains.

Evaluation of the potential biological control of *Drosophila suzukii* with Asian parasitoids

Pierre Girod[1,2], Tim Haye[1,2], Marc Kenis[1,2], Jin-Ping Zhang[1], Feng Zhang[1]
[1] MoA-CABI Joint Laboratory for Bio-safety, Institute of Plant Protection, Chinese Academy of Agricultural Sciences, Beijing 100193, China
[2] CABI, CH-2800 Delémont, Switzerland E-Mail: f.zhang@cabi.org

Native to Asia, the Spotted Wing Drosophila, *Drosophila suzukii* (Diptera: Drosophilidae) has successfully invaded the Americas and Europe since the late 2000s, followed by rapid range expansion and increased damage records within these continents. Despite a few indigenous larval and pupal parasitoids being recorded and attacking *D. suzukii* in Europe, the control effects of these European parasitoids are rather limited due to lower parasitism rates and/or impossible to complete development within the host body of *D. suzukii*. Classical biological control is strongly considered as a sustainable approach to control *D. suzukii* in invaded regions by introducing natural enemies from its native region. In the the framework of the EU-funded project DROPSA, we conducted extensive surveys in varied habitats, locations and time of the season in 2015 and 2016 in China and Japan, where *D. suzukii* causes little damage and very little is known on its natural enemy complex. Three Asian larval parasitoids were recovered from field surveys, e.g. *Leptopilina japonica*, *Ganaspis brasiliensis* and *Asobara japonica*. Efficiency of Asian larval parasitoids was studied in the quarantine laboratory to understand whether the parastioids are able to forage and parasitize *D. suzukii* reared with artificial diet or fresh blueberry. Single mated female parasitoid was used and allowed to forage for 48 h with 10–30 24 h old fly larvae in a tube. Then the number of emerging flies and parasitoids were counted and the dead host larvae were dissected to record encapsulation events. Three Asian parasitoids can attack and successfully develop in *D. suzukii* larvae in both rearing substrates, while as a control the European *Leptopilina heterotoma* eggs were all encapsulated by *D. suzukii*. Moreover, *G. brasiliensis* strains showed a strong preference for the host larvae in blueberries in comparison with the diet, indicating a high degree of behaviour response of the parasitoid to fruit cues. No-choice host specific tests of three Asian parastioids were also conducted with *D. suzukii* and another four non-target *Drosophila* species in Europe. Our preliminary results showed that *G. brasiliensis* Japan strain was more host specific than other two Asian parasitoids. Further research is still required to fully understand the efficiency and host specificity of the selected Asian larval parasitoid.

Pathogens to control *Drosophila suzukii*

Sarah Biganski, Johannes A. Jehle, Regina G. Kleespies
Julius Kühn-Institut, Federal Research Centre for Cultivated Plants, Heinrichstraße 243, 64287 Darmstadt, Germany

Drosophila suzukii MATSUMURA (Spotted Wing Drosophila, SWD) is an invasive pest that causes enormous damage to soft ripening fruits. It appeared first in Germany in 2011. During the last years, investigations on potential natural enemies and microbial antagonists have been intensified. The widely used biocontrol agent *Bacillus thuringiensis israelensis* (B.t.i.) and the plant extract Azadirachtin from the Neem oil tree have been tested in the laboratory. Whilst B.t.i. did not show any significant efficacy against SWD, Azadirachtin increased mortality rates up to 100%, but only when applying a concentration ten-times higher than recommended for other pest insects, whereas recommended concentrations could only achieve up to 20% mortality. Furthermore, SWD samples from affected countries are continuously screened for microbial and viral pathogens. Recently, microsporidia have been detected. These are obligate intracellular parasites infecting many organisms up to vertebrates. Microsporidia often cause chronic diseases with low mortality rates, mostly decreased fertility and fecundity, retarded developmental time and reduced fitness of host individuals. For biological control, these characteristics can be advantageous if a pest insect has rapid reproduction time and large offspring numbers or when control of the pest is complicated by its preference of hardly accessible habitats. In our screening, a microsporidium was detected in SWD samples obtained from USA. Its introduction to our German breeding line of SWD and its re-isolation was possible. Its characterization was initiated with molecular markers based on SSU rDNA that were amplified by PCR using universal primer pairs. Sanger sequencing of the PCR fragments suggested that the isolated microsporidium belongs to the genus *Tubulinosema* (Tubulinosematidae). For further species characterization, morphological examinations on tissue tropism and life cycle are conducted by light and electron microscopy. Infection experiments to evaluate median lethal concentration (LC50) as well as possible impacts on developmental times are ongoing.