iPot: An innovative platform for the Belgian potato sector

BEODay
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Context of the potato crop in Belgium

• Current situation:
  *Fast developing sector, world leader for frozen potato products, high-tech processing industry*

• Request for new development
Global objectives

• To provide the Belgian processing and fresh potato sectors with near real time information at field or district level, regarding growing conditions (soil, weather), crop development status and early yield estimation/prediction based on use of satellite images time series and crop growth simulation models.

• To develop a web-platform with geolocalized data allowing growers and industry (fresh and processed potato), together with research and technical centers, to analyse and combine those data with fields observations, aiming to improve management decision during growing season and at harvest and storage of the tubers for several months.

• Finally, to improve potato fields monitoring over the whole production area, leading to higher volume and quality
Satellite data

- At country scale
- Atmospheric correction (OPERA)
- Cloud & shadow detection

-> Derivation of Vegetation Indices (VIs) expressing the productivity of the crop (INRA-EMMAH algorithms)

- $f_{\text{APAR}}$ Fraction of Absorbed Photosynthetically Active Radiation
- $f_{\text{COVER}}$ Fraction of Green Vegetation Cover
Yield estimation / prediction at field scale

• Crop growth models tested: AQUACROP, WOFOST (PCSE), LINTUL-POTATO-DSS
• Aims at harvest and storage planification + **benchmarking**

**Needs for re-calibration / validation data set**

- Meteo
- Soil data
- Crop data
- Field data:
  - Geolocalisation
  - Phenology
  - Tubers samples
  - Irrigation
  - ...

Yields estimations and predictions
2 field campaigns (2015-2016)

Varieties: Bintje, Fontane (processing) and Nicola (fresh market)
Field observations

- **Field observations**
  - Geographic coordinates
  - Field area
  - Management data (planting, fertilisation...)
  - Tubers sampling (every two weeks for yield assessment starting July)

- **Phenological stages follow up**
  - BBCH scale (2-digits)
  - Every 2 weeks

- **Specific events detection:**
  - Waterlogging / flooding
  - Drought
  - Pest and diseases
  - ...
Weather data

- Temperature
- Precipitation

• Useful
  - To monitor field conditions
  - To interpret crop behavior
  - To run crop growth simulation models

• Available on the WEB TOOL
Validation of satellite VI

- 3 UAV monitoring campaigns (2014-15-16) in 3 fields (1 per variety)
- In Gembloux area – eBee with a RGB/MSpec Camera
- Comparison of indices derived from satellite vs. UAV and ground measurements (DHP)
Validation fCover

- Comparison with UAV derived fCover estimates

**Example: Bintje, 22/8/2015**

**First S2 results**
- 5 Aug 2015
- 22 Aug 2015

**Classification**: veg/no veg

**S2**
- fCover: % veg in 10m pixels

**DMC results** (2014-15)

<table>
<thead>
<tr>
<th></th>
<th>R2</th>
<th>RMSE</th>
<th>MAE</th>
<th>MEAN_DMC</th>
<th>MEAN_UAV</th>
<th>STDDEV_DMC</th>
<th>STDDEV_UAV</th>
<th>OBS</th>
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<tbody>
<tr>
<td></td>
<td>0.97</td>
<td>0.06</td>
<td>0.04</td>
<td>0.55</td>
<td>0.54</td>
<td>0.29</td>
<td>0.30</td>
<td>494</td>
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</tbody>
</table>
Validation fCover

- Comparison with DHP derived fCover estimates
  - Per field (see examples)
  - Per block

GM - Bintje, 2014

PL - Fontane, 2014

SV - Bintje, 2014

Bintje, 2015

Fontane, 2015

Nicola, 2015

Bintje, 2016

Fontane, 2016

Nicola, 2016
Validation fAPAR

- Comparison with DHP derived fAPAR estimates: per field & per block (see examples)

Bintje, 2015
Crop growth monitoring

Emergence →

Senescence →

based on “greenness index” (fAPAR)

• **Variability within a field:**
  - Allows **Variable Rate Applications** (fertilizers, irrigation,...) -> **Management Zones**
  - Definition of tubers sampling strategy (ground truth)
Variability (in season)

- Variability between fields:

  Due to early varieties (in blue) vs. late varieties (in red) or to different planting dates or events.

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Sentinel-2 of 23 June 2016

```
fCover
0 12.5 25 37.5 50 62.5 75 87.5 100
late
mid-late
early```

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iPot
industrial potato monitoring
Variability (end of season)

• **Variability between fields:**

  Senescence started? Haulm killing applied? -> harvest planning

**Sentinel-2 of 22 Aug 2016**

- More advanced senescence
- Still green

**8 Sept 2016**

**1 Oct 2016**

Haulm killing applied or harvested

• **Variability within a field:**
  - haulm killing: variable rate application
  - where to take yield samples?
Yields estimation & prediction

Aquacrop (2015)

<table>
<thead>
<tr>
<th>Fontane</th>
<th>fields</th>
<th>samples</th>
<th>RMSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lutosa</td>
<td>5</td>
<td>5</td>
<td>1,2 t/ha</td>
</tr>
<tr>
<td>Mydibel</td>
<td>8</td>
<td>7</td>
<td>1,3 t/ha</td>
</tr>
<tr>
<td>Farm Frites</td>
<td>10</td>
<td>3-4</td>
<td>1,6 t/ha</td>
</tr>
<tr>
<td>Agristo</td>
<td>7</td>
<td>3</td>
<td>2,1 t/ha</td>
</tr>
<tr>
<td>Nicola</td>
<td>Pomuni</td>
<td>5</td>
<td>0,9 t/ha</td>
</tr>
</tbody>
</table>

Aquacrop (Bintje, 2015)

- Good in-season trends:
  $R^2 = 0,85$
  RMSE = 1,4 t/ha

- Problematic final yields:
  $R^2 = 0,08$
  RMSE = 2,5 t/ha

Historical weather daily data 1980-2015

For ease of computing:
- for each grid cell
- for each year

$$\sum_{i=day1}^{crop\ season} (Rainfall_i - ET_{0i})$$

- quintiles:
  - wet > 80%
  - normal 40-60%
  - dry < 20%

Simulate 3 scenarios.
Development of web application, in progress

Target users:
- Industry
- Farmers
- Advisors
- Research centres
• Start of **Promotional campaign** at Interpom Primeurs (27-29 Nov 2016 in Courtrai/Kortrijk, B)

• **Official launch of the iPot service**: March 2017

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Live demo during the Lunch break!
Thank you!