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

OliveFlyNet test site implementation in Attiki, Greece

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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).

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Introduction

- The implementation stages of Olive Fly Net prototype
- Materials and methods
- Results
- Conclusions
Implementation stages

- Digitization of the orchard
- Monitoring (traps, insect population, remarks, sampling)
- DSS (when, where, how to spray)
- Spraying treatments
Materials and methods

- Orchard digitization
- Protected areas
- Monitoring traps (insect population)
- Monitoring trees (phenological stage)
- Olive Fly DSS for spray
- Month temperatures
Orchard digitization

Standard (Conventional) 152 trees/1.56ha

LAS 151 trees/1.56ha

Control 56 trees/0.67ha
Protected areas – Dynamic buffer zones

- For each type of protected area (biological cultivations, domestic areas, playgrounds, hospitals etc) we can set a minimum distance for zero wind speed.
- Dynamic buffer zones. Depend on wind speed and direction.
- To avoid spray in protected areas the DSS optimized to handle large number of “protected polygons”

Diagram:
- Protected object
- Buffer zone
- Wind speed
- Time
- Developed
- Implemented

- Wind direction
- Developed
- Implemented

- Obstacle
- Not developed
- Not investigated (future work)
Monitoring traps

- **e-trap**
  - Trap
  - Camera
  - Enter the insect data directly

- **mobile GIS**
  - Locates the insect in the photo of the trap (Enter the insect data visually)

- **Trapping (conventional and e-trap)**
  - Traps monitoring using the mobile GIS in the field
Monitoring trees

- % estimation of the fruit load for each LAS tree
- Alive infestation of the fruits from larvae
- A scale used to identify the phenological development stages of the plant
Olive Fly DSS for spray

- **A. DSS auto trapping**
- **B. DSS when to spray**
- **C. DSS where to spray**
- **D. DSS how to spray**
- **E. DSS spraying action**

The main menu of the implemented DSS:

- Set DSS initial parameters
- DSS A: Automatic trapping
- DSS B: When to spray
- DSS C: Where to spray
- DSS D: How to spray
- DSS E: Spraying action
- DSS settings

As output it gives if we have to spray or not.

As output it gives interpolated risk maps and the risk for each tree.

It gives instructions to the tractor attendant how to spray (to avoid protected areas, to spray with specific density, to stop the spray process).

It helps to find out the trees that have been sprayed and avoid over spraying on trees.

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Olive Fly DSS for spray (LAS)

- DSS A (Automatic counting of insects using photo)
  - Not performed (not enough data available)
- DSS A (Semi-automatic trapping)
  - Conducted more than 100 times
- DSS B (when to spray)
  - Conducted 20 times (20 trapping dates)
- DSS C (where to spray)
  - The Inverse Distance Weight (IDW) interpolation was used (power=2, Buffer=50m) for infestation risk maps
- DSS D (how to spray)
  - Minimum buffer zone distance for protected areas defined to 20m
- DSS E (spraying action)
  - The <RIGHT> method for locating the trees that are spraying
Methods for locating the sprayed trees

- **NEAREST**: The nearest tree
- **RIGHT**: The nearest tree at right
- **LEFT**: The nearest tree at left
- **RIGHT>**: The nearest tree at right and forward
- **LEFT>**: The nearest tree at left and forward
- **Visual using Tracking path**
- **Ground truth**
• At August and 10 first days of September were high temperatures
Results

- Olive fly population
- DSS B
- DSS C
- DSS D
- DSS E
Olive fly population (mobile GIS) - Block

Count of insects

Month/Day (Year 2015)

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Olive fly population (mobile GIS) - Control

![Graph showing olive fly population counts over months from July to November 2015](image-url)
Olive fly population (mobile GIS) - Convectional

Spraying (B-No LAS) performed at: 14/10/2015
Olive fly population (mobile GIS) - LAS

Blank Sprayings (A1,A2,A3) performed at: 1/11/2015
The development growth was stopped due to the heat wave.

Start of the harvest of the LAS plot.
The DSS B result was:
APPLY SPRAY TYPE C (72.9%)

Because the confidence to spray was more than 70% we decided to perform spraying.
## Spraying applications performed

<table>
<thead>
<tr>
<th>Application</th>
<th>Plot</th>
<th>Method of spraying</th>
<th>Method of locating sprayed trees</th>
<th>Type of spraying</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1</td>
<td>B</td>
<td>Conventional</td>
<td>Right</td>
<td>Real</td>
</tr>
<tr>
<td>A1</td>
<td>A</td>
<td>Conventional</td>
<td>Right</td>
<td>Blank</td>
</tr>
<tr>
<td>A2</td>
<td>A</td>
<td>LAS</td>
<td>Right</td>
<td>Blank</td>
</tr>
<tr>
<td>A3</td>
<td>A</td>
<td>LAS</td>
<td>Right</td>
<td>Blank</td>
</tr>
<tr>
<td>(Many)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Simulated</td>
</tr>
</tbody>
</table>
DSS C: Where to spray Application-A (LAS plot)

Infestation risk map

Mobile GIS DSS C

Infestation risk for each tree

<table>
<thead>
<tr>
<th>Risk</th>
<th>symbolic state</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No Risk</td>
</tr>
<tr>
<td>1</td>
<td>Low Risk</td>
</tr>
<tr>
<td>2</td>
<td>Average Risk</td>
</tr>
<tr>
<td>3</td>
<td>High Risk</td>
</tr>
<tr>
<td>4</td>
<td>Very High Risk</td>
</tr>
</tbody>
</table>

Trapping date: 25/10/2015

Run DSS

Process completed!
Infestation risk map and protected areas
DSS D and E: Spraying (Conventional plot)

Tracking path

Decisions, Locating sprayed trees

During spraying
DSS D (how to spray): Tracking paths (LAS)

Application B
Plot B, Conventional spray

Application A1
Plot A, Conventional spray

Application A2
Plot A, LAS spray

Application A3
Plot A, LAS spray

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Off target spraying (Conventional plot)

- Protected area sprayed
- Non target area sprayed
- Protected area sprayed in non target area
Spraying (Conventional plot)
Tracking path
Spraying (Conventional plot)
Tracking path, **start-end** points

- North direction
- South direction
- Both directions
Off target sprayings of each application

- With no infestation risk
- Outside the plot
- In protected area

Number of trees

Spraying application

A1

A2

A3

B

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Volume of the spraying solution or water applied of each application

The diagram shows the volume of spraying solution or water (l) applied for different spraying applications:

- **A1**: 30 liters
- **A2**: 10 liters
- **A3**: 5 liters
- **B**: 60 liters

**Spraying application**

The data suggests that application B requires the most volume of the spraying solution or water, followed by A1 and A2 with significantly lower volumes.
Spraying duration of each application

- **Total spraying duration**
- **Duration of the sprayed trees**

![Spraying duration chart](chart.png)

**Spraying application:**
- A1
- A2
- A3
- B

**Spraying duration (s):**
- A1
- A2
- A3
- B

**Y-axis:** Spraying duration (s)

**X-axis:** Spraying application

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Length (distance) of the tracking path of each application
Spraying (Conventional PLOT-No LAS)

Setup

Action

Recording
Distribution of the data using Web mapping
Conclusions

- In LAS applications less off target sprayings occurred, less spraying solution was used, the duration of the sprayings and the length of tracking paths were less than Conventional applications.

- Due to these results the cost of the treatments can be reduced.

- The treatment applications are more environmental friendly.

- The public health is protected.
Thank you!!!