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FruitFlyNet

A Location–aware System for Fruit Fly Monitoring and Pest Management Control

CherryFlyNet

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Cherryflynet

Cherry fly pilot in Thessaly – application of the LAS concept to control the cherry fruit fly

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The 2007-2013 ENPI CBC Mediterranean Sea Basin Programme is a multilateral Cross-Border Cooperation initiative funded by the European Neighbourhood and Partnership Instrument (ENPI). The Programme objective is to promote the sustainable and harmonious cooperation process at the Mediterranean Basin level by dealing with the common challenges and enhancing its endogenous potential. It finances cooperation projects as a contribution to the economic, social, environmental and cultural development of the Mediterranean region. The following 14 countries participate in the Programme: Cyprus, Egypt, France, Greece, Israel, Italy, Jordan, Lebanon, Malta, Palestine, Portugal, Spain, Syria (participation currently suspended), Tunisia. The Joint Managing Authority (JMA) is the Autonomous Region of Sardinia (Italy). Official Programme languages are Arabic, English and French (www.enpicbcmed.eu).

The European Union is made up of 28 Member States who have decided to gradually link together their know-how, resources and destinies. Together, during a period of enlargement of 50 years, they have built a zone of stability, democracy and sustainable development whilst maintaining cultural diversity, tolerance and individual freedoms. The European Union is committed to sharing its achievements and its values with countries and peoples beyond its borders.

The project FruitFlyNet total budget is 1.662.872,32€ and it is financed, on an amount of 1.496.585,09€ (90 %), by the European Union (ENPI CBC Mediterranean Sea Basin Programme) through the European Neighbourhood and Partnership Instrument.

Editor(s): Name, Email

Challenges in cherry fly control

- Predict adult emergence in spring
  - Day degree models
  - Trapping
- Population density, spatial dispersion
  - Hard to predict – previous year and winter mortality
  - Trapping
  - Fruit sampling
- Cultivars sensitivity
- Infestation on ripening and/or ripe fruits
  - Insecticide residues

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Goals of the cherryflynet

- Develop
  - e-monitoring system for adult population monitoring and spatial dispersion
  - Spatial Decision Support System
- Optimize cherry management procedures
  - especially spraying
- Bring technology to bear on cherry fly management
  - Real time data acquisition
  - Provide electronic pest management services based on accurate biological information

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Ultimate goal

Managing the European cherry fruit fly with a low input, ecologically sound and sustainable system

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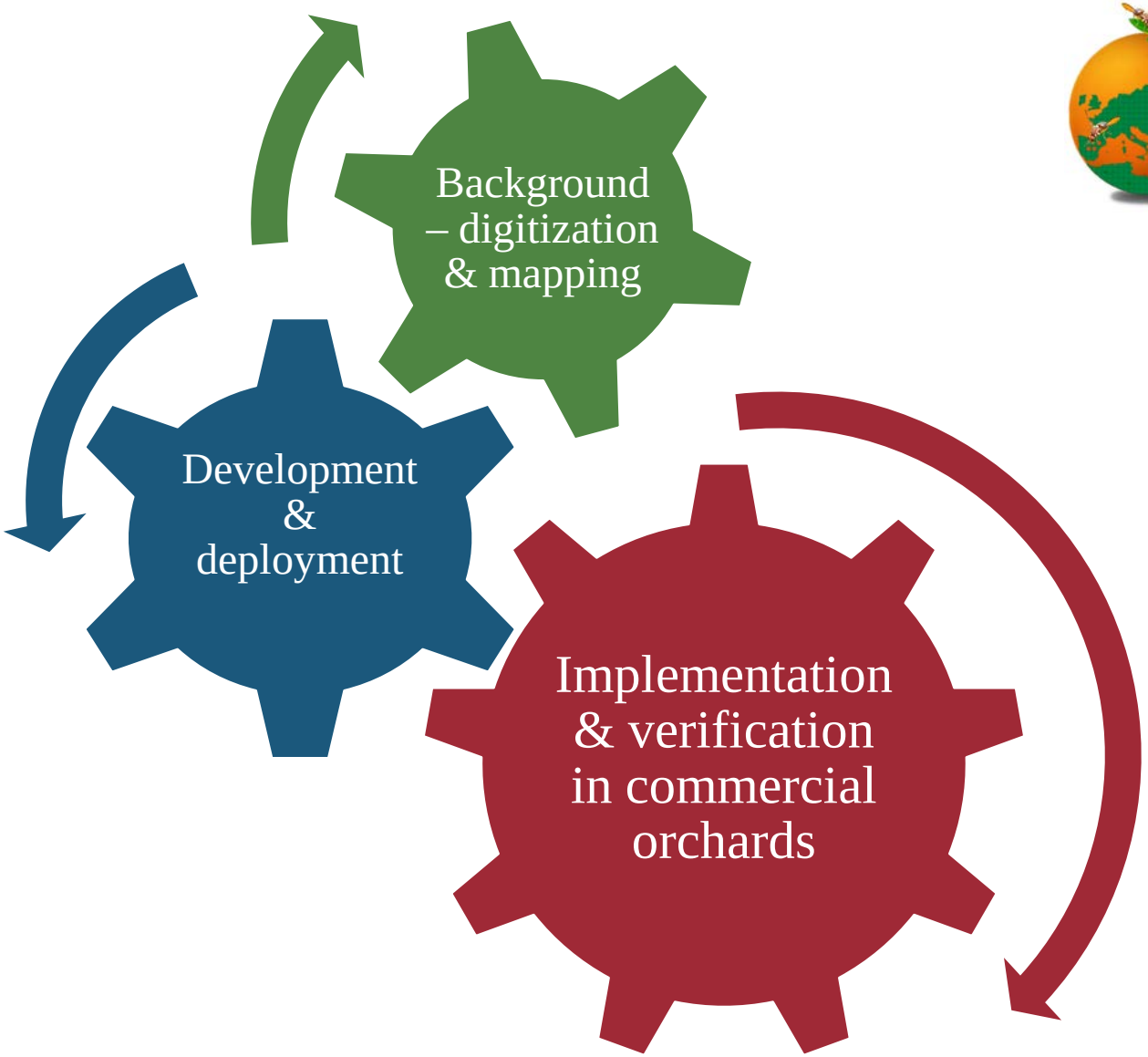
Procedures - Methodology



FruitFly Net

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Background, Digitization and mapping

Biological and economic data from previous years

Digitization, area, orchards, plots sensors …

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Experimental area Thessaly, Greece

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Experimental farms

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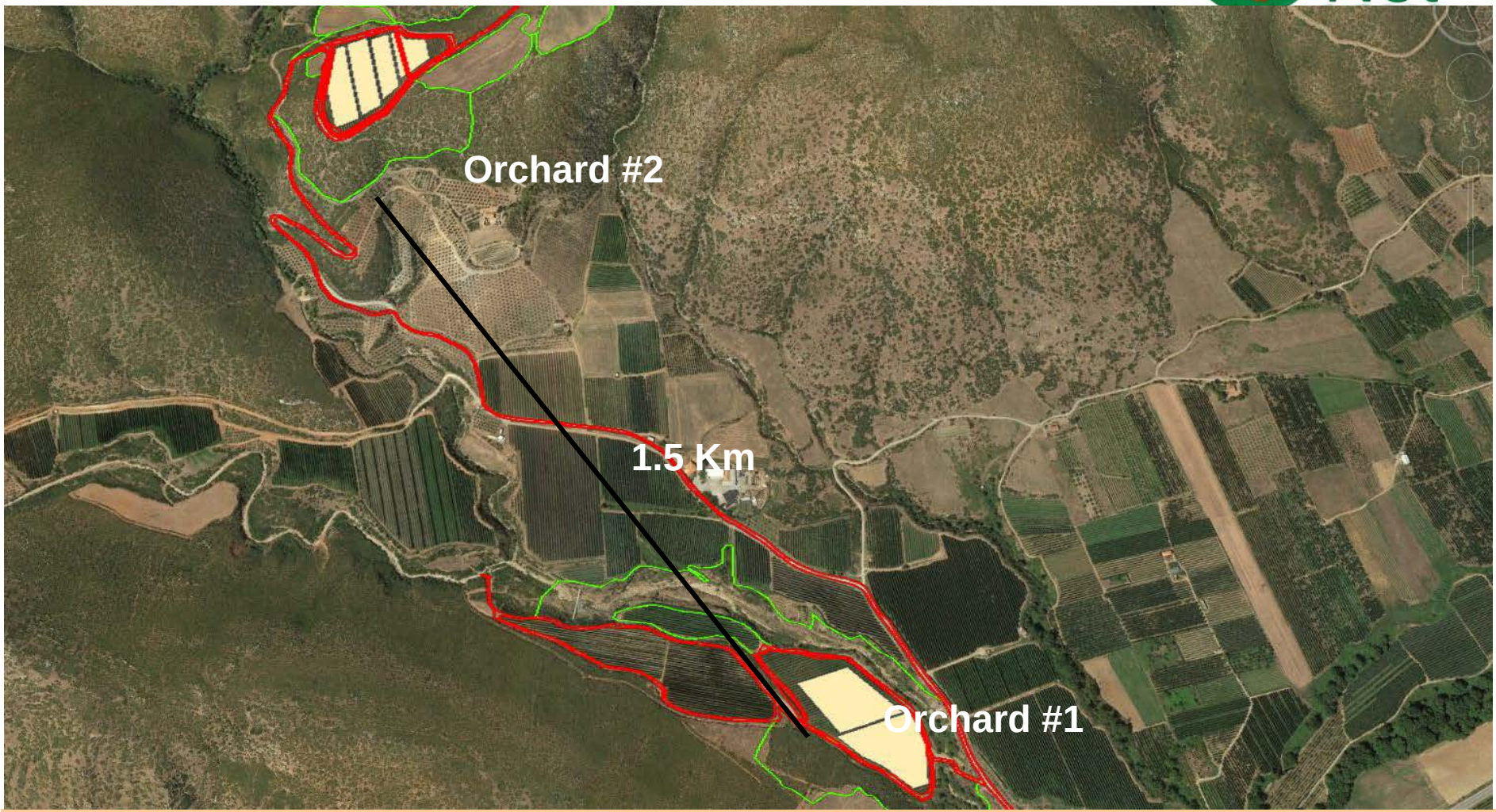
Orchards #1 and #2



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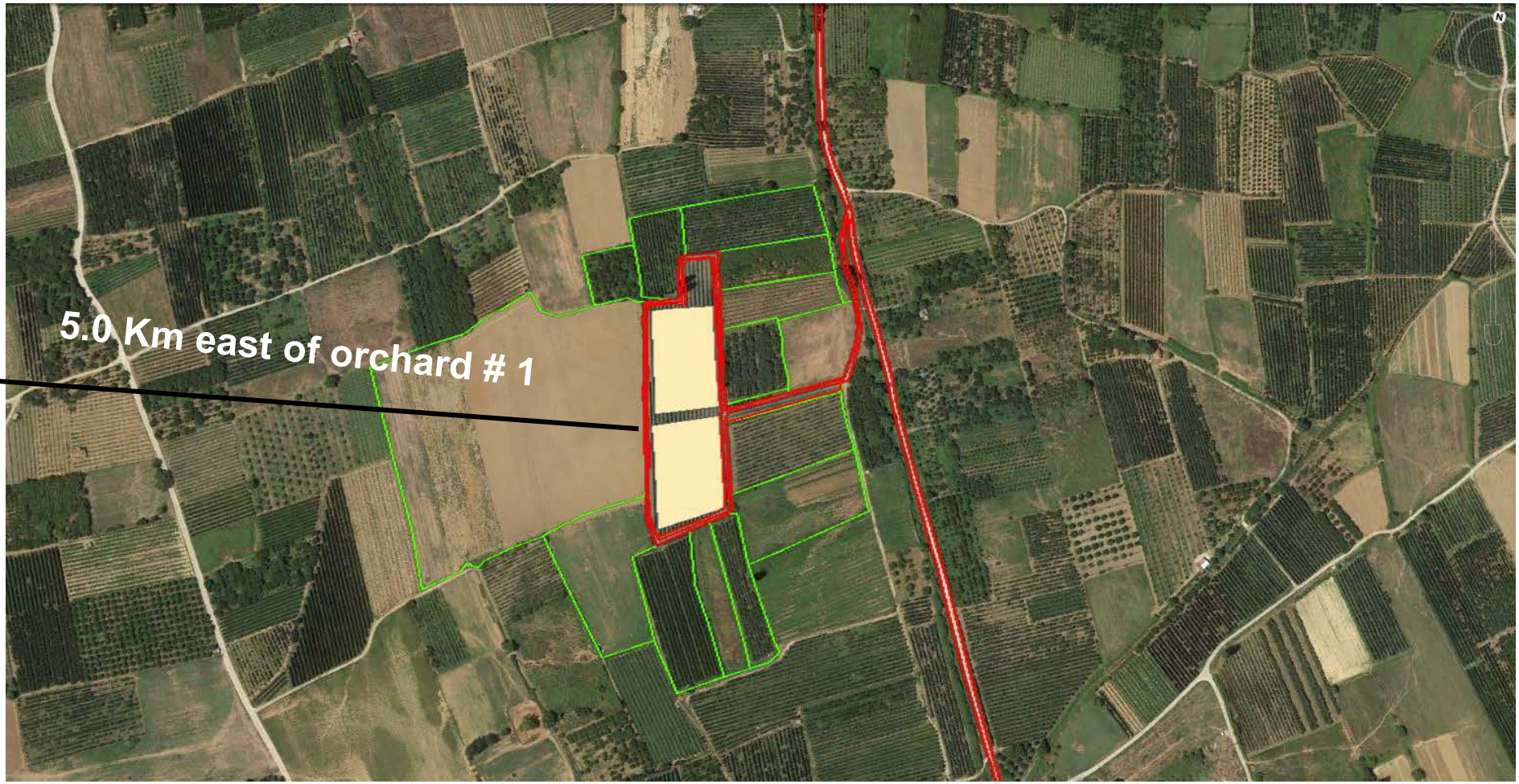
Orchard #3



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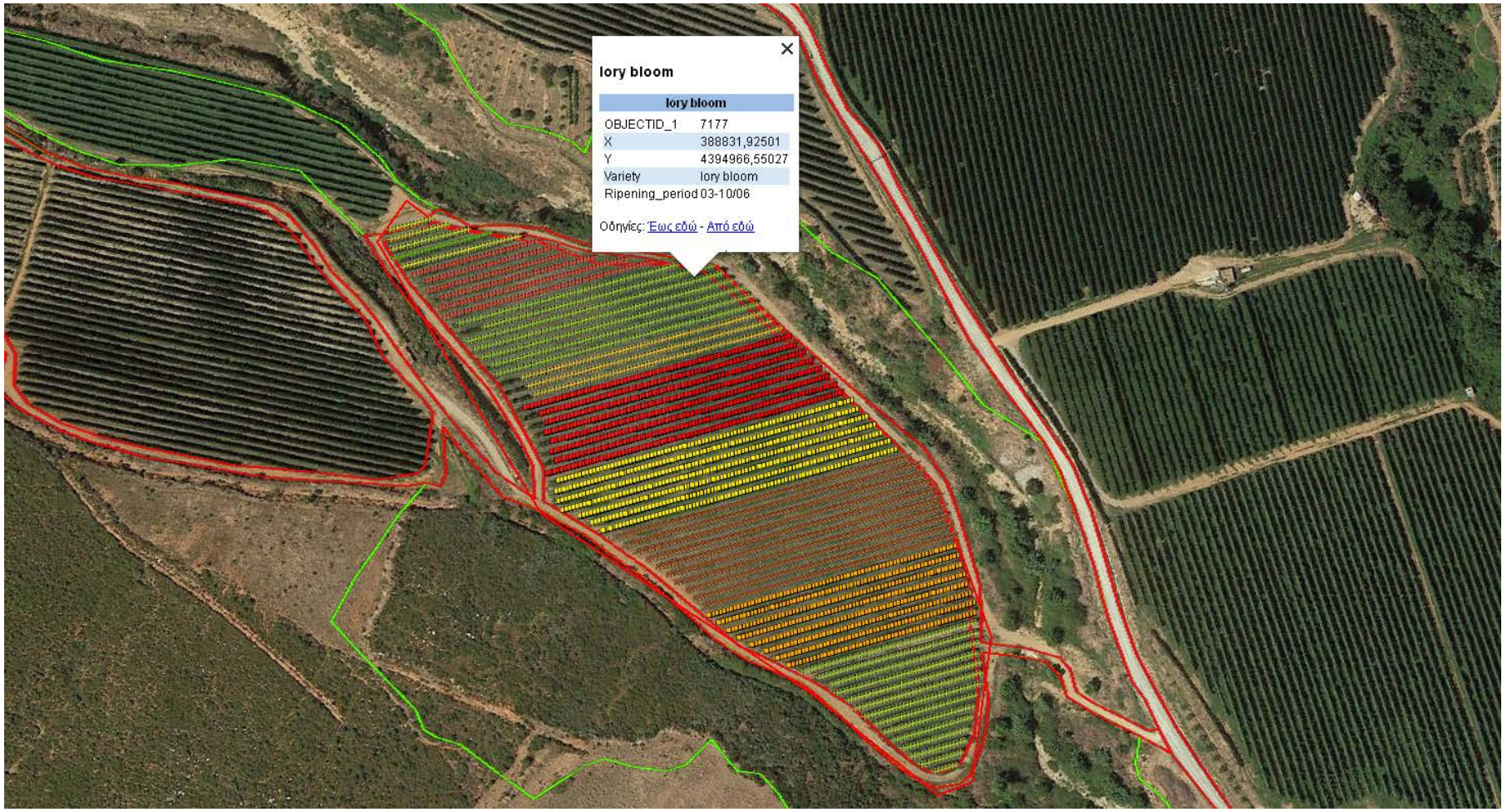
Orchard #1 - Sweet cherry varieties



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Developments

ReTIC – yellow sticky real time trapping system

SDSS – Spatial decision support system

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The cherry fly ReTIC

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Decision Support System for setting out traps

- Accumulation of 400 Day Degrees on April 29th.
- Setting of 5 Rebell traps per plot us indicators on April 10th
- Setting of entire trap network (appr. 190 traps) on April 20th.

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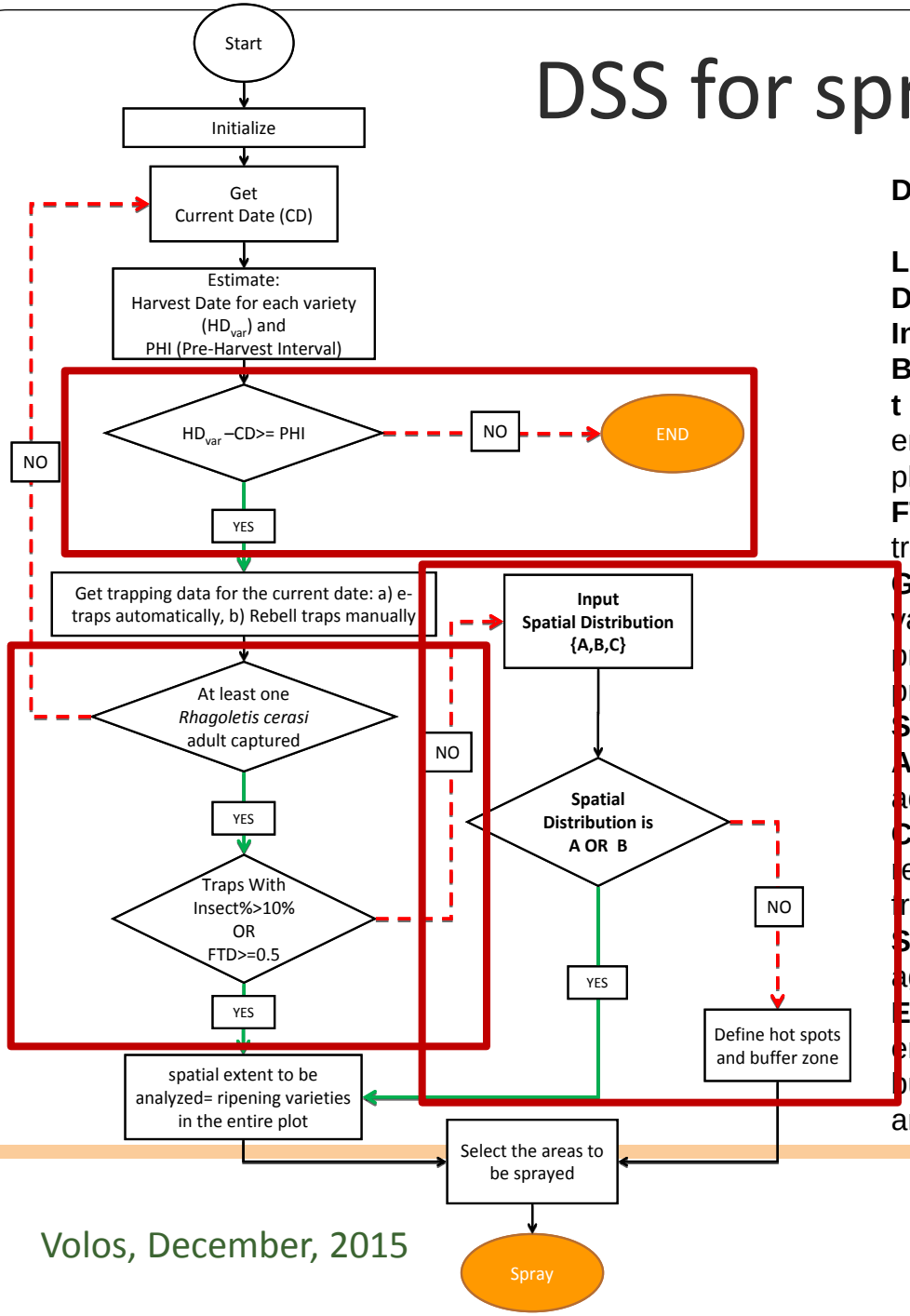
DSS for spraying



DD: Day Degrees = Σ(Tmax-Tmin)/2 – 5
i = n the day that DD sum is reaching 400
LDT: Lower developmental threshold = 5°C
DDb: Day degrees buffer = 32°C
Initialize, t0: date entered manually (February 1st)
BBCH: phenological development stages entered manually
t harvest: average harvest date of the last 3 years - date entered manually on April 20th based on current fruit phenology.
FTD: Flies per trap per day = Σ(adults of every trap)/(no of traps/days) from previous trap check.
Get Tmax, Tmin (when a sensor is not working): Use values of the closest Air Temperature sensor. The same procedure can be applied in the case of RH, wind speed and precipitation sensors failure.
Spraying buffer period: >=7 days before harvest
Adults on traps: adults on e-traps (automatically) as well as adults on Rebell traps entered manually.
Cherry fruit susceptibility: color break from yellow to reddish after examination of 100 randomly inspected cherry fruit from each cultivar
Spatial distribution: A = random, B = uniform, C = aggregated
Estimation of the spatial distribution and hot spots: entered manually using semivariography and kriging and a buffer zone of 10 m (two lines of trees). Hot spots will include areas with probability of more than 0.5 FTD.

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Deployment

ReTIC

Wireless Sensor Network

Real time data collection and transmission

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Wireless Sensors Network

- Four sensor nodes
  - ReTIC
  - Air temperature
  - Soil temperature
  - Humidity
  - Wind speed
- One central node (3G connection)
- Data transmission twice a day

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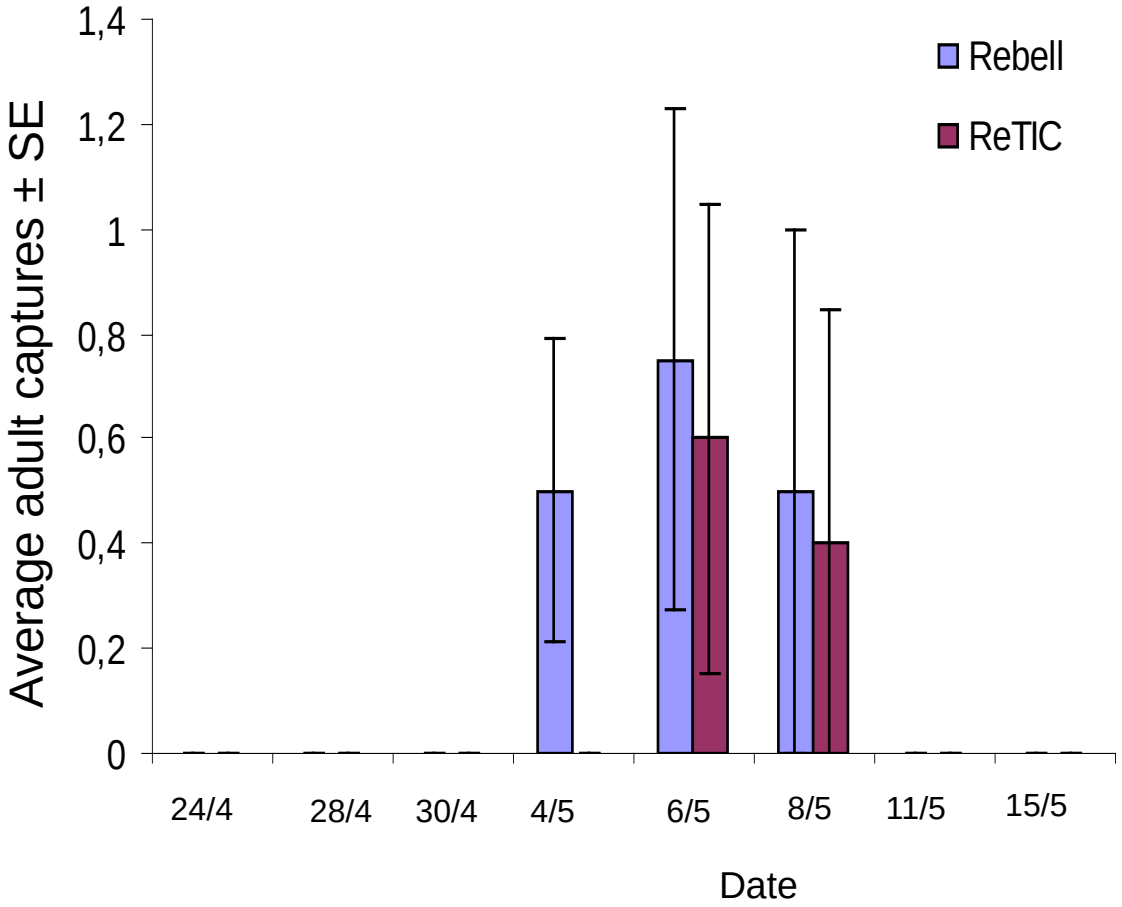
ReTIC performance (conventional orchard)



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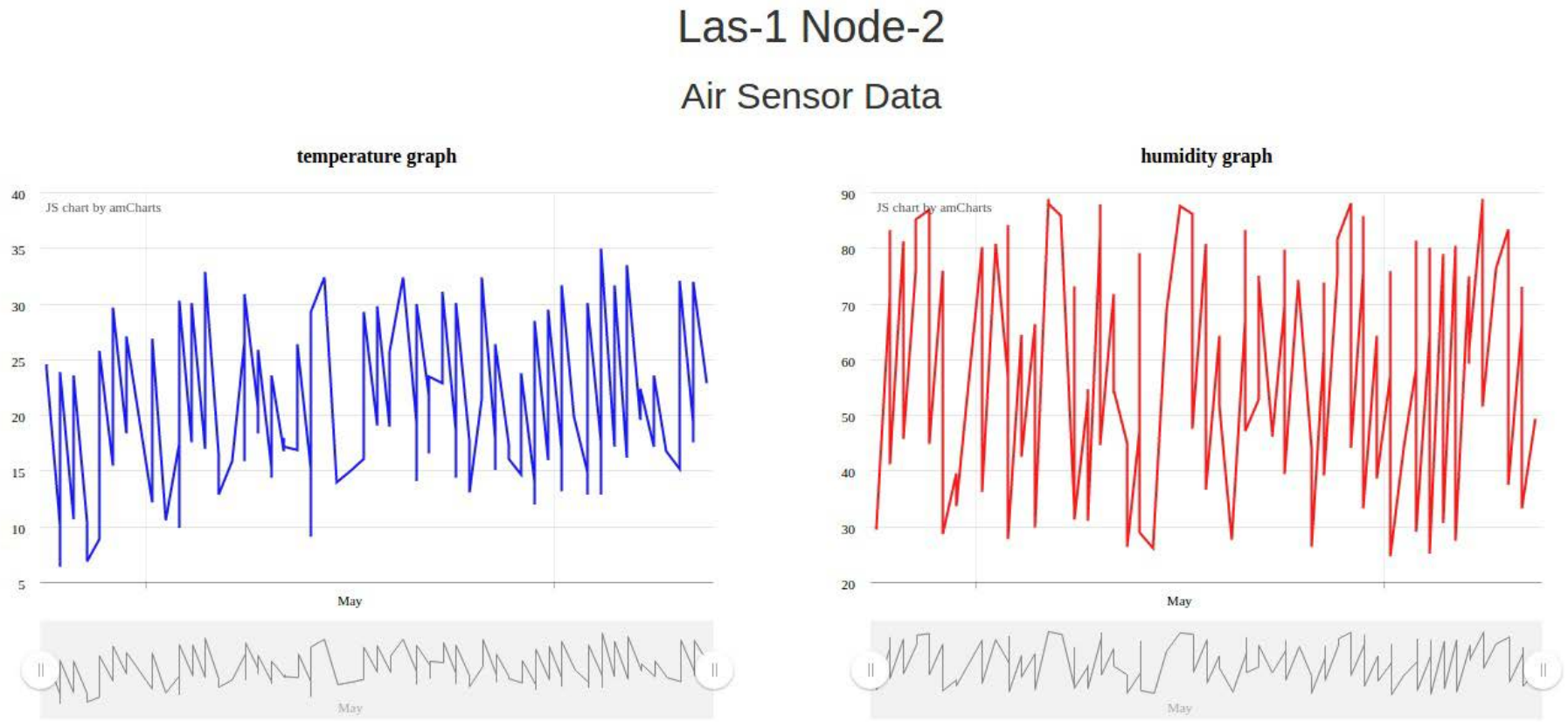
Temperature and humidity



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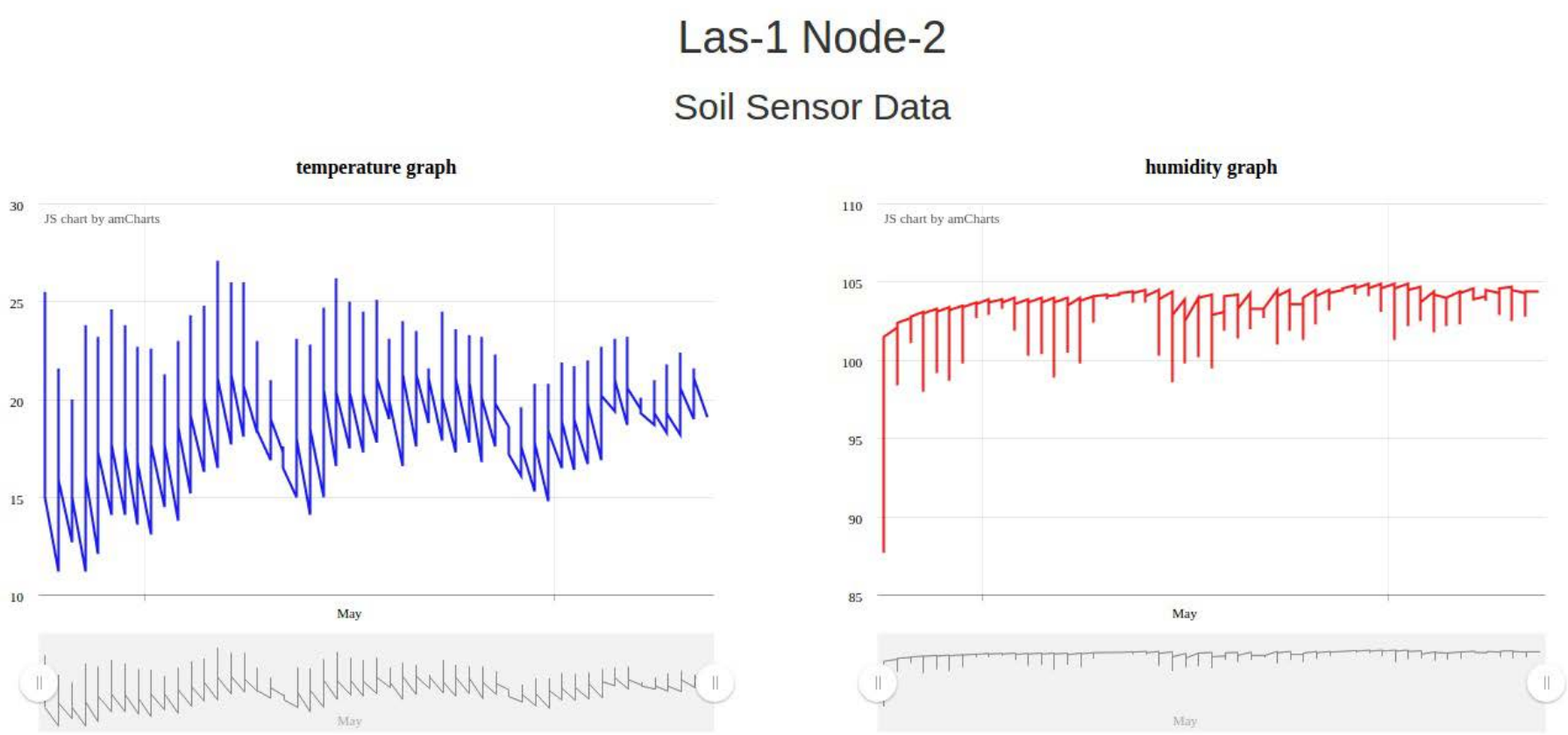
Soil Temperature and humidity



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Implementation

Location aware system (LAS) in four commercial plots of cherry orchards

Conventional and organic orchards served as controls

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Rhagoletis cerasi monitoring

- Trap network:
  - 20 Rebell traps and 4 ReTIC traps in each of the 4 LAS Plots
  - 20 Rebell traps in each of the 4 Conventional Plots
  - Monitoring every 2 – 4 days during spring and every week in June.

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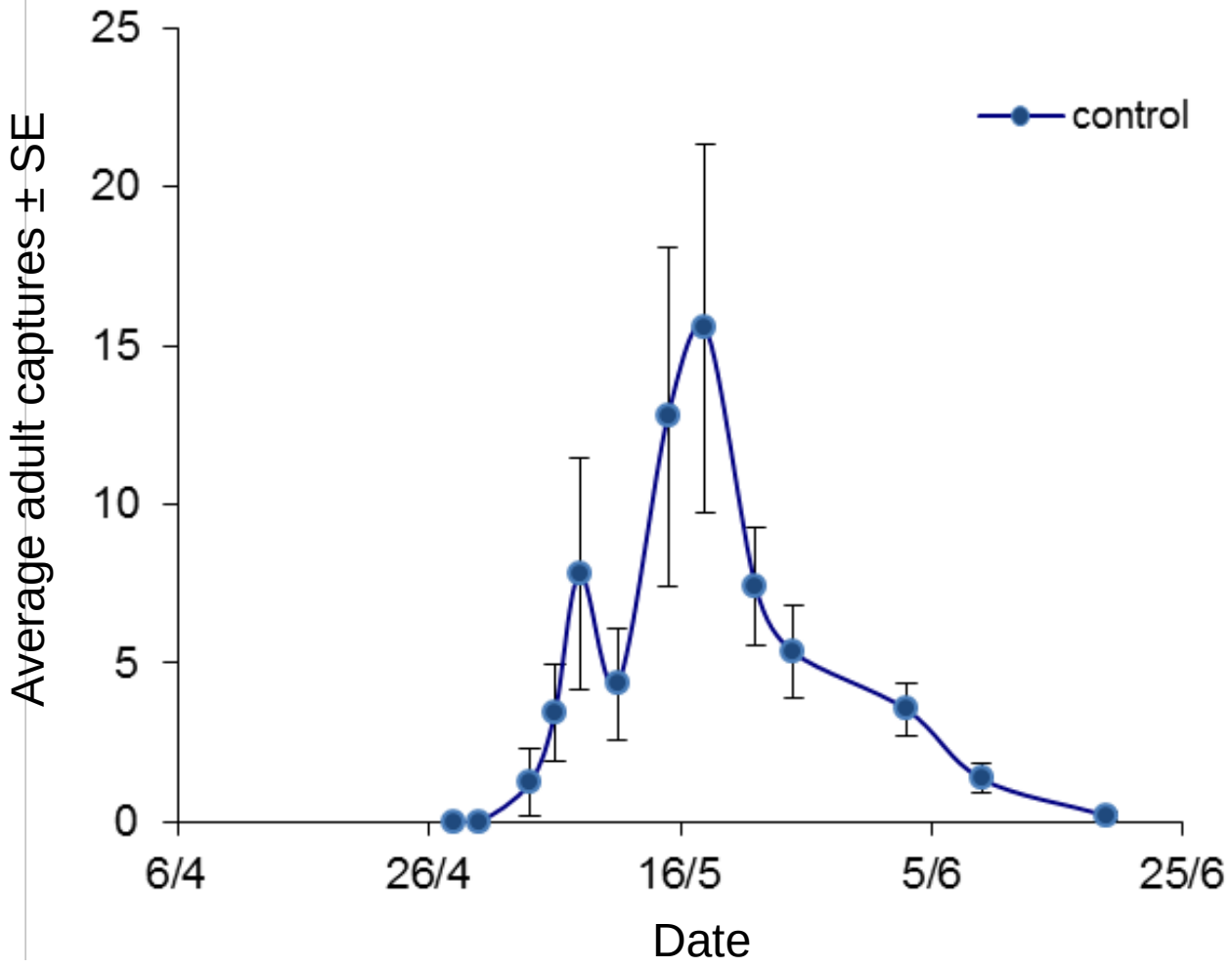
Adult captures



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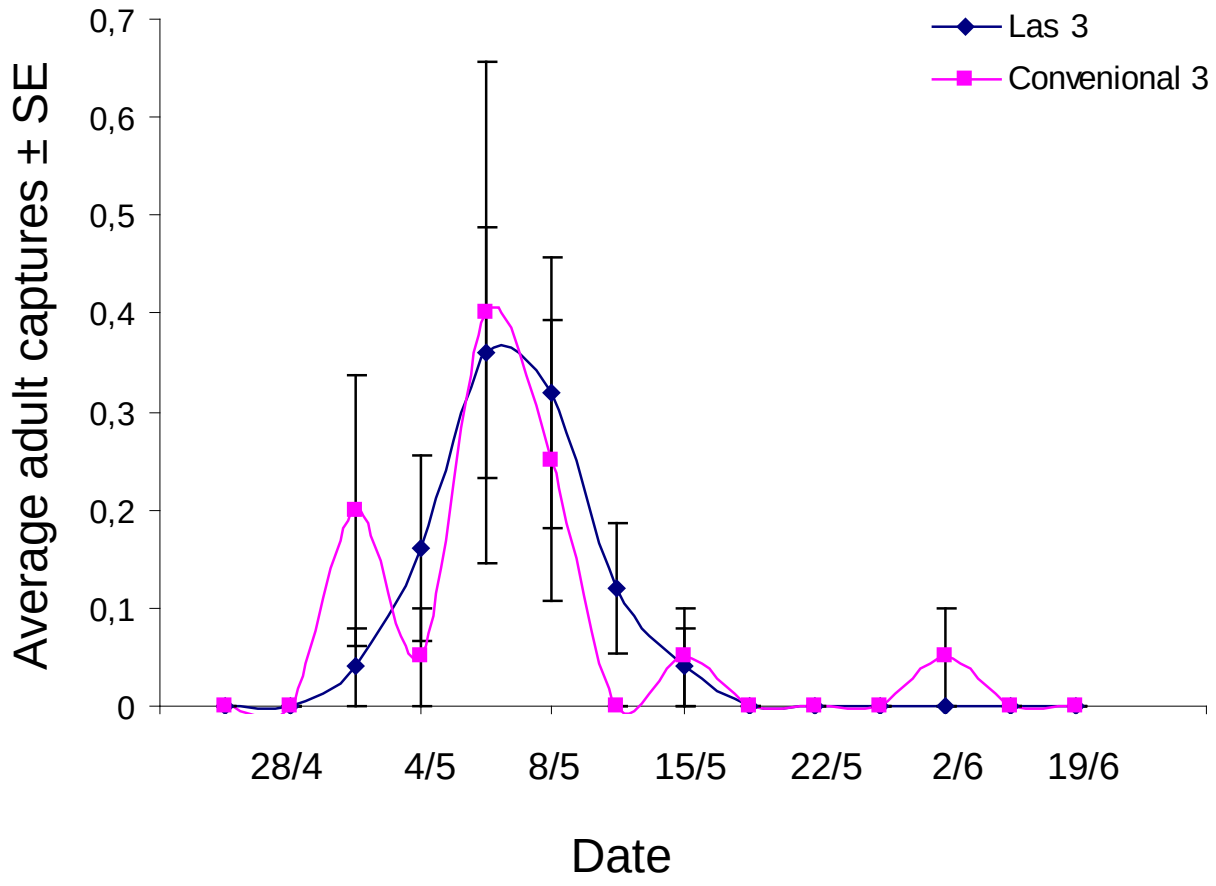
Adult captures



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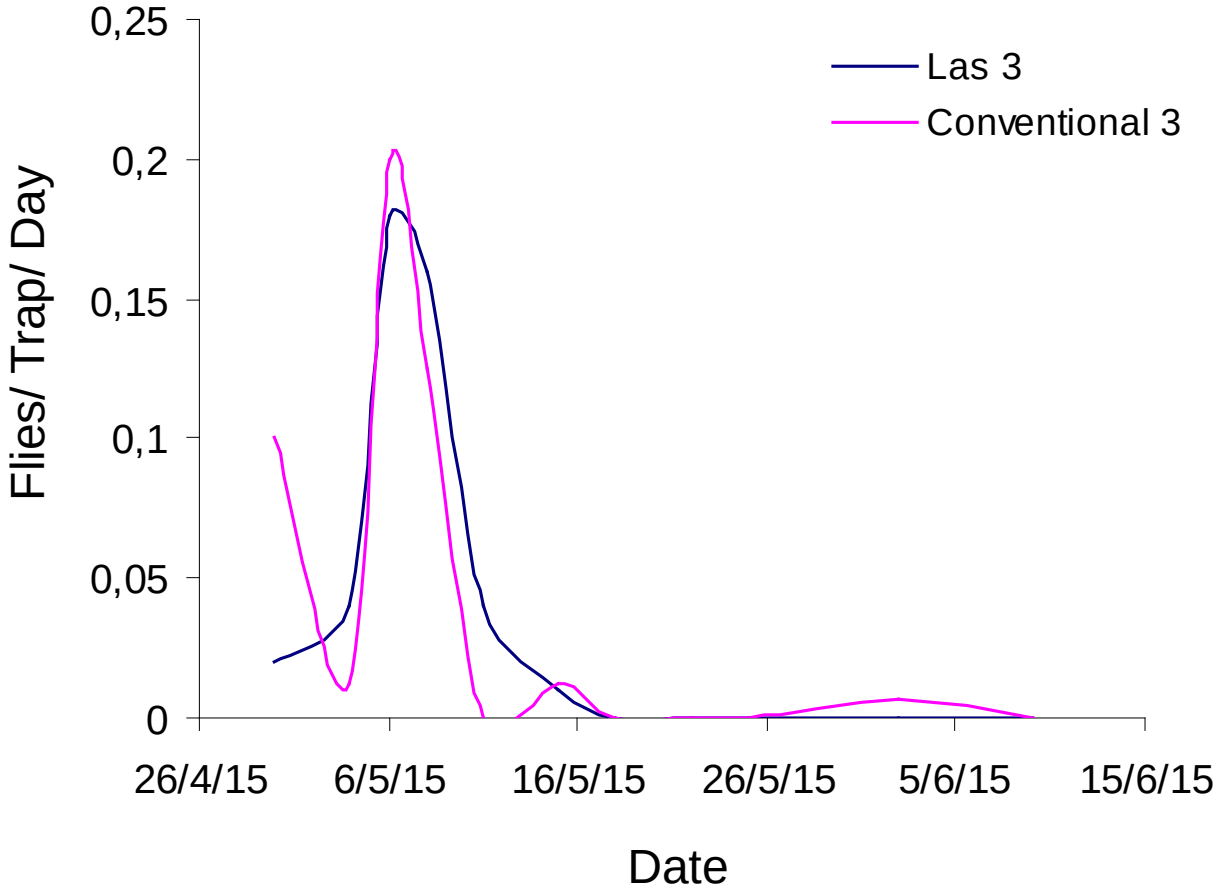
Flies per Trap Per Day (FTD)



Las 1: 0 captures throughout the season

Las 4: 1 female on April 30th

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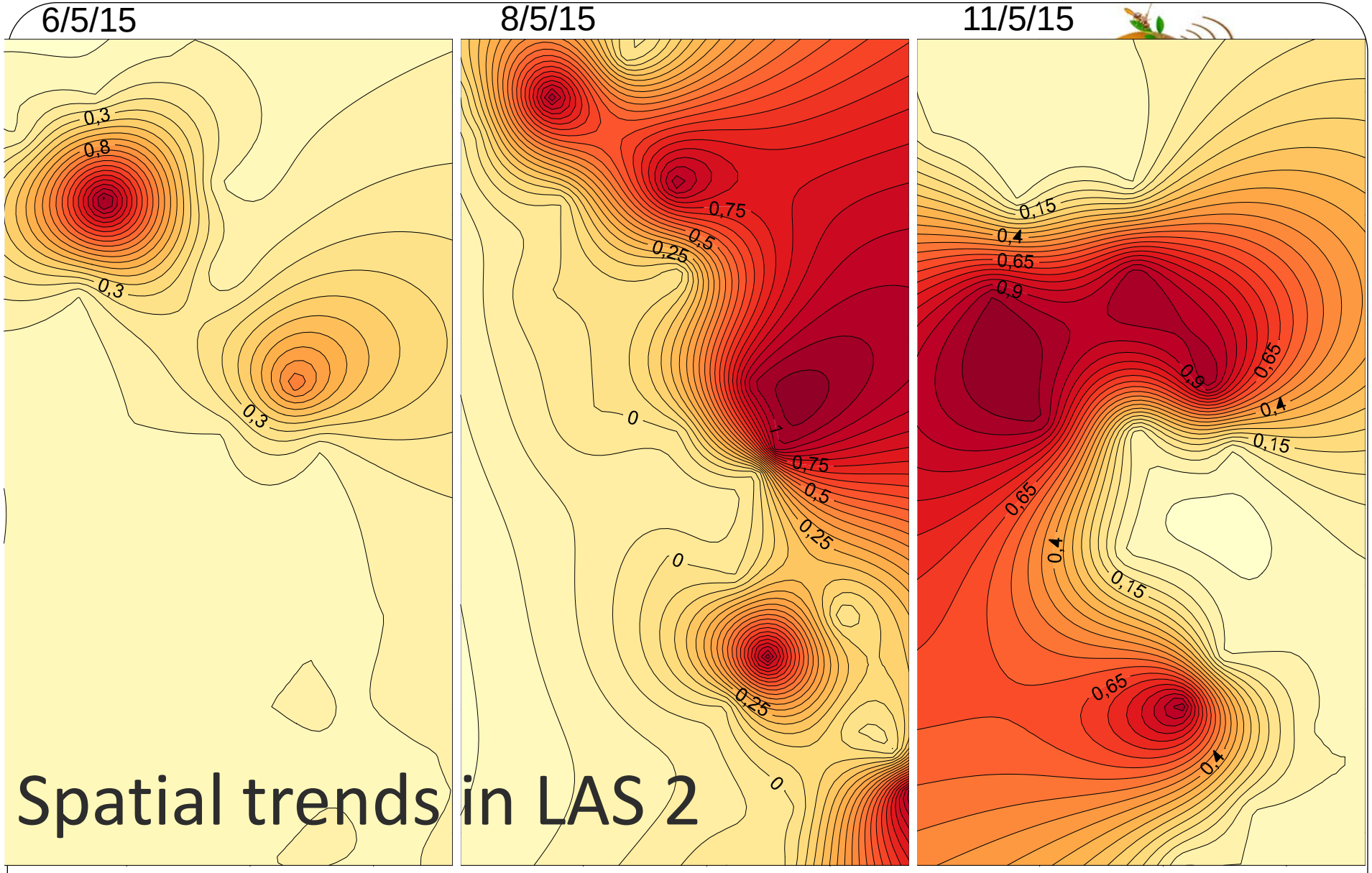

Spatial trends in LAS 2

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Validation

- Fruit infestation rate
- Number of insecticide applications – volume of insecticide
- Residues on harvested fruit
- Economics
- Biodiversity

Efficacy of the LAS system

Plots	Insecticide applications (#)		Fruit infestation (%)		
	LAS	Conventional	LAS	Conventional	Control
1	0	2	0.0	0.0	21.5
2	1	2	0.0	0.0	8.1
3	1	2	0.0	0.0	6.4
4	0	2	0.0	0.0	-
Average	**0.5**	**2**	**0.0**	**0.0**	**12.0**

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Indicators of LAS Performance

Plots	Spraying solution (litter10^3/ha)		Insecticide volume (ml/ha)		Hours of labor		Tractor Fuel (lt/ha)	
	LAS	Conv	LAS	Conv	LAS	Conv	LAS	Conv
1	0	2.8 - 3.2	0	280 - 340	0	110	0	8
2	1.4 - 1.6	2.8 - 3.2	140 - 170	280 - 340	67	134	8	16
3	1.4 – 1.6	2.8 - 3.2	140 - 170	280 - 340	67	134	8	16
4	0	2.6 - 2.9	0	230 - 330	21	21	5.5	5.5
Avg	**0.7 - 0.8**	**2.7 - 3.1**	**70 – 85**	**267.5 -337.5**	**38.7**	**99.7**	**5.4**	**11.4**
	3.9		3.8		2.5		2.1	

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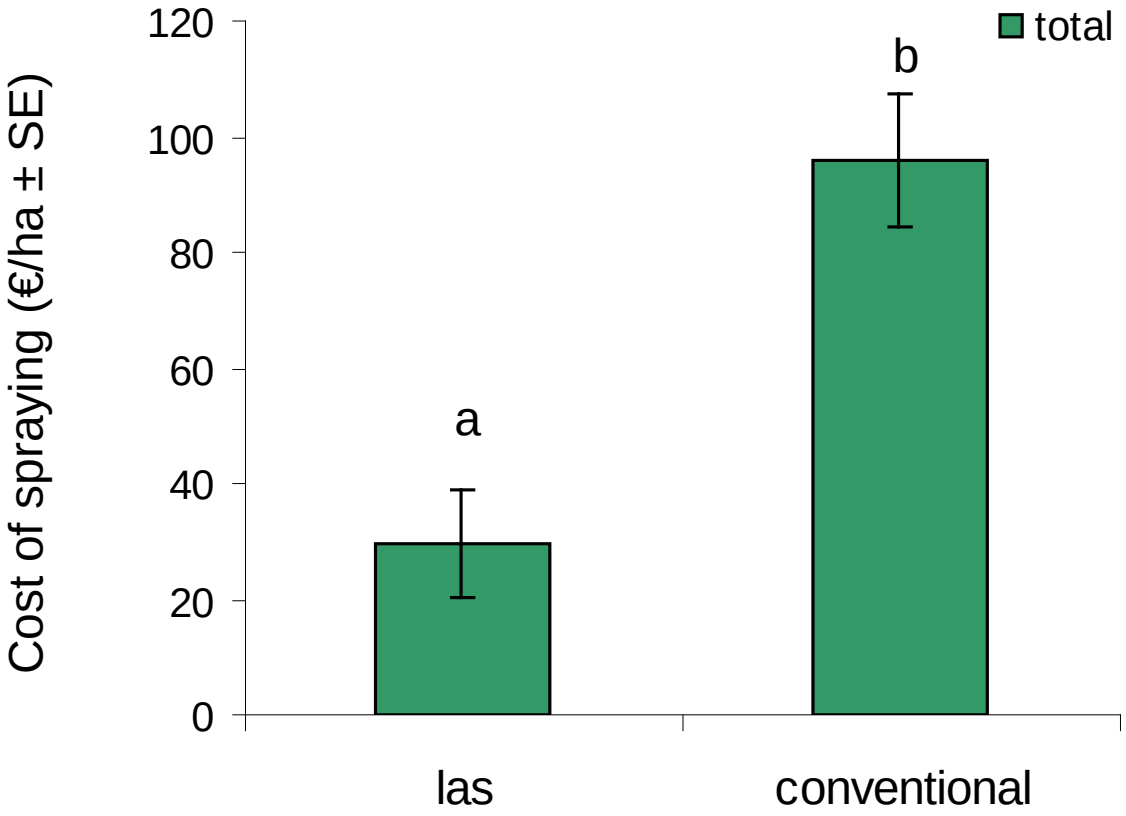
Economic impact



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Insecticide residues

Cherries were stored at – 20 °C

300 g per sample

ID of AIs

Thiamethoxam
Deltamethirn

Sample extraction (acetone/hexane)

GC-EAD

(Only for deltamethirn)

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Deltamethrin residues analysis

Plots	Limits of detection and quantification (BDL = Bellow detection Limits, LOD = Limits of Detection)	
	LAS	Conventional
1	BDL	BDL
2	0.016 μg/g - (LOD)	BDL
3	BDL	0.069 μg/g - Below MRL
4	BDL	BDL
Control	BDL	BDL

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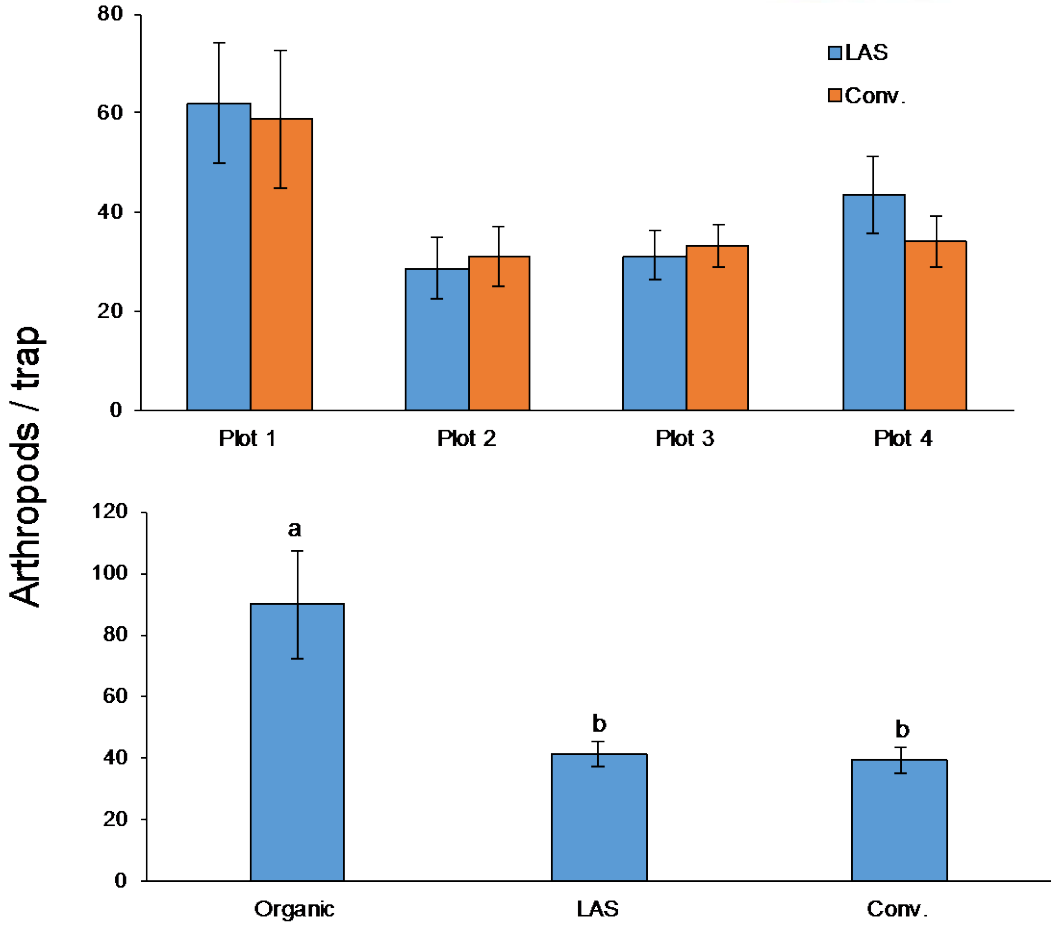
Biodiversity - Richness



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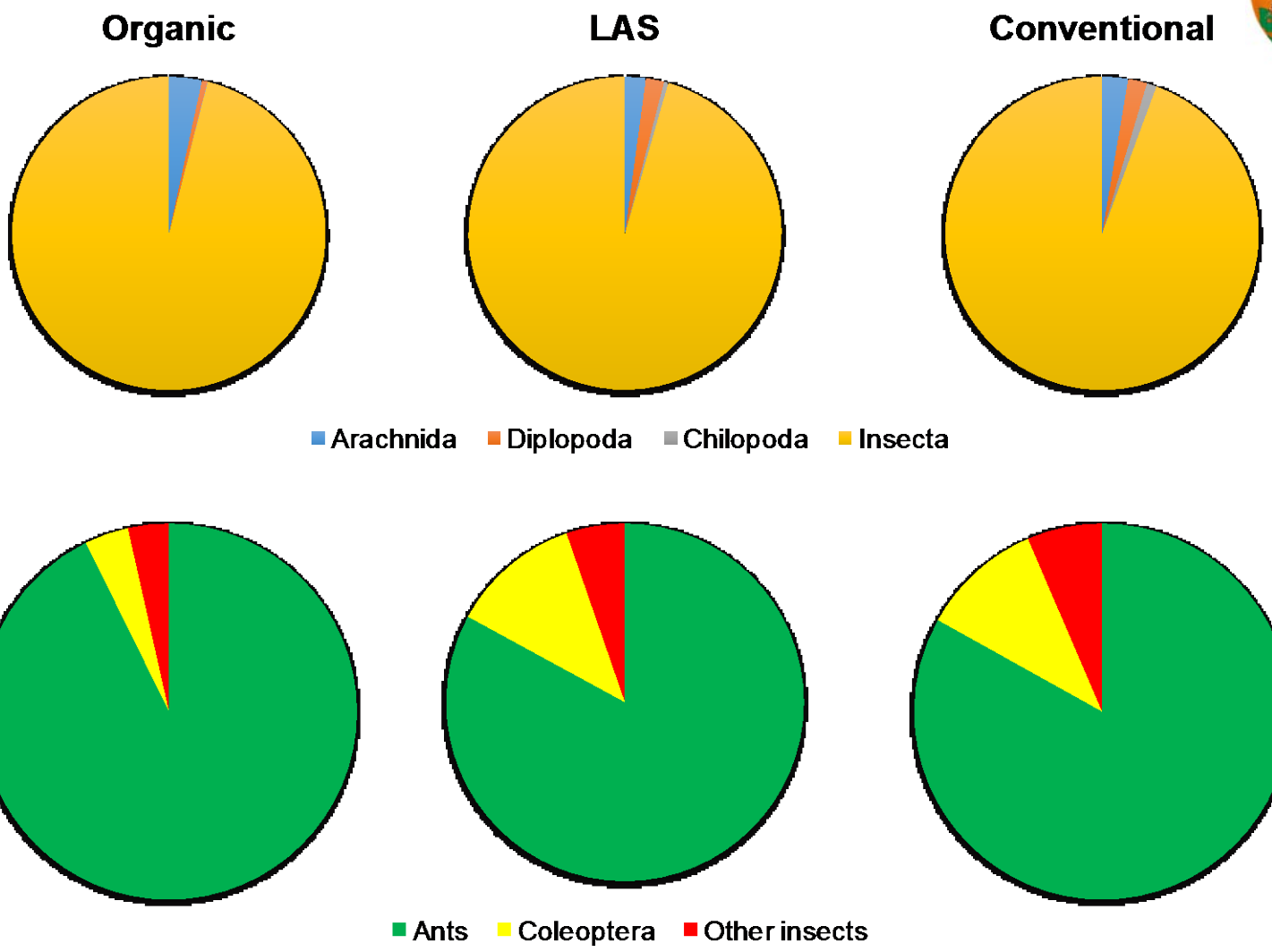
Insects Biodiversity



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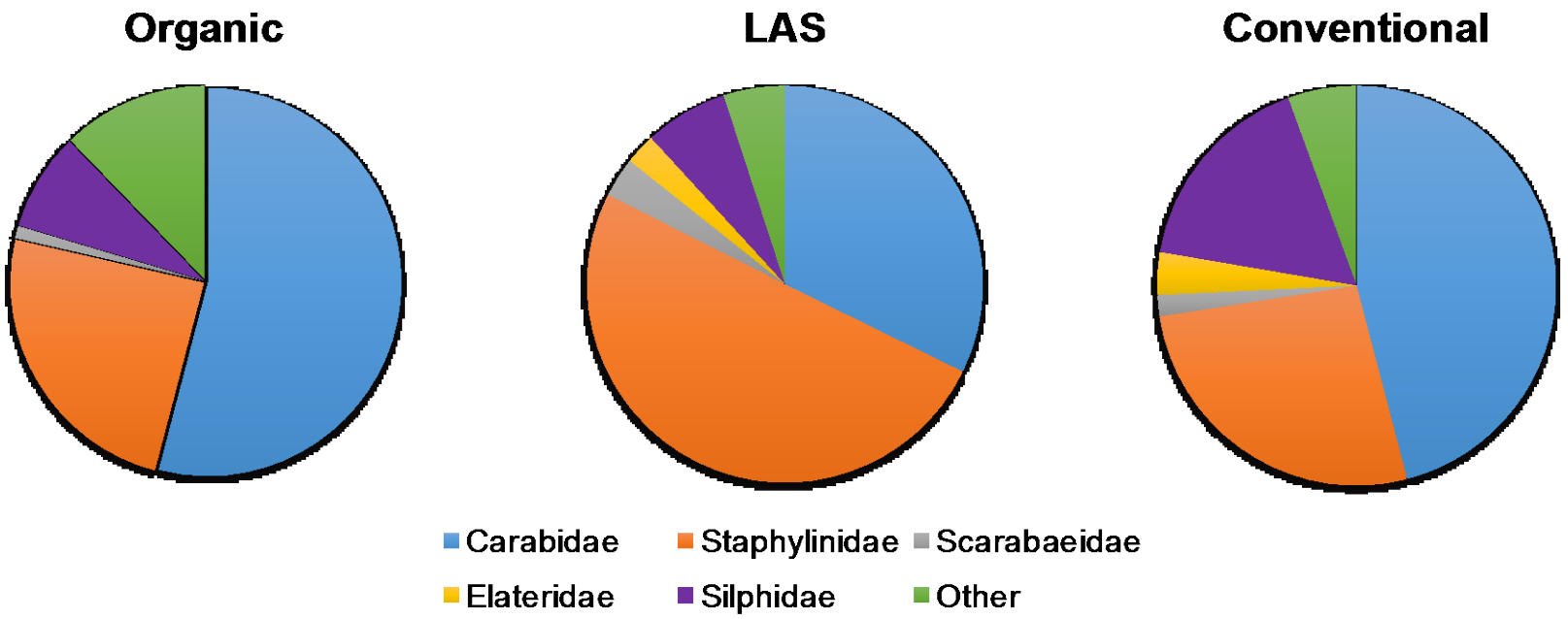
Beetles Biodiversity



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Conclusions

- The successful application of the cherryflynet is a big step forward towards establishing an automated, real time Location Aware System for managing the cherry fly at various spatial levels
  - Reduction of insecticide applications
  - Reduction of insecticide volume
  - Achieve no fruit infestation
- There is need for various optimizations including ReTIC, web-based services, and toolboxs for monitoring and spraying

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Acknowledgments

The University of Thessaly

•Christos Athanassiou
•Stella Papanastasiou
•Babis Ioannou
•Kostas Zarpas
•Fanouris Panagopoulos
•Apostolos Xenakis
•Giannis Koutsaftikis
•Giorgos Gitsis
•Elpida Neofytou
•Christos Genitseftsis

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Thank you!!!

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