IOBC Working Group "Integrated Plant Protection in Fruit Crops"
Sub Group "Soft Fruits"

9th International IOBC/WPRS Workshop on Integrated Plant Protection of soft fruits

5–7 September 2018
Rīga, Latvia

Abstracts

Trichopria drosophilae (Perkins), the parasitoid of *Drosophila*

Photo by: © Jana Collatz, Steffen Hagenbucher & Urs Wyss

IOBC Working Group "Integrated Plant Protection in Fruit Crops"
Sub Group "Soft Fruits"

9th International IOBC/WPRS Workshop on Integrated Plant Protection of soft fruits

5–7 September 2018
Rīga, Latvia

Dobele, 2018

Abstracts of the *9th International IOBC/WPRS Workshop on Integrated Plant Protection of soft fruits,* Dobele (Latvia): Institute of Horticulture (ed. A. Stalažs)
ISBN 978-9934-19-641-6 (print), ISBN 978-9934-19-642-3 (online)

Printed by "Drukātava", Šampētera iela 36, Rīga, LV-1046, Latvia

Abstracts

of the 9th International IOBC/WPRS Workshop on Integrated Plant Protection of soft fruits

Content

General

Organisers 6

Time table 7

Programme 8

Abstracts

Marc Kenis, Pierre Girod, Laetitia Driss, Tim Haye
How close are we from a release of Asian parasitoids against *Drosophila suzukii* in Europe? 12

Nasim Amiresmaeili, Jörg Romeis, Jana Collatz
Cold tolerance of *Trichopria drosophilae*, a natural enemy of *Drosophila suzukii* 13

Sarah Wolf, Svetlana Boycheva, Jörg Romeis, Jana Collatz
Multitrophic interactions of *Dosophila suzukii*, wild fruits and a native pupal parasitoid 14

Estelle Postic, Caroline Granado, Yannick Outreman, Anne Le Ralec
Unravelling trophic webs between aphids and parasitoids in strawberry greenhouses to improve a biological control program 15

Marco Valerio Rossi Stacconi, Alberto Grassi, Gianfranco Anfora, Claudio Ioriatti
Biological control of *Drosophila suzukii* by means of the pupal parasitoid *Trichopria drosophilae*: field and semifield experiences 16

Christa Lethmayer, Matthias Wernicke, Sylvia Blümel
Investigations of potential oviposition deterrents for *Drosophila suzukii* 17

Camille Minguely, Catherine Baroffio, Lindsey Norgrove, Christoph Kopp
Distribution of the eriophyoid mite species *Phyllocoptes gracilis* (Acari: Eriophyidae) on European raspberries (*Rubus idaeus*) in Switzerland 18

Arturs Stalažs, Maksims Balalaikins
Overview of seabuckthorn fruit fly (*Rhagoletis batava*) in Latvia and Europe 19

Aurore D. C. Panel, Laura Zeeman, Bart J. van der Sluis, Peter van Elk, Bart A. Pannebakker, Bregje Wertheim, Herman H. M. Helsen
Overwintered Drosophila suzukii are the main source for infestations of the first fruit crops of the season 20

Isa Lindqvist, Anne Lemmetty, Satu Latvala
The common flower bug (*Anthocoris nemorum*) — a potential biological control agent for apple orchards in Finland 21

Małgorzata Tartanus, Eligio Malusá, Witold Danelski
Monitoring of fruit pests in organic soft fruits plantations and testing of biocontrol agents 22

Arturs Stalažs
Glischrochilus beetles as pests of raspberry and strawberry fruits 23

Vincent Michel, Christian Wohler, Max Kopp, Hagen Thoss, Michael Mannale, Marilena Palmisano
Fungicide resistance of *Botrytis cinerea*: first results from Switzerland 24

Brankica Tanović, Jovana Hrustić, Milica Mihajlović
Pathogens associated with strawberry crown and root rot 25

Inga Moročko-Bičevska, Olga Sokolova, Kristīne Vēvere, Māris Jundzis, Jamshid Fatehi
Fungal pathogens associated with cankers and decline of seabuckthorn 26

Arne Stensvand, Aruppillai Suthaparan, Belachew Asalf, Rodrigo Onofre, Pål From, Natalia Peres, William Turechek, Andrew Bierman, Mark Rea, David Gadoury
Non-chemical control of powdery mildew in strawberry 27

Abstracts of the *9th International IOBC/WPRS Workshop on Integrated Plant Protection of soft fruits*
Dobele (Latvia): Institute of Horticulture (ed. A. Stalažs), ISBN 978-9934-19-641-6 (print), ISBN 978-9934-19-642-3 (online)

Vincent Michel
Phytophthora cactorum disseminated by irrigation in substrate grown strawberries 28

Peter Melis, Marieke Vervoort, Tom Van Delm
Autonomous control of powdery mildew as part of IPM strategy in strawberry 29

Daniele Prodorutti, Davide Profaizer, Gianpiero Ganarin, Sandro Conci, Tommaso Pantezzi, Gino Angeli
Experimental trials to control strawberry powdery mildew in Italy 30

Michelle T. Fountain, Chantelle Jay, David Hall, Dudley Farman
Push-Pull with synthetic attractants and repellents for control of fruit pests 31

Bianca Boehnke, Kirsten Köppler, Clemens Augel, Alexandra Wichura, Julian Lindstaedt, Jan-Henrik Wiebusch, Adrian Engel, Silke Benz, Heidrun Vogt
Demonstration project "Exclusion netting for managing spotted wing drosophila in fruit crops" — Results 2017 32

Vincent Van Kerckvoorde, Rik Clymans, Eva Bangels, Ammar Alhmedi, Tom Thys, Madelena De Ro, Jochem Bonte, Hans Casteels, Patrick De Clercq, Dany Bylemans, Tim Belien
Comparison of additives to enhance chemical control of *Drosophila suzukii* 33

Simon Foster
Using Biobest Flying Doctors for targeted application of biopesticides 34

Eligio Malusá, Małgorzata Tartanus, Cezary Tkaczuk, Loredana Canfora, Flavia Pinzari
Protection of organic strawberry plantations from *Melolontha* spp. through an integrated approach: results from four-year trials in Poland 35

Katherine A. G. Nielsen, Gunn Mari Strømeng, Magne Nordang Skårn, Kari Ørstad, Arne Stensvand, May Bente Brurberg
Resistance to fenhexamid, boscalid and pyraclostrobin in *Botrytis* spp. in Norwegian strawberry fields 36

Mila Grahovac, Vera Stojšin, Mladen Petreš, Brankica Tanović, Ferenc Bagi, Dragana Budakov
Efficacy of *Bacillus subtilis* (strain BS10) in control of *Botrytis cinerea* in strawberry 37

Fabio Kuonen, Mélanie Dorsaz, Camille Minguely, Catherine Baroffio
Swiss IPM strategies against Drosophila suzukii (Diptera: Drosophilidae) 38

Pauliina Palonen, Anni Pinomaa, Tero Tommila
Effect of high tunnel on raspberry yield and berry quality 39

Darinka Koron
Weed control in Slovenian integrated and organic strawberry production 40

Sandra Minova, Zane Metla, Līga Jankevica
Impact of coniferous trees bark extract formulations on growth of phytopathogenic fungi *Botrytis cinerea* and *Colletotrichum acutatum* on strawberry leaves 41

Sarmīte Strautiņa, Valda Laugale, Ieva Kalniņa, Anita Osvalde, Dace Siliņa
Project: Evaluation of small fruit cultivars perspective for integrated production in different regions of Latvia and development and improvement of their growing technologies 42

Author index 43

List of participants 44

For notes 48

Organisers

WG Convenor **Claudio Ioriatti**

Center for Technology Transfer
Fondazione Edmund Mach
Via E. Mach 1 38010 S. Michele all'Adige (TN), ITALY
claudio.ioriatti@iasma.it

SG Convenor **Christian Linder**

Département fédéral de l'économie, de la formation et de la recherche DEFR, Agroscope
Route de Duillier 50
CP 1012 1260 Nyon 1, SWITZERLAND
christian.linder@agroscope.admin.ch

Local organisers **Inga Moročko-Bičevska**
Arturs Stalažs (secretary)
Inese Ebele

Institute of Horticulture, Latvia University of Life Sciences and Technologies
Graudu iela 1, Ceriņi, Krimūnu pagasts,
Dobeles novads, LV-3701, LATVIA
inga.morocko@llu.lv
arturs.stalazs@llu.lv

Scientific committee

Arturs Stalažs (Institute of Horticulture, Local organiser, Latvia)

Christian Linder (Agroscope Changins, Sub Group Convenor, Switzerland)

Daniele Prodorutti (Fondazione Edmund Mach, Italy)

Inga Moročko-Bičevska (Institute of Horticulture, Local organiser, Latvia)

Līga Jankevica (University of Latvia)

Vincent Michel (Agroscope Conthey, Switzerland)

Time table

Tuesday, 4 September 2018

Arrival and accommodation

Wednesday, 5 September 2018

9:00–9:30	Registration	
9:30–10:00	Opening and introductory presentations	
10:00–10:50	**Session 1**	Parasitoids in IPP of soft fruits
10:50–11:10	Coffee break	
11:10–12:10	**Session 1**	Parasitoids in IPP of soft fruits (continued)
12:10–13:10	Lunch	
13:10–14:30	**Session 2**	Pests and their biology
14:30–15:00	**Poster session** & Coffee break	(posters of Session 1 & 2)
15:00–17:00	**Session 3**	Guidelines for Integrated Production of soft fruits

Thursday, 6 September 2018

9:00–9:30	Registration	
9:30–10:50	**Session 4**	Diseases and pathogens of soft fruits
10:50–11:10	Coffee brake	
11:10–11:30	**Session 4**	Diseases and pathogens of soft fruits (continued)
11:30–12:10	**Session 5**	IPP strategies in soft fruits
12:10–13:10	Lunch	
13:10–14:50	**Session 5**	IPP strategies in soft fruits (continued)
14:50–16:30	**Poster session** & Coffee break	(posters of Session 4 & 5)
18:00–22:00	Social dinner & closing of conference	

Friday, 7 September 2018

8:00–<19:00	Technical tour to seabuckthorn and cranberry growing farms

Programme

Wednesday, 5 September 2018

9:00–9:30	**Registration**	
9:30–10:00	**Opening and introductory presentations**	
	Christian Linder & Claudio Ioriatti (IOBC) Inese Ebele (Director of Institute of Horticulture, Latvia)	
Session 1	**Parasitoids in IPP of soft fruits** Session leaders: Christian Linder & Marc Kenis	
	Invited lecture	
10:00–10:30	**Marc Kenis** How close are we from a release of Asian parasitoids against *Drosophila suzukii* in Europe?	
	Oral presentations	
10:30–10:50	O1.1	Nasim Amiresmaeili, Jörg Romeis, **Jana Collatz** Cold tolerance of *Trichopria drosophilae*, a natural enemy of *Drosophila suzukii*
10:50–11:10	Coffee break	
11:10–11:30	O1.2	**Sarah Wolf**, Svetlana Boycheva, Jörg Romeis, Jana Collatz Multitrophic interactions of *Dosophila suzukii*, wild fruits and a native pupal parasitoid
11:30–11:50	O1.3	**Estelle Postic**, Caroline Granado, Yannick Outreman, Anne Le Ralec Unravelling trophic webs between aphids and parasitoids in strawberry greenhouses to improve a biological control program
11:50–12:10	O1.4	Marco Valerio Rossi Stacconi, Alberto Grassi, Gianfranco Anfora, **Claudio Ioriatti** Biological control of *Drosophila suzukii* by means of the pupal parasitoid *Trichopria drosophilae*: field and semifield experiences
12:10–13:10	Lunch	
Session 2	**Pests and their biology** Session leaders: Claudio Ioriatti & Arturs Stalažs	
13:10–13:30	O2.1	**Christa Lethmayer**, Matthias Wernicke, Sylvia Blümel Investigations of potential oviposition deterrents for *Drosophila suzukii*
13:30–13:50	O2.2	**Camille Minguely**, Catherine Baroffio, Lindsey Norgrove, Christoph Kopp Distribution of the eriophyoid mite species *Phyllocoptes gracilis* (Acari: Eriophyidae) on European raspberries (*Rubus idaeus*) in Switzerland

13:50–14:10	O2.3	**Arturs Stalažs**, Maksims Balalaikins Overview of seabuckthorn fruit fly (*Rhagoletis batava*) in Latvia and Europe
14:10–14:30	O2.4	**Aurore D. C. Panel**, Laura Zeeman, Bart J. van der Sluis, Peter van Elk, Bart A. Pannebakker, Bregje Wertheim, Herman H. M. Helsen Overwintered *Drosophila suzukii* are the main source for infestations of the first fruit crops of the season

Poster session & Coffee break
(posters of Session 1 & 2)

14:30–15:00	P1.1	**Isa Lindqvist**, Anne Lemmetty, Satu Latvala The common flower bug (*Anthocoris nemorum*) — a potential biological control agent for apple orchards in Finland
	P1.2	Małgorzata Tartanus, **Eligio Malusá**, Witold Danelski Monitoring of fruit pests in organic soft fruits plantations and testing of biocontrol agents
	P2.1	**Arturs Stalažs** *Glischrochilus* beetles as pests of raspberry and strawberry fruits

Session 3 **Guidelines for Integrated Production of soft fruits**
Session leaders: Carlo Malavolta & Aude Alaphilippe

15:00–17:00 **Christian Linder, Carlo Malavolta, Aude Alaphilippe**
Update of the IOBC IP Guidelines for soft fruits

Thursday, 6 September 2018

9:00–9:30 **Registration**

Session 4 **Diseases and pathogens of soft fruits**
Session leaders: Vincent Michel & Inga Moročko-Bičevska

9:30–9:50	O4.1	**Vincent Michel**, Christian Wohler, Max Kopp, Hagen Thoss, Michael Mannale, Marilena Palmisano Fungicide resistance of *Botrytis cinerea*: first results from Switzerland
9:50–10:10	O4.2	**Brankica Tanović**, Jovana Hrustić, Milica Mihajlović Pathogens associated with strawberry crown and root rot
10:10–10:30	O4.3	**Inga Moročko-Bičevska**, Olga Sokolova, Kristīne Vēvere, Māris Jundzis, Jamshid Fatehi Fungal pathogens associated with cankers and decline of seabuckthorn
10:30–10:50	O4.4	**Arne Stensvand**, Aruppillai Suthaparan, Belachew Asalf, Rodrigo Onofre, Pål From, Natalia Peres, William Turechek, Andrew Bierman, Mark Rea, David Gadoury Non-chemical control of powdery mildew in strawberry

10:50–11:10 Coffee break

11:10–11:30	O4.5	**Vincent Michel** *Phytophthora cactorum* disseminated by irrigation in substrate grown strawberries
Session 5		**IPP strategies in soft fruits** Session leaders: Arne Stensvand & Brankica Tanovič
11:30–11:50	O5.1	**Peter Melis**, Marieke Vervoort, Tom Van Delm Autonomous control of powdery mildew as part of IPM strategy in strawberry
11:50–12:10	O5.2	**Daniele Prodorutti**, Davide Profaizer, Gianpiero Ganarin, Sandro Conci, Tommaso Pantezzi, Gino Angeli Experimental trials to control strawberry powdery mildew in Italy
12:10–13:10	Lunch	
13:10–13:30	O5.3	**Michelle T. Fountain**, Chantelle Jay, David Hall, Dudley Farman Push-Pull with synthetic attractants and repellents for control of fruit pests
13:30–13:50	O5.4	**Bianca Boehnke**, Kirsten Köppler, Clemens Augel, Alexandra Wichura, Julian Lindstaedt, Jan-Henrik Wiebusch, Adrian Engel, Silke Benz, Heidrun Vogt Demonstration project "Exclusion netting for managing spotted wing drosophila in fruit crops" — Results 2017
13:50–14:10	O5.5	**Vincent Van Kerckvoorde**, Rik Clymans, Eva Bangels, Ammar Alhmedi, Tom Thys, Madelena De Ro, Jochem Bonte, Hans Casteels, Patrick De Clercq, Dany Bylemans, Tim Belien Comparison of additives to enhance chemical control of *Drosophila suzukii*
14:10–14:30	O5.6	**Simon Foster** Using Biobest Flying Doctors for targeted application of biopesticides
14:30–14:50	O5.7	**Eligio Malusá**, Małgorzata Tartanus, Cezary Tkaczuk, Loredana Canfora, Flavia Pinzari Protection of organic strawberry plantations from *Melolontha* spp. through an integrated approach: results from four-year trials in Poland
Poster session & Coffee break (posters of Session 4 & 5)		
14:50–16:30	P4.1	Katherine A. G. Nielsen, Gunn Mari Strømeng, Magne Nordang Skårn, Kari Ørstad, **Arne Stensvand**, May Bente Brurberg Resistance to fenhexamid, boscalid and pyraclostrobin in *Botrytis* spp. in Norwegian strawberry fields
	P5.1	Mila Grahovac, Vera Stojšin, Mladen Petreš, **Brankica Tanović**, Ferenc Bagi, Dragana Budakov Efficacy of *Bacillus subtilis* (strain BS10) in control of *Botrytis cinerea* in strawberry

P5.2 Fabio Kuonen, Mélanie Dorsaz, **Camille Minguely**, Catherine Baroffio
Swiss IPM strategies against *Drosophila suzukii* (Diptera: Drosophilidae). Part I

P5.3 Fabio Kuonen, Mélanie Dorsaz, **Camille Minguely**, Catherine Baroffio
Swiss IPM strategies against *Drosophila suzukii* (Diptera: Drosophilidae). Part II

P5.4 **Pauliina Palonen**, Anni Pinomaa, Tero Tommila
Effect of high tunnel on raspberry yield and berry quality

P5.5 Sandra Minova, Zane Metla, **Līga Jankevica**
Impact of coniferous trees bark extract formulations on growth of phytopathogenic fungi *Botrytis cinerea* and *Colletotrichum acutatum* on strawberry leaves

P5.6 **Darinka Koron**
Weed control in Slovenian integrated and organic strawberry production

P5.7 **Sarmīte Strautiņa**, Valda Laugale, Ieva Kalniņa, Anita Osvalde, Dace Siliņa
Project: Evaluation of small fruit cultivars perspective for integrated production in different regions of Latvia and development and improvement of their growing technologies

18:00–22:00 Social dinner & closing of conference

Friday, 7 September 2018

8:00–<19:00 Technical tour to seabuckthorn and cranberry growing farms

How close are we from a release of Asian parasitoids against *Drosophila suzukii* in Europe?

Marc Kenis, Pierre Girod, Laetitia Driss, Tim Haye

CABI, 1 Rue des Grillons, 2800 Delémont, Switzerland,
email: m.kenis@cabi.org

Since its arrival in Europe, *Drosophila suzukii* has become a major pest on many fruit crops. Various methods have been developed to control the pest in conventional and organic systems. However, because of the wide host range of the fly and the high number of generations per year, crops are constantly reinvaded from neighbouring habitats, which complicates management strategies. Classical biological control through the introduction of parasitoids from Asia could provide an area-wide control of the pest. Surveys were carried out in East Asia to identify the most abundant and most specific parasitoid species in the native range of *Drosophila suzukii*. These surveys and subsequent research in quarantine in Europe showed that the most abundant and most specific parasitoid is a figitid wasp, presently named *Ganaspis* cf. *brasiliensis*. However, we also showed important variations between populations in host specificity, which suggests a possible occurrence of two biotypes, or sibling species. Indeed, some populations seem totally specific to *Drosophila suzukii* in fruits, refusing even to parasitize *Drosophila suzukii* in diet, whereas others develop successfully in *Drosophila suzukii* and some other Drosophila spp. in diet. The two biotypes occur sympatrically in China and Japan. Cross-mating experiments and molecular studies are presently being carried out to sort out the taxonomic status of the species. The final objective is to select the most specific and best adapted populations for release in Europe.

Keywords: biological control, *Ganaspis*, parasitoid, spotted wing drosophila

Cold tolerance of *Trichopria drosophilae*, a natural enemy of *Drosophila suzukii*

Nasim Amiresmaeili, Jörg Romeis, Jana Collatz

Biosafety group, Agroscope,
Reckenholzstrasse 191, 8047 Zürich, Switzerland,
email: jana.collatz@agroscope.admin.ch

In temperate climates, cold tolerance determines establishment, fitness and thus efficacy of natural enemies during spring releases. We investigated cold tolerance in *Trichopria drosophilae* (Perkins) (Hymenoptera: Diapriidae), a pupal endoparasitoid of *Drosophila* spp. (Diptera: Drosophilidae) that is currently considered for biological control of the invasive fruit pest *Drosophila suzukii* (Matsumura).

We determined the super cooling point (i.e., the temperature when hemolymph freezes) of adult *Trichopria drosophilae* to be 27.2 ± 0.5 °C. Lower lethal temperature was assessed by cooling adults at –1 °C min^{-1} down to a fixed temperature. Mortality increased significantly at –15 °C and few individuals survived at –20 °C. Moreover, adults survived and reproduced after short exposure to constant cold, but 11 days at 0 °C were lethal. Host species did not influence cold hardiness. In an outdoor experiment we exposed different parasitoid life-stages to winter conditions and identified larvae as the overwintering stage. They survived for 76 days, with mean temperatures of 3.5 °C and minimum –8.9 °C during that period. Overwintering of *Trichopria drosophilae* in a sub-adult stage explains why adults are found outdoors only in summer and autumn, as development has to be completed during spring. Given that laboratory rearing of *Trichopria drosophilae* can be performed all year round and that the adults show tolerance to short-term cold exposure, augmentation of populations during spring could be promising for biological control.

Keywords: augmentation, life-stage, overwintering, parasitoid

Multitrophic interactions of *Dosophila suzukii*, wild fruits and a native pupal parasitoid

Sarah Wolf, Svetlana Boycheva, Jörg Romeis, Jana Collatz

Agroscope, Research Division Agroecology and Environment,
Reckenholzstrasse 191, 8046 Zurich, Switzerland,
email: sarah.wolf@agroscope.admin.ch

Drosophila suzukii not only attacks fruit and berry crops but can also develop in a large variety of wild fruits. Semi-natural habitats in proximity to crops provide wild fruits during most of the year. They offer food and oviposition resources to *Drosophila suzukii* enabling them to sustain populations outside crops. Native natural enemies of *Drosophila suzukii* such as parasitoid wasps are present in these habitats and could play a role in reducing *Drosophila suzukii* populations. We wanted to know how wild fruits influence the ability of wasps to find and utilize *Drosophila suzukii* as hosts.

We investigated the interactions of a native pupal parasitoid, *Trichopria drosophilae*, with *Drosophila suzukii* developing in seven species of wild fruits in the laboratory. We offered fruits to *Drosophila suzukii* for oviposition and checked larval development. Then we offered infested fruits to *Trichopria drosophilae* and followed the development of the parasitoid. In a behavioural assay, we tested the attractiveness of infested and un-infested fruits to female *Trichopria drosophilae*. We show that not all tested wild fruit species support *Drosophila suzukii* development. Females of *Trichopria drosophilae* eagerly parasitize *Drosophila suzukii* pupae in all offered fruit species, but the attractiveness of fruits differs. The results from the laboratory suggest that *Trichopria drosophilae* is able to find and explore *Drosophila suzukii* pupae in wild fruits and that fruits differ in suitability for both flies and parasitoids. These findings could be used to manage habitats for pest suppression.

Keywords: wild fruits, parasitic wasps, spotted wing drosophila

Unravelling trophic webs between aphids and parasitoids in strawberry greenhouses to improve a biological control program

Estelle Postic, Caroline Granado, Yannick Outreman, Anne Le Ralec

UMR 1349 IGEPP, INRA,
Agrocampus Ouest, 65, rue de Saint-Brieuc CS 84215,
35042 Rennes Cedex, France,
email: estelle.postic@agrocampus-ouest.fr

In French strawberry greenhouses, aphids are major pests, leading to yield and quality losses. Biological control of these pests relies on the inundative release of predators (e. g. *Chrysoperla carnea*) and parasitoids (mainly belonging to the subfamily Aphidiinae). However, these releases are often inefficient, so chemical applications are often needed. The lack of reliability of biological control of aphids prevents the implementation of a global Integrated Pest Management strategy in strawberry greenhouses. In order to improve biological control of aphids, our study focuses on structure and spatio-temporal variability of trophic webs between strawberry aphid species, their insect parasitoids and hyperparasitoids.

During two successive years, we sampled aphid and parasitoid individuals in French strawberry greenhouses at the national scale. First, we investigated aphid communities in spring and summer in various production contexts. Second, identification of parasitized aphids and parasitoid individuals enabled us to build quantitative food webs. In spring, four aphid species dominated the communities and their relative abundance was related to the production context. Two generalist parasitoid species, *Aphidius ervi* and *Praon volucre*, parasitized the dominant aphid pest species. Also, we observed some specific relationship within trophic webs: one aphid species, *Chaetosiphon fragaefolii* was parasitized by a single specialist parasitoid species, *Aphidius eglanteriae*. Temporal variation in food webs structure was found as a shift in aphid community composition between spring and summer was observed, leading to both change and diversification of the parasitoid community composition. This study also highlights the negative role of hyperparasitoids species in the success of biological control as a lot of hyperparasitoid individuals emerged from parasitized aphids.

This study is a first step in the unravelling of aphid-parasitoids interaction networks in strawberry greenhouses. It will help identifying parasitoid species or populations well adapted to the aphids found in this system.

Keywords: *Acyrthosiphon malvae*, *Aphis gossypii*, host-parasitoid associations, *Macrosiphum euphorbiae*, multivariate analysis, *Rhodobium porosum*

Biological control of *Drosophila suzukii* by means of the pupal parasitoid *Trichopria drosophilae*: field and semifield experiences

Marco Valerio Rossi Stacconi[1], Alberto Grassi[2], Gianfranco Anfora[3, 4], Claudio Ioriatti[2]

[1]Department of Horticulture, Oregon State University, 4017 Ag and Life Sciences Building, Corvallis, OR 97331, United States

[2]Technology Transfer Centre, Fondazione Edmund Mach (FEM), via E. Mach 1, 38010, San Michele all'Adige (TN), Italy, email: claudio.ioriatti@fmach.it

[3]Research and Innovation Centre, Fondazione Edmund Mach (FEM), via E. Mach 1, 38010, San Michele all'Adige (TN), Italy

[4]Center Agriculture Food Environment (C3A), University of Trento, via E. Mach 1, 38010, San Michele all'Adige (TN), Italy

Biological control remains unutilized as yet in the framework of *Drosophila suzukii* Matsumura management. Nonetheless, natural enemies may play an important role in regulating this pest, particularly after the winter population bottleneck (reproductive diapause). Research on biological control of *Drosophila suzukii* has followed two different approaches. The first is classical biological control and involves the release of parasitoids from the pest's native range, while the second avenue investigates the occurrence and efficacy of local parasitoids in the invaded areas. Co-evolved *Drosophila suzukii* parasitoids show advantages in terms of efficacy and specificity, nonetheless their open field release is limited by restrictive laws regulating the importation of exotic species. Indigenous parasitoids may represent an alternative, since their use does not suffer legal restrictions and some species shown high parasitism rates against *Drosophila suzukii* in laboratory assays. A survey to determine the presence, seasonal phenology and biological control status of indigenous parasitoid populations of *Drosophila suzukii* was carried out in Trentino (Italy). Three indigenous parasitoids of larvae and pupae were found: *Leptopilina heterotoma* (Thomson), *Pachycrepoideus vindemiae* (Rondani) and *Trichopria drosophilae* (Perkins). Comparison of their performances under controlled laboratory conditions suggested selecting *Trichopria drosophilae* as the best candidate for augmentation strategy against *Drosophila suzukii* due to its ability to parasitize *Drosophila suzukii* on a wider temperature condition range.

Here we present the results of a two-year project aimed to test the ability of the cosmopolitan parasitoid, *Trichopria drosophilae* to reduce *Drosophila suzukii* populations in open field conditions.

Keywords: augmentation, indigenous parasitoid, open field trials

Investigations of potential oviposition deterrents for *Drosophila suzukii*

Christa Lethmayer, Matthias Wernicke, Sylvia Blümel

AGES — Austrian Agency for Health and Food Safety,
Institute for Sustainable Plant Production,
Spargelfeldstraße 191, A-1220 Vienna, Austria,
email: christa.lethmayer@ages.at

The vinegar fly *Drosophila suzukii* (Drosophilidae, Diptera), spotted wing drosophila, is a highly polyphagous pest of many fruit crops (mainly soft and stone fruits) with origin in Asia which has successfully invaded Europe and North America during the last decade. In contrast to many other Drosophilidae species, the spotted wing drosophila lays its egg in ripening fruits with its serrated ovipositor. Due to larval feeding inside the fruits severe damages and high crop losses are caused. Effective and sustainable integrated pest management strategies against *Drosophila suzukii* are still urgently needed.

An alternative strategy for the control of spotted wing drosophila is the potential use of oviposition deterrents in order to avoid oviposition. Within the Interreg V program AGES carried out laboratory tests with several substances to evaluate their ability for reducing respectively preventing oviposition of *Drosophila suzukii*.

Preliminary results will be shown.

Keywords: control, laboratory test, oviposition deterrent, spotted wing drosophila,

Distribution of the eriophyoid mite species *Phyllocoptes gracilis* (Acari: Eriophyidae) on European raspberries (*Rubus idaeus*) in Switzerland

Camille Minguely[1, 2], **Catherine Baroffio**[1], **Lindsey Norgrove**[2], **Christoph Kopp**[2]

[1]*Agroscope Route des Eterpys 18, 1964 Conthey, Switzerland,*
email: camille.minguely@agroscope.admin.ch

[2]*HAFL Bern University of Applied Sciences School of Agricultural,*
Forest and Food Sciences HAFL Länggasse 85, 3052 Zollikofen, Switzerland

Phyllocoptes gracilis Nalepa (Acari: Eriophyidae) is an important pest of raspberry plantations in Switzerland. Due to its small size and tendency to hide, it is very difficult for growers to detect its presence on crops before the development of symptoms and crop damage. In 2017, severe infestations of *Phyllocoptes gracilis* resulting in significant crop damage and economic loss affected organic raspberry growers in Switzerland. This situation highlighted the urgent need to develop efficient tools for the early detection and monitoring of *Phyllocoptes gracilis*. The objective of this study was to characterize the intraplant distribution of *Phyllocoptes gracilis* on raspberry canes to optimize the detection and monitoring methods of the pest. The distribution of *Phyllocoptes gracilis* in dormant buds along infested overwintering canes of raspberry was characterized by extracting mites from their overwintering sites. The results showed a prevalence of eriophyoid mites on the upper part of the cane with the greatest mean number of mites found in buds located between 100 and 120 cm above the collar level.

The distribution of *Phyllocoptes gracilis* within its host was studied over eight months by sampling specific organ types at three height categories along infested raspberry canes. Although the presence of *Phyllocoptes gracilis* was observed in all organ types and at all height categories on all sampling dates, there were significant differences in the distributions of the mites. It appeared that the populations of *Phyllocoptes gracilis* were actively influenced by morphological changes in their host. The mite populations presented an aggregated distribution along the cane illustrated by a prevalence of mites on the upper two-thirds of the canes. Those results should be used to improve monitoring of *Phyllocoptes gracilis* by sampling specific organ types according to crop development between 60 and 180 cm above collar level.

Keywords: intraplant distribution, Eriophyidae, monitoring, raspberries

Overview of seabuckthorn fruit fly (*Rhagoletis batava*) in Latvia and Europe

Arturs Stalažs[1], **Maksims Balalaikins**[2]

[1]*Institute of Horticulture,*
Graudu iela 1, Ceriņi, Krimūnu pagasts, Dobeles novads, LV-3701, Latvia
email: arturs.stalazs@llu.lv

[2]*Institute of Life Sciences and Technology, Daugavpils University,*
Vienības iela 13, Daugavpils, LV-5401, Latvia

Numerous *Rhagoletis* species are economically important pests of different fruits. Although the seabuckthorn fruit fly (*Rhagoletis batava*) has been first described from Europe (The Netherlands), for a long time this species was only known as important pest of seabuckthorn in Siberia, especially in Altay region. Kolomiec believed that the Siberian population is a separate subspecies of *Rhagoletis batava* and described it as subspecies, *Rhagoletis batava obscuriosa*. Notwithstanding the fact that *Rhagoletis batava* already occurred in several European countries in the past, serious damage of seabuckthorn fruit was not observed, like in Siberia. It is only in the last 15 years that the intensive spread of *Rhagoletis batava* in Europe has been observed, — first in European part of Russian Federation, later in Belarus and further in following countries: Germany, Latvia, Lithuania and Poland, where serious damage of fruit have been observed too.

According to latest confirmed information (data until the end of 2017), in Europe *Rhagoletis batava* has been recorded from following countries: Belarus, Belgium, Czech Republic, Estonia, Finland, Germany, Italy, Latvia, Lithuania, Poland, Russian Federation (European part, excluding Kaliningrad Region), Spain, Sweden, Switzerland and The Netherlands. The report from Hungary was a mistake based on information misunderstanding, and *Rhagoletis batava* in this country remains unconfirmed.

Results of the several yearlong study on flying dynamics of *Rhagoletis batava* shows that in Latvia this species appears in the last decade of June and remains active until the end of August, or the first part of September in Eastern part of country. The highest activity of flies occurs from the mid of July until the mid of August. Mating observations in Latvia and Lithuania suggest that egg lying last at least 30 days.

Keywords: distribution, fruit pest, monitoring results

Overwintered *Drosophila suzukii* are the main source for infestations of the first fruit crops of the season

Aurore D. C. Panel, Laura Zeeman, Bart J. van der Sluis, Peter van Elk, Bart A. Pannebakker, Bregje Wertheim, Herman H. M. Helsen

Groningen Institute for Evolutionary Life Sciences, University of Groningen, Nijenborgh 7, 9700 CC, Groningen, The Netherlands, email: a.d.c.panel@rug.nl

Drosophila suzukii is a widespread invasive pest of small fruits and cherry crops. The mechanisms allowing this fruit fly to survive from early spring until the availability of the first fruit crops are poorly understood. It has been hypothesized that winter survivors establish a generation on early spring hosts and that these offspring then migrate into orchards to infest fruits. The goal of this study was to test this hypothesis, using experiments combined with field monitoring and cumulative degree-days (DD) analysis. We specifically **1)** identified hosts available to *Drosophila suzukii* in early spring, **2)** assessed their suitability for *Drosophila suzukii* oviposition and reproductive success, and **3)** correlated the infestation of these hosts with long-term monitoring data on seasonal reproductive biology and morphology of the pest. Our results revealed that the ornament *Aucuba japonica* was highly infested by *Drosophila suzukii* during early spring. Seasonal reproductive biology of field captured *Drosophila suzukii* showed that in 2017, the first gravid females appeared at 87 degree days, coinciding with collection of the first infested early host fruits, in particular *Aucuba japonica*. The latter was infested by the pest from early spring until May, but it only yielded a few summer morph offspring. However, field monitoring in orchards revealed that *Drosophila suzukii* individuals consisted solely of winter morphs until mid-June. These observations indicate that overwintered *Drosophila suzukii* females are the main contributors of the infestations in the first available fruit crops of the season. We discuss these findings in the context of possible pest control strategies.

Keywords: alternative host, integrated pest management, phenotypic plasticity, seasonal biology, spotted wing drosophila

The common flower bug (*Anthocoris nemorum*) — a potential biological control agent for apple orchards in Finland

Isa Lindqvist, Anne Lemmetty, Satu Latvala

Natural Resource Institute Finland (Luke), Plant Health,
Tietotie 2, FI-31600 Jokioinen, Finland,
email: isa.lindqvist@luke.fi

Import of plant material from all over the world increases the possibility of new pests to arrive in Finland. Furthermore, the global warming enhances adaption of the pests in our country. These facts together with the continuously decreasing number of efficient and permitted pesticides create a threat to our cultivations. In addition, the pests can already be partly resistant to some pesticides. New methods compatible with the IPM practices are needed to compensate the lack of usable pesticides.

A new project focusing on the predator-prey chain aiming to find new natural enemies that could be used in apple orchards and on small fruits was started in 2017 at Natural Resources Institute Finland (Luke). The growing area of apple cultivation has lately expanded in Finland and apple trees have many injurious pests. Our aim is to speed up the detection of new natural beneficial insects by identifying their prey with molecular biological methods. These methods are usable also when the morphological development stage of insects is difficult to identify.

First we focus on the predatory insect, *Anthocoris nemorum* (Heteroptera, Anthocoridae) which is common on apples in whole Finland and is also found on different plants in the garden searching for suitable food. This bug is a polyphagous predator eating several pest species as psyllids, aphids, mites and small larvae. A closely related predatory bug, *Anthocoris nemoralis* has already been used as a biological control agent on pear in Europe.

We identify the pray species the bugs have eaten by analyzing the gut content of *Anthocoris nemorum*. Adult bugs and available prey species were collected from the apples by beating funnel at several time points during the growing season. The samples were separated and frozen at –80 °C prior to DNA isolation. The primers used in PCR were either universal or group and/or species specific and they were adapted from published literature or designed in this study.

In the laboratory tests, after a fasting period, A. nemorum individuals were given one kind of prey and their DNA content was analyzed. Our results showed that the prey DNA was detectable from *Anthocoris nemorum*. The preliminary results also indicate that the DNA of prey species can be detected and identified from *Anthocoris nemorum* collected in the apple orchards.

Keywords: common flowerbug, PCR detection, predator-prey

Monitoring of fruit pests in organic soft fruits plantations and testing of biocontrol agents

Małgorzata Tartanus[1], Eligio Malusá[1, 2], Witold Danelski[1]

[1]Research Institute of Horticulture, Skierniewice, Poland,
email: eligio.malusa@inhort.pl

[2]CREA — Research Centre for Engineering and Agro-Food Processing,
Turin, Italy

A survey in organic plantations of rugosa rose (*Rosa rugosa*) and common seabuckthorn (*Hippophae rhamnoides*) allowed determining the presence of *Rhagoletis alternata* and *Rhagoletis batava* respectively in the former and latter species, as well as other fruit pests. In order to assess the feasibility for mass trapping of these species, we have conducted a monitoring with yellow traps in parallel to mass traps with lures designed for *Rhagoletis cerasi* or *Ceratitis capitata*. Both kinds of mass traps were effective in attracting the three *Rhagoletis* species as well as adults of *Anomoia purmunda*. Furthermore, trials testing the efficacy of different plant extracts or biocontrol agents to control R. batava in the seabuckthorn plantation and *Grapholita tenebrosana* in rugose rose plantations, the most diffuse fruit pest together with *Rhagoletis alternata*, were performed. Extracts from neem tree or quassia as well as a *Beauveria bassiana* formulation were used in the seabuckthorn plantation, while biopesticides based on *Bacillus thuringiensis* or *Cydia pomonella granulovirus* (CpGV) were applied in rugose rose. Results show some of these products to be quite effective in pest control and worthy to be included in an integrated strategy of pest control.

Keywords: fruit pests, *Hippophae rhamnoides, Rosa rugosa*

Glischrochilus beetles as pests of raspberry and strawberry fruits

Arturs Stalažs

[1]Institute of Horticulture,
Graudu iela 1, Ceriņi, Krimūnu pagasts, Dobeles novads, LV-3701, Latvia
email: arturs.stalazs@llu.lv

Glischrochilus beetles (family Nitidulidae) are not traditional plant pests and some of them even are predaceous species. However, it is known that these beetles are attracted to beverage liquids and plant sap, and commonly feed on suffusing wounds of different trees. Up to date, five *Glischrochilus* species (*Glischrochilus grandis, G. hortensis, G. quadriguttatus, G. quadripunctatus* and *G. quadrisignatus*) have been registered in the territory of Latvia, and two of them — *Glischrochilus grandis* and *Glischrochilus quadrisignatus* are of alien origin. In Latvia, several complaints about *Glischrochilus* beetles found in fruits of raspberries and strawberries have been received from raspberry and strawberry growers during the last ten years, and the same observations has been done by author. The observations shows that *Glischrochilus* beetles in raspberry and strawberry fruits become more common year from year, and in July 2018, *Glischrochilus grandis* beetles were found in each of six randomly selected fruit collected from one plant of unknown *Rubus idaeus* cultivar (at orchard of Institute of Horticulture, Krimūnu pagasts). Although the most common and widespread native species *Glischrochilus hortensis* occurred in Latvia, it was not included in lists of fruit pests. Supposedly, the recent spread of two alien species *Glischrochilus grandis* and *Glischrochilus quadrisignatus* in Latvia is the reason why more and more *Glischrochilus* beetles are found in fruits of raspberries and strawberries.

Keywords: alien species, fruit damage, Latvia, Nitidulidae, sap feeders

Fungicide resistance of *Botrytis cinerea*: first results from Switzerland

Vincent Michel[1], Christian Wohler[2], Max Kopp[3], Hagen Thoss[4], Michael Mannale[5], Marilena Palmisano[6]

Agroscope,
[1]Route des Eterpys 18, 1964 Conthey, Switzerland,
email: vincent.michel@agroscope.admin.ch

[2]Landwirtschaftliches Zentrum Liebegg,
5722 Gränichen, Switzerland

[3]INFORAMA Oeschberg,
3425 Koppigen, Switzerland

[4]Strickhof,
[6]Riedhofstrasse 62, 8408 Winterthur, Switzerland

[5]BBZ Arenenberg
8268 Salenstein, Switzerland

[6]ZHAW — IUNR,
Einsiedlerstrasse 31, 8820 Wädenswil, Switzerland

Resistance of *Botrytis cinerea*, causal agent of grey mold, to fungicides is an increasing problem in the strawberry production in Switzerland. In 2017, a monitoring survey to assess the actual situation in four major strawberry growing cantons was conducted by the concerned cantonal extension services. Samples from fruits with typical grey mold sporulation were sent to the laboratories of Agroscope (microbiological analysis) and of the applied University ZHAW (molecular analysis). Samples were taken in fields of ten growers who assumed to have a resistance problem in their fields. Per grower, six to seven strains were isolated and analysed. Resistance to the nine following active ingredients was assessed: boscalid, cyprodinil, fenhexamid, fenpyrazamin, fluodixonil. Fluopyram, iprodion, mepanipyrim and pyrimethanil. The microbial analysis revealed that 58 % of the strains were resistant to five or more active ingredients. Most strains were resistant to boscalid (92 %), mepanipyrim (77%), and fenhexamid (75 %), whereas only 29 % were resistant to pyrimethanil. The molecular analysis showed that Multidrug resistance (MDR) 2 was three times more frequent than MDR 1 or MDR 3. The results of the survey have to be considered with care as i) only 66 strains were analysed, and ii) the strains originated from fields suspected to have a fungicide resistance problem. Actually, a second monitoring survey in the same fields is ongoing to assess the evolution of the resistance patterns.

Keywords: fungicide resistance, grey mold, multi drug resistance

Pathogens associated with strawberry crown and root rot

Brankica Tanović, Jovana Hrustić, Milica Mihajlović

Institute of Pesticides and Environmental Protection,
Banatska 31b, Belgrade, Serbia,
email: brankica.tanovic@pesting.org.rs

Strawberry belongs to the family Rosaceae, genus *Fragaria*, and is among the most widely consumed fruit throughout the world. They are grown across a wide range of regions worldwide with the exception of polar latitudes. Over the last two decades, the production increased from 3.6 to more than 9 million tons. However, the production is severely affected by black root disease complex and some other diseases caused by soil borne pathogens. Despite their routine control by soil fumigation, plant death has recently been extremely high in some strawberry fields. Thus, in a newly established strawberry crop cultivar 'Roxana', in the central part of Serbia, a high incidence of stunning, wilting and dieback of plants was observed during April 2018. Typical symptoms included root and crown necrosis, accompanied by plant wilting and chlorosis of leaves. Necrotic lesions in the inner crown tissue were recorded. Eventually, infected plants collapsed or died. In order to identify the disease causal agent(s), crown and roots of individual plants were examined. Roots were washed under running tap water and the crown of each plant was dissected. Fragments of roots and crowns, taken from the border between diseased and healthy tissue were surface sterilized in 2 % sodium hypochlorite for 2 min and aseptically placed on potato dextrose agar amended with 200 mg L^{-1} of streptomycin. The isolates were identified based on morphological characteristics and the sequence of the rDNA ITS region. Pathogenicity was confirmed by inoculation of strawberry-leaf-petiole fragments. The following species were associated with the observed symptoms: *Neopestalotiopsis clavispora, Fusarium oxysporum, Ceratobasidium* sp., and *Parathaespaeria sporulosa*.
Project III46008

Keywords: *Ceratobasidium* sp., *Fusarium oxysporum*, *Neopestalotiopsis clavispora*, *Parathaespaeria sporulosa*

Fungal pathogens associated with cankers and decline of seabuckthorn

Inga Moročko-Bičevska, Olga Sokolova, Kristīne Vēvere, Māris Jundzis, Jamshid Fatehi

[1]Institute of Horticulture,
Graudu iela 1, Ceriņi, Krimūnu pagasts, Dobeles novads, LV-3701, Latvia,
email: inga.morocko@llu.lv

Common seabuckthorn (*Hippophae rhamnoides*) is a deciduous shrub (family Elaeagnaceae) used for centuries in medicine, cosmetics and food. In several European countries, it is an indigenous species and nowadays a commercially important cultivated fruit crop in northern temperate regions of Europe, Asia and North America. Despite its importance, studies on diseases and pests are at an early stage, and plant health concerns are still not efficiently addressed. In Latvia, the seabuckthorn cultivation is rapidly expanding. In general, seabuckthorn diseases and their causal agents have been poorly studied, limited to only a few records of stem canker, wilt and dry shrink diseases caused by *Stigmina* sp, *Verticillium* spp., and *Fusarium* spp., respectively. To identify and characterise fungal diseases of seabuckthorn 55 locations including commercial orchards and wild habitats were surveyed. The samples from branches, roots, and trunks with various disease symptoms were collected. Fungi were isolated from surface sterilised plant tissues on potato dextrose agar, sub-cultured in pure cultures and preserved for further studies. The isolated fungi were characterised and identified by morphological characters and sequencing. The pathogenicity of the selected fungi was tested on potted plants in the greenhouse assays. During the surveys, overall decline, wilt, severe canker and dieback symptoms often causing the death of the plants was observed. The majority of fungi obtained from the diseased tissues were identified as belonging to *Diaporthe*, *Eutypa*, *Fusarium*, *Valsa* and *Verticillium*. The pathogenicity evaluation of the selected fungal isolates on seabuckthorn plants in the greenhouse is currently in progress.

Keywords: canker, decline, *Hippophae rhamnoides*, pathogenic fungi, wilt

Non-chemical control of powdery mildew in strawberry

Arne Stensvand[1, 2], Aruppillai Suthaparan[2], Belachew Asalf[1], Rodrigo Onofre[3], Pål From[2], Natalia Peres[3], William Turechek[4], Andrew Bierman[5], Mark Rea[5], David Gadoury[6]

[1]Norwegian Institute of Bioeconomy Research (NIBIO), Ås, Norway
email: arne.stensvand@nibio.no

[2]Norwegian University of Life Sciences (NMBU), Ås, Norway

[3]University of Florida, Gulf Coast Research and Education Center, Wimauma, FL, United States

[4]USDA-ARS, U.S. Horticultural Research Laboratory, Fort Pierce, FL, United States

[5]Lighting Research Center, Rensselaer Polytechnic Institute, Troy, NY, United States

[6]Cornell University, New York State Agricultural Experiment Station, Geneva, NY, United States

Widespread fungicide resistance among strawberry pathogens, as well as public pressure to reduce chemical use, has spurred a search for alternatives to chemical control. High tunnel production systems have reduced losses from gray mould (*Botrytis* spp.), but elevated severity of powdery mildew (*Podosphaera aphanis*). We explored and refined several non-chemical means to control strawberry powdery mildew. Mobile robotic and tractor-drawn units with ultraviolet (UV) lamp arrays were designed and deployed, and suppressed powdery mildew in greenhouse, high tunnel and field production by more than 90 %; a level of efficacy comparable to the best available fungicides. Conventional glass, polyethylene, and polycarbonate plastics block nearly all solar UV-B. When UV-transmitting fluorocarbon plastics were used in tunnel construction, powdery mildew was reduced to levels approximating that observed in open field plantings, largely eliminating the stimulation of disease that had been widely attributed to elevated RH and temperature in such structures. Carefully timed brief overhead sprinkling with water has further reduced powdery mildew nearly as efficiently as the best fungicide treatments. Meteoric water droplets have removed *Podosphaera aphanis* conidia and physically damaged mildew colonies. Lastly, we have used precisely regulated steam in a 2-stage process to pre-treat transplants to simulate host tolerance of heat, followed by a warmer therapeutic temperature to eradicate pathogens.

Keywords: high tunnel, *Podosphaera aphanis*, steam treatment, UV light, water sprinkling

Phytophthora cactorum disseminated by irrigation in substrate grown strawberries

Vincent Michel

Agroscope,
Route des Eterpys 18, 1964 Conthey, Switzerland,
email: vincent.michel@agroscope.admin.ch

In summer 2017, a grower sent strawberries (cultivar Murano) grown on substrate for analysis to the Agroscope diagnostic laboratory in Conthey. All plants were infected by *Phytophthora cactorum*. As the grower recycled the drainage water on the same crop, the presence of *Phytophthora cactorum* in the irrigation water was investigated. Samples from the drainage water, irrigation water (mix of drainage and fresh water) and fresh water were taken by the grower and sent to Agroscope. For each water type, two 100, two 50, and one 20 ml aliquot were filtered through a 5 µm mesh size sterile filter disk (Millipore LSWP). After filtration, filter disks were placed on selective PARPH medium and incubated for two weeks at 24 °C. No *Phytophthora cactorum* was found in the fresh water. One 100 ml aliquot of the irrigation water and all five aliquots of the drainage water contained *Phytophthora cactorum*. This confirmed the risk of the spread of pathogens in recycled irrigation systems used for substrate crops. A simple remedy for this problem is the use of a slow sand filter to remove fungal pathogens, inclusive oomycetes, from the drainage water before re-using it for irrigation.

Keywords: drainage water recycling, sand filter, strawberry, substrate crop

Autonomous control of powdery mildew as part of IPM strategy in strawberry

Peter Melis, Marieke Vervoort, Tom Van Delm

Research Centre Hoogstraten,
Voort 71, B-2328 Meerle, Belgium,
email: peter.melis@proefcentrum.be

UV-ROBOT is an NWE interreg project that focuses on automatic mildew management with UVc light in five different horticultural crops. In strawberry UVc treatments proved to be very effective in the control of powdery mildew at Research Centre Hoogstraten, Belgium. UVc can be the basic treatment to control the leaf disease even on very susceptible cultivars like 'Elsanta'. Earlier trials point out a need of at least three treatments per week with a day treatment dose of 12 mJ cm^{-2} and reach an efficacy of 60 % during the period with highest natural disease pressure. Only after automation this intense, repetitive treatment can be realized. UV-ROBOT will develop a fully autonomous vehicle to treat strawberry crops in substrate and creates the opportunity to determine optimal dose rates and frequency for day or night time treatments. Additionally the side effects of the treatments on other pathogens, beneficials and on chemical active ingredients will be investigated. The first automatic applications and side effect trials will take place in spring and summer 2018. Finally UVc will be implemented in a fully functioning IPM strategy. With this project we will realize a strong reduction in the use of chemical pesticides, lowering the amounts of residues and maintaining a healthy crop with optimal production rates.

Keywords: autonomous, IPM, mildew, NWE interreg, robot, strawberry, UVc

Experimental trials to control strawberry powdery mildew in Italy

Daniele Prodorutti, Davide Profaizer, Gianpiero Ganarin, Sandro Conci, Tommaso Pantezzi, Gino Angeli

Center for Technology Transfer, Fondazione Edmund Mach,
Via Mach 1, 38010 San Michele all'Adige (TN), Italy,
email: daniele.prodorutti@fmach.it

Powdery mildew (*Podosphaera aphanis*) is the main pathogen of strawberry (*Fragaria ×ananassa*) grown under high tunnels and can infect all the aerial parts of the plant. Increasing restrictions on the use of chemical fungicides make necessary to develop new technologies and to evaluate the efficacy of alternative substances such as natural, microbial or low-impact products. Starting from 2013, greenhouse and field trials have been carried out in Trentino region (Northeastern Italy) to evaluate the efficacy of alternatives to chemical fungicides on strawberry. Their integration into strategies against powdery mildew was also tested. On the June-bearing cultivar 'Elsanta', repeated applications of products based on potassium bicarbonate and orange essential oil showed a good efficacy against powdery mildew, both in field and in semi-field trials. These active ingredients can therefore be included in strategies for disease management on strawberry, allowing a reduction of pesticide residues. Other substances such as vegetal extracts, whey and fertilizers were not sufficiently effective in controlling *Podosphaera aphanis*. Everbearing varieties, given the long production cycle and susceptibility, showed greater problems in containing the disease. Further trials, integrating different agronomical and disease management practices, will be necessary to achieve an effective control of powdery mildew on these cultivars.

Keywords: efficacy trials, *Podosphaera aphanis*, strawberry

Push-Pull with synthetic attractants and repellents for control of fruit pests

Michelle T. Fountain[1], **Chantelle Jay**[1], **David Hall**[2], **Dudley Farman**[2]

NIAB EMR,
[1]New Road, East Malling Kent ME19 6BJ, United Kingdom,
email: michelle.fountain@emr.ac.uk

[2]Natural Resources Institute, University of Greenwich,
Chatham Maritime, Kent ME4 4TB, United Kingdom

Insect pest species in fruit crops are controlled by a range of management strategies including cultural, biological and synthetically produced pesticides. Changes in insecticide approvals and climate change coupled with non-native species introductions are jeopardising current control practices and risk disrupting Integrated Pest Management. Push-pull strategies have an element which repels pests (the push), and an attractant source to draw pests away from the crop (the pull). The pull can be combined with a killing agent to prevent the pest re-entering the crop and to reduce population growth.

Using synthetic semio-chemicals, two push-pull systems were tested for control of *Lygus rugulipennis* and *Drosophila suzukii*. We investigated whether strawberry fruit damage could be reduced by using synthetically produced repellents, attractants or a combination of the two (push-pull). In field trials with replicated plots (25 × 25 m) significantly fewer adult and nymph *Lygus rugulipennis* were present where the push or push-pull combined was applied. There was no significant effect of the pull treatment when used alone. There were also significantly fewer damaged fruits where a 'push' treatment and a 'pull' treatment were combined compared to no treatment.

Preliminary field trials on *Drosophila suzukii* in cherry orchards indicated that some coded synthetic volatile substances reduced the numbers of eggs laid in fruits. Push-pull field trials are currently underway in strawberry crops and results will be presented.

Keywords: attractants, capsid, mirid, push-pull, repellent, spotted wing drosophila, synthetic

Demonstration project "Exclusion netting for managing spotted wing drosophila in fruit crops" — Results 2017

Bianca Boehnke[1], Kirsten Köppler[2], Clemens Augel[2], Alexandra Wichura[3], Julian Lindstaedt[4], Jan-Henrik Wiebusch[4], Adrian Engel[5], Silke Benz[5], Heidrun Vogt[1]

[1]Julius Kuehn-Institute, Federal Research Centre for Cultivated Plants, Institute for Plant Protection in Fruit Crops and Viticulture, Schwabenheimer Str. 101, 69221 Dossenheim, Germany, email: bianca.boehnke@julius-kuehn.de

[2]Landwirtschaftliches Technologiezentrum Augustenberg, Nesslerstraße 25, 76227 Karlsruhe, Germany

[3]Landwirtschaftskammer Niedersachsen, Pflanzenschutzamt, Wunstorfer Landstraße 9, 30453 Hannover, Germany

[4]Wiebusch, Landwirtschaftskammer Niedersachsen, Moorende 53, 21635 Jork, Germany

[5]Landwirtschaftskammer Nordrhein-Westfalen, Pflanzenschutzdienst, Gartenstraße 11, 50765 Köln-Auweiler, Germany

The invasive spotted wing drosophila *Drosophila suzukii* (Matsumura 1931) has become an enormous threat for European fruit cultivation. A technical possibility of control is the use of exclusion netting. In 2017, the BMEL-funded demonstration project has started, including 19 producers of cherry, raspberry, blackberry and blueberry. The cherry orchards were covered with foil canopies and netted laterally. Berry cultures were equipped with foil tunnels in combination with nets or nets only. The nets had different mesh sizes varying between 0.8 × 0.8 mm and 1.3 × 1.3 mm. Due to frost damages and late infestation pressure in 2017, the examination was limited. Yet, the positive effect of exclusion netting was evident. Despite of captures of spotted wing drosophila outside of the netted crops no or only limited fruit infestation occurred within the exclusion nettings. In most cases higher temperatures and lower relative humidity was measured within exclusion netting, but to different extents in the course of the day. The first year showed that the differences in microclimate were mainly affected by the foil system and not by the net: berry cultures protected with netted foil tunnels showed bigger differences than the laterally netted foil canopies of cherries. Nevertheless, the differences in microclimate were negligible. The exclusion nets also reduced other pests like cherry fruit fly or summer fruit tortrix. But it has to be considered that if a pest can enter the exclusion netting system it can spread rapidly. Furthermore, problems with the assembly of the nets and also the deficient pollination in netted raspberry tunnels became apparent.

Keywords: *Drosophila suzukii*, Exclusion netting, net, spotted wing drosophila

Comparison of additives to enhance chemical control of *Drosophila suzukii*

Vincent Van Kerckvoorde[1], Rik Clymans[1], Eva Bangels[1], Ammar Alhmedi[1], Tom Thys[1], Madelena De Ro[2], Jochem Bonte[2], Hans Casteels[2], Patrick De Clercq[3], Dany Bylemans[1, 4], Tim Belien[1]

[1]Pcfruit npo, Department of Zoology, Sint-Truiden, Belgium, email: vincent.vankerckvoorde@pcfruit.be

[2]ILVO, Plant, Department of Crop Protection — Entomology, Merelbeke, Belgium

[3]Ghent University, Faculty of Bioscience Engineering, Department of Crop Protection, Laboratory of Agrozoology, Ghent, Belgium

[4]KULeuven, Department of Biosystems, Leuven, Belgium

The objective was to identify the most efficient feeding enhancers in the lab and confirm their ability to improve chemical control of spotted wing drosophila (SWD) in the field. Tested feeding enhancers were white sugar 0.2 % v/v (**WS**), brown sugar 0.2 % (**BS**), Attracker® 0.2 % (**A**), Combi-Protec® 0.2% (**CP**), Blossom Protect® 0.1% (**BP**) and a mixture of baker's yeast 0.125 % (*Saccharomyces cerevisiae*) and brown sugar 0.125 % (**BYBS**). A wetting agent, Trend® 0.1 % (**T**), was also included. The methods used in the lab were a capillary feeding assay, a Petri dish assay (in which the attraction of SWD to drops of feeding enhancer was evaluated) and a fruit bioassay (in which 10 SWD per replicate were exposed to treated and untreated fruit in condiment cups and their mortality was scored after 16, 24, 48 and 72 hours). The field trial was performed in a sweet cherry orchard. It consisted of a random block design trial with four replicates of five trees.

The capillary feeding and Petri dish assay revealed a shift in preference: at the beginning, the sugar-based feeding enhancers are preferred by SWD, but as the tests progress this preference shifts to protein based products. In the fruit bioassay, only BYBS significantly increased the mortality caused by cyantraniliprole after 16 hours. The wetting agent T significantly decreased the mortality at 16 hours and 24 hours. In the field trial, only the mixture of baker's yeast and brown sugar was able to improve the effect of spinosad on all three sampling dates but this was not significant.

In conclusion, the mixture of baker's yeast and brown sugar was the best feeding enhancer, both in lab (significant) as in field (not significant). The wetting agent Trend 0.1 % was revealed as a feeding 'disturber' in the lab (significant).

Keywords: chemical control, feeding enhancers, insecticides, spotted wing drosophila

Using Biobest Flying Doctors for targeted application of biopesticides

Simon Foster

Biobest Group,
Ilse Velden 18, 2260 Westerlo, Belgium,
email: simon.foster@biobestgroup.com

The precise and targeted delivery of crop protection products is not only good agricultural practice but also ensures efficacy against target pest and disease organisms. The Flying Doctors delivery system uses bumble bees to deliver a biopesticide directly into the flowers of target crops resulting in a high level of efficacy. Results of two recent field trials in soft fruit crops give further insight into the value of this methodology as a useful management tool against post-harvest deterioration of raspberries and strawberries.

Keywords: biopesticide, bumble bee, entomovector, Flying Doctors, *Gliocladium*

Protection of organic strawberry plantations from *Melolontha* spp. through an integrated approach: results from four-year trials in Poland

Eligio Malusá[1, 2], **Małgorzata Tartanus**[1], **Cezary Tkaczuk**[3], **Loredana Canfora**[4], **Flavia Pinzari**[4, 5]

[1]*Research Institute of Horticulture, Skierniewice, Poland, email: eligio.malusa@inhort.pl*

[2]*CREA — Research Centre for Engineering and Agro-Food Processing, Turin, Italy*

[3]*Siedlce University of Natural Sciences and Humanities, Siedlce, Poland*

[4]*CREA- Research Centre for Agriculture and Environment, Rome, Italy*

[5]*Natural History Museum, London, United Kingdom*

An integrated and holistic strategy including various control methods and agronomical practices has been developed to control *Melolontha* spp. in organic strawberry plantations. Reduction of adult populations was attempted by means of luring, trapping and by covering the planted rows with fabric-like mulching during the period of the beetles' flight, to decrease the number of eggs deposited in the soil. The control of grubs in the soil was pursued with pre-planting soil tillage and sowing of different annual crops showing phytosanitary properties, in particular buckwheat (*Fagopyrum esculentum*), as well as with microbial inocula. Biocontrol treatments were based on entomopathogenic fungi (*Beauveria bassiana, Beauveria brongniartii, Metarhizium anisopliae*) and entomopathogenic nematodes (*Heterorhabditis bacteriophora* and *Steinernema kraussei*). Different formulations of the inocula (single or co-inocula), application methods, doses and timing of treatments were tested to evaluate their effect on overall efficacy of the treatment. Data from trials carried out in several locations in the last four years will be presented. The results indicated some effective action of the different practices in reducing the number of active grubs when used independently. However, an overall satisfactory control was obtained only when the different practices were integrated and, particularly for the BCAs, applied with an appropriate method and timing.

Keywords: biological control agents, European cockchafer, phytosanitary crops

Resistance to fenhexamid, boscalid and pyraclostrobin in *Botrytis* spp. in Norwegian strawberry fields

Katherine A. G. Nielsen[1], Gunn Mari Strømeng[1], Magne Nordang Skårn[1], Kari Ørstad[1], Arne Stensvand[1, 2], May Bente Brurberg[1, 2]

[1]Norwegian Institute of Bioeconomy Research (NIBIO), Ås, Norway, email: arne.stensvand@nibio.no

[2]Norwegian University of Life Sciences (NMBU), Ås, Norway

Botrytis fruit rot caused unusually high yield losses in strawberry (*Fragaria ×ananassa*) in southern Norway in 2016. Unsatisfactory disease control prompted suspicion of fungicide resistance in the *Botrytis* population. To investigate fungicide resistance, *Botrytis* isolates were collected from plant material from 19 fields in Norway and tested for resistance with a germination assay. The percentages of isolates classified as resistant to boscalid, pyraclostrobin, and fenhexamid were 89.7, 86.0, and 65.0, respectively. PCR assays enabled identification of common mutations known to confer resistance to these active ingredients. A majority of isolates resistant to pyraclostrobin had the G143A mutation. The F412S and H272R mutations were detected in fenhexamid- and boscalid-resistant isolates, respectively. Field experiments testing the effect of spraying with single products through a season also showed that the active ingredients gave inadequate control in both 2016 and 2017. In 2016, fruit decay was reduced from 65.4 % in untreated plots to 47.2 % and 52.0 % if treated either with fenhexamid and boscalid + pyraclostrobin, respectively. Similar numbers for 2017 were 13.8 % in untreated plots and 9.4 % and 6.7 %, respectively, for treatments with the same fungicides. The present results clearly indicate a close relationship between high degree of fungicide resistance in tests in vitro and poor field efficacy.

Keywords: field control, fungicide resistance, mutation

Efficacy of *Bacillus subtilis* (strain BS10) in control of *Botrytis cinerea* in strawberry

Mila Grahovac, Vera Stojšin, Mladen Petreš, Brankica Tanović, Ferenc Bagi, Dragana Budakov

[1]University of Novi Sad, Faculty of Agriculture, Trg Dosijeta Obradovića 8, Novi Sad, Serbia,

[2]Institute of Pesticide and Environmental Protection, Banatska 31b, Belgrade, Serbia, email: brankica.tanovic@pesting.org.rs

Grey mold, caused by *Botrytis cinerea*, is globally widespread and probably the most important disease of strawberry (*Fragaria ×ananassa* Duchesne). It can cause significant pre- and post-harvest losses. Although application of synthetic fungicides is the most effective way to control the disease occurrence, biological agents, such as *Bacillus* spp. are becoming increasingly important, due to their environmentally friendly and consumer safety properties. The aim of this study was to evaluate the potential of *Bacillus subtilis* strain BS10 (cultivation liquid with 1.5 × 108 cfu ml^{-1}) to be used as a biocontrol agent against *Botrytis cinerea* in strawberry. The trial was set in 2017 vegetation period at two localities in Serbia (Kisač and Bečej) in strawberry open field crops, according to EPPO method PP 1/16 (2). Three concentrations of *Bacillus subtilis* strain BS10 (0.5, 1 and 2 %) were tested and compared with standard fungicide boscalid + piraclostrobine, applied at a label rate. An untreated plot served as a control. In total, six treatments were applied, starting from the beginning of flowering. The effect of the tested products was assessed based on the intensity of mature fruit infection. According to the obtained results, *Bacillus subtilis* BS10 strain, applied at concentration of 2 %, was highly effective in the control of *Botrytis cinerea*, with an efficacy ranging from 79 % (locality Kisač) to 85 % (locality Bečej). In order to obtain a complete evaluation of the potential of *Bacillus subtilis* BS10 strain in strawberry protection against *Botrytis cinerea*, further investigation considering formulation improvements, adjustment of concentration and timing of application is required. Project III46008.

Keywords: biocontrol, fungicides, grey mold

Swiss IPM strategies against *Drosophila suzukii* (Diptera: Drosophilidae)

Fabio Kuonen, Mélanie Dorsaz, Camille Minguely, Catherine Baroffio

Agroscope,
Route des Eterpys 18 1964 Conthey, Switzerland,
email: camille.minguely@agroscope.admin.ch

In 2011, the spotted wing drosophila (SWD) (*Drosophila suzukii* Matsumura) was first recorded in Switzerland. Since then, the pest caused important harvest losses in various crops, including berries. To date, the Swiss strategy especially relies on preventative measures such as considerable field hygiene, anti-insect nets and reduced harvest intervals, all of which are time consuming and expensive measures for producers. Chemical treatment is only recommended to mitigate population peaks and to clean cultivation fields in case of very high infestation rates.

At the national research station Agroscope, several innovative trials such as understanding the ecology and behavior of the fruit fly and alternative treatments have been carried out since the pest appeared. Lime treatment was first tested in the lab and in semi-field trials. The efficacy of weekly application of lime alone or combined with mass trapping was then tested on-farm in strawberry and raspberry fields in Valais. In order to study the daily activity of SWD, traps were set in a hedge from July to November and controlled every four to five hours, one day per month. In addition, various repulsive substances were tested against SWD.

Results in the lab and in semi-field cages showed that lime treatment significantly reduced infestation level in berries. Combination of lime treatment and mass trapping can also be interesting for producers. The day-cycle trials showed that in warm periods, SWD is moving primarily during morning and evening. In contrast, during periods of lower temperature, it is active during afternoon hours.

In general, SWD must be controlled by a combination of measures, for no single treatment is efficient. Lime treatment might be an interesting alternative to chemical insecticides. The strategy must be applied at the beginning of the season and at regular intervals so that the infestation can be kept at a low level. Agroscope will continue testing alternative treatment against SWD and optimizing control programs.

Keywords: berries, day cycle, lime, sanitary measures, traps

Effect of high tunnel on raspberry yield and fruit quality

Pauliina Palonen, Anni Pinomaa, Tero Tommila

University of Helsinki, Department of Agricultural Sciences,
PO Box 27, FI-00014 University of Helsinki, Finland,
email: pauliina.palonen@helsinki.fi

Growing raspberries in high tunnels has become very popular. However, little is known about how tunnel growing environment affects fruit quality including fruit bioactive properties. The aim of our study was to examine the effect of high tunnel on the yield and fruit quality in three floricane raspberry cultivars under Northern high-latitude conditions. The experiment included two Scottish cultivars 'Glen Ample' and 'Glen Dee', and the Finnish cultivar 'Maurin Makea' planted in an identical randomized complete block design in a polyethylene high tunnel and an adjacent open field at 60°13' Northern latitude.

Harvest season was 47 days in the open field and 62 days in the high tunnel. The average total yield per cane was doubled in the tunnel as compared to the open field. Fruit size was not affected by growing environment, but was affected by cultivar: 'Glen Dee' had larger fruit (6.3 g) than 'Glen Ample' (5.1 g) or 'Maurin Makea' (4.1 g). High tunnel decreased the contents of sugars (°Brix) and titratable acids. Fruit bioactive properties were not affected by the growing environment, but were affected by cultivar. In both growing environments 'Glen Dee' fruit were lowest in total phenolics. In the open field, antioxidant activity was higher for 'Glen Ample' fruit than 'Glen Dee'. In conclusion, high tunnels may provide major benefits in raspberry production, as fruit yield per cane was significantly higher in the tunnel, while fruit bioactive properties, including phenolic compounds and antioxidant activity, were not affected. However, tunnel-grown fruit contained less sugars and acids than the ones in the open field. 'Glen Ample' and 'Maurin Makea' fruit were higher in phenolics and sweeter than 'Glen Dee' berries.

Keywords: high tunnel, phenolics, raspberry, *Rubus idaeus*

Weed control in Slovenian integrated and organic strawberry production

Darinka Koron

Agricultural Institute of Slovenia,
Hacquetova ulica 17, 1000 Ljubljana, Slovenia,
email: darinka.koron@kis.si

In strawberry production, next to diseases, weeds present a big problem. In Slovenian integrated production under tunnels and in organic production in general, the use of herbicides is prohibited. Foils placed over slightly elevated beds generally reduce the growth of weeds, except for the planting holes where weeds can grow as long as strawberry plant covers the area. The majority of soil disinfectants have herbicidal effect. In our field and pot experiments, we compared alternative methods of soil disinfection (biofumigation, green manure, and solarisation) with common soil fumigant dazomet. Biofumigation was applied with three biocidal plants, *Brassica juncea, Sinapis alba, Eruca sativa* and green manure using *Vicia faba* var. *minor*. The amount of weeds in the field experiment in all treatments with non-biocidal plant and biocidal plants was greater, probably due to the increased organic matter in soil. The maximum weediness was observed in the *Vicia faba* treatment and the minimum in the Sinapis alba treatment which reduced the growing of weeds. In pot experiments, *Sinapis alba* treatment had the greatest influence on weeds and it was not significantly different from dazomet treatment. Solarisation with the transparent foil applied before planting strawberries in the field experiment has the greatest influence on weeds among alternative methods. There was no statistically significant difference between solarisation and dazomet treatment. In the Slovenian climatic conditions the combination of solarisation and biofumigation is a perspective technology, because using only solarisation it is difficult to achieve the required amount of high temperatures.

Keywords: biofumigation, mycorrhiza, number of weeds, solarisation,

Impact of coniferous trees bark extract formulations on growth of phytopathogenic fungi *Botrytis cinerea* and *Colletotrichum acutatum* on strawberry leaves

Sandra Minova, Zane Metla, Līga Jankevica

University of Latvia, Institute of Biology,
Miera iela 3, Salaspils, Salaspils novads, LV-2169, Latvia,
email: Liga.Jankevica@lu.lv

Phytopathogenic fungi caused damage on strawberries (*Fragaria ×ananassa*) results in considerable economic losses in strawberry production. Application of synthetic fungicides is the main way to control fungal diseases. The increasing concern for health hazards, environmental pollution and development of resistance of pathogens to chemical substances has triggered the development of alternative strategies for the control of strawberry fungal diseases. Plant extracts with fungistatic and/or fungicidal properties possess the potential for their use as biofungicide. The aim of this study was to evaluate impact of Scots pine (*Pinus sylvestris*) and Norway spruce (*Picea abies*) bark ethanol extracts and formulated preparations on phytopathogenic fungi *Colletotrichum acutatum* and *Botrytis cinerea* mycelial growth on strawberry leaves. In vitro phytotoxicity test of pine and spruce bark ethanol extracts on detached strawberry leaves were carried out. Damage caused by *Botrytis cinerea* and *Colletotrichum acutatum* to detached strawberry leaves treated with various concentrations (1 g L^{-1}, 10 g L^{-1}, 20 g L^{-1}) of pine and spruce bark extracts and preparations was measured.

No phytotoxic effect of coniferous bark extracts on strawberry leaves was observed. Pine and spruce ethanol extracts and preparations reduced the growth of *Colletotrichum acutatum* mycelium on strawberry leaves. However, these differences were not statistically significant, except for the variant of 10 g L^{-1} extracts.

Pine and spruce extracts possess fungistatic properties, but further investigations are needed to identify extracts for a possible use as antifungal agent for the control of strawberry fungal pathogens.

Keywords: bark extracts, biofungicides, *Fragaria ×ananassa, Picea abies, Pinus sylvestris*

Project: Evaluation of small fruit cultivars perspective for integrated production in different regions of Latvia and development and improvement of their growing technologies

Sarmīte Strautiņa[1], **Valda Laugale**[1], **Ieva Kalniņa**[1], **Anita Osvalde**[2], **Dace Siliņa**[3]

[1]*Institute of Horticulture, Graudu iela 1, Ceriņi, Krimūnu pagasts, Dobeles novads, LV-3701, Latvia, email: sarmite.strautina@llu.lv*

[2]*Institute of Biology, University of Latvia, Miera iela 3, Salaspils, Salaspils novads, LV-2169, Latvia*

[3]*Latvia University of Life Sciences and Technologies, Lielā iela 2, Jelgava, LV-3001, Latvia*

The Project "Evaluation of small fruit cultivars perspective for integrated production in different regions of Latvia and development and improvement of their growing technologies'' started in 2015. It is supported by Latvia Ministry of Agriculture. The main aim of the project is to select strawberry, raspberry and bush berry cultivars appropriate for integrated production in different regions of Latvia and to improve growing technologies for increasing of productivity. Several institutions are involved in this project: Institute of Horticulture; Department of Agriculture of Latvia University of Life Sciences and Technologies; and Institute of Biology, University of Latvia. The evaluation of strawberry, raspberry and currant cultivars is done at the Institute of Horticulture and at commercial farms that are dealing with integrated production. Main focus is concentrated on cultivar resistance to pests and diseases and winter hardiness that is very important in Latvia climate influencing plant surviving and productivity. Besides, trials on growing technologies such as evaluation of different mulches, growing under high tunnels, and fertilization for small fruits are carried out. In the Latvia University of Life Sciences and Technologies, the effect of shrub pruning methods and intensity on the growth and production of highbush blueberry is investigated. The research on cultivated blueberry and cranberry fertilisation is performed at the Institute of Biology.

Keywords: blueberries, currants, productivity, raspberry, resistance, strawberry, winter hardiness

Author index

Alhmedi A.	33	Ganarin G.	30
Amiresmaeili N.	13	Girod P.	12
Anfora G.	16	Grahovac M.	37
Angeli G.	30	Granado C.	15
Asalf B.	27	Grassi A.	16
Augel C.	32	Hall D.	31
Bagi F.	37	Haye T.	12
Balalaikins M.	19	Helsen H. H. M.	20
Bangels E.	33	Hrustić J.	25
Baroffio C.	18, 38	Ioriatti C.	16
Belien T.	33	Jankevica L.	41
Benz S.	32	Jay C.	31
Bierman A.	27	Jundzis M.	26
Blümel S.	17	Kalniņa I.	42
Boehnke B.	32	Kenis M.	12
Bonte J.	33	Kopp C.	18
Boycheva S.	14	Kopp M.	24
Brurberg M. B.	36	Köppler K.	32
Budakov D.	37	Koron D.	40
Bylemans D.	33	Kuonen F.	38
Canfora L.	35	Latvala S.	21
Casteels H.	33	Laugale V.	42
Clymans R.	33	Le Ralec A.	15
Collatz J.	13, 14	Lemmetty A.	21
Conci S.	30	Lethmayer C.	17
Danelski W.	22	Lindqvist I.	21
De Clercq P.	33	Lindstaedt J.	32
De Ro M.	33	Malusá E.	22, 35
Dorsaz M.	38	Mannale M.	24
Driss L.	12	Melis P.	29
Engel A.	32	Metla Z.	41
Farman D.	31	Michel V.	24, 28
Fatehi J.	26	Mihajlović M.	25
Foster S.	34	Minguely C.	18, 38
Fountain M. T.	31	Minova S.	41
From P.	27	Moročko-Bičevska I.	26
Gadoury D.	27	Nielsen K. A. G.	36

Norgrove L.	18	Stojšin V.	37
Onofre R.	27	Strautiņa S.	42
Ørstad K.	36	Strømeng G. M.	36
Osvalde A.	42	Suthaparan A.	27
Outreman Y.	15	Tanović B.	25, 37
Palmisano M.	24	Tartanus M.	22, 35
Palonen P.	39	Thoss H.	24
Panel A. D. C.	20	Thys T.	33
Pannebakker B. A.	20	Tkaczuk C.	35
Pantezzi T.	30	Tommila T.	39
Peres N.	27	Turechek W.	27
Petreš M.	37	Van Delm T.	29
Pinomaa A.	39	van der Sluis B. J.	20
Pinzari F.	35	van Elk P.	20
Postic E.	15	Van Kerckvoorde V.	33
Prodorutti D.	30	Vervoort M.	29
Profaizer D.	30	Vēvere K.	26
Rea M.	27	Vogt H.	32
Romeis J.	13, 14	Wernicke M.	17
Rossi Stacconi M. V.	16	Wertheim B.	20
Siliņa D.	42	Wichura A.	32
Skårn M. N.	36	Wiebusch J.-H.	32
Sokolova O.	26	Wohler C.	24
Stalažs A.	19, 23	Wolf S.	14
Stensvand A.	27, 36	Zeeman L.	20

List of participants

Aude **Alaphilippe**
France
aude.alaphilippe@inra.fr

Bianca **Boehnke**
Germany
bianca.boehnke@julius-kuehn.de

Jana **Collatz**
Switzerland
jana.collatz@agroscope.admin.ch

Simon **Foster**
Belgium
simon.foster@biobestgroup.com

Michelle **Fountain**
United Kingdom
michelle.fountain@emr.ac.uk

Caroline **Granado**
France
caroline.granado@fraisesdefrance.fr

Jan **Hulshof**
Finland
jan.hulshof@biotus.fi

Claudio **Ioriatti**
Italy
claudio.ioriatti@fmach.it

Inta **Jakobija**
Latvia
inta.jakobija@laapc.lv

Līga **Jankevica**
Latvia
Liga.Jankevica@lu.lv

Nauja Lisa **Jensen**
Danmark
nlj@seges.dk

Māris **Jundzis**
Latvia
maris.jundzis@llu.lv

Ieva **Kalniņa**
Latvia
ieva.kalnina@llu.lv

Marc **Kenis**
Switzerland
m.kenis@cabi.org

Dong-Su **Kim**
Republic of Korea
dongsu@ewha.ac.kr

Dmitrijs **Konavko**
Latvia
dmitrijs.konavko@llu.lv

Darinka **Koron**
Slovenia
darinka.koron@kis.si

Valda **Laugale**
Latvia
valda.laugale@llu.lv

Christa **Lethmayer**
Austria
christa.lethmayer@ages.at

Christian **Linder**
Switzerland
christian.linder@agroscope.admin.ch

Isa **Lindqvist**
Finland
isa.lindqvist@luke.fi

Carlo **Malavolta**
Italy
Carlo.Malavolta@regione.emilia-romagna.it

Eligio **Malusá**
Poland
eligio.malusa@inhort.pl

Sanja **Manduric**
Sweden
sanja.manduric@jordbruksverket.se

Helle **Mathiasen**
Danmark
hmat@seges.dk

Peter **Melis**
Belgium
peter.melis@proefcentrum.be

Vincent **Michel**
Switzerland
vincent.michel@agroscope.admin.ch

Camille **Minguely**
Switzerland
camille.minguely@agroscope.admin.ch

Inga **Moročko-Bičevska**
Latvia
inga.morocko@llu.lv

Rosa **Morón Agut**
Spain
rmoron@royalberries.es

Carmen **Palanco Ramírez**
Spain
cpalanco@sathortifrut.es

Pauliina **Palonen**
Finland
pauliina.palonen@helsinki.fi

Aurore D. C. **Panel**
The Netherlands
a.d.c.panel@rug.nl

Estelle **Postic**
France
estelle.postic@agrocampus-ouest.fr

Daniele **Prodorutti**
Italy
daniele.prodorutti@fmach.it

Olga **Sokolova**
Latvia
olga.sokolova@llu.lv

Arturs **Stalažs**
Latvia
arturs.stalazs@llu.lv

Arne **Stensvand**
Norway
arne.stensvand@nibio.no

Sarmīte **Strautiņa**
Latvia
sarmite.strautina@llu.lv

Abraham **Sztejnberg**
Israel
asztejnberg@gmail.com

Brankica **Tanović**
Serbia
brankica.tanovic@pesting.org.rs

Vincent **Van Kerckvoorde**
Belgium
vincent.vankerckvoorde@pcfruit.be

Kristīne **Vēvere**
Latvia
kristine.vevere@llu.lv

Matthias **Wernicke**
Austria
matthias.wernicke@ages.at

Sarah **Wolf**
Switzerland
sarah.wolf@agroscope.admin.ch