Optimal irrigation of cotton in Northern Greece using AquaCrop: A multi-year simulation study

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The FIGARO EU-FP7 Project

Flexible and precise irrigation platform to improve farm scale water productivity

Project goal:
Improve the use of irrigation water via the development and implementation of irrigation strategies that take into account, in real-time, soil water availability, local weather forecasts, crop physiological status and water needs
### The FIGARO EU-FP7 Project

**Flexible and precise irrigation platform to improve farm scale water productivity**

#### Project participants:

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<tr>
<th>Netafim</th>
<th>IL</th>
<th>Technical University of Lisbon</th>
<th>PT</th>
</tr>
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<td>Aarhus University</td>
<td>DK</td>
<td>University of Bologna</td>
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<td>Hydrologic Research</td>
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Beginning of season:

Crop model → Expected weather → Water quotas → Soil data → Prices → Optimization procedure → Optimal irrigation schedule
During the season, whenever information becomes available:

- New information
- Expectations

Update of scheduling required?

If yes, repeat optimization

Crop model
Expected weather
Water quotas
Soil data
Prices

Optimization procedure

Optimal irrigation schedule
Developed by FAO to simulate crop development and yield in response to various irrigation scenarios
Includes modeling of soil water content
Not too complex
Calibrated for many crops
Can be used to determine irrigation required in order to keep soil water content within user-specified boundaries
Flexible and precise irrigation platform to improve farm scale water productivity
Optimization concept

![Graph showing root zone water depletion over time with stress and irrigation trigger levels.]

- **Stress threshold 1**
- **Irrigation trigger level**
- **Stress threshold 2**
Optimization concept

Flexible and precise irrigation platform to improve farm scale water productivity

2 decision variables

5 decision variables at the most
Case study: Cotton in Northern Greece

- Locally calibrated AquaCrop model
- Ten years of climate data (rain range: 112-367mm)
- Three scenarios:
  - Scenario #1: perfect weather forecasts available for the whole season
  - Scenario #2: perfect weather forecasts available daily for the five coming days and historical weather data available for the rest of the season.
  - Scenario #3: only historical weather data available for future.
- Optimization goal: 4.5 t/ha
Case study: Cotton in Northern Greece

- Day 29
- Day 65
- Day 101
- Day 145
Case study: Cotton in Northern Greece

- Perfect weather forecasts
- Perfect 5-day forecasts
- Historical weather only

Graphs showing the relationship between irrigation and yield for the years 2006 and 2007.
Case study: Cotton in Northern Greece

Irrigation, mm
Yield, t/ha

2008

2009

Perfect weather forecasts
Perfect 5-day forecasts
Historical weather only
Case study: Cotton in Northern Greece

Slide 14

- Perfect weather forecasts
- Perfect 5-day forecasts
- Historical weather only

Irrigation, mm vs. Yield, t/ha

2010

2011
Case study: Cotton in Northern Greece

Graphs showing the relationship between yield (t/ha) and irrigation (mm) for 2012 and 2013. The graphs compare perfect weather forecasts, perfect 5-day forecasts, and historical weather only.

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An efficient sub-optimal procedure for irrigation scheduling has been developed.

The computations require less than 1 minute so that the procedure can be executed in real-time.

Recalculating the irrigation every four days brings the sub-optimal solution very close to the optimal Pareto front.
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http://www.figaro-irrigation.net/