Development and efficacy of Droskidrink, a food bait for trapping *Drosophila suzukii*

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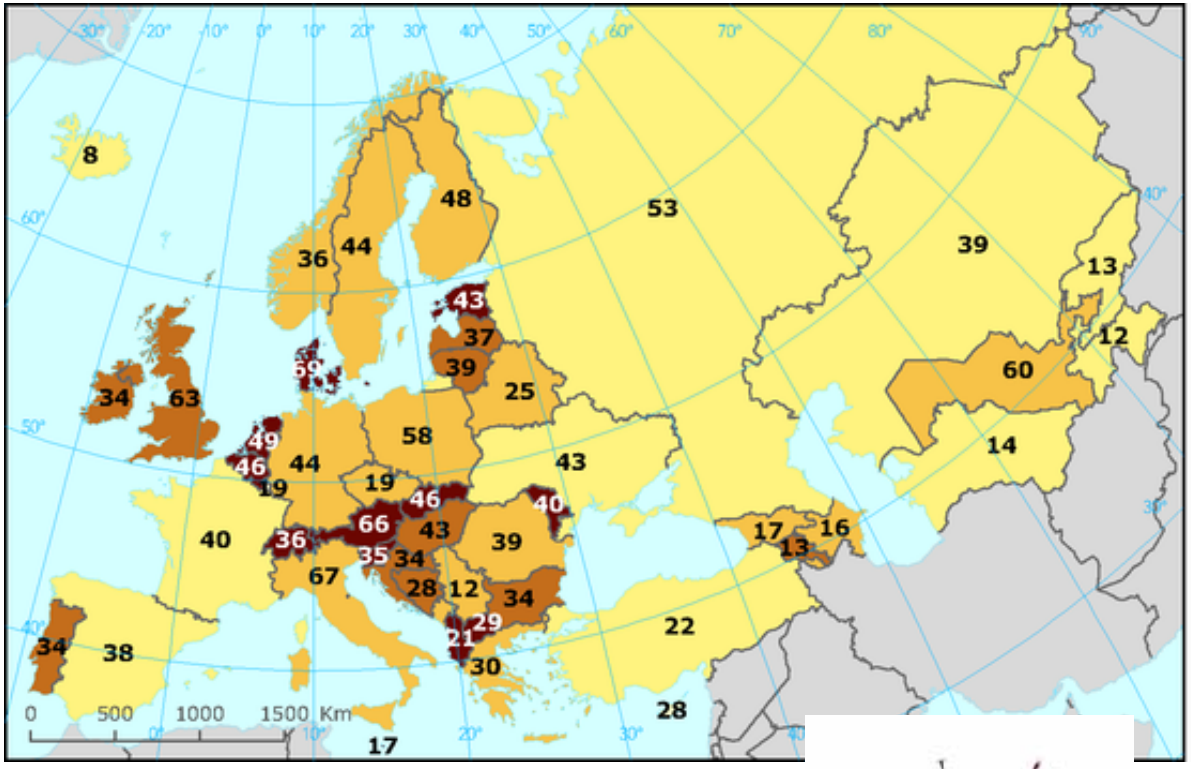
FONDAZIONE EDMUND MACH

INVASIVE ALIEN SPECIES



Number of worst invasive alien species registered per country

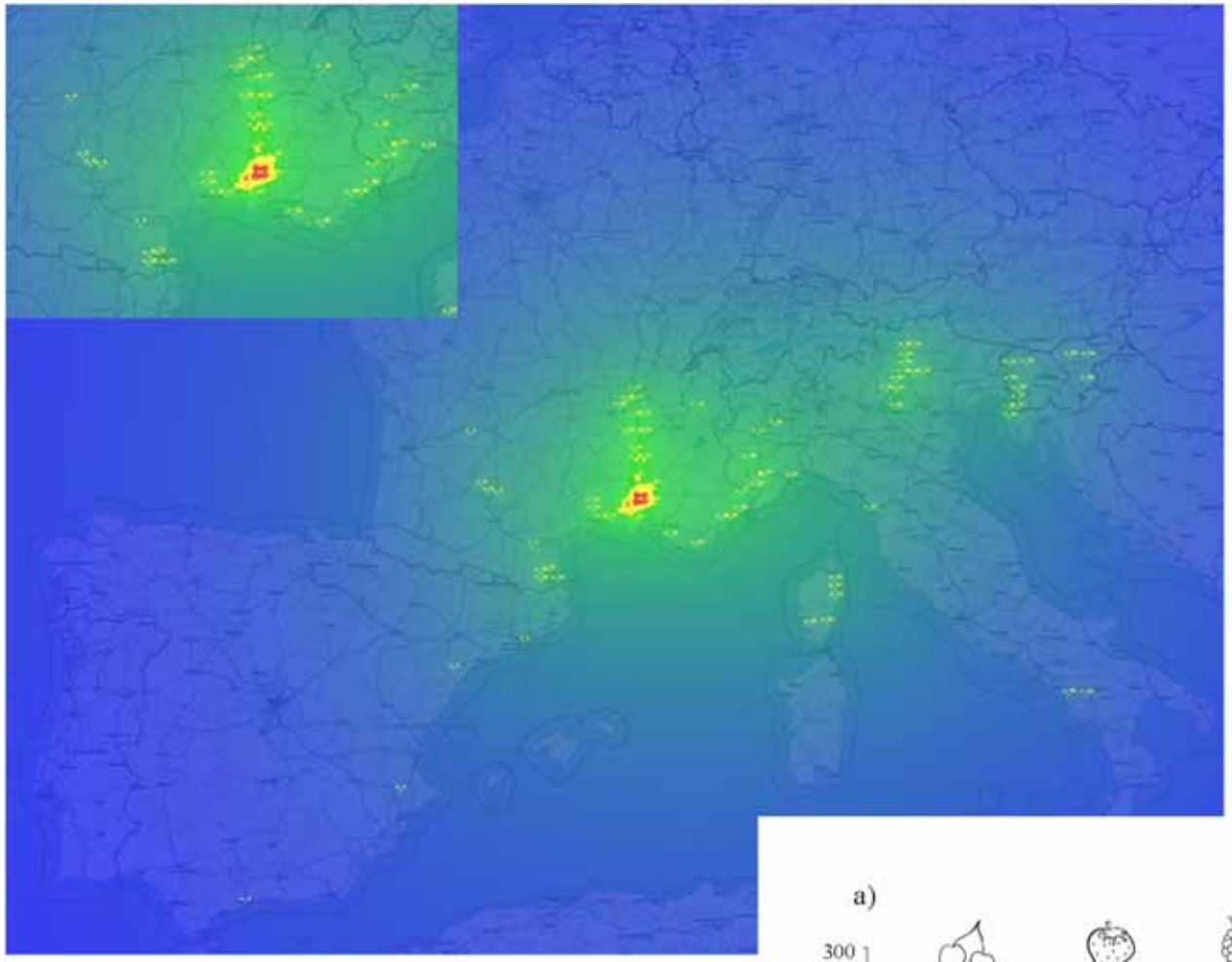
Species per 1 000 km²

- < 0.10
- 0.10–0.25
- 0.25–0.7
- 0.7–3.0
- Outside report coverage

LEXEM

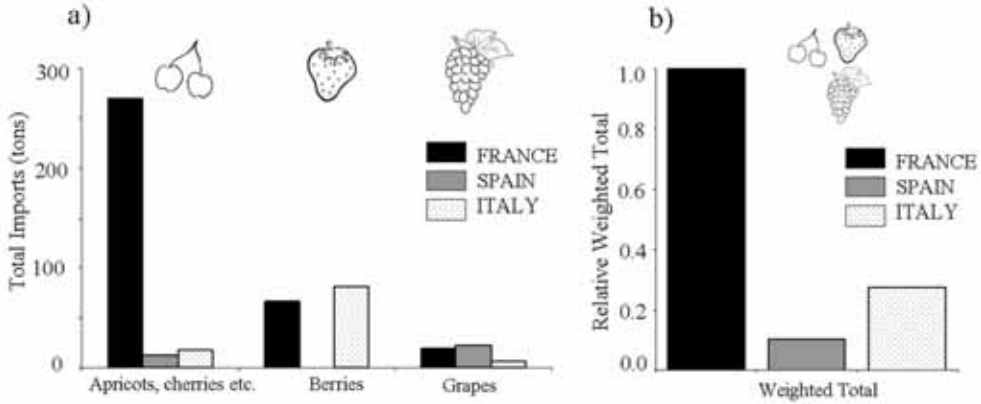
The escalating outbreak in Europe

Cini *et al.*, 2012. Bull. Insectol.
Rota Stabelli et al. 2013. Curr Biol.
Ioriatti, Rossi Stacconi, Anfora, 2014. CABI



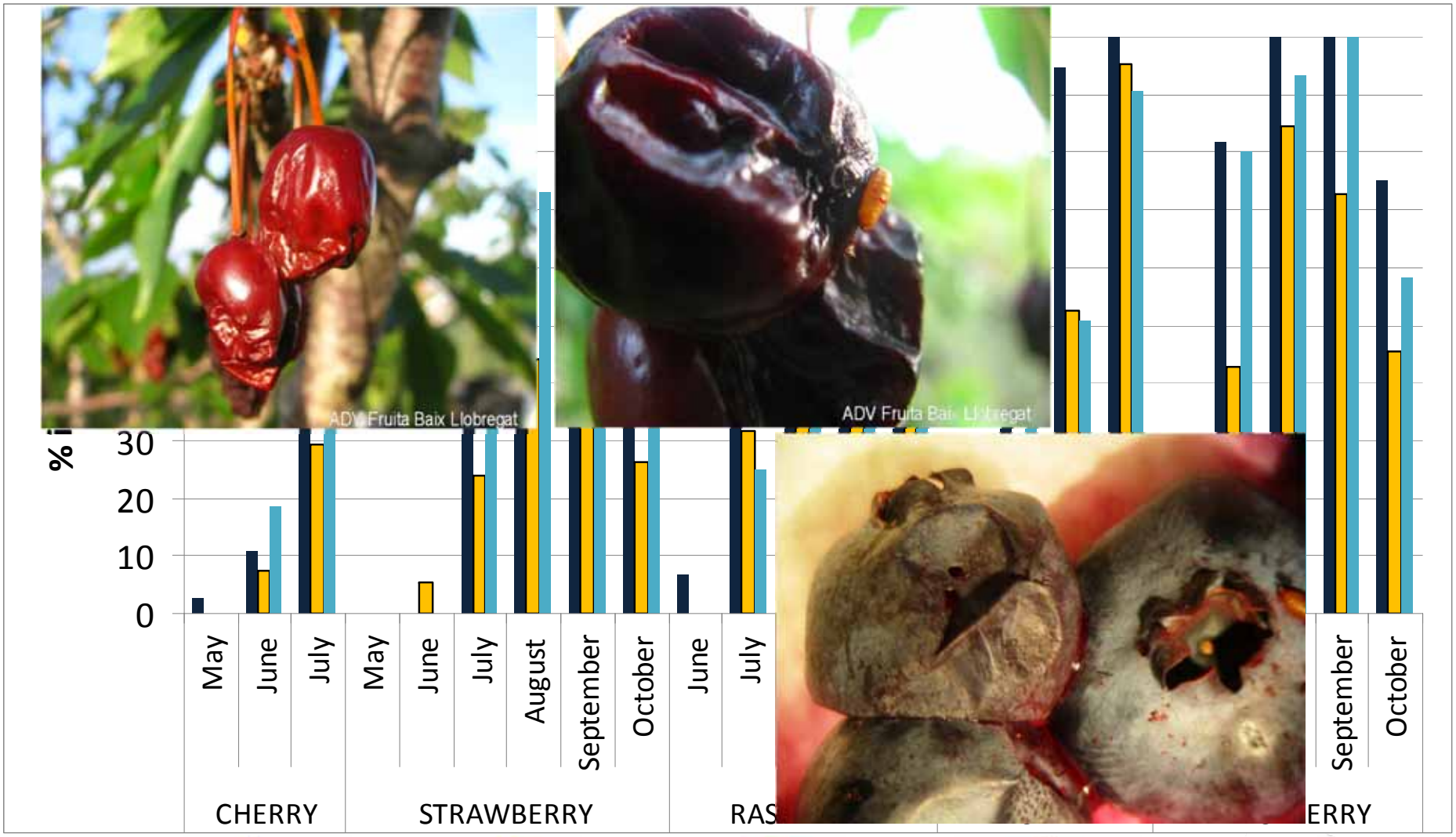
Understanding the invasion history helps tracking introduction pathways and organizing integrated management strategies

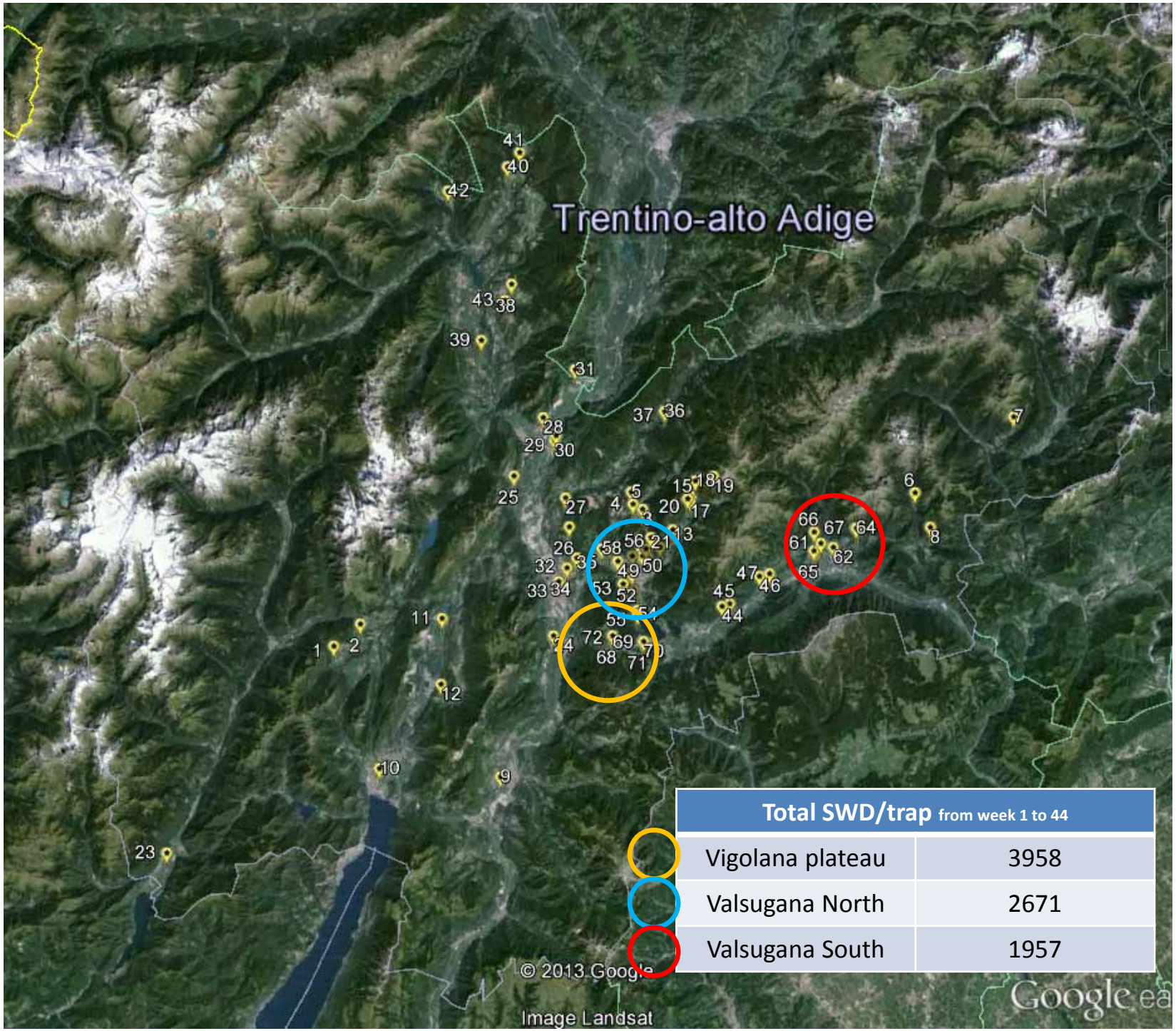
Geographic profiling coupling trap catches with trade flows quantification



Cini *et al.*, 2013. Biol. Inv. (in review)

Trend of SWD damage on different small fruit crops in Trentino





Total SWD/trap from week 1 to 44	
Vigolana plateau	3958
Valsugana North	2671
Valsugana South	1957

Traps were deployed particularly in the valleys where sweet cherry and soft fruits are mainly cultivated

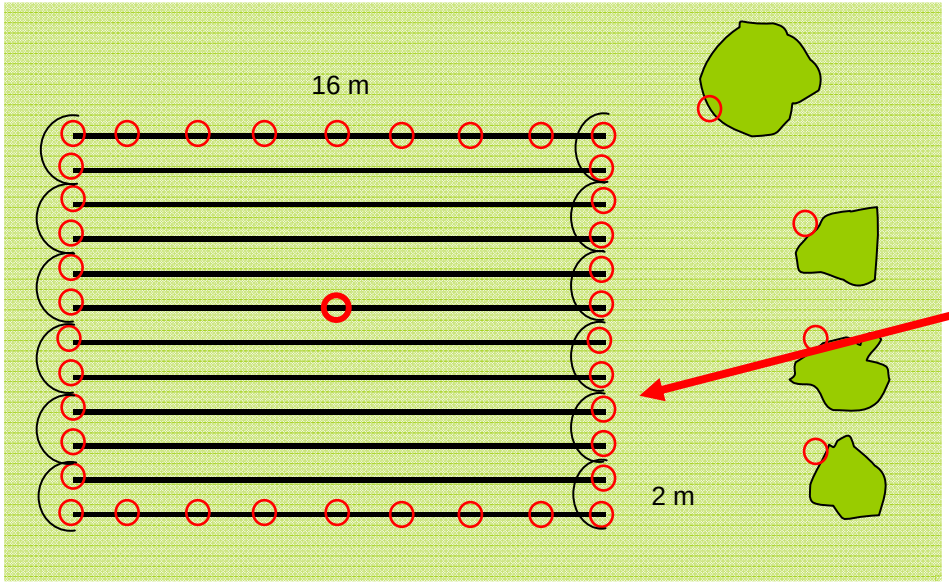
n 6 holes of 0.5 mm Ø

200 ml **Droskidrink** *(75% apple cider vinegar, 25% red wine, 4 grams raw brown sugar)*

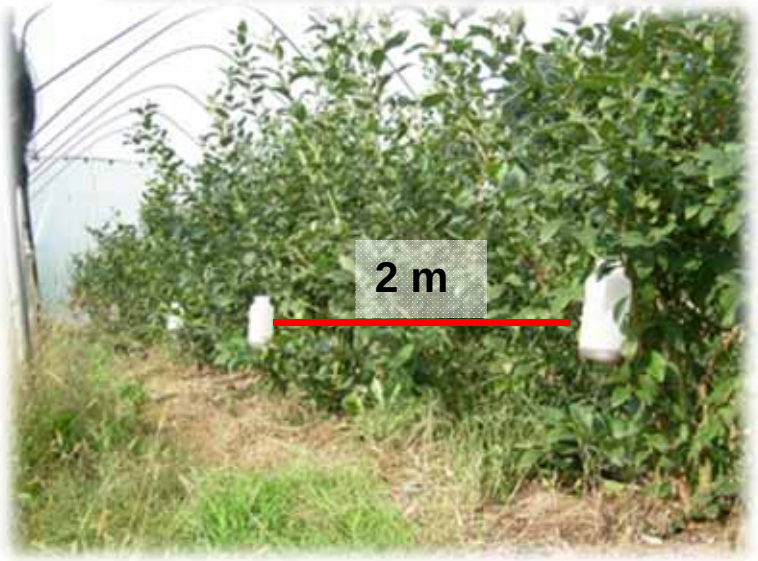
Talk Outline

- **2011**
  - **First version of droskidrink in mass trapping experiments**
  - **Addition of sugarcane in attract-and-kill trials**
  - **Selection of the red bottle as trap model**
- 2012
  - Comparison of baits and trap models
  - Attract-and-kill
  - Correlation between captures and oviposition
- 2013
  - Comparison of baits and trap models

PERIMETER MASS TRAPPING



week	SWD adults: central trap	SWD adults: border traps	% infested fruits: central bushes	% infested fruits: border bushes	
21	*posit.*				
22-27	0				
28	0	*posit.*	0		HARVEST
29	0	11	0		
30	0	84	0	7	
31	1	156	0.8	5	
32	1	111	0	2.2	
33	0	1048	9	18	
34	0	681	32	34	
35	1	***end***	30		



ATTRACT AND KILL: attractiveness

control 10 x 20 cm yellow sticky traps without bait

A USA bait; 0.03 grams + 0.03 grams brewers yeast + 25 ml water

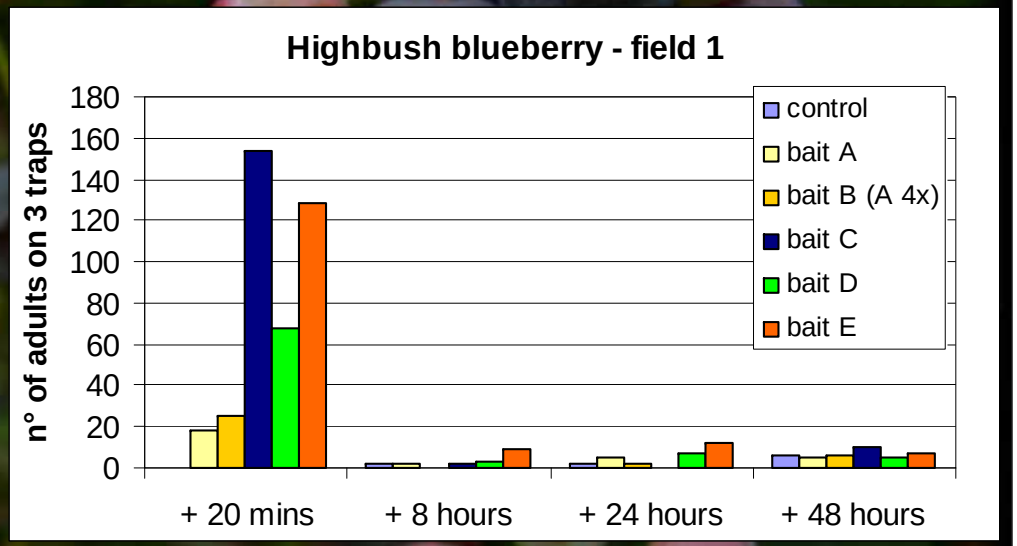
B USA bait (4x concentrated); 0.12 grams + 0.12 grams brewers yeast + 25 ml water

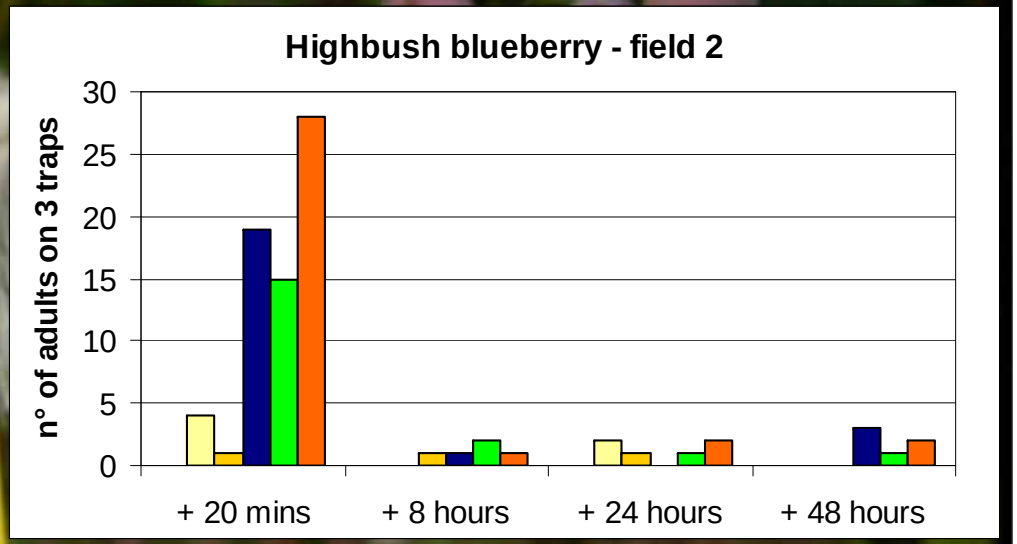
C Spintor Fly (GF 120 in USA); 12.5 ml + 25 ml water + 3 grams brown sugar + 25 ml apple cider vinegar

D LASER (spinosad); 0.5 ml + 3 grams brown sugar + 25 ml apple cider vinegar + 25 ml water

E Spintor Fly (GF 120 in USA); 12.5 ml + 25 ml water + 3 grams brown sugar + 16.6 ml apple cider vinegar + 8.4 ml water

- some bait formulations proved to be very effective in attract the SWD adults in semi-field trials
- high efficacy, but too short persistence (it's necessary to work on formulations)
- mortality of adults was observed in lab tests





This work is part of a collaboration with dr.Vaughn Walton (OSU, Oregon) to evaluate and set-up baits effective against *D.suzukii*

ATTRACT AND KILL: Control efficacy

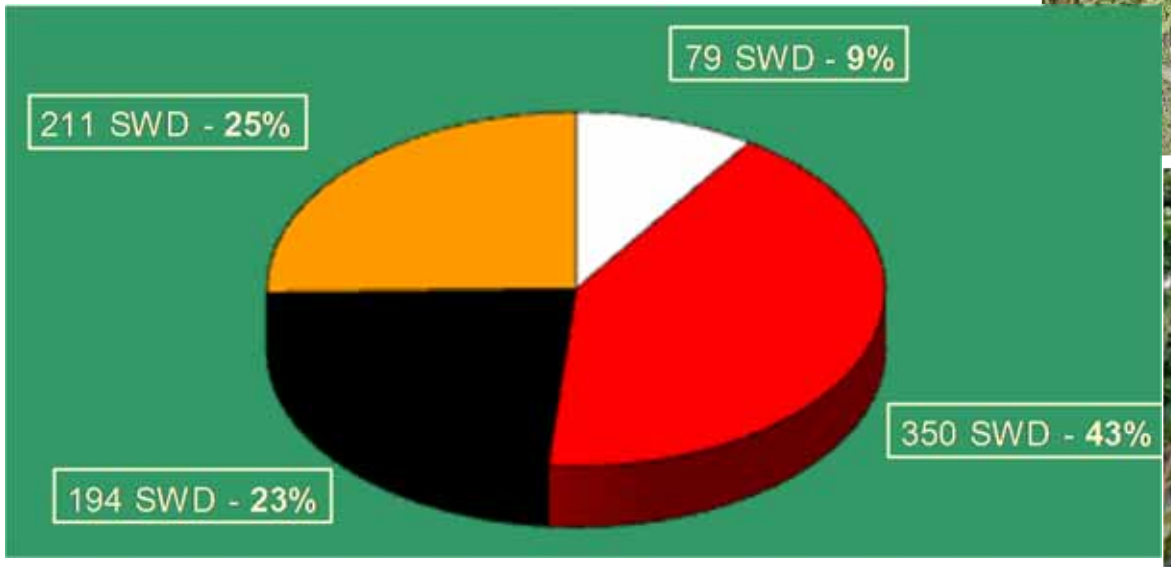
- the most effective bait was uneffective in an open field application trial on raspberry
- a bad result was likely due to a late application (fruits were already infested) and to the too short persistence

Summary data of open field trial with bait					
week	bait applications	% fruits infested		SWD adults in ACV trap	
		control plot	A&K plot	control plot	A&K plot
32	before bait application	23.5	11.5	positioned	
33	after 2 applications	43	21	8	1
34	after 4 applications	13.3	19	4	0
35	after 6 applications	36	30	15	6
36	after 8 applications	94	77	11	6

TRAPS IMPROVEMENT

- coloured traps (orange, black, red) baited with apple cider vinegar were more attractive than white traps

- red coloured traps caught significantly more adults than the other colours



Talk Outline

- 2011
  - First version of droskidrink in mass trapping experiments
  - Addition of sugarcane in attract-and-kill trials
  - Selection of the red bottle as trap model
- **2012**
  - **Comparison of baits and trap models**
  - **Attract-and-kill**
  - **Correlation between captures and oviposition**
- 2013
  - Comparison of baits and trap models

Comparative evaluation of bait efficacy and trap design

What is the trap combination more sensitive for early detection of the fly?

Bait	Trap number
200 ml apple cider vinegar	1-14
200 ml Droskidrink + 4 gr.sugarcane	2-4-5-6-7-8-11-15-16
200 ml red wine vinegar	3
300 ml fruit fly protein bait	9
300 ml protein bait specific for SWD	10
200 ml H2O + 4 gr. Brewer's yeast + 8 gr. sugarcane	12
80 ml Monterey bait (USA) + 120 ml H2O	13

Comparative evaluation of bait efficacy and trap design

What is the trap combination more sensitive for early detection of the fly?

Forest
Vigolo V.

sett.	data	1	2	3	4	5	6	7	8	9	10	11	12
19-25	08/05-18/6	0	np	0	0	0	0	0	0	0	0	0	0
26	25/6	0		0	0	1F	0	0	1M	0	0	0	1M

Cherry
Costasavina

sett.	data	1	2	3	4	5	6	7	8	9	10	11	12
19-24	08/05-11/6	0	np	0	0	0	0	0	0	0	0	0	0
25	18/6	0		0	0	0	0	0	1F	0	0	0	0

Cherry
S.Caterina

sett.	data	1	2	3	4	5	6	7	8	9	10	11	12
19-25	08/05-18/6	0	np	0	0	0	0	0	0	0	0	0	0
26	25/6	0		1F	0	0	0	0	0	0	0	1M	0

Cherry
Vigolo V.

sett.	data	1	2	3	4	5	6	7	8	9	10	11	12
19-26	08/05-25/6	0	np	0	0	0	0	np	np	0	0	0	0
27	2/7	0		0	0	1M+1F	1F			0	0	0	0

Cherry
Susà

sett.	data	1	2	3	4	5	6	7	8	9	10	11	12
16-18	17/4-02/5	0	np	0	0	0	0	0	0	0	0	0	0
19	8/5	0		0	0	0	0	0	0	0	0	1F	0

compost
S.Michele

sett.	data	1	2	3	4	5	6	7	8	9	10	11	12	13	14
16	17/4	0	0	0	0	0	0	0	1M	0	0	0	0	0	0

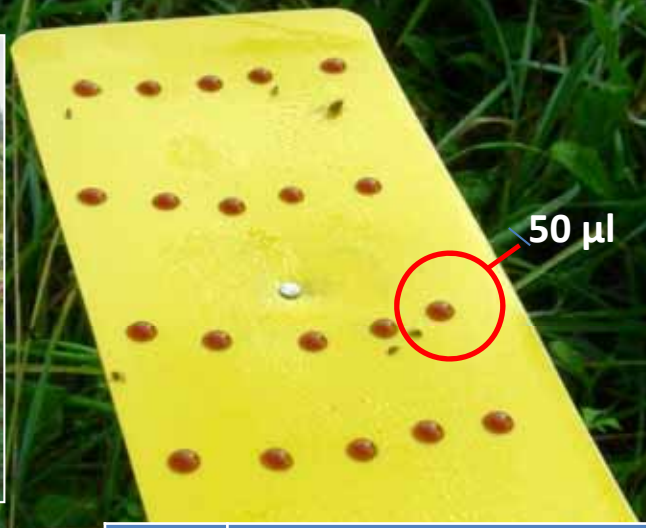


- Red traps baited with Droskidrink are always the most sensitive
- Traps n° 8-5-11 showed good sensitivity

Evaluation of different baits for an Attract-and-kill strategy

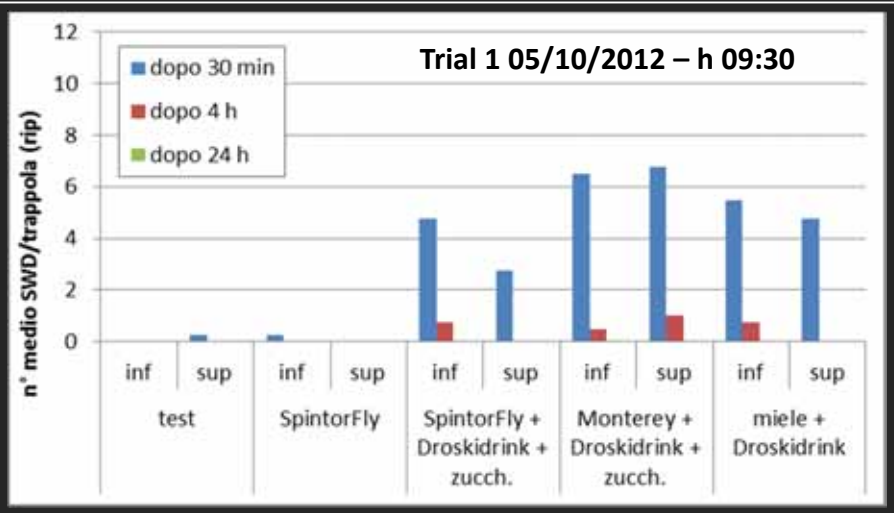
Efficacy, stability and persistence

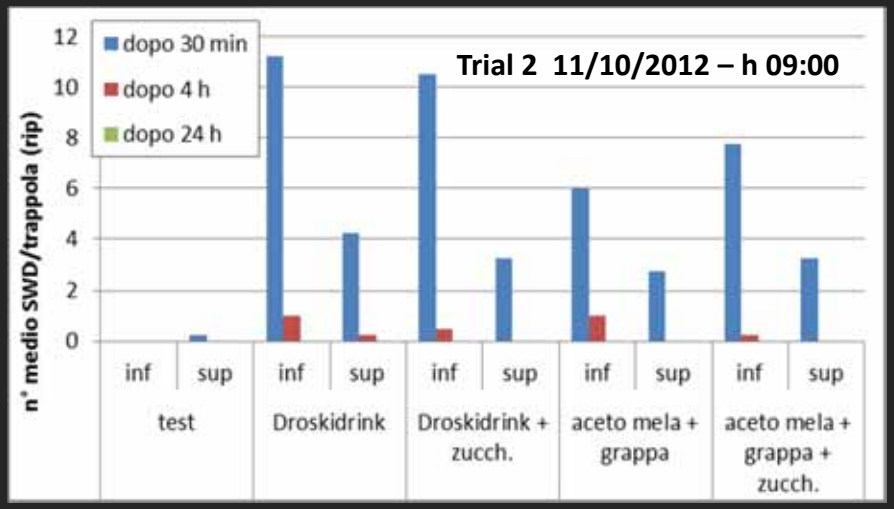
Blueberry (Vattaro) in post-harvest



	Trial 1 – 05 October	**Trial 2 –** 11 October
Test1	control (no bait)	control (no bait)
Test 2	SpintorFly	Droskidrink
Test 3	SpintorFly+Droskidr.+sugar	Droskidr.+sugar
Test 4	Monterey bait+Droskidr.+sugar	Apple cider vin.+grappa
Test 5	Honey+Droskidrink	Apple cider vin.+grappa+sugar

Evaluation of different baits for an Attract-and-kill strateg





- Most of the captures are recorded during the first morning hours of field exposure (insect behaviour, high humidity, no wind, short persistence of the baits)
- The first caught individuals are males (explorers?)
- They come from the adjacent wood and fly close to the ground (captures mainly on the lower side of the panels)
- Baits with Dorskidrink are always more effective

Correlation between captures and oviposition

For each site in different agroecosystems we have recorded both the week of the first adult catch and the first oviposition

N° of sites	13	14
N° of sites where oviposition preceded captures	3	1
% of sites where oviposition preceded captures	23	7
Mean delay (weeks)	3	2

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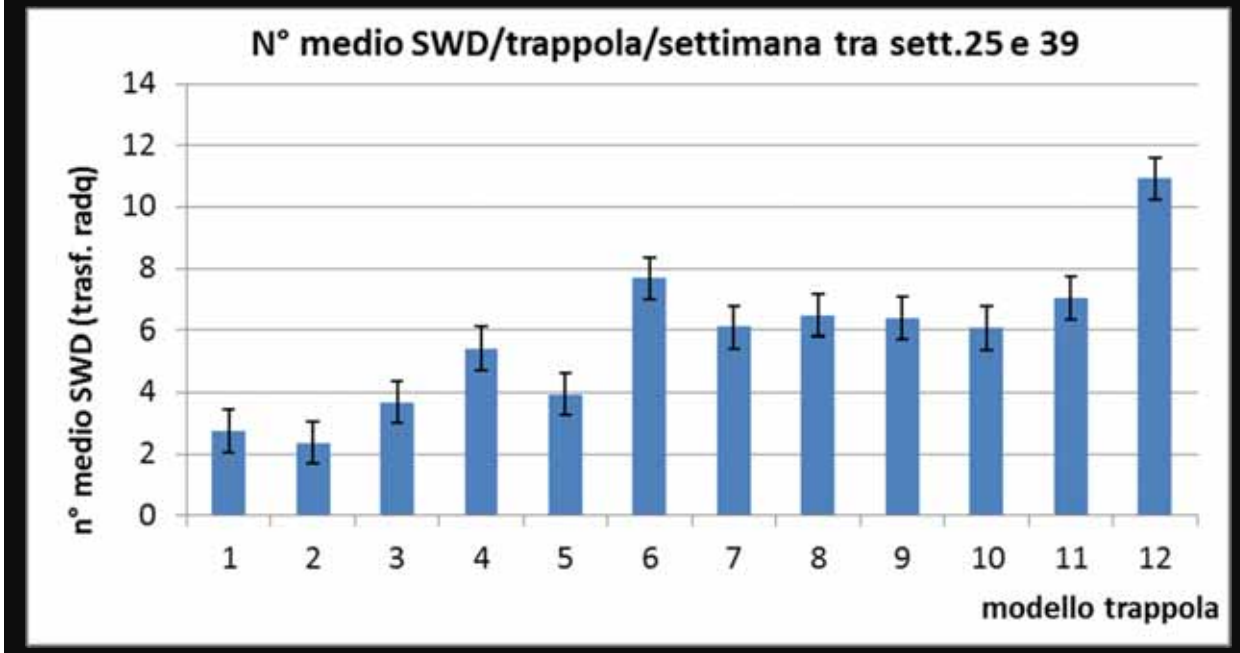
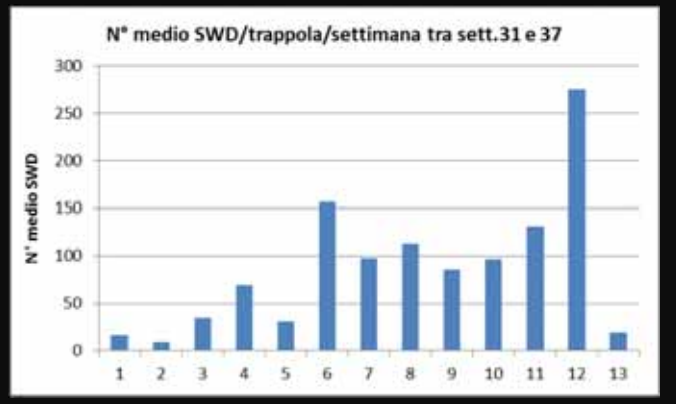
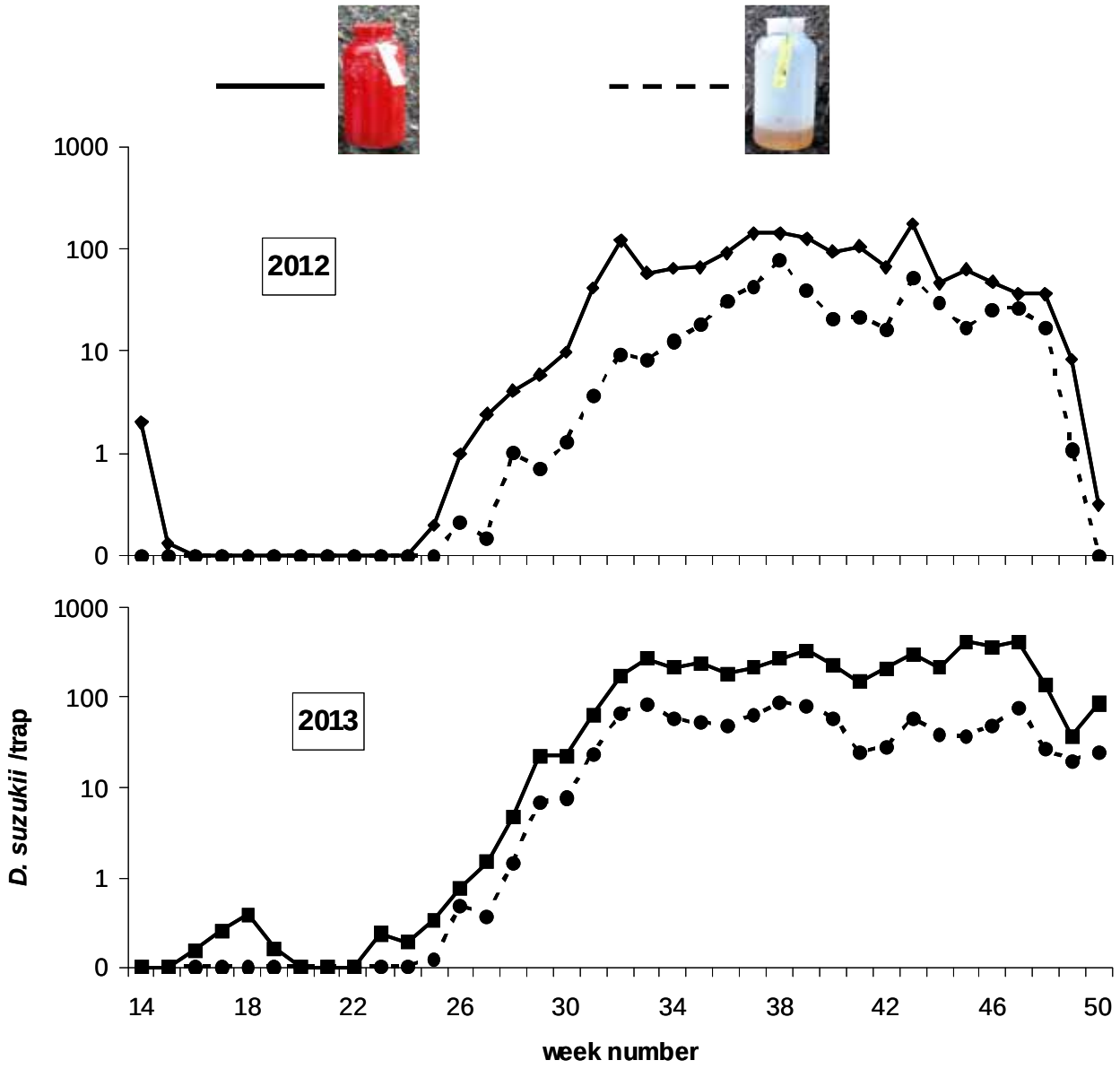
Comparative evaluation of bait efficacy and trap design

- *3 replicates/model*
- *Randomized sequence every week*

	trappola	esca
trappola 1	Kartell bianca	Droskidrink (200 ml)
trappola 2		aceto mela (200 ml)
trappola 3		Droskidrink (200 ml) + 4 gr.zucchero canna integrale
trappola 4	Kartell rossa	Droskidrink (200 ml)
trappola 5		aceto mela (200 ml)
trappola 6		Droskidrink (200 ml) + 4 gr.zucchero canna integrale
trappola 7		aceto mela (200 ml) + vino rosso (50 ml)
trappola 8		aceto mela (200 ml) + vino rosso (50 ml) + 4 gr.zucch.canna integrale
trappola 9		Droskidrink "integrale" (200 ml)
trappola 10	mod. Dreves	Droskidrink (200 ml) + 4 gr.zucchero canna integrale
trappola 11	Vaso Trap	Droskidrink (200 ml) + 4 gr.zucchero canna integrale
trappola 12	Biobest	Droskidrink (200 ml) + 4 gr.zucchero canna integrale
trappola 13	Kartell rossa	esca sintetica dr. Dong Cha (USDA - WA, USA)

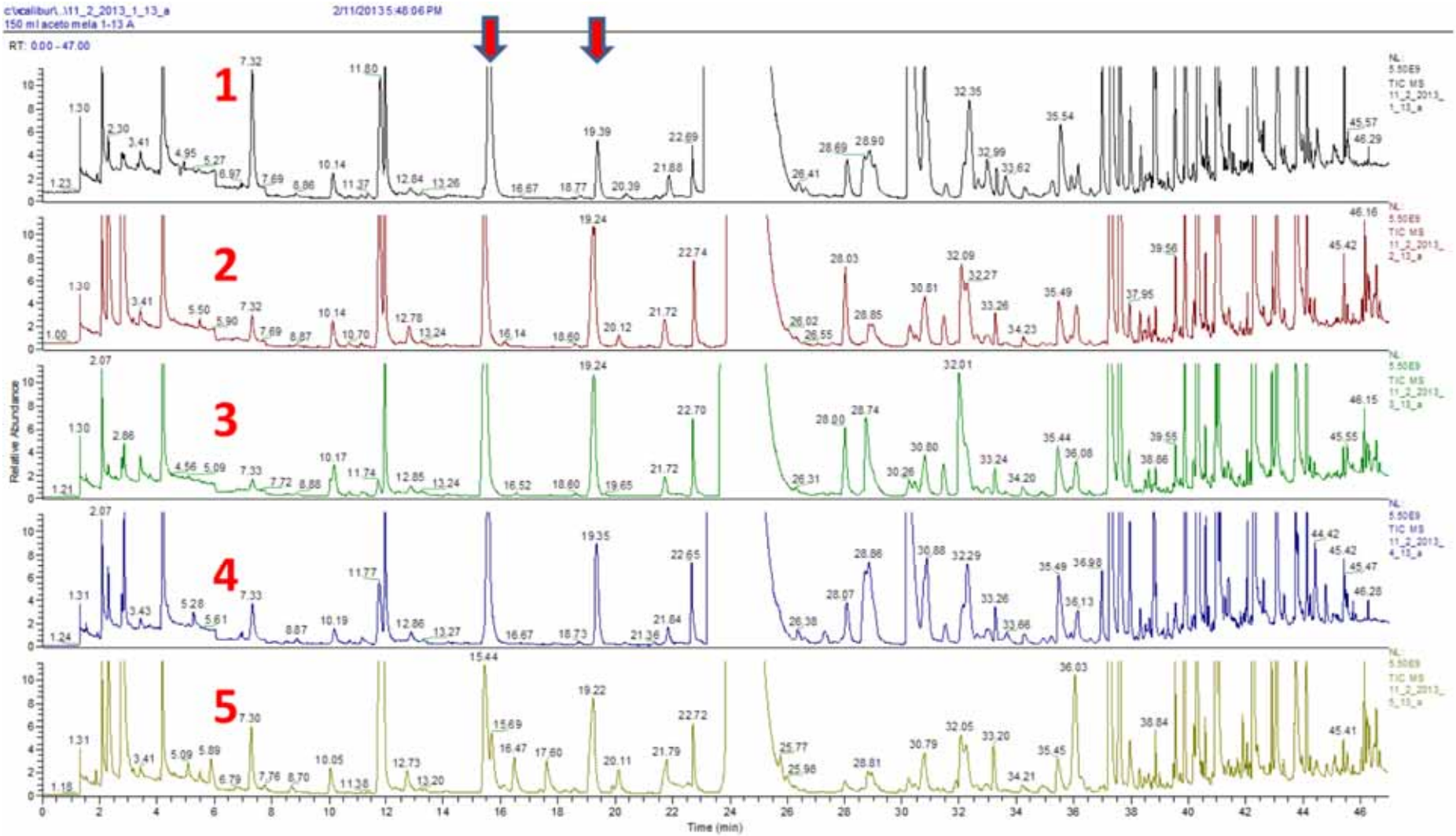






An exemplary graph of a field experiment for the evaluation of Droskidrink. Mean number of *D. suzukii* flies captured in monitoring traps in 2012 (n=63) and 2013 (n=44), from week 14 (beginning of April) to week 50 (mid December) on a log scale.

Ongoing studies



Acknowledments

This work was possible thanks to internal and external collaborations and the contribution of technical advicers and soft fruits growers

Poster session

- Monitoring activity
  - **Monitoring of *D. suzukii* in Emilia Romagna region (2012-2013) - Boselli M. *et al*.:** Fluctuations according to climates. More damage in 2013.
  - ***D. suzukii* - Monitoring in Poland - Piotrowski W. *et al*.:** 2012-2013 no captures of *D. suzukii* in the sampled areas.
  - ***D. suzukii*: monitoring in Switzerland in 2012 and 2013 - Richoz P. *et al*.:**Different traps. The fly has a wide distribution, from valley bottom to high altitudes, both agro- and natural systems. More damage in 2013.

Poster session

- Baits and traps evaluation
  - **Comparison of different trap types for *D. suzukii* in cherry fields - Vaccari G. *et al*.**:Droskidrink as a bait. “Drosotrap new” and “Bot” performed better. Low selectivity.
  - **Evaluation of the strategy of mass trapping for control of populations of *D. suzukii* using SUZUKII TRAP®SYSTEM in Spain - Carrión M. *et al*.**: Bioiberica has developed a specific food attractant. Mass trapping reduced population levels in the interior of the plot and the percentage of fruit damage.

Poster session

- Control strategies with insecticides
  - **Delegate WG: an innovative tool to control emerging pest *D. suzukii* - Galli M. *et al*.:** Spinetoram, new compound (mixture of 2 spinosyns chemically modified).
  - **Efficacy of different protection strategies against *D. suzukii* in combination with mass trapping - Profaizer D. *et al*.:** In field the damage observed on the three treatments was always similar and low. In semifield Spada 200 EC was the most effective, while Boundary was the less effective, and Laser intermediate.

Poster session

- Biocontrol
  - **Evaluation of predatory activity of *Orius laevigatus* (Fieber) and *O.maiusculus* (Reuter) towards *D. suzukii* under laboratory conditions - Malagnini V. *et al*.**: Marginal role of *O. laevigatus* and *O. maiusculus* in controlling *D. suzukii*.
  - **Experimental studies on *D. suzukii* in protected strawberry crops: biology of the pest and effectiveness of a parasitoid of pupa in field conditions - Trottin Y. *et al*.**: The effectiveness of the pupal parasitoid, *Trichopria drosophilae*, was evaluated on strawberries in greenhouses (bulk and augmentorium). It was able to find *D. suzukii* pupae and to parasitize them successfully.

Poster session

- Projects, consortia
  - **Overview on DROSKII Project: evaluation on two year experience on insight on the damage potential of *D. suzukii* and control measures - Simoni S. *et al*.**: Euphresco network, ended.
  - **Strategies to develop effective, innovative and practical approaches to protect major european fruit crops from pests and pathogens (DROPSA) - Audsley N.**: Recently funded, FP7.