iPOT project

“Industrial Potato monitoring for the Belgian potato sector”

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iPot project

• Financed by:
  BELSPO

• Project of 36 month
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• Collaborations
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  o VITO - Isabelle Piccard, Kris Nackaerts
  o ULg (Campus Arlon) - Bernard Tychon
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Context

Belgian potato sector

- Fast growing sector of the Belgian food industry (largest exporter of potato products & largest importer of potatoes)
- More & more contracts with farmers
- Crop consulting between factories & traders - growers
- Necessity to realise higher yields in a sustainable way

iPot ➔ on line follow up of the potato parcels in order to control and improve potato quality and volume
Belgium is since the 17th biggest potato producer of the world, Nowhere in the world higher yields are obtained than in Belgium (FAO statistics, 2011)

• potato is the fourth most important food crop with respect to production in Belgium - potato production (in tons) per inhabitant, Belgium is ranked on the 4th place with a production of 395,5 tons per 1000 inhabitants (WES report, 2013).

• Industrial potatoes represent around 80% of the total potato cropped area in Belgium. The Belgian potato processing industry evolved to the world’s largest exporter of frozen potato products

• Belgapom (union of the potato trade and processing industry) is the active platform for the industry, trying to gather the industry in its way towards a sustainable growth.
processors, traders and packers are increasingly working with **potato contracts** - follow up of the contracted potato parcels in order to control and improve potato quality and volume, in close relationship with the farmer - follow up of these fields on the land as well as from above is becoming an important tool to improve the quantity and quality of the potato crop.

The iPot project aims to bridge the gap between the latest research efforts regarding crop growth monitoring and the industry.
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User needs

Information for decision making on
• Crop management in specific parcels
• Destination of potatoes (processing vs. fresh market)
• For commercial negotiations

Specific needs
The following monitoring techniques are considered as essential information to contribute to a better quality and quantity management of the production:

• Potato yield and quality information (tuber size and under water weight) to decide on haulm killing and/or harvesting;
• Real-time information on potato growth and development (phenology) as physical follow up / sampling by industry experts is difficult given the increase in acreage and larger parcels with large within field variability;
• Information on crop and soil moisture, temperature and solar radiation to allow crop risk assessment for diseases or deformations;
• Soil information for potato cultivation.
To provide information on potato growth and development at field level and yield estimates forecasts to the Belgian potato sector by means of a web-based geo-information platform.
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Specific objectives

• To develop - in close collaboration with the users - information products for potato crop growth monitoring based on the integration of field observations, close range sensing measurements, satellite images and crop growth models
• To set up a web based geo-information platform that can be used
  - by the potato processing industry, research centres and farmers to retrieve information at field level
  - for exchange of field data between the industry and research groups
• To demonstrate the service and products in near-real time in 2015 and 2016
An intuitive web based geo-information platform will be developed for both the Belgian potato processing industry and research centres focusing on the cultivation of the potato crop as an answer to specific challenges and information needs. Continuous yield estimates and crop growth monitoring are on the top of the industry’s priority list.
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Methodology
Methodology / expected results

• A combination of EO and modelling techniques will be used to investigate these issues and to develop practical solutions in the form of geo-referenced maps and graphs accessible via a web based interface. A multi-scale approach is proposed, integrating field observations and close range sensing measurements with UAV and satellite images taken at regular intervals during the growing season (for crop monitoring) and with crop growth models (for yield assessment).

• Through the involvement of Belgapom (as project coordinator) and its members the applicability and future use of the developed products will be ensured. The processing industry, their network of potato farmers as well as the regional and provincial potato research institutes will provide the necessary inputs, i.e. field measurements and expertise, for product development. The involvement of the research institutes will also ensure the dissemination of the project results to the wider farmer community.
Methodology

Crop growth monitoring
Maps can be derived on a regular basis with for each pixel the actual development stage of the potato crop
Crop emergence maps will illustrate the time (date) and degree of crop emergence and crop closure (in terms of % cover)
Crop senescence maps will reflect the % cover of non-photosynthetic active vegetation

Field condition monitoring
Photosynthetic activity and hence vegetation productivity
Vegetation moisture status
Soil Moisture
Temperature and solar radiation
Methodology

- Multi-scale approach for potato monitoring and yield estimation, integrating field observations and close range sensing measurements with UAV and satellite images and with crop growth models.

- Remote sensing data (DMC, S2, SPOT, RapidEye,...) available via BELAIR and JECAM

- Field data collected / provided by the industry, potato research centres, government, research partners

- Set up of a user-friendly web based geo-information platform for data exchange

- Close interaction with the users (data collection, product development, validation, evaluation)
Objective: monitoring field and crop condition to assess risk of yield or quality losses

- fAPAR from HR satellite sensors to estimate the crop’s photosynthetic activity
- Vegetation moisture via NDWI, GVMI,…
- Soil moisture via Soil Moisture Index from B-CGMS (water balance module)
- Temperature and solar radiation from weather stations (interpolated to 10x10km grid) and from MSG (5km)

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Field condition monitoring

fAPAR variations within a potato field

Meteo station network in Belgium

10-km Meteo Grid Data
Examples: sum of rainfall & temperature sum
Objective:

- Parcel management & control, planning & logistics
- Input for crop yield modelling

Methods: (Gobin, 2012)

Growth Stage Timing = f(temperature, soil type, moisture, cultivar, ...)
Dynamic coupling between weather, farm management and crop growth
Emergence and canopy closure
• Senescence

“Scaled approach”:  
• Field observations:  
  – counting seedling emergency & field assessment of crop closure  
  – Measurements of chlorophyll content with handheld sensors (e.g. Dualex Scientific+) to estimate vegetation / haulm condition
• Estimation of these parameters from UAV imagery
• Extrapolation to (V)HR satellite images

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Crop growth / phenology monitoring
Expected outcome:

- Regular maps with, for each pixel, the actual development stage of the potato crop
- Crop emergence maps illustrating the time (date) and degree of crop emergence and crop closure (in terms of % cover)
- Crop senescence maps reflecting the % cover of non-photosynthetic active vegetation based on (V)HR satellite images
**Methodology / expected results**

**Yield estimation**

- **crop emergence and phenology data** incorporated into the model for two varieties:
  
  - Bintje for the processing industry
  - Charlotte for the fresh market

- **yield data** collected at the parcel level

- observed **weather characteristics** will be derived from the B-CGMS historical meteorological dataset based on a model inter-comparison and testing, the best performing, most suitable and easiest to implement model will be included in the web-tool to simulate potato yields
**Objective**: crop yield estimates for 2 varieties, Bintje for processing, Charlotte for the fresh market

- **Forcing**
  - Crop emergence date at parcel level

- **Recalibration**
  - Observed yields at parcels level (calibration set)
  - Canopy closure and haulm killing dates
  - B-CGMS + selected models (literature review: Aquacrop, Lintul-potato,...)

- **Constraints**
  - B-CGMS historical meteorological dataset

- **Generation of an ensemble of weather data**

- **Assessment based on RMSE between observed and simulated yields**
  - Observed yields at parcel level (validation set)
Expected outcome (at parcel level):
- Crop yield estimates
- Early crop yield prediction (i.e. at harvest) including uncertainty range
- For 2 varieties (Bintje & Charlotte)
Intra-field & inter-field variability

Expected outcome:

- **“Status maps”**: actual field condition, crop status (incl. development stage) and yield
- **“Anomaly maps”**: comparison of actual vs. average status
- Soil type from soil association map

**Variability mapping**

- “inter-field variability”
- fAPAR variations between potato fields (same date)

“intra-field variability”

Anomaly maps: fAPAR return period May-October 2012 (potato parcel)
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Geo-spatial web platform

• By opting for web based interface in combination with a lean development approach, maximal relevance, usability and user-friendliness is pursued.
  – Data and model complexity is hidden from the end user
  – End products will be readily available without needs to install tools and will have a desktop like intuitive interface.
• Re-use of building blocks of Stereo-II ADASCIS platform
Thank you for your attention!

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