Use of GIS-platform in potato crop management
Corné Kempenaar et al.
Potato GAP workshop, Zhangjiakou, 15 July 2016
Precision farming

- Precision farming is a whole farm management concept based on measuring and responding to temporal and/or spatial variability in crops and livestock.
- Benefits: higher yields, better quality, less inputs, less environmental pressure, less tiring work, new business opportunities

- Enabling technologies are available
  - ICT, FMIS, GNSS, many sensors, data, implements, robotics
  - Smart implementation
GNSS on farms
Precision farming and scale of precision of precision

- **Grid**
  - In practice

- **Plant**
  - On station research

- **Leaf**
  - On institute research

- **Disease**
  - On institute and university research
Connecting DSS in PF applications

- Examples of variable rate application (VRA)
  - Haulm killing potato
  - Lime application
  - Topdress Nitrogen potato
  - Soil herbicides
  - Fuel use monitoring
  - Nematode management and granulate task maps
  - Late blight control (Geert Kessel presentation)
An internet GEO-platform used by farmers and farm advisors to implement precision farming

- Started in 2012

A Public Private initiative of Wageningen UR, Agrifirm and DOBS

Data ownership policy

Basic Apps for free, other Apps for sale in store

Status

- > 20 Apps
- Ca.30,000 Dutch fields in Akkerweb 2015
My Akkerweb
## Comé Kempenaar

<table>
<thead>
<tr>
<th>2016</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Suikerbieten (Florena)</td>
<td>20.62ha</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2A Wintertarwe, Voederproductie (Expert)</td>
<td>9.45ha</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2B Wintertarwe, Voederproductie (Export)</td>
<td>10.84ha</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Consumptieaardappelen (Fontane)</td>
<td>20.40ha</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4A</td>
<td>8.75ha</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4B Zaaiui (Motion)</td>
<td>11.54ha</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 delen eerste 12 tarwe en 8 erwten</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>De Born</td>
<td>2.07ha</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Biomass sensing

Remote sensing,

e.g. Worldview-2, Sensing with UAS, and manned airplane
## Overview of biomass indices

<table>
<thead>
<tr>
<th>Index</th>
<th>Name</th>
<th>Formula</th>
<th>Authors (year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NDVI</td>
<td>Normalized Difference Vegetation Index</td>
<td>$(R_{\text{nir}}-R_{\text{red}})/(R_{\text{nir}}+R_{\text{red}})$</td>
<td>(Rouse et al. (1974))</td>
</tr>
<tr>
<td>RVI</td>
<td>Ratio Vegetation Index</td>
<td>$R_{\text{nir}}/R_{\text{red}}$</td>
<td>Jordan (1969)</td>
</tr>
<tr>
<td>WDVI$_r$</td>
<td>WDVI$_r$, with red light reflection in formula</td>
<td>$R_{810}=(R_{810}-R_{560})xR_{560}$</td>
<td>Clevers (1989)</td>
</tr>
<tr>
<td>WDVI$_g$</td>
<td>WDVI$_g$, with green light reflection in formula</td>
<td>$R_{810}=(R_{810}-R_{660})xR_{660}$</td>
<td>Bouwman (1992)</td>
</tr>
<tr>
<td>REP-LI</td>
<td>Red Edge Position: Linear Interpolation method</td>
<td>$700+40x(R_{\text{re}}-R_{700})/(R_{740}-R_{700})$ ; and $R_{\text{re}} = (R_{670}+R_{780})/2$</td>
<td>Guyot et al. (1988)</td>
</tr>
<tr>
<td>MTCI</td>
<td>Meris Terrestrial Chlorophyll Index</td>
<td>$(R_{754}-R_{708})/(R_{708}-R_{680})$</td>
<td>Dash, Curran (2008)</td>
</tr>
<tr>
<td>TCARI</td>
<td>Transformed Chlorophyll Absorption in Reflectance Index</td>
<td>$3x((R_{700}-R_{670})-0.2x(R_{700}-R_{550})x(R_{700}/R_{670}))$</td>
<td>Haboudane et al. (2002)</td>
</tr>
<tr>
<td>TCARI/OSAVI</td>
<td>TCARI with Optimized Soil-Adjusted Vegetation Index</td>
<td>$1.16x(R_{800}-R_{670})/(R_{800}+R_{670}+0.16)$</td>
<td>Haboudane et al. (2002)</td>
</tr>
<tr>
<td>MCARI</td>
<td>Modified Chlorophyll Absorption Index</td>
<td>$(R_{700}-R_{670})-(0.2x(R_{700}-R_{550})x(R_{700}/R_{670}))$</td>
<td>Daughtry et al. (2000)</td>
</tr>
<tr>
<td>DCNI</td>
<td>Double-peak Canopy Nitrogen Index</td>
<td>$((R_{720}-R_{700})/(R_{700}-R_{670})/(R_{720}-R_{670}+0.03))$</td>
<td>Chen et al. (2010)</td>
</tr>
<tr>
<td>NDRE</td>
<td>Normalized Difference Red Edge index</td>
<td>$(R_{780}-R_{720})/(R_{780}+R_{720})$</td>
<td>Eitel et al. (2010)</td>
</tr>
</tbody>
</table>

$R_{\text{nir}}$ = reflection at near-infrared wavelengths, $R_{\text{red}}$ at red light wavelengths, other reflections at specified wavelengths.
Satellite image of potato crop (Aug. 2015)
Sat. image April ’16 (wheat crop)
Haulm killing DSS

Weather data, forecast, soil moisture

Herbicide data

FMIS: Crop management data

Variety data

WUR minimum effective dose model

WUR PHK VRA App op Akkerweb

Crop biomass data (NDVI, WDVI, S1)

Others, e.g. weeds on field
VRA Potato haulm killing App.

- VRA of potato haulm killing herbicides on basis of variation in crop biomass on the field
- Apps on Akkerweb
- Access to crop biomass data
  - Satellite, drone, proximal sensors
Selection of field in crop rotation
Go to Apps

you can use 2B in the following apps

HaulmKilling
New task

Satellite
New satellite image

TopdressNSensing
New task

dashboard  blight  cropping...

haulmKilling  satellite  sensordata

topdressings...
Processed satellite image download
Select sensor data
Decision support algorithm

Reglone

Minimum effective dose (l/ha)

Reflection parameter CropScan
Calculate apply map

Cropfield: 2B
Sensor data: NDVI - 2B, 09/11/2015
Product: Reglone

Field area: 10.68 ha
Water usage: 4504 litre
Regular usage of Reglone: 42.731 litre
Variable usage of Reglone: 23.38 litre
Savings of Reglone: 45.29 %

Download ISOXML taskcard
Download shape taskcard
Biomass map from UAS, DSS gives task map (2012)

Acknowledgement: TerraSphere, Vd Borne
SensiSpray: variable rate application on the go
VRA Topdress N in potato App

- VRA of nitrogen based on site specific N-content of the aboveground biomass, and crop growth and nitrogen uptake models
- Apps on Akkerweb
- Access to N-content data
Topdress N potato DSS

- Weather data and prediction
- N mineralization prediction and N soil data
- FMIS: Farm and crop management data
- Crop and variety data
- N in crop biomass data and prediction
- WUR potato growth and NUE models
- WUR N topdress App on Akkerweb
- Others, expected yield data and fertilizer data
Step 1

Crop sensing and Calculation of N-uptake from proximal sensor (in kg N/ha)
### Step 2

**Calculation of task map N-rate in kg N/ha and application**

<table>
<thead>
<tr>
<th>Task Nai</th>
<th>Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Precision</td>
<td>N/A</td>
</tr>
<tr>
<td>Process</td>
<td>N/A</td>
</tr>
<tr>
<td>Opkomendag</td>
<td>N/A</td>
</tr>
<tr>
<td>Tweetwoord</td>
<td>N/A</td>
</tr>
<tr>
<td>Bron</td>
<td>N/A</td>
</tr>
<tr>
<td>Bron datum</td>
<td>N/A</td>
</tr>
<tr>
<td>Laag</td>
<td>N/A</td>
</tr>
<tr>
<td>Gewas is gedroren</td>
<td>N/A</td>
</tr>
<tr>
<td>Weerstation</td>
<td>N/A</td>
</tr>
<tr>
<td>Meters</td>
<td>N/A</td>
</tr>
<tr>
<td>Nai (N%)</td>
<td>N/A</td>
</tr>
<tr>
<td>Strooier</td>
<td>N/A</td>
</tr>
<tr>
<td>Min output (kg/ha)</td>
<td>N/A</td>
</tr>
<tr>
<td>Max output (kg/ha)</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Download**
- ISOXML, shapefile
- Shapefile, topojson
- Shapefile, topojson, CSV

**Legend**
- Nai (N%): 60.00 - 70.00
- Nai (N%): 70.00 - 80.00
- Nai (N%): 80.00 - 90.00
- Nai (N%): 90.00 - 100.00
VRA Soil herbicides App.

- VRA of herbicides based on site specific variation in soil properties
- Apps on Akkerweb
- Access to soil maps and other data
Soil herbicide DSS

- Weather data and prediction; Soil moisture
- Herbicide data
- FMIS: Farm and crop management data
- WUR minimum effective dose models
- WUR herbicide App on Akkerweb
- Crop and variety data
- Soil data and maps (clay, o.m. and/or pH)
- Others, e.g. weed (prediction) data

Wageningen UR
For quality of life
Soil sensors systems in practice
Soil maps organic matter and clay content (Veris sensor)
Select soil **Herbicide App**

you can use **ClaassenLauwermeer2** in the following apps

- **Herbicide**
  - New task

- **Satellite**
  - New satellite image

- **Stripbuilder**
  - Divide field in strips
Task map Stomp based on O.M. and clay variation within the parcel
Boxer task map, FF, Abbenes, 20 May 2016
Concluding remarks

- Akkerweb is a new platform for use of spatial and temporal data in crop management
- Several Apps for potato crop management have been developed and tested successfully
- The new precision farming applications will contribute to more sustainable production
Thanks for your attention

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