



Issue 1



Strategies to develop effective, innovative and practical approaches to protect major European fruit crops from pests and pathogens



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Funded by the European Community's Seventh Framework Programme under grant agreement No. FP7 KBBE 2013-613678 (DROPSA)

DROPSA is a 4-year project involving 26 partners from Europe, Asia, New Zealand and North America. It is focusing on new and emerging threats due to *Drosophila suzukii*, and the bacterial pathogens *Pseudomonas syringae* pv. *actinidiae*, *Xanthomonas fragariae* and *X. arboricola* pv. *pruni*.

These pathogens and *Drosophila suzukii* are a major concern and challenge to the fruit industry because their eradication or containment is not possible. Hence the development of targeted integrated pest management (IPM) is vital to minimize the economic impact on EU fruit production.

Dropsa Kick off Meeting

DROPSA Kick off meeting was held 27th - 28th January 2014 at York, hosted by The Food and Environment Research Agency (FERA).

Overviews of the proposed work and approaches of reaching the goals of Dropsa were discussed. The enthusiastic atmosphere contributed to ideas for exchanging strains and material from different locations in Europe, China and North America.



Project Meeting in Bologna



A General Assembly meeting was organized the 16th and 17th December 2014, hosted by the University of Bologna. Substantial scientific progress was presented by project partners and work planned for 2015 discussed.

It was noted that, especially for *Drosophila suzukii*, much research is ongoing by groups all over the world. Close contacts with scientists outside Dropsa is therefore essential and in some cases planned activities should be adapted to encompass new information.

Several partners already have made contact with different stakeholder groups such as end-users. This will help direct activities to provide solutions.

Update of Scientific Progress

Pathways of introduction of fruit pests and pathogens.

Alert lists of pests that may be introduced into Europe with fruit trade are being prepared for selected crops (e.g. apples, Vaccinium berries, wine and citrus fruits). Particular case studies involving international fruit trade networks and transshipments within the EU as pathways for several of these agents are also being undertaken. A consistent approach is being developed to ensure that methods developed in case studies can be widely applied. The risk analysis methods draw on previous collaboration in the FP7 PRATIQUE project, EUPHRESCO and other projects involving international partners. (JKI, EPPO, Imperial College).

DROPSA investigates *D. suzukii* in its area of origin

Various studies were carried out in China by DROPSA partners to better understand the biology and ecology of *D. suzukii* in its area of origin. Work was conducted in several provinces but particularly around Beijing by CABI, and in Yunnan by the Yunnan Agricultural University. This research includes population dynamics, host range, overwintering biology and attack rates in fruit crops. Samples have also been collected for molecular studies to investigate the routes of invasion, in collaboration with partners in Europe and North America. Of particular importance is the study on natural enemies. Several parasitoids were reared from *D. suzukii* in Yunnan that will be studied for their suitability as biological control agents in Europe.



Pathogen source-tracking and evolutionary risk

It is postulated that the bacterium *Xanthomonas fragariae* is introduced via air transport. Bacteria can be incorporated in small droplets of rain or artificial irrigation of strawberry crops, and spread through the aerosol to clean plants. Mowing strawberries is considered a dangerous activity for spread of the bacterium. Wet infected plants were mown and the presence of *X. fragariae* was monitored using an air sampler. The amount of *X. fragariae* decreased exponentially with distance, but bacteria could be detected up to 100 metres from the source. This is a significant distance considering that very low numbers of bacteria (10-100) may cause the disease.



Largest study on host range ever

In Switzerland, Italy and the Netherlands, wild and cultivated fruits were collected throughout the year 2014 to assess the host range of *D. suzukii* in natural, semi-natural and cultivated habitats. Fruits of over 100 potential host plant species were collected. *Drosophila suzukii* emerged from 43 species. The percentage of species attacked varied per country (29% in the Netherlands; 59% in Switzerland). The fly was particularly abundant in the second half of the season and in fruits of the genera *Rubus*, *Sambucus*, *Frangula*, *Cornus* and *Prunus*. Given its polyphagy, it will be particularly difficult to develop management methods simply based on the destruction of wild hosts around crops.



Grapes in the process of being air-dried in a storehouse

Control of *Drosophila suzukii* and *D. melanogaster* with ozone gas on air-drying grape.

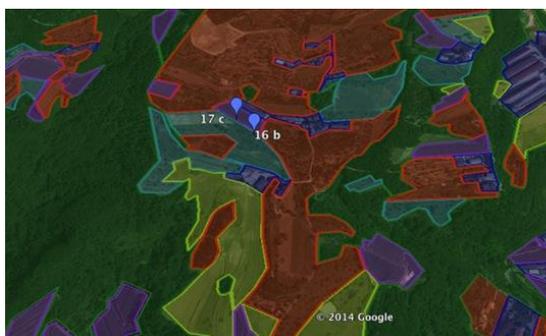
The use of insecticides for the control of *D. suzukii* can be critical since the fly damages ripening fruits. DROPSA is developing practical solutions for sustainable pest control, and one option is using ozone gas during the grape drying process. Larvae and adult *D. suzukii* and *D. melanogaster* were directly exposed to the treatment while infested fruits were treated to evaluate the effect on eggs and young larvae. The exposure time required to kill 100% of the individuals ranged from a few hours to a few days, depending on the concentration of the ozone delivered, the species, and the stage of development of the insect.

Evaluation of the edge-crop movements

In order to better understand the dispersal of *D. suzukii* between crop and non-crop areas, field edges are studied between forests and cultivated areas (both cherry orchards and vineyards) and between cherry and vineyard fields. Transects have been set up with traps at different distances from the edge of the field to the centre of the cultivated area (0, 10, 25 and 50 m) and at different heights (1 to 6 m). The study will elucidate the flight height of *D. suzukii* and the spillover dynamics over one growing season.



Transect of traps in a cherry orchard



Example of a landscape buffer around traps (different colours show different landscape uses).

Effect of landscape composition on *Drosophila suzukii* population in vineyards.

In a large field study in Northern Italy, the University of Padova is evaluating how the composition of the habitats surrounding croplands affects the population density of *D. suzukii*. Insect populations in vineyards and cherry orchards are monitored using traps and insect damage on grapevine and cherry is assessed. The aim is to demonstrate a correlation between *D. suzukii* populations in the cultivated areas and the surrounding landscape. This study will identify the temporal dynamics and spatial distribution of *D. suzukii* between crop and non-crop areas.

Screening existing compounds on pathogens

Antibacterials and resistance inducers have been tested in kiwiplants infected with *Pseudomonas syringae* pv. *actinidiae* (Psa) strawberry plants infected with *Xanthomonas fragariae* (Xf), and in peach plants infected with *X. arboricola* pv. *Pruni* (Xap). Representative collections of Psa, Xf, and Xap strains were used as targets to verify in vitro the activity of antibacterial, biological and other compounds that are used in plant tests that are under progress. The plant-pathogen platform has been set-up for the assays of Xap and Xf in the quarantine greenhouse.



Quarantine greenhouse at the University of Girona-CIDSAV facility.

Novel antimicrobial compounds

Synthetic antimicrobial peptides have been selected from existing peptide libraries. A set of 45 compounds from the libraries of linear, cyclic, cyclic lipopeptides, peptidotriazoles, fengicycyn and iturin derivatives have been tested *in vitro* against two representative strains of the three pathogens Psa, Xap and Xf. Several of these products showed promising activity and are strongly active against the three pathogens.



Peptide libraries are being replicated at the University of Girona with a robotic handler to assay activity against the plant *in vitro*.

Isolation, identification and testing of novel biological control agents

After a first screening of products with test inoculum in the greenhouse, conducted by the University of Bologna, effective products were tested by CRA against *Pseudomonas syringae* pv. *actinidiae* (Psa) in field trials in four different areas of cultivation: Cuneo, Verona, Faenza and Latin America. The use of common protocols allowed the comparison of the results obtained by different research groups under conditions of natural inoculum to increase the reliability of the results. The results were presented to an audience of over 400 people in Bussolengo, Italy, at the XXII provincial Congress "Quality and sustainability of kiwifruit research on new varieties and bacterial diseases", and at the "VIII Kiwifruit International Symposium held in the city of Dujiangyan", Sichuan Province, China.



Italian partners at the kiwifruit symposium in China

Testing chemicals and biological control agents on *Drosophila suzukii*

A variety of chemicals (not currently registered for use on soft fruit in Europe) and commercially available biological control agents e.g. (predators, entomopathogenic fungi) have been tested under laboratory conditions at Fera, UK. Some of the chemicals provided excellent control of both adults and larvae tested by topical application and treating blueberries. The most active compounds are to be tested further under field conditions later this year by the University of Padova, Italy. Although predators tested were largely ineffective, some strains of entomopathogenic fungi did significantly reduce fly populations. These will be considered for use in lure and infect strategies currently under development by Wageningen University and Research Centre, Netherlands.

Economic analysis

The economic work started with the collection of data for several crops in different countries. Requested information for each type of fruit relevant to project was, yield, price, quality (% of each class 1,2, etc.), % discard after harvest, labour costs and the cost of *D. suzukii* specific activities (e.g. hygiene, nets, lure and kill, trapping), cost of crop protection activities (with and without pest) and also any consequential cost (increased costs in packhouses for example). Focus will be for Psa on Kiwifruit, and for *D. suzukii* on raspberry, blueberry, strawberry and cherry. In the coming months, calculations will be made for countries both in the Northern as well as the Southern part of Europe.

"Pherobank has developed an attractant for *Drosophila suzukii* based on a combination of Torula yeast tablets and a mixture of organic acids. The attractant can be used for monitoring and mass trapping, and tests are being carried out in the Netherlands and Spain. Other combinations of compounds have been tested in the field and may have potential for use as repellents, which could represent another control option in fruit production systems." Frans Griepink, Pherobank.



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Meetings, conferences and workshops

2014

January

The Dropsa project kick off meeting was held at the Food and Environment Research Agency, UK.

May

The University of Girona, Spain, organised a workshop on "Plant straighteners and biopesticides for a sustainable agriculture" at the University's Science and Technology Park.

July

Jean-Luc Gatti (INRA) presented the DROPSA project to a member of the French GIS fruit (a stakeholder) and gave a talk on "The Spotted Wing Drosophila: interactions between *Drosophila suzukii* and native versus local parasitic species" at the College des Entomophagistes 2014 in Louvain-la-Neuve, Belgique.

August

Neil Audsley (Fera) presented the Dropsa project poster at the 10th European Congress of Entomology at University of York, UK, and Marylène Poirié (INRA) gave a talk on parasitoid venom: "Improving our knowledge of Leptopilina parasitoids venom: estimation of intra and inter-specific variation and development of an RNAi approach".

October

The University of Girona delivered oral presentations and posters at the XVII meeting of the Spanish Society for Plant Pathology.

November

The 62nd Annual Meeting of Entomological Society of America took place in Portland, USA. Andrew Cuthbertson represented DROPSA with a presentation in the Spotted Wing Drosophila symposia.

December

Dropsa Project Meeting was held at University of Bologna, Italy.

2015

January

Andrew Cuthbertson presented "*Drosophila suzukii*, the latest invader" at the Fera Science Conference.

Neil Audsley presented "*Strategies to develop effective, innovative and practical approaches to protect major European fruit crops from pests and pathogens*" as invited speaker at the final meeting (Innovative disease control strategies for European organic and integrated vineyards) of the vineman project.

February

Elwyn Isaac presented a paper entitled 'Sex peptide and the circadian regulated behaviour of *Drosophila suzukii* - the spotted wing Drosophila', at the 2015 Invertebrate Neuropeptide Conference held in Bagan, Myanmar, 15th-19th February, 2015.

Publications

Poirié M, Colinet D, Gatti J-L. Insights into function and evolution of parasitoid wasp venoms. *Current Opinion in Insect Science* 2014, 6:52-60.

Cuthbertson AGS, Blackburn LF, Audsley N. Efficacy of Commercially Available Invertebrate Predators against *Drosophila suzukii*. *Insects* 2014, 5:488-498.

Audsley N, Down RE, Isaac RE. Genomic and peptidomic analyses of the neuropeptides from the emerging pest, *Drosophila suzukii*. *Peptides in press*.

Lee, J.C., A.J. Dreves, A.M. Cave, S. Kawai, R. Isaacs, J.C. Miller, S. Van Timmeren, D.J.

Bruck. Infestation of wild and ornamental non-crop fruits by *Drosophila suzukii*. *Annals of the Entomological Society of America*, in press. DOI: 10.1093/aesa/sau014.

Burrack, H.J., M. Asplen, L. Bahder, J. Collins, F.A. Drummond, C. Guedot, R. Isaacs, D. Johnson, A.

Blanton, J.C. Lee, G. Loeb, C. Rodriguez-Saona, S. Van Timmeren, D. Walsh, D.R. McPhie. Multi-state comparison of attractants for monitoring *Drosophila suzukii* (Diptera: Drosophilidae). *Environmental Entomology*, in press.

Media

June 2014

The Dropsa project generated its first press release.

<http://www.freshplaza.com/article/121998/Project-launched-to-protect-major-EU-fruit-crops>

October 2014

"L'invitée surprise des vendanges" was published on the "Fortune" economic blog.

"Invasion of Drosophila Suzukii on vines", published by Terre portal.

May 2014

Jean-Luc Gatti (INRA) was interviewed by the French local TV (FR3 Nice Cote d'Azur).



FUTURE EVENTS

Living Soils Conference, 28-30 April 2015
<http://www.wageningenur.nl/livingsoils>

Conference on the ecology and control of *Drosophila suzukii*
5-6 May 2015, Valencia, Spain

II International PSA Symposium. Bologna 10-13 June 2015
<https://eventi.unibo.it/psa2015>

Consortium Partners

