# Activities in EUBerry WP2
# Improved cultivation techniques

Päivi Parikka
MTT Agrifood Research Finland

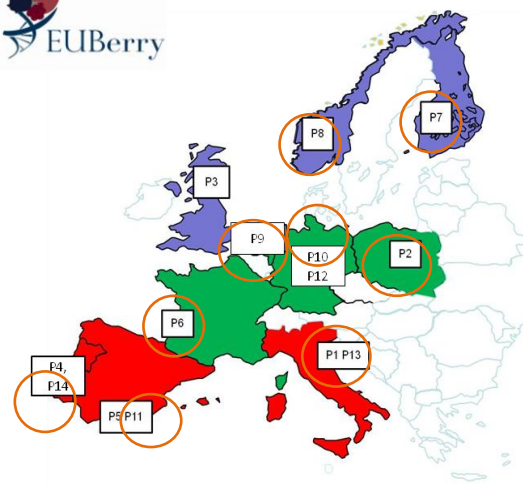
## Tasks and subtasks in WP2

**Task 2.1. Cultivation techniques for season extension** *Task Leader Pedro Bras de Oliveira* P14
- Sub-Task 2.1.1 Controlling plant development for season extension
- Sub-Task 2.1.2 Determining economical methods to modify growth conditions for season extension

**Task 2.2. Ensuring profitable berry production in changing climate** *Task Leader Rolf Nestby* P8
- Sub-Task 2.2.1 Developing technology to control temperature stress in berry plants
- Sub-Task 2.2.2 Identifying the impact of changing climate on perennial berry plants

**Task 2.3. Reducing environmental impact** *Task Leader Gijs van Kruistum* P9
- Sub-Task 2.3.1 Improved biocontrol and integrated pest management
- Sub-Task 2.3.2 Improved disease management by biocontrol and other sustainable methods
- Sub-Task 2.3.3 Improved substrate, nutrient and water use efficiency

**Deliverables:** 5, no delivery dates during the first year




**P1** Marche Polytechnic University
**P2** Instytut Ogrodnictwa
**P6** National Institute of Agronomical Research, Fruit Species Research Unit
**P7** MTT Agrifood Research Finland
**P8** Norwegian Institute for Agricultural and Environmental Research
**P9** Stichting DLO
**P10** Geisenheim Research Center Department of Pomology
**P14** Instituto Nacional dos Recursos Biológicos
**P11****Freson de Palos
**P13****Sant'Orsola

**Partners in WP2:** P1, P2, P6, P7, P8, P9, P10, P14, P11SME P13 SME

## Task 2.1 Cultivation techniques for season extension (P1– P13)

P13 set the trials using own structure, know-how and materials to evaluate fruiting results; P1 analysed the plant to evaluate vegetative-reproductive behaviour.

**<u>Sub-task 2.1.1</u> Controlling plant development for season extension (2012).**

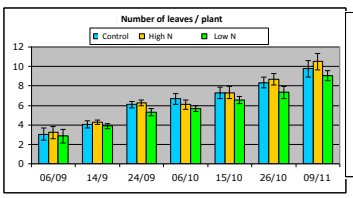
**<u>Sub-task 2.1.2</u> Determining economical methods to modify growth conditions for season extension (2012).**

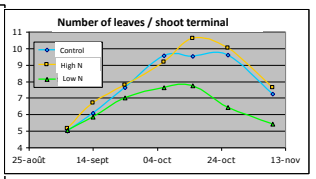
•P13 is comparing 3 types of plastic covering

**Plant ready for architectural analysis at the end of 1° producing cycle**

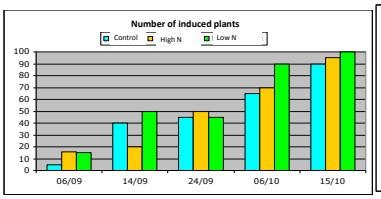
**WP2 – P06** (ii) REGULATED NUTRIENT INPUT, EXPECIALLY LEVEL AND TIMING OF NITROGEN APPLICATIONS

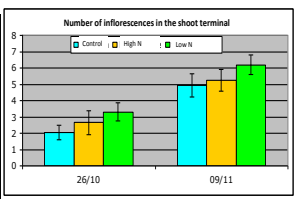
## Effect of fertilisation on floral initiation




Low nitrogen fertilisation decreases the number of leaves in the plant and in the shoot terminal




Low nitrogen fertilisation increases the number of induced plant and the number of inflorescences in the shoot terminal

In 2012, comparison on the yields obtained in the different conditions of fertilisation

## Task 2.1 Cultivation techniques for season extension P2

### Subtask 2.1.1. Controlling plant development for season extension

(v) different plant types including fresh and cold-stored plants (two series of the exp.) - MASNY A.

1. Plant material (potted and bare root plants of Grandarosa, Pink Rosa and Elsanta) was produced for the experiment.
2. Experiment will be planted on 1 June, 15 June and 30 June, 2012 (+covering by straw).
3. Plant vigor, ripening time, marketable and unmarketable yield, fruit weight, fruit decay, fruit firmness, soluble solid content, ascorbic acid content and plant infection by *Mycosphaerella fragariae*, *Diplocarpon earliana* and *Sphaerotheca macularis* will be assessed in summer 2012.
4. Production of plant material for the 2nd series started.

(vii) different light conditions utilizing light-emitting diode (LED) technology (two series of the exp.) - KLAMKOWSKI K.

1. Experiment was established on February 16, 2012 with Grandarosa, Pink Rosa and Elsanta; Lightening treatments: LED lamps, sodium lamps, control.
2. Plant vigor (leaf area, weight of plant organs), ripening time, marketable and unmarketable yield, fruit weight, fruit decay, fruit firmness, soluble solid content and ascorbic acid content, measurement of rate of gas exchange were assessed.
3. Production of plant material for the 2nd series started.

## Task 2.1 Cultivation techniques for season extension P2

### Subtask 2.1.1. Controlling plant development for season extension

(viii) novel soilless plant propagation method in greenhouse to produce plants for cold-storing (two series of the exp.) - TREDER W.

1. Experiment was established on February 16, 2012 with Grandarosa, Pink Rosa and Elsanta; treatments – rooting of runner plants in small pots (50 $cm^3$) filled with peat substrate or coco peat substrate)
2. Assessment: performance of the cultivars, including plant vigor, number and size of runner plants, runner plant quality (after two weeks of rooting), weight and length of roots.

3. Field experiment was established on 9 May, 2012 with potted plants of Elsanta, rooted in pots (peat substrate and coco peat substrate)
4. Plant vigor, ripening time, marketable and unmarketable yield, fruit weight, fruit decay, fruit firmness, soluble solid content, ascorbic acid content and leaf disease infection will be assessed in summer 2012.

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## Task 2.1. Cultivation techniques for season extension

### Subtask 2.1.1. Controlling plant development for season extension

**Strawberry**

Autumn production with day-neutral plants

soil cultivation

August 2011

soilless cultivation

September 2011

Albión and San Andreas from Eurosemillas; Cristal from Planasa; Valor and Premier from Plant Science

Plant growth and yield pattern were assessed in the beginning, middle and at the end of the growing season

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## Task 2.1. Cultivation techniques for season extension

### Subtask 2.1.1. Controlling plant development for season extension

**Raspberry**

Season extension of late-season fruiting raspberry

Late season fruiting (December)

Nine primocane-fruiting cultivars are under study: Amira, Kweli, Glen Lyon, Himbo-Top, Polka, Erika, Grandeur, Elegance and Radience

Variety trial set up to evaluate yield and quality during late season (autumn – winter)

## Task 2.1 Cultivation techniques for season extension P2

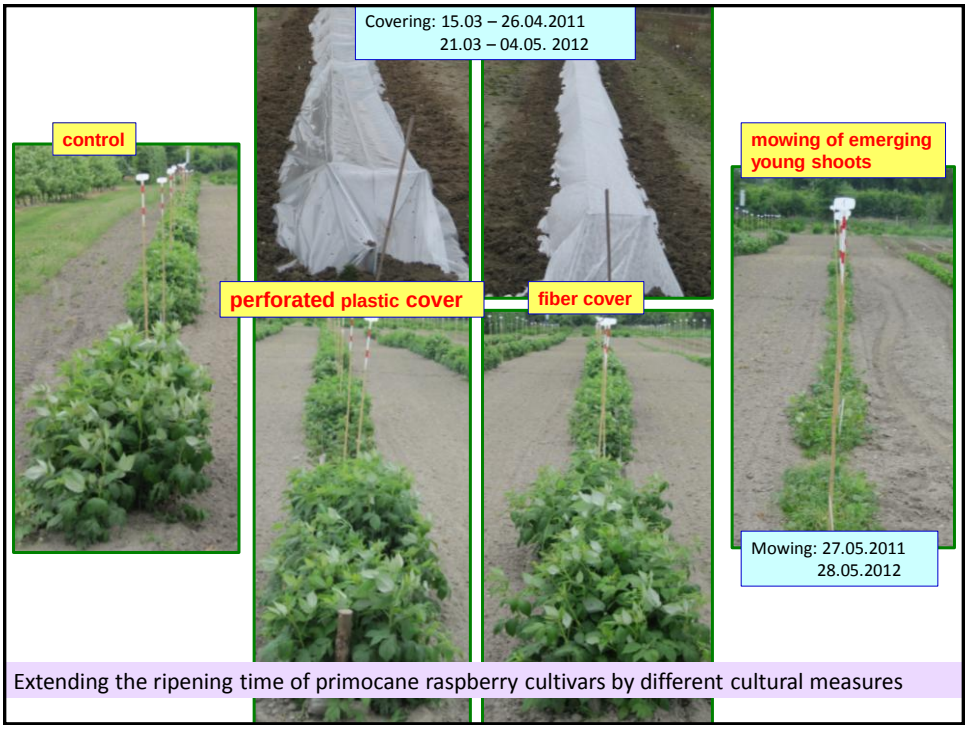
### Subtask 2.1.1. Controlling plant development for season extension

i) Season extension of late-season (i.e. primocane) fruiting raspberry – LEWANDOWSKI M.

1. Experiment was established in autumn 2010 with Polana, Polka, Polesie,
2. 4 treatments: covering with perforated plastic film in the middle of March (for 1 month), covering with fiber cover (the same time), mowing of emerging young shoots in the middle of May, Control plants - neither covered nor mowed.
3. First results of ripening time, marketable and unmarketable yield, fruit weight, fruit decay, soluble solid content and ascorbic acid content were collected in 2011 and presented in the Annual Report and in Sant'Orsola (Italy).

SUBCONTRACTOR

1. Experiment was established on June 1st, 2010, with plants of raspberry 'Meeker' and blackberry Čačanska Bestrna produced in vitro and propagated by the standard method.
2. In 2011 first results of physiological properties, vegetative potential and yield parameters, organoleptic quality (fruit weight, height, width and thickness of fruits, drupelets properties, fruit colour and chemical parameters of fresh fruit, as well as resistance to fungal diseases, winter hardiness and assessment of plant genetic stability were collected and presented in the Annual Report and in Sant'Orsola (Italy).




Extending the ripening time of primocane raspberry cultivars by different cultural measures

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**Task 2.1. Cultivation techniques for season extension**

**Blackberry**

Blackberry double production

Rooting of floricane stems for early production;

Evaluation of the best summer rooting method in order to be possible to obtained new primocanes to be used as long-canes for next autumn season in nine different cultivars.

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**Task 2.1. Cultivation techniques for season extension**
**Blueberry**

Trial with Northern and Southern Highbush cultivars for fruiting season manipulation in cold storage

Trial with open field grown Rabbiteye cultivars for late season production

## Task 2.1. Cultivation techniques for season extension (P9)

**2.1.2 Determining economical methods to modify growth conditions for season extension**

Work plan

- Greenhouse climate & production model
- Modify for tunnels and berries
- Validate/calibrate with real data ← We are here (data from P13)
- Run scenarios for climate of P13 & P14
- Evaluate in terms of cumulative degree days

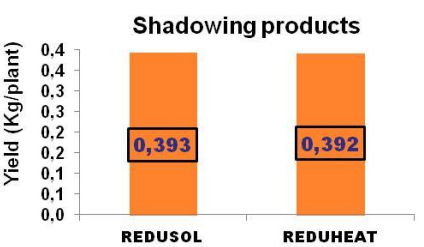
## Scenarios to be evaluated

- In agreement with P13 (Sant'Orsola, Italy) and P14 (INRB, Portugal), we selected:
- Extension of the autumn growing season:
  - side insulation
  - aluminium screen
  - air circulation
  - water spraying on the plastic
- Extension of the spring growing season:
  - misting
  - whitewash and/or shade
  - air circulation

## Task 2.2 Ensuring profitable berry production in changing climate P1-P13

**Sub-task 2.2.1 Developing technology to control temperature stress in berry plant**

P13 compared 2 shadowing products (Redusol, Reduheat) added to plastic covering. No productive, qualitative or climatization differences were found;
- Redusol system was less expensive.



## Task 2.2. Ensuring profitable berry production in changing climate P2

Sub-task 2.2.1 Developing technology to control temperature stress in berry plants

b.) Methodology to prevent low temperature injuries

STRAWBERRY – MASNY A.

1. Field experiment was planted on 2-4 May, 2012 with Grandarosa, Pink Rosa, Honeoye and Elsanta.
2. Three treatments: the mist maker (first use is planned for spring 2013), fibre cover and control (no protection).
3. Assessment: percentage of flower buds damaged by spring frosts in each replication.

BLACKCURRANT – PLUTA S.

1. Field experiment was planted on 10-11 May, 2012 with Tiben, Tisel, Ruben, Polares and Titania .
2. Two treatments: the mist maker (first use planned for spring 2013) and control (no protection against spring frosts).
3. Assessment: percentage of flower buds damaged by spring frosts in each replication.

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## Task 2.2. Ensuring profitable berry production in changing climate P8

**Sub-task 2.2.1 Developing technology to control temperature stress in berry plants**

2.2.1, b(i) Trial 1. Low temperature stress (LTS) in frutocane raspberries 'Glen Ample, 'Stiora' and selection 91-39-7. Active 2011 and 2012. R. Nestby

**Sub-task 2.2.2 Identifying the impact of changing climate on perennial berry plants**

2.2.2, a (ii) Trial 1. The effect of autumn temperatures on yield parameters for raspberry cultivars suitable for protected cultivation in the Northern Europe. Active 2011 and 2012. A. Sønsteby

2.2.2, b (ii) Trial 1.Effects of autumn temperatures on phenological characters of black currant genotypes. Active 2011 and 2012. A. Sønsteby

2.2.2 c (ii) Trial1. Fruit quality and yield of the European blueberry (Vaccinium myrtillus L.). Active 2012. I. Martinussen

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## Task 2.2 Ensuring profitable berry production in changing climate P10

**Sub-task 2.2.2 Identifying the impact of changing climate on perennial berry plants**
**Raspberry -** Activities of P 10 (Geisenheim Research Center)

**Eco-physiological studies** - time of flower initiation and development in autumn and its effect on plant characteristics in the following cropping season (greenhouse production)

- 'Tulammen' and 'Glen Ampel'
- evaluation of flower inititation in autumn since mid-august in a weakly interval
- plants then moved to cold storage to preserve the developed stage
- plants moved into a greenhouse in February

Evaluated parameter
- lateral length, time of flowering, yield and fruit size

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Praxis.
ZUKUNFT WÄCHST.

***Task 2.2 Ensuring profitable berry production in changing climate***
**Sub-task 2.2.2 Identifying the impact of changing climate on perennial berry plants**

**Eco-physiological studies** - time of flower initiation and development in autumn

Bud dissection:

stage 2

- apex flat and broadening
- was reached for 'Tulameen' at the 5th October

Growth performance spring 2012:

- plants brought into a cool chamber on the 29th Sept.➔ most buds remained vegetative

- while plants brought into a cool chamber after the 5th October
- all buds are fruiting

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## Task 2.2. Ensuring profitable berry production in changing climate

### Sub-task 2.2.2. Identifying the impact of changing climate on perennial berry plants

1. Late production with three potted plants (tray) primocane-fruiting cultivars in soil and pots
2. Early production with long-cane primocane-fruiting vs floricane-fruiting cultivars

Site preparation and plantation.

## Task 2.2. Ensuring profitable berry production in changing climate P7

**Sub-Task 2.2.2 Identifying the impact of changing climate on perennial berry plants**

**Blueberry**

-The effect of growing conditions: increased temperature and growing season
-Effects on growth and flower initiation and yield of semi-highbush blueberry
-Field trial in tunnel and open field on cv Arto.
-Observations of growth, flowering, yield, pests and diseases

## Task 2.3. Reducing environmental impact P9

**Sub-task 2.3.1 Improved biocontrol and integrated pest management**

IPM Strategy for *Thrips*

Reduce levels of residues on strawberry at a economic beneficial production

- **Means**

  Monitoring Thrips by blue sticky traps

  Biological control with predatory mites

  Strategies for 'lure & retain' natural enemies

## First results 2011 and future outlook

- In planting 1&2 none effects of predatory mites
- In 3th planting some effect of *N. reductus*
- Mainly in 3th and 4th planting effective *Thrips control* by *Orius majusculus & O. niger*
- Further development of application methods predatory mites
- Further improvement of systems for 'lure & retain' *Orius spp.*

## Task 2.3. Reducing environmental impact P2

**Sub-task 2.3.1 Improved biocontrol and integrated pest management**

a) Developing IPM strategies to reduce the use of pesticides in berry production (two series of the exp.) – ŁABANOWSKA B.

- 1. Experiment was started on 16 May, 2012 with Grandarosa, Pink Rosa, Honeoye and Elsanta.

2. Introduction of *Tarsonemus pallidus* and *Tetranychus urticae* .
3. Treatments: abamectin against strawberry mite, abamectin and fungus *Beauveria bassiana* (Naturalis) against twospotted spider mite + control (no protection).
4. Effectiveness of the pesticides will be assessed.

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## Task 2.3. Reducing environmental impact

**Sub-task 2.3.1 Improved biocontrol and integrated pest management**
Developing IPM strategies to reduce the use of pesticides in berry production

The evaluation of mite diversity and abundance in blackberry crops

Evaluation of thrips and beneficial arthropods (diversity and abundance) in blackberry and blueberry crops and in the associated weeds (inside and outside the crops).

## Task 2.3. Reducing environmental impact P9

**Sub-task 2.3.2. Improved disease management by biocontrol and other sustainable methods**

DSS as a tool to control Botrytis and powdery mildew

Reduce residues on fruit

19 June 2012, A. Evenhuis & C. Topper

## Demonstration of strategies, 2011

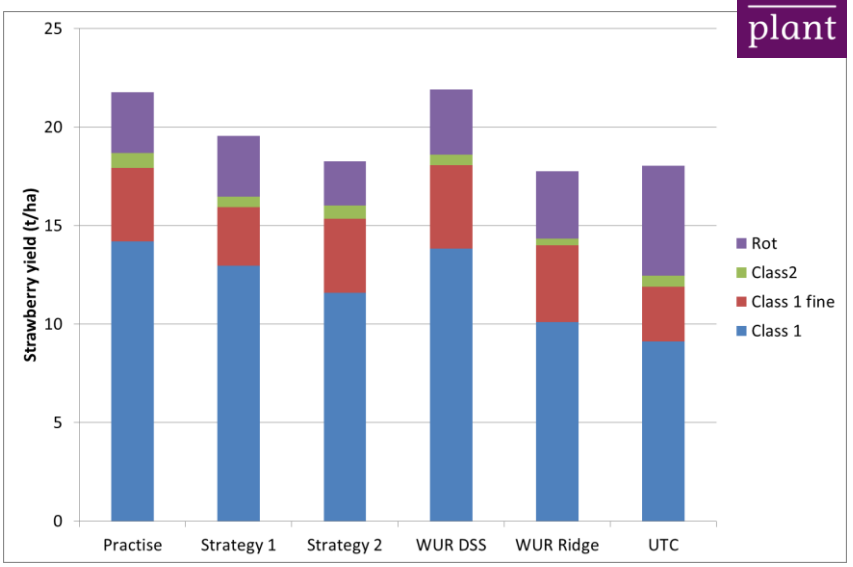
- Objective to reduce fungicide input in order to produce residue low strawberries
- Field experiment organized by DLV
- 6 control strategies
  - UTC
  - 2 private companies
  - DLV (practise)
  - 2 WUR (based on DSS)
- Field demonstration to strawberry farmers in September

AGROVISION

DLV plant

Uw sector investeert in dit project via het Productschap Tuinbouw

Yield and quality




## Conclusions

- 2012: continuous Botrytis infection risks
  - DSS advice similar to practise (#)
  - Timing DSS adjusted
- Yield en Bc rot same as practise
- 2012 Low powdery mildew infection risk
- Timing of spray appl. different from practise
- Number of spray application WUR less than practise
- DSS needs improvement
- UTC no residues
- UTC 30 % rot
- UTC low class 1 fruits
- Residues Practise & WUR low & comparable
- Within the demands of the retailer

## Task 2.3. Reducing environmental impact P8

**Sub-Task 2.3.1 Improved biocontrol and integrated pest management**

**Developing biological-based strategies for pesticide-free berry production**

2.3.1 b (ii) Trial 1. Developing biological-based strategies for pesticide-free berry production. Active 2011 and 2012. N. Trandem

**2.3.2. Improved disease management by biocontrol and other sustainable methods**

**Control of strawberry powdery mildew with new technology and Natural Defence Stimulators**

2.3.2 c (i)Trial 1. Reduced severity of powdery mildew on strawberries under night interruption with red light. Active 2011 and 2012. A.Stensvand

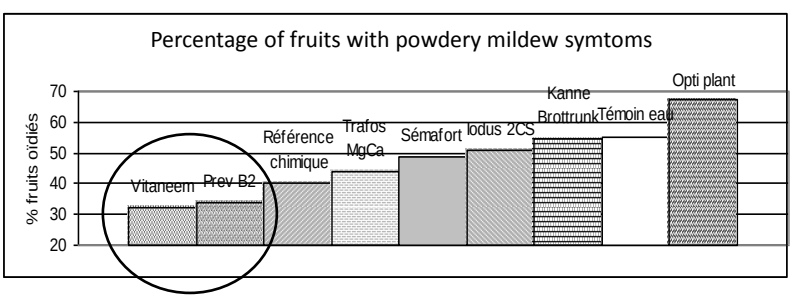
**WP2 – P06**

**WP2 - Improved cultivation techniques**

**Reducing environmental impact for controlling powdery mildew**

Natural Defence Stimulators (NDS)

- Preliminary test with 15 products
- Choice of 2 products for further assays



## Task 2.3. Reducing environmental impact P7

### Sub-Task 2.3.1 Improved biocontrol and integrated pest management

**Developing biological-based strategies for pesticide-free berry production**

- Biological and alternative control methods on raspberry
- Trial in tunnel and open field, cvs Glen Ample and Maurin Makea
- Biological control of two-spotted spider mite, raspberry gall mite and aphids
- Rapeseed oil treatment of plants against gall mites
- Presence of gall mites on raspberry cultivars

### Sub-Task 2.3.2. Improved disease management by biocontrol and other sustainable methods

**Utilisation of beneficial microorganisms in biocontrol and increasing disease resistance**

- Biological control of *Phytophthora cactorum*
- Greenhouse trials on strawberry with endophytic bacteria and mycorrhiza species
- Two bacteria species in trials in 2011, trials continue
- 12 mycorrhiza isolates tested, continued with 4 isolates




## Task 2.3. Reducing environmental impact P11 Freson de Palos

### Sub-Task 2.3.1 Improved biocontrol and integrated pest management

**Developing biological-based strategies for pesticide-free berry production**

**Two-spotted spider mite** (*Tetranychus urticae*)

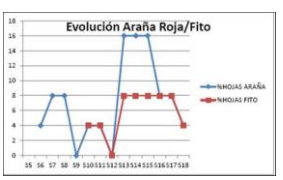
- Control effective with *Phytoseiulus persimilis*

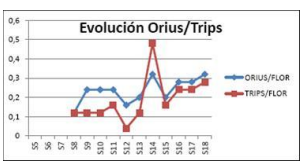
**Aphids** (*Myzus persicae*, *Aphis gossypii*)

- Control with *Aphidius colemani* and *Lysiphlebus testaceapies*
- Varying results, needs support of alternative products, also natural pyrethrin used

**Thrips**

- Control with *Orius laevigatus* and *Amblyseius cucumeris*
- Generally good control with *Orius*



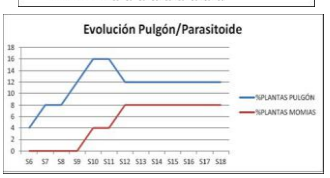




### Sub-Task 2.3.2 Utilisation of beneficial microorganisms in biocontrol and increasing disease resistance

**Powdery mildew** (*Podosphaera aphanis)and* **Grey mould** (*Botrytis cinerea*)

- Control with alternative products
- Disease trials on Agroalfaro

**Soil-borne diseases** (*Fusarium, Pythium, Phytophthora, Rhizoctonia*)




*Phytoseiulus persimilis*

*Orius laevigatus*


*Aphidius colemani*

**Trial sites and cultivars**

| FARMER | SURFACE | VARIETIES |
|---|---|---|
| AGROSUR Socio nº 52 | 1.01 Has | Candonga |
| JM GARRIDO Socio nº 454 | 3.84 Has | Fortuna, Candonga, Antilla, Sabrina, Camarosa |
| FJ GARRIDO Socio nº 559 | 1.8 Has | Sabrina, Candonga, Antilla |
| GOMEZ LAZARO E HIJOS Socio nº 516 | 8.69 Has | Sabrina, Antilla, Fortuna, Candonga |
| Mª CARMEN MARQUEZ Socio nº 468 | 3.49 Has | Sabrina, Antilla, Candonga, Fortuna |
| FRESERRANO Socio nº 521 | 2.46 Has | Candonga |
| AGROALFARO Socio nº 530 | 8.07 Has | Antilla, Candonga |
| **TOTAL** | **29.36 Has** | |

## Task 2.3. Reducing environmental impact P2

**Sub-task 2.3.3. Improved substrate, nutrient and water use efficiency**

a)Water and nutrient use efficiency and improved organic substrates of strawberry in Central and Southern Europe (two series of the exp.) – TREDER W. + KLAMKOWSKI K.

1. The glasshouse experiment was established on 2nd April, 2012, the field experiment - on 8-9 May, 2012 with Grandarosa, Pink Rosa and Elsanta.
2. Plant vigor, ripening time, marketable and unmarketable yield, fruit weight, fruit decay, fruit firmness, soluble solid content and ascorbic acid content. will be assessed. Soil moisture will be also measured for each plot.

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# P14 – PT

## Task 2.3. Reducing environmental impact

### Sub-task 2.3.3. Improved substrate, nutrient and water use efficiency


The effects of nitrogen (three levels) on short-day cultivars (Figaro, Elsanta and Elegance) yield and fruit quality was assessed for winter production

## Task 2.3 Reducing environmental impact P1- P13

**Sub-task 2.3.3 Improved substrate, nutrient and water use efficiency**

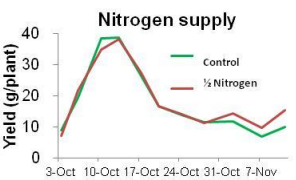
P13 compared substrates in 2 trials for strawberry fruit production, using different containers. Coco fiber (in pot) tendentially induced lower shoot/root ratio; peat mix in plastic bag induced higher flower bud differentiation (P1).

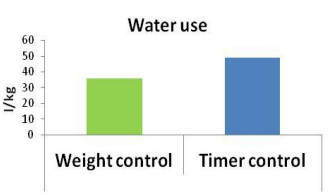
P13 carried out a trial with 4 fertigation treatments and different volumes of substrate on strawberry. No productive differences were found reducing nitrogen supply down to half (5 mmol/l) of the control (10,8 mmol/l). P1 analysed flower differentiation and described plant.

Raspberry nutrient absorption was investigated analysing the mineral content in the plant organs along the growing cycle (P13). 1000 $m^2$ of cultivation absorbed 19.9 kg nitrogen, 3.7 kg phosphorus, 19.5 kg potassium during producing cycle.

P13 carried out a trial to evaluate efficiency of 2 water management techniques. Timer control of the irrigation consumed more water per kg of produced fruit compared to irrigation related to water content decrease (weight control). Further, less flower differentiated buds per plant were found, without differences in the shoot/root ratio (P1).

peat mix in plastic bag



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# Thank You!