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# The effects of the liquid organic fertilizer- Herbali on potatoes

## 2023

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## Practice Center for Precision Agriculture



The Practice centre for Precision Agriculture is originated from the Van den Borne Aardappelen precision farm. The goal is to scale up field trial measurements towards plain field level, with integration of data from both sensors and manual test probings. The trials are conducted on sandy soils around Reusel, on the Belgian-Dutch border. The Practice centre is essentially working on potato, but also other crops like corn and sugar beets are possible.

### Possibility's:

- Soil conductivity scan with Dualem 21 (H)S
- Soil sampling possible before or after planting
- NIRS manure measurement if requested
- Planting at variable distances
- Variable fertilization by means of Fritzmeier Isaria crop sensor (NDVI and biomass index)
- UAV-images with RGB- or multispectral camera
- Variable irrigation
- Variable foliage destruction based on online Fritzmeier Isaria measurements
- Storage losses conservation bags



Together with precision ag techniques that have been implemented throughout the years, it is also possible to test new equipment in practice at the Practice centre for Precision Agriculture.

For more information you can always contact [dieter@vandenborneaardappelen.com](mailto:dieter@vandenborneaardappelen.com)

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## Objective

The objective of this field trial is to investigate **whether the application of Herbali in the soil and on the plants optimizes the intake of nutrients, supporting the condition and resistance of the plants. Additionally, replenishment of important substances.**

**Evaluate the effects on crop performance of Fontane potatoes, compared to standard application without additional organic fertilizers.**

## Trial location

The trial was conducted on light loamy-sand soil on the Van den Borne farm in Reusel. The field, 'guy lauwreisen wateringstraat', is located in Arendonk, North of Belgium (51°18'31.9"N 5°07'50.1"E). The previous crop was silage corn.



Figure 1 The trial consists of 2 treatment zones. 1 zone treated with Herbali while planting + 2 times with spraying and 1 zone that didn't receive any additional products.

## Trial registrations

Table 1: Trial registrations of the field, crop protection not included.

Date	Treatment
<b>May 31<sup>st</sup></b>	Rotary tillage of the whole field.
<b>June 1<sup>st</sup></b>	Injection of 50m <sup>3</sup> cattle slurry/ha (147kg N working, 55kg P, 350kg K per ha).
<b>June 3<sup>rd</sup></b>	Ploughing the field, rotary tillage of the whole field.
<b>June 5<sup>th</sup></b>	Planting (variety: Fontane, size 45/55) with a Grimme GL860 Compacta II planter at 34cm distance in the row. During planting we applied Herbali at 2l/ha on 1 treatment zone in the potato ridge.
<b>June 12<sup>th</sup></b>	Making ditches in the field.
<b>July 7<sup>th</sup></b>	Spreading KAS 24%N on the field.
<b>July 18<sup>th</sup></b>	Spreading Kali 60 on the field.
<b>July 26<sup>th</sup></b>	Spraying Herbali at 1l/ha on 1 treatment zone in the field just before closing of the potato plants.
<b>August 2<sup>nd</sup></b>	Spraying Herbali at 1l/ha on 1 treatment zone in the field just before closing of the potato plants.
<b>October 5<sup>th</sup></b>	Spraying the crops for haulm killing.

All plots received the same crop protection treatments. During the entire growing season, we sprayed **9 times foliar fertilizers on the entire field.**

Figure 2 Timeline icons.

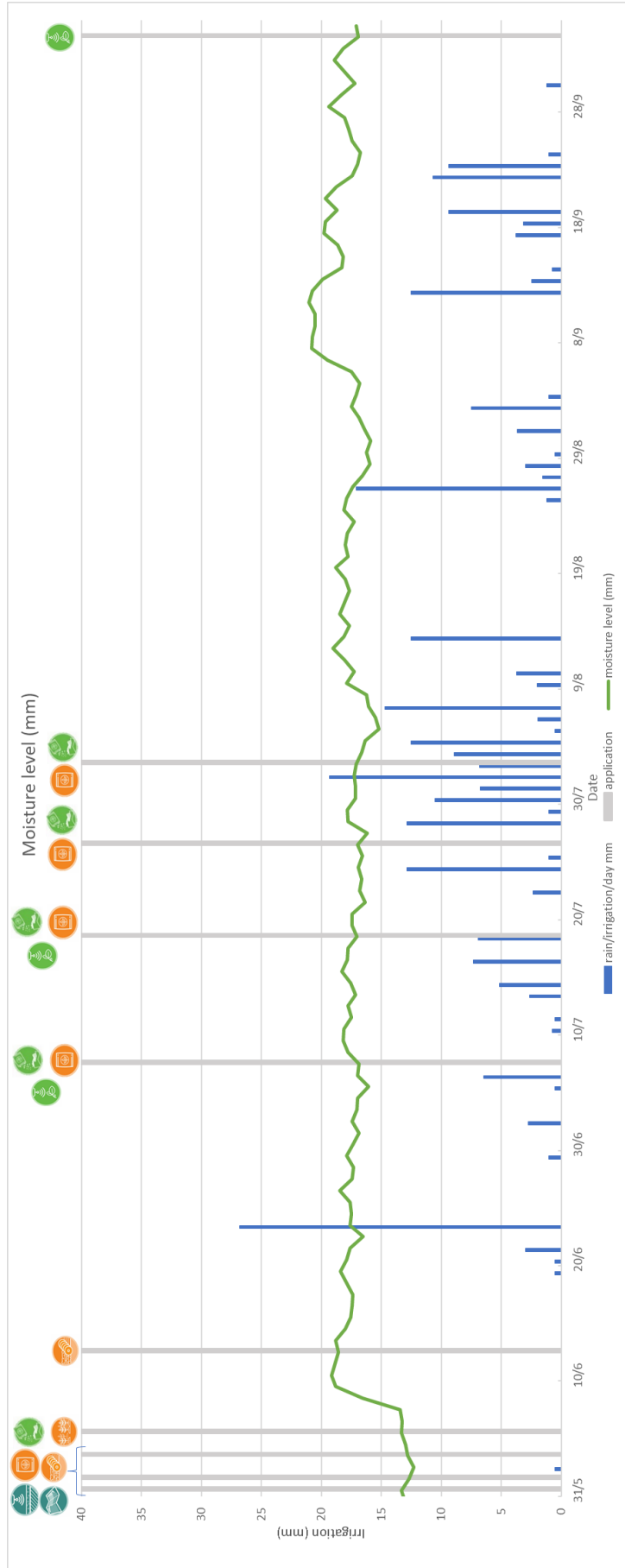
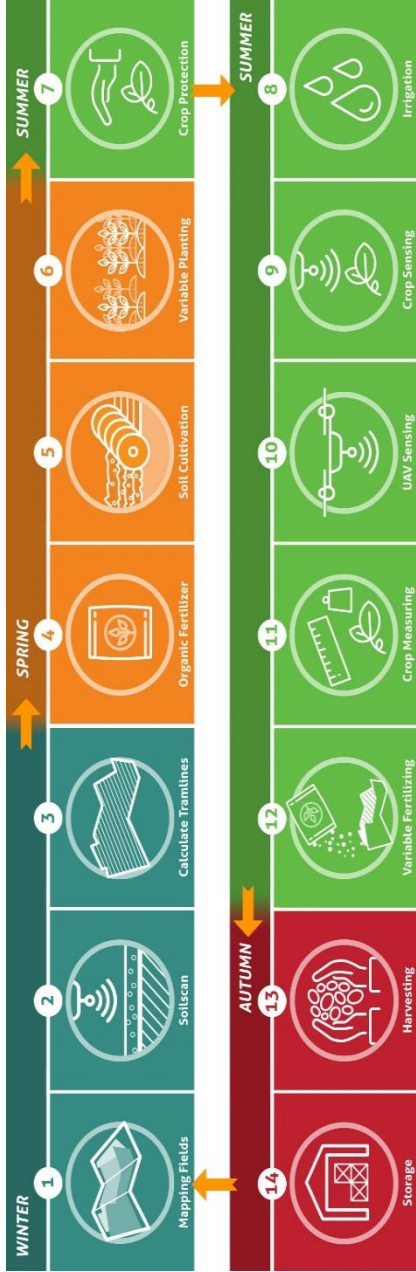


Figure 3 Timeline of the trial, we can see the moisture in the soil, the rain and application moments in the field.

## Measurements

If available, raw datasets are attached in Excel file(s) of the soil scan data folder.

### Soil scan/height map

Based on the soil scan with a Dualem 21 (H)S it is possible to map the spatial variability in electrical conductivity (EC). EC is an indicator for the organic matter content, water-holding capacity and nutrient content.



Figure 4 Dualem 21 H(S) EC scanner.



If no soil scan is available, we can use the recent height map image(s) attached at the end of the report.

## Soil analysis

Table 2 Soil analysis performed by Eurofins Agro on soil samples taken on June 13th. Values are expressed in plant available nutrients/ha

Treatment zone	N (kg)	S (kg)	P (kg)	K (kg)	Ca (kg)	Mg (kg)	Si (kg)	Fe (g)	Zn (g)	Mn (g)	B (g)
Reference	134	40	5,4	438	316	250	11	396	2040	2040	816

These values are expressed in plant available nutrients/ha.

The standard practice at the Van den Borne farm is aiming to provide 65-75% of the total amount of N and K at the beginning of the season, to be able to provide the rest by split applications according to the actual needs and weather conditions later in the season.

## Fertilizer applications



Table 3 Fertilizer applications in the field for both treatment zones.

Treatment zone	Date	Product name	% N	% P2O5	% K2O	% MgO	% MnO	% CaO	% SO3	Dosage kg or l/ha
Standard Practice	1/Jun	Cow slurry	147	55	350					50000
	7/Jul	Kas 24	26,88						16,8	112
	18/Jul	Kali 60			87					145
Total			174	55	437	0	0	0	17	
Herbali treatment zone	1/Jun	Cow slurry	147	55	350					50000
	7/Jul	Kas 24	26,88						16,8	112
	18/Jul	Kali 60			87					145
Total			174	55	437	0	0	0	17	

## Weather information Reusel

Weather station located on the Van den Borne Farm, Postelsedijk 15 in Reusel.

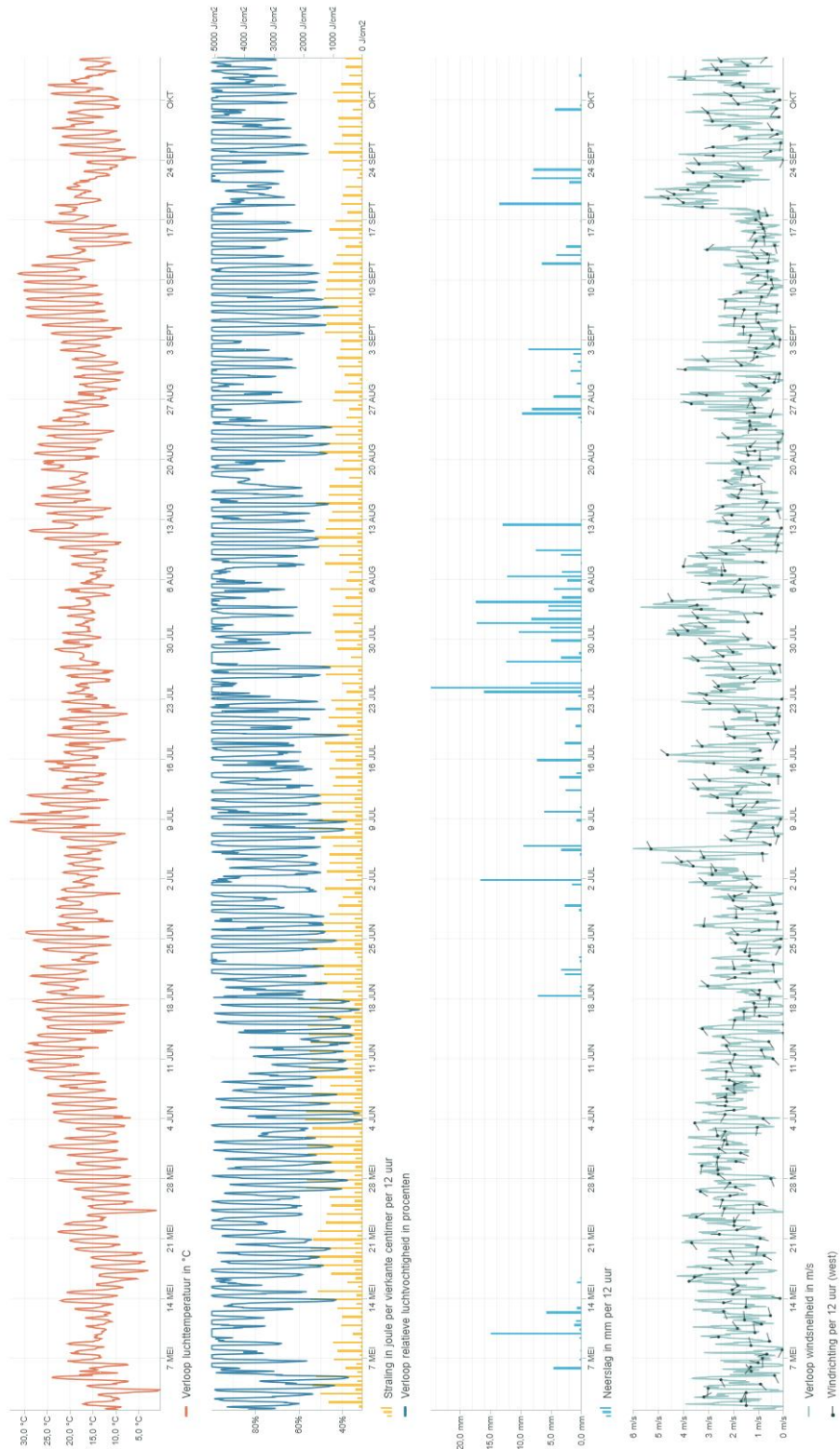


Figure 5 Weather data from Reusel, we see the temperature, humidity in %, rain in millimetres and the windspeed.





### Soil moisture and precipitation station

We can use a Dacom weather and soil station in our trial fields. This station collects data like precipitation, soil temperature and moisture for each 10 cm in the profile depth of 0 to 30cm for the moisture and temperature sensor. We can use this data to look at differences in moisture content between used products or different soil preparation.



Figure 6 Dacom soil moisture and rain sensor.

### Drone images

Several RGB-images (red-green-blue) have been collected by drone flights throughout the season. For each date on top the regular image is provided, with a VARI-map (biomass index) below. So red means low level of above ground biomass or nitrogen, whereas dark green means a high level of above ground biomass, nitrogen.



An RGB camera, in contrast to multispectral camera, does not compensate for changes in light intensity. Therefore, images of the multispectral sensor can be included as well, presented as Nitrogen Differential Vegetation Index (NDVI), Nitrogen Differential Red Edge (NDRE), Soil Adjusted Vegetation Index (SAVI) and Visual Atmospheric Resistance Index (VARI), thermal data is collected and can be processed if desired.

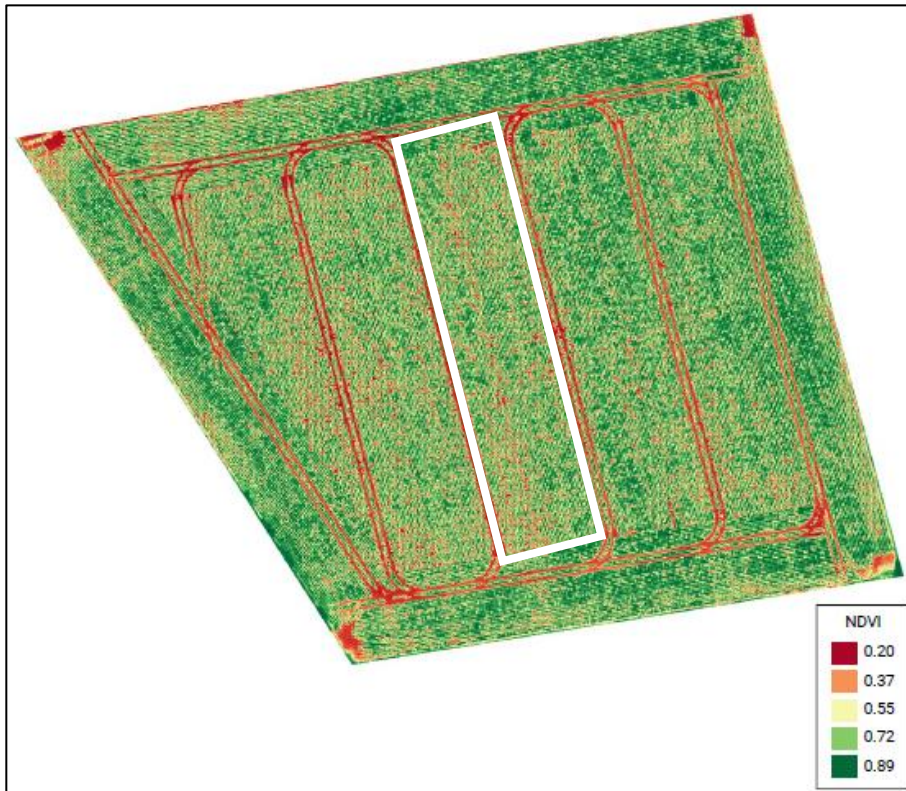


Figure 7 Drone DJI Matrice M300 RTK with MicaSense Altum and DJI Zenmuse P1 camera.

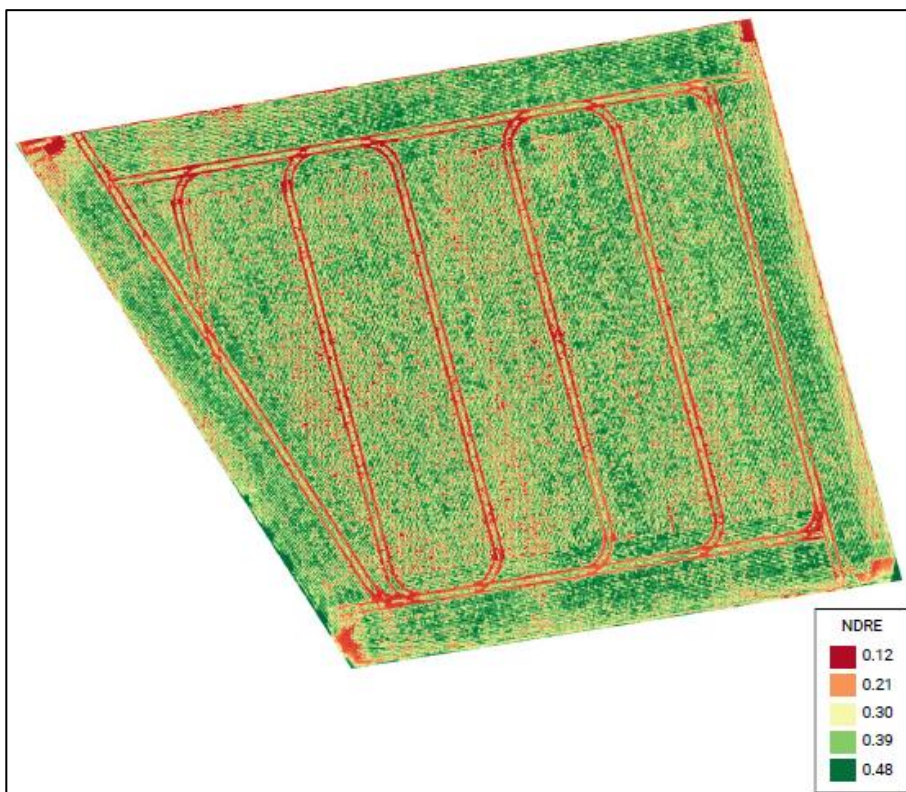
On the next pages we are going to take a closer look at the drone flights through the season.



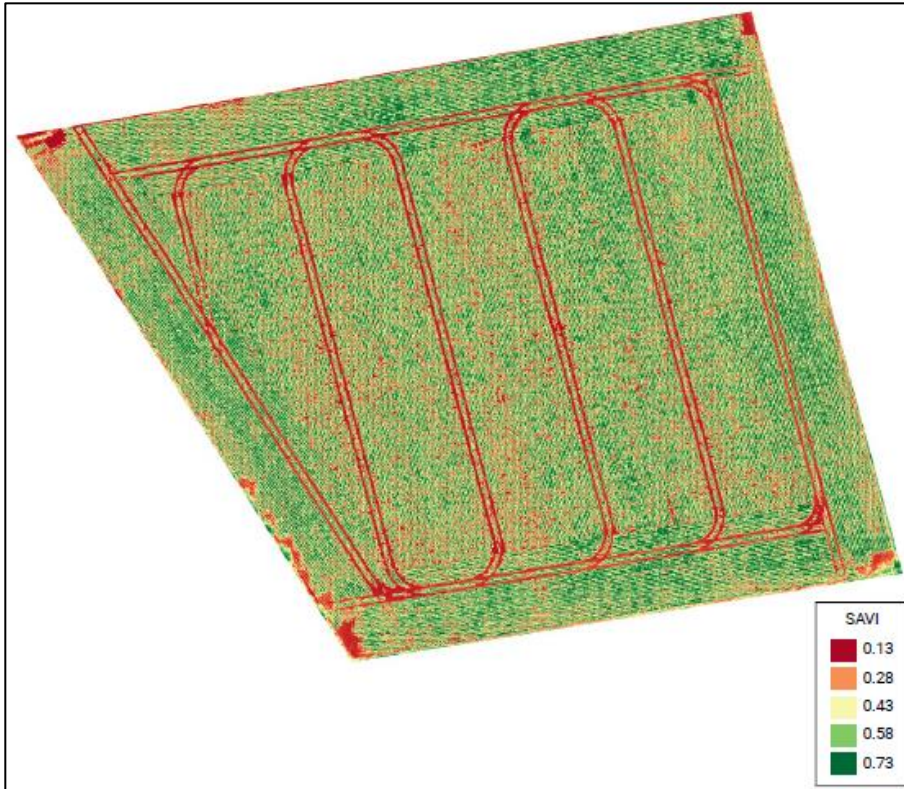
July 8<sup>th</sup>



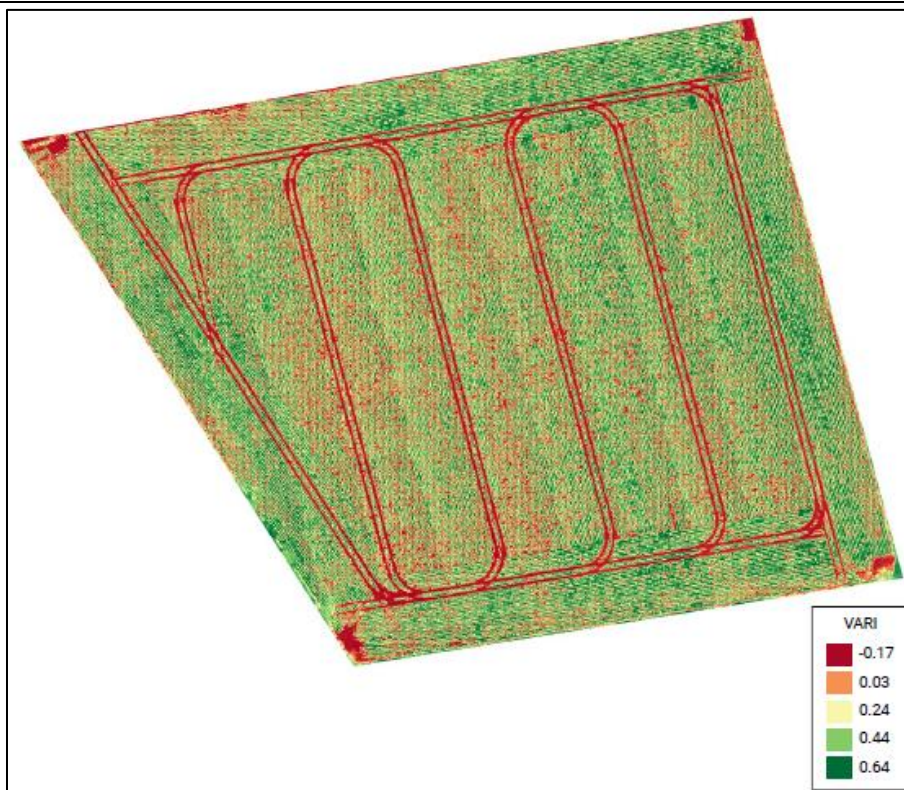
On the NDVI picture from July we see some parts of the field are showing a higher chlorophyll content or lower.



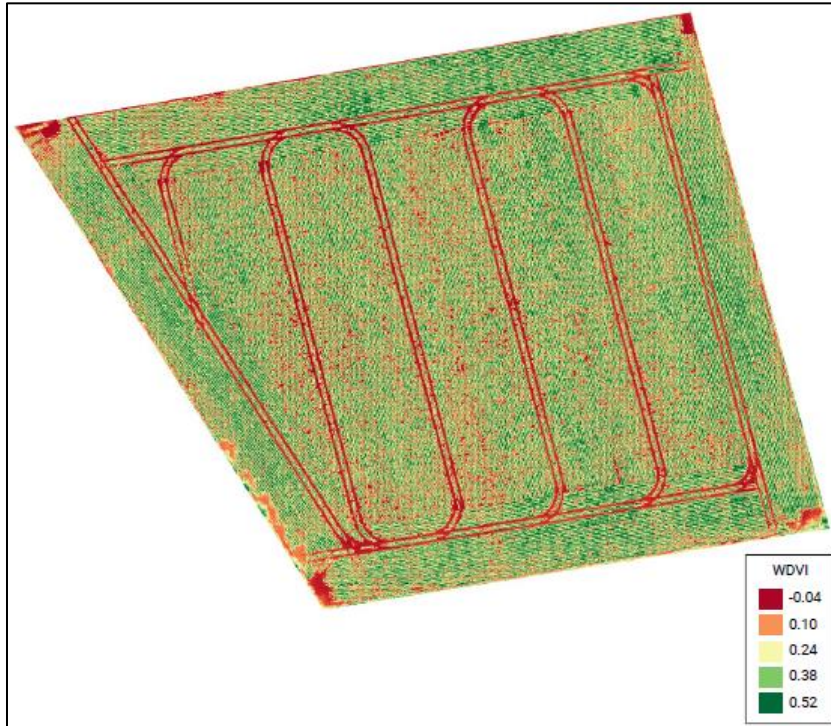
The NDRE shows in the deeper layers of the leaves a similar pattern of the growing process from the plants.



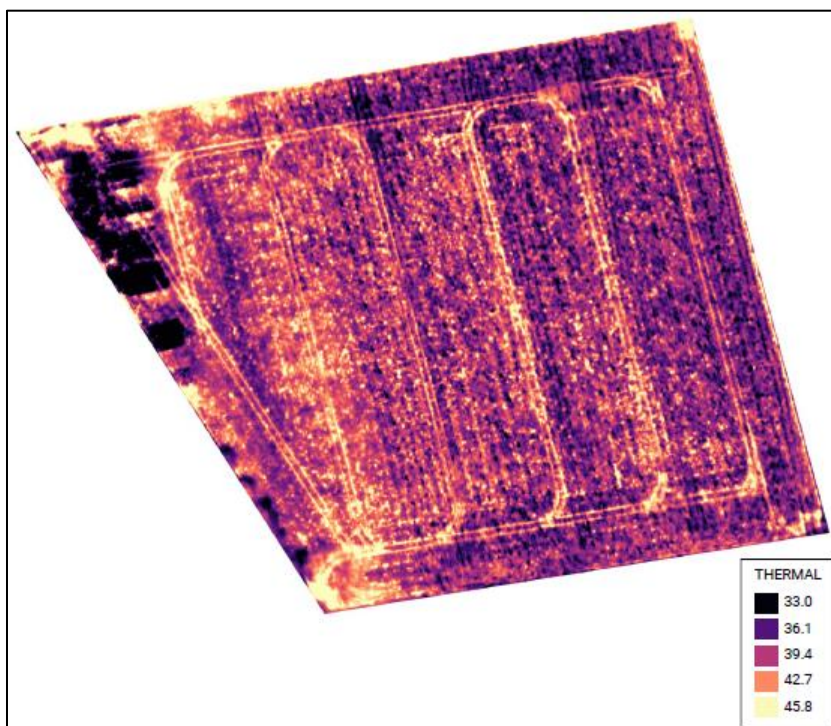
Taking the soil reflectance in account there are some changes visible in the field, they mostly are caused by nature and field history.



The VARI image gives us an idea of the crop stress areas. Between the spraying paths we can see some stressful lines where the end of the spraying boom passes each other while spraying the field against diseases.

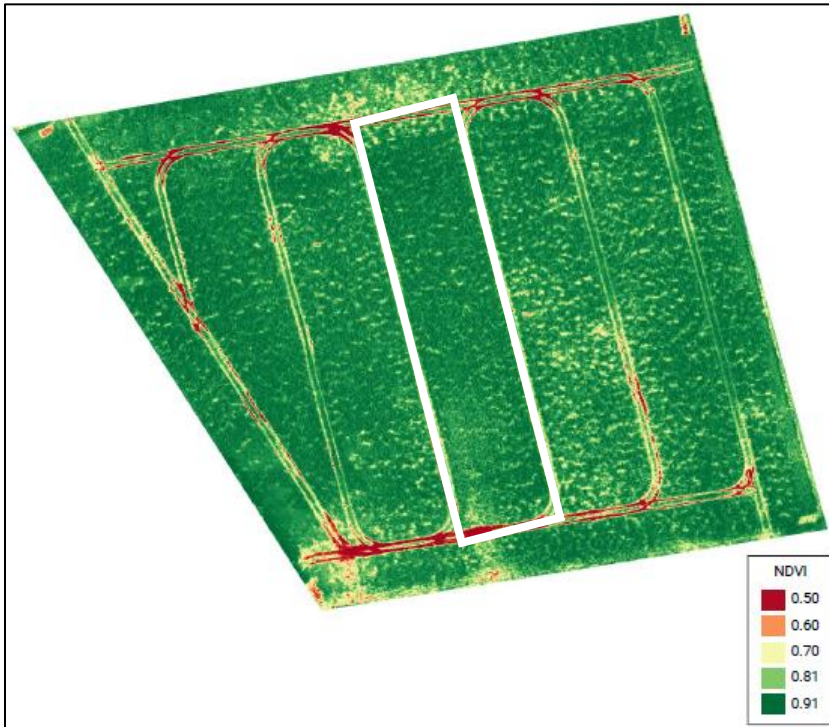


On this WDWI layer the plants give us a closer look in the deeper layers to filter out the effects from a lighter or darker green top layer of the potato plants.

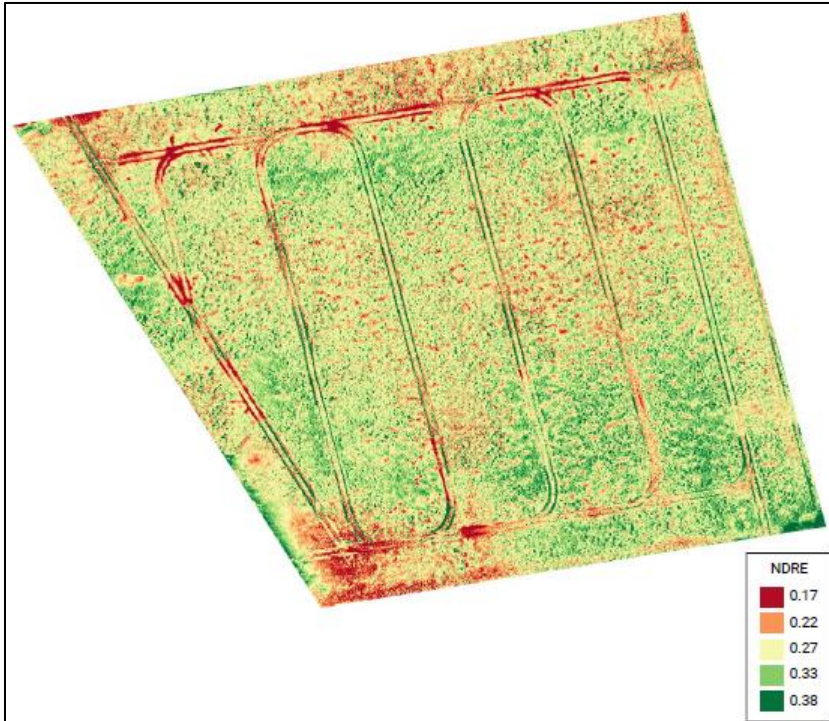


On this thermal image the warmer places from the spraying tracks are visible. The zones where we saw more biomass are showing here a colder/pleasant temperature.

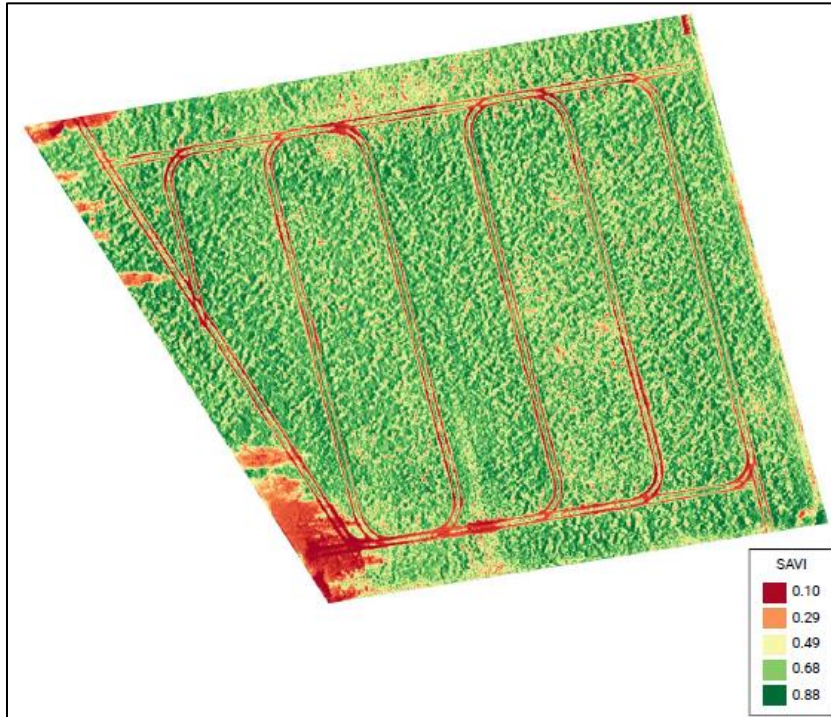
**August 10<sup>th</sup>**



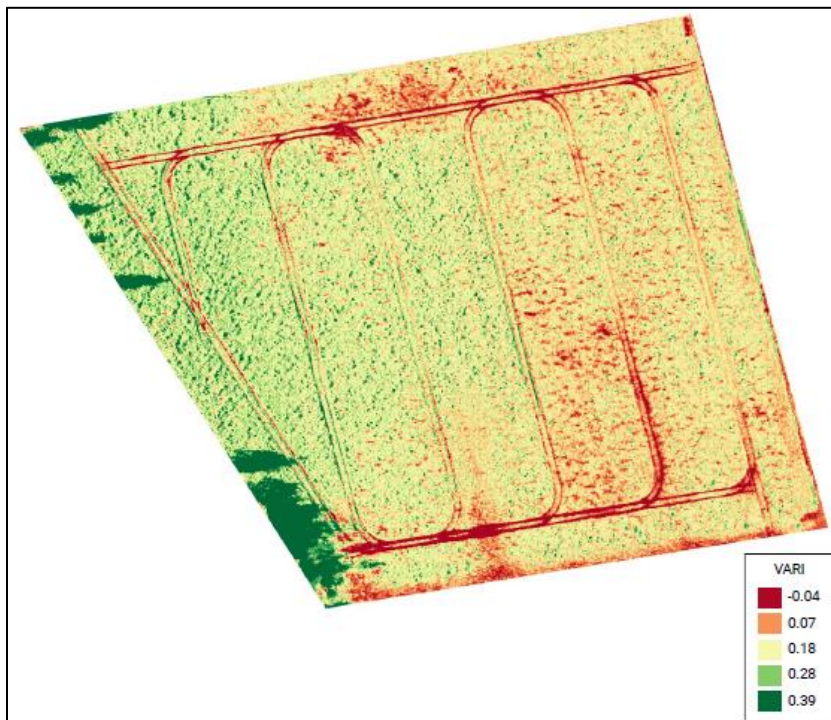
The chlorophyll maps of the field around August are showing a homogeneous variation. The location of the treatment zone that received Herbali (marked by the white rectangular), shows us a little more chlorophyll on the full length of the treatment zone.



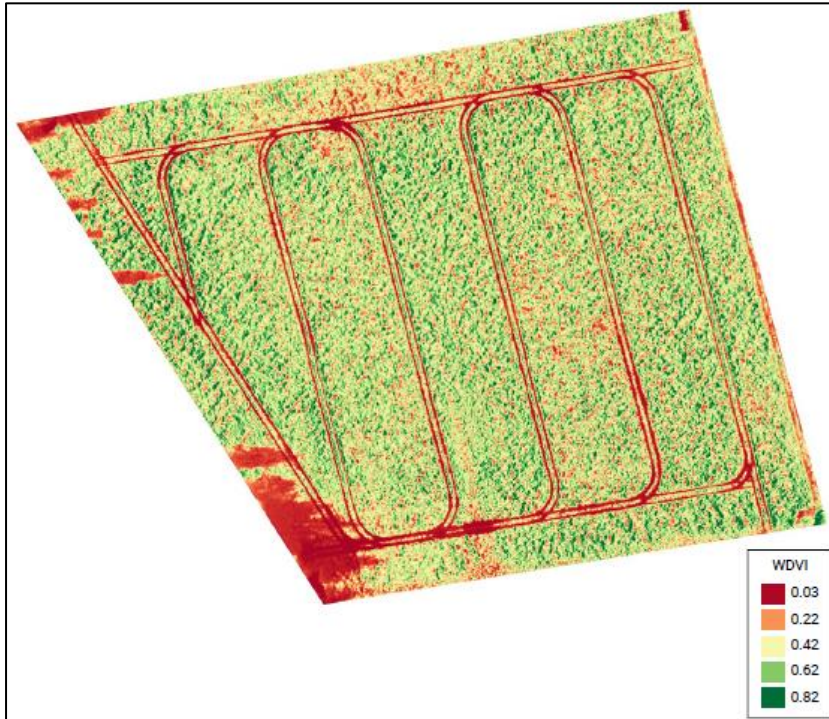
The greenness variation in the field shows some greener spots in the top and bottom of the field.



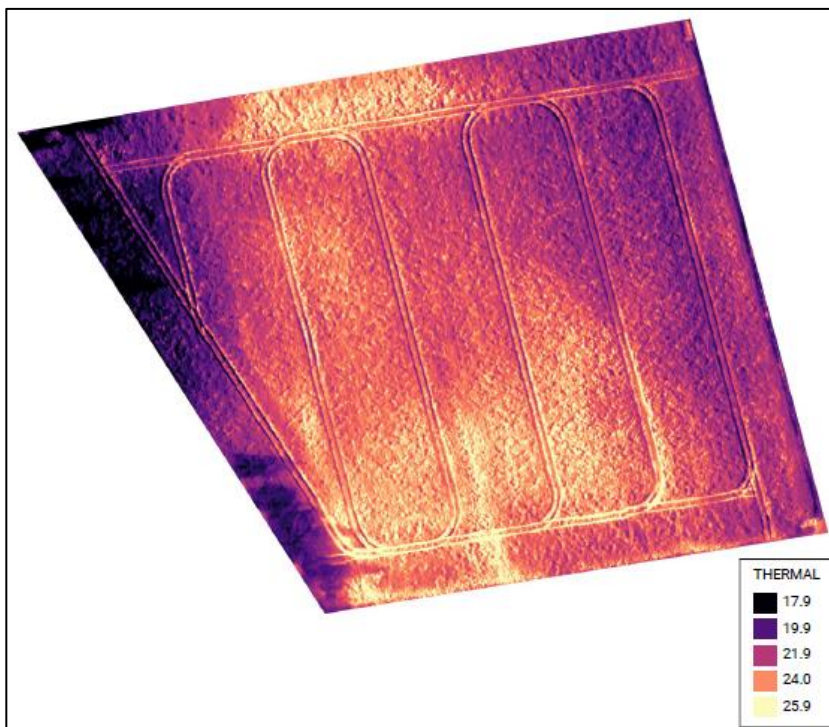
Without the soil reflectance we see some changes in the field, the Herballi treated zone looks a bit more homogeneous and received a higher value.



The spots that had a lower chlorophyll or greenness level are showing a lower value on the VARI map. The

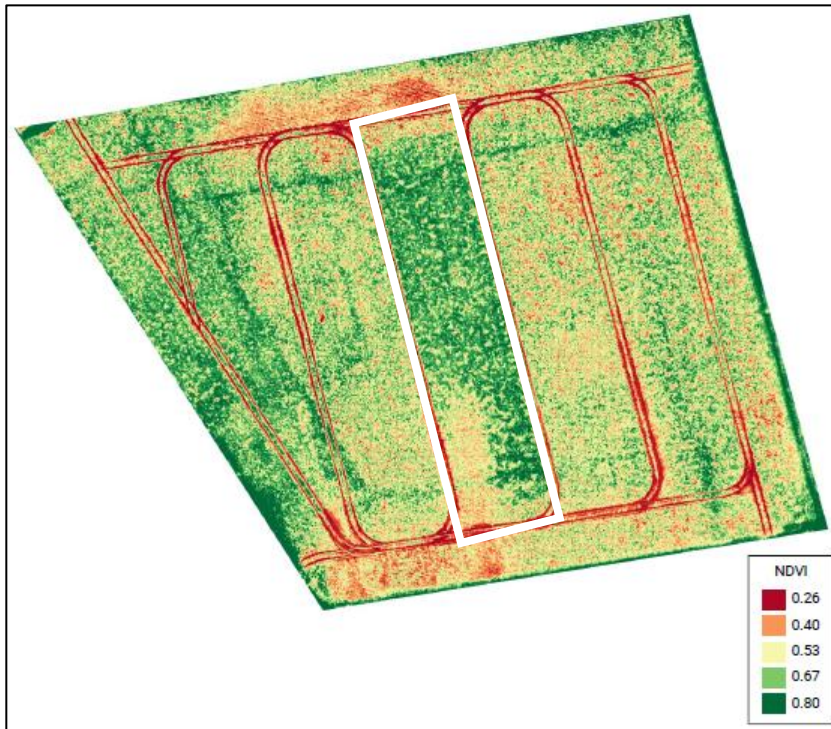


We see some more darker green on the WDWI map of the treatment zone that received the Herbali with planting and 2 times with spraying.

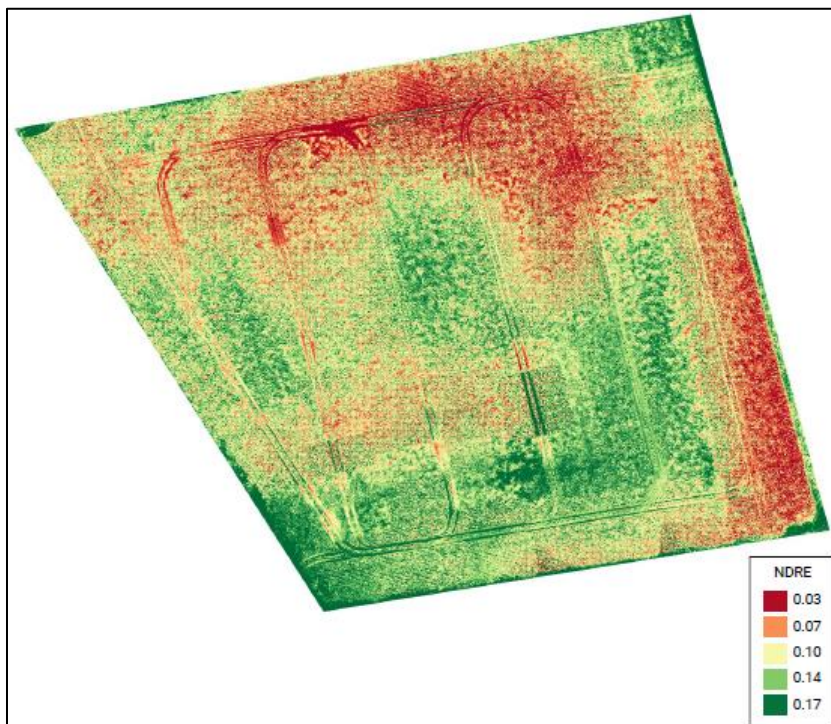


When we look back at the height map from the field (attached in the end), the lower parts of the field are showing a little higher temperature compared to the rest of the field. In other plant layers we saw that the amount of plants/leaf coverage was less some of these zones that's why that are warming up some more.

September 9<sup>th</sup>

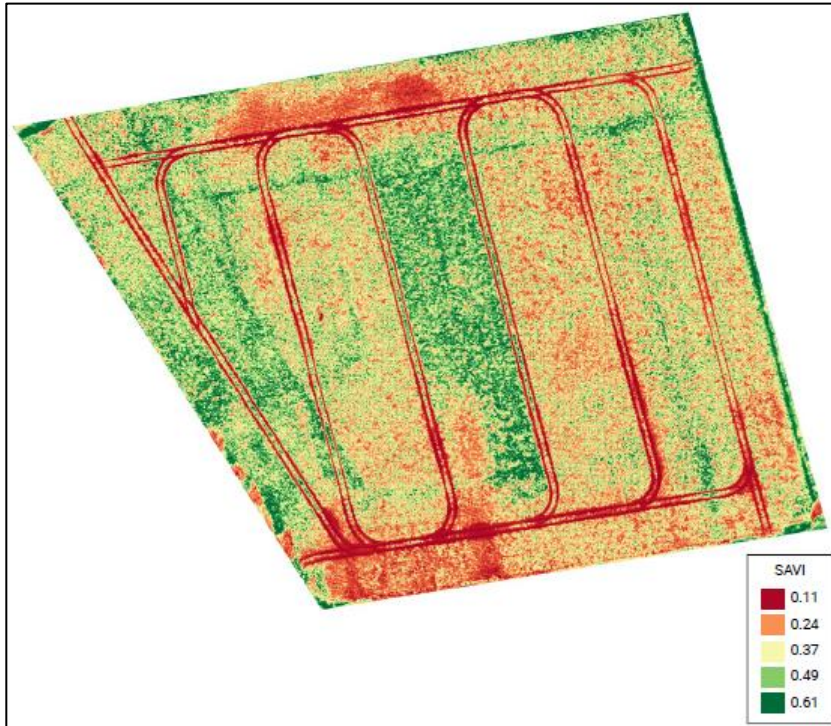


Coming closer to the end of the growing season we can see there is still a lot more chlorophyll content in the zone treated with Herbali.

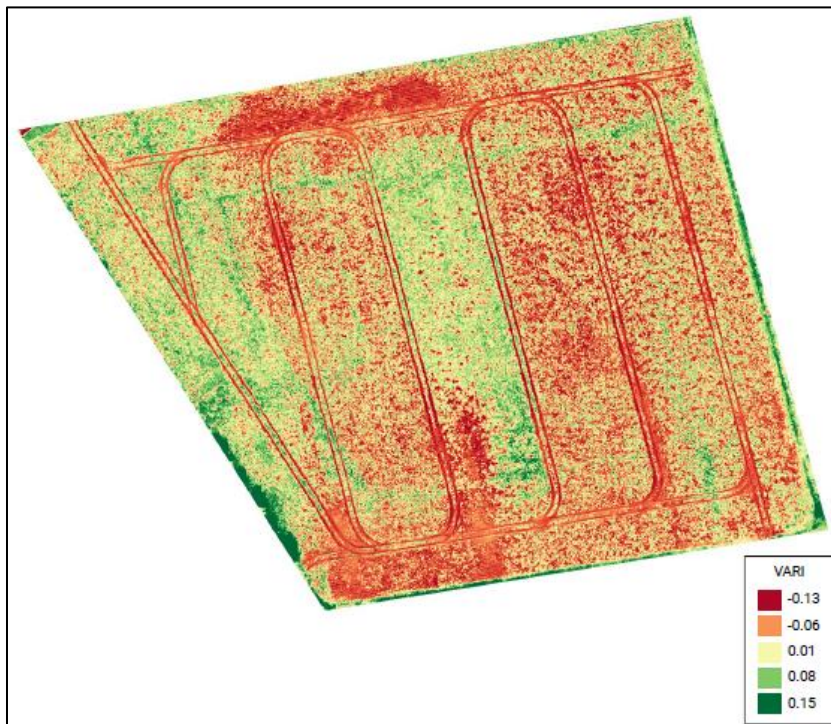


Deeper inside the leaf layers we see a similar pattern, on the higher parts of the field we see some lower NDRE values for the greenness of the plants.

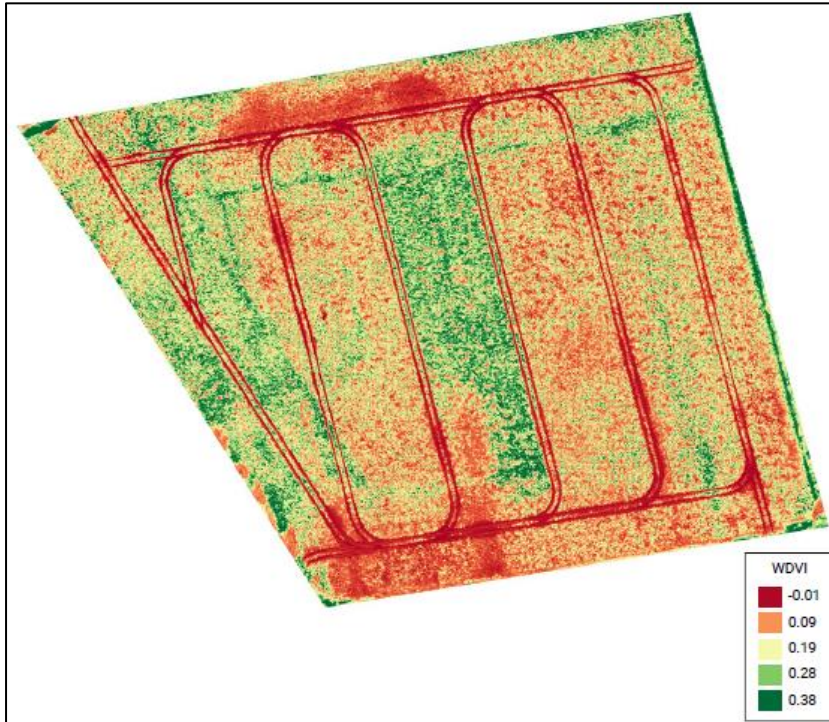




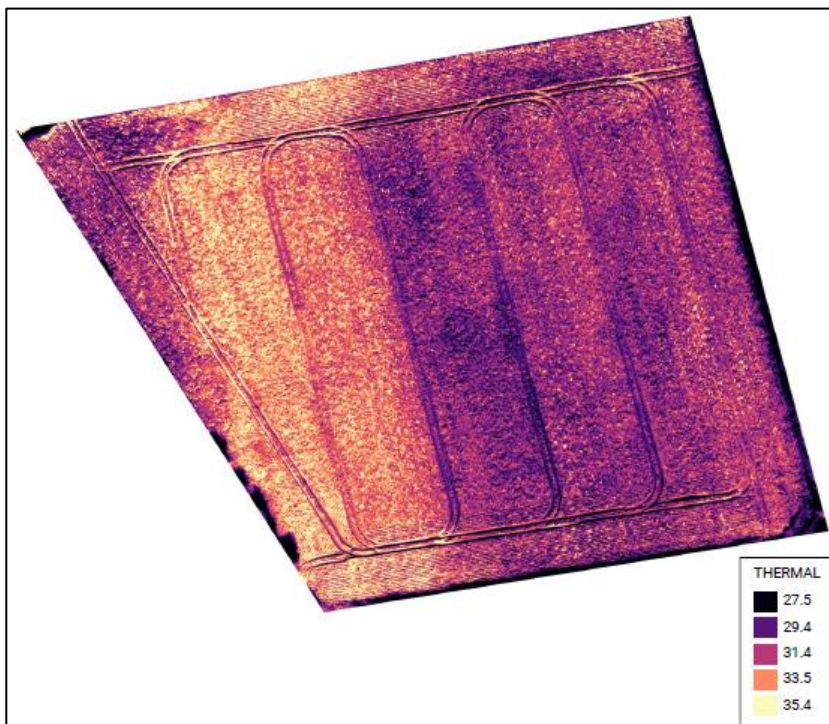
When we leave out the effect of soil reflectance the treatment zone that received Herbali comes out with a higher value compared to the rest of the field.



The treated area is also showing some stressful spots but not so badly compared to the rest of the field.



Even through the lower layers of the plant we can still see they were more vital and contained more chlorophyll compared to other not treated areas of the field.



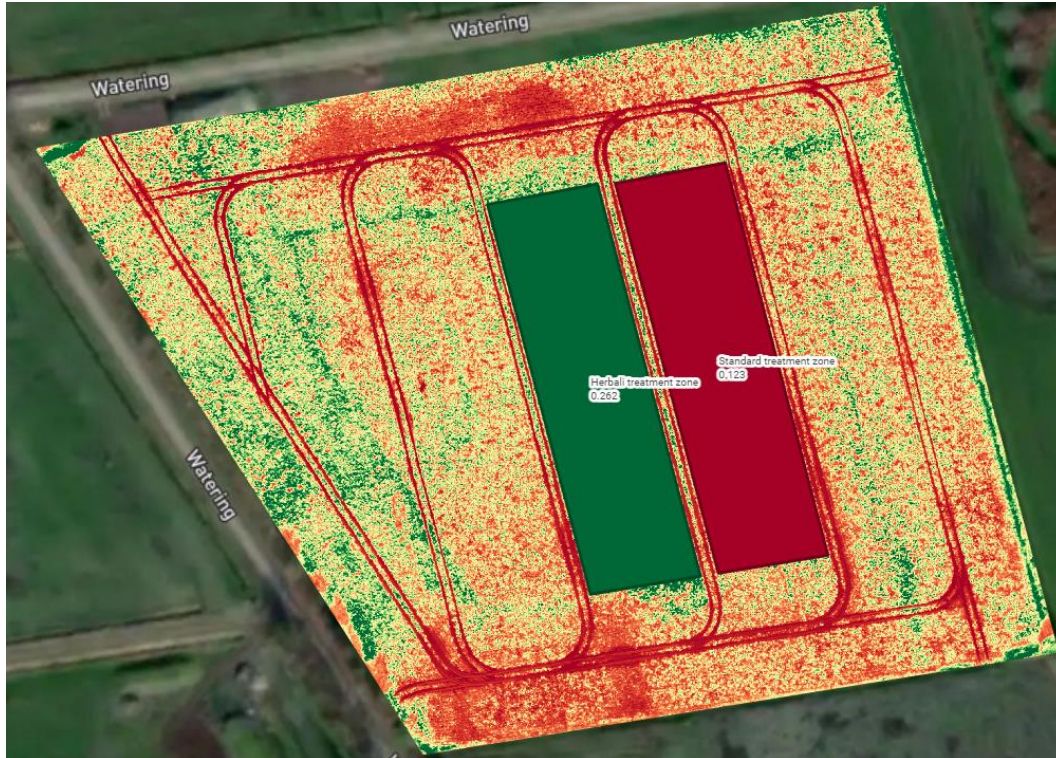
Due to the high amount of rain we had during the growing season, there are some areas in the field that were performing low in terms of nitrogen/biomass but showing a lower temperature value.

If the amount of water/flooding areas would be drier those areas with lower nitrogen/biomass would show a higher (warmer) value in the THERMAL map from September 9<sup>th</sup>.

## Drone detail map

When we analyse the WDV image from September 9<sup>th</sup> we can clearly see a difference between the **treated (Green)** and **not treated (Red)** zone with Herbali.

**1:** In the 2-treatment zones the difference is visible on the first picture what shows us the median WDV value.



**2:** The second picture shows us the difference inside both treatment zones with their respective median WDV value.



## Fritzmeier Isaria crop sensor

Fritzmeier Isaria crop sensors mounted on the sprayers can record crop reflectance to estimate biomass (IBI) and nitrogen indication (IRMI).



For this year's trial no fritzmeier data was ordered.

**July 17<sup>th</sup>**



Example from the trial field biomass map (IBI) from 2023.



Example from the trial field nitrogen (IRMI) indication map from 2023.

## Crop monitoring

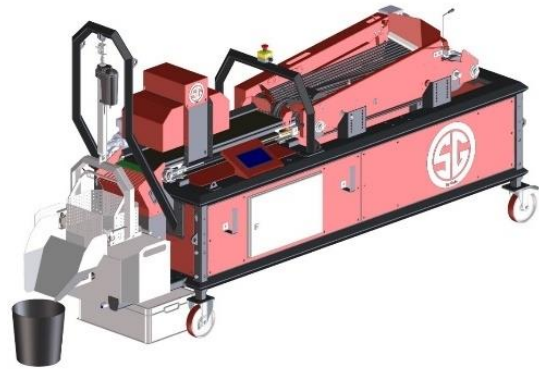


During the growing season, manual test probing can be carried out.

During these probing 3 neighbouring plants will be harvested in the 7<sup>th</sup> row next to the spraying path.

For these plants countings and weighings are done on stems, roots and tubers.

At several points in time the petioles of the youngest mature leaves of 15-20 plants per plot can be collected for nitrate analysis. For the end probing we can harvest 2x3 meter potatoes instead of 3 plants to collect more tuber size and length data.



## Yield map

A yield map can be generated by the AVR Puma 4 yield measuring.

Due to the high rainfall we had during the growing season and in the harvest period we were not able to harvest the whole field.



The amount of water between the ridges was at a certain high level what caused a lot of rotten potatoes inside the ridge. When the water level would have dropped sooner, we would be able to try harvest the field with the harvester that we equipped with tracks instead of wheels.

Unfortunately, this was for the trial field and other fields not possible. In an attempt to harvest some potatoes by hand we came quickly to the conclusion that there were too much rotten potatoes to make a comparison of the differences between the treated zone with Herballi and the not treated zones in the field.

To give an idea of how the field is looking at 12 December 2023, attached in the back some pictures of the treated zone with Herballi and the not treated zone are visible.

## Storage losses

Since 2020 it is possible to collect storage samples of the trial fields.  
We collect a bag of potatoes from every treatment zone or from every plot.



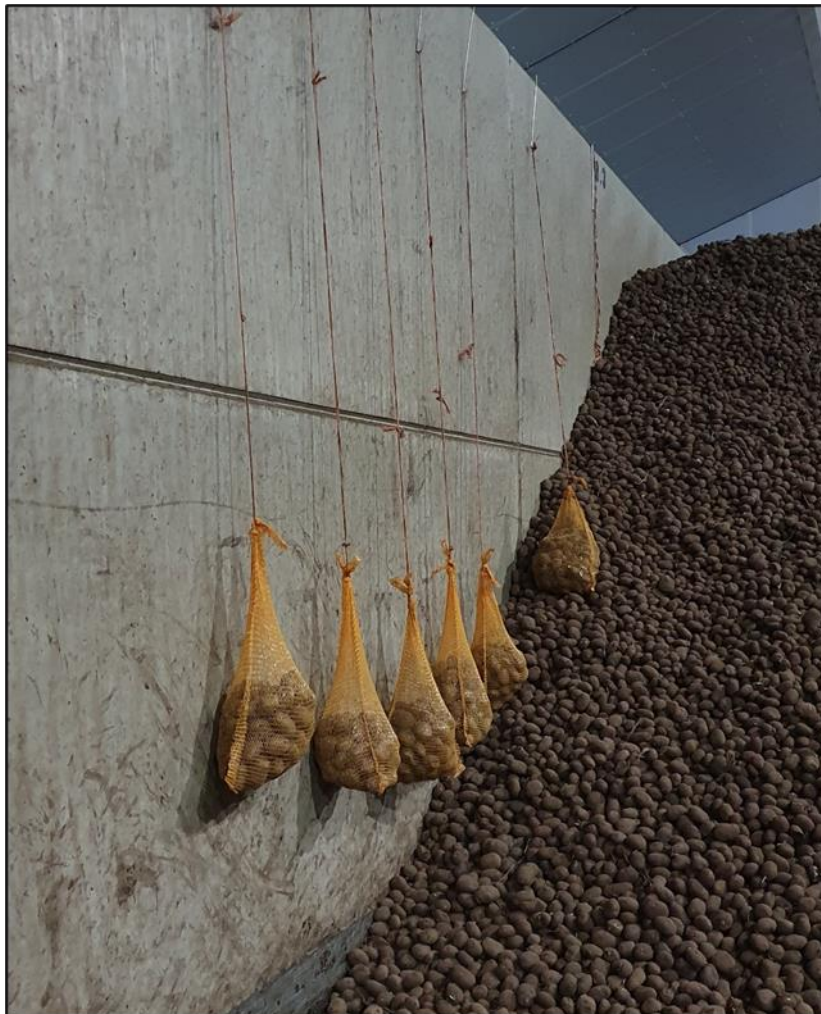
These samples get measured by the same robot that we use for the intermediate probings.  
The robot will measure the number of counts and the amount of weight from the potatoes that we harvested.

The set of multiple camera's calculate how many potatoes are passing and what their length and width is. After passing the camera's the potatoes fall down into a bucket which measures the dry weight.

The underwaterweight is the only value we can't measure in the beginning of the storage samples because we would need to submerge the potatoes in water to calculate this, if the potatoes get wet we can't store them anymore.

This means that we only measure the underwaterweight when the potatoes are getting delivered while the storage places get emptied.

With these measurement data we make a comparison of the weight and length losses during conservation in the storage places.



**No storage samples were ordered for this year's trial.**

## Conclusions

- Beginning with the registrations of the field we can see the planting season was this year later than usual.
- The plants were sprayed with Herbali in 1 treatment zone, we sprayed 2 times a dosage on the field.
- The first time just before the plants closed the ridges and the second dosage after the plants closed the ridges.
- The application moments are visible on a timeline, here we can see that the moisture content was on a high level throughout the whole growing season.
- The amount of rain in the area is giving an idea of how much and how frequently we received larger amount of rain.
- To look at the difference in the soil we took a recent height map to locate the treatment zones in the field, the soil analysis showed us what was available in the soil around June 13<sup>th</sup>.  
In the fertilizer application table, we see that on both zones there was the same amount of manure and/or chemical fertilizers were applied to have an equal balance to compare the plants from both treatment zones.
- The weather station on the Farm in Reusel gives an idea of the temperature, rain, wind, ...
- The drone images from July 8th didn't show a lot of variation in the field expect effects from the field/history itself.
- Around August 10th we can see in some layers of the drone maps slight changes inside the field. What we can notice here is that the whole treatment zone from top till bottom shows a more homogeneous variation.  
The Herbali treated zone didn't receive the highest values in some map layers but overall good or a bit better here and there.
- The last drone flight of September 9th gives an idea of what the Herbali applications caused in the field.  
The treatment zone that is marked and received the Herbali shows a higher value in biomass, greenness, less stressful areas and a colder/more pleasant temperature of the potato plants in the field.  
Compared to the rest of the field that started to die off here and there.
- We calculated the WDVl layer of the last drone flight on page 18 to give an idea of the variation between the Herbali treated and not treated zone with a closer look inside the zones on the second image which is transparent.
- We didn't take potato tubers from the treated and not treated zone what doesn't give us the possibility to take a closer look at the number of tubers and the size/length variation between both treatment zones during the season.
- The yield map that we receive normally from the harvester was not made this year because it was not possible drive on the field.  
The quality of the potatoes that were left over was not good enough due to the high percentage of rotten or starting to rotten potatoes.
- When the harvester was converted on tracks instead of wheels, we went again by foot on the field to evaluate the conditions.
- The pictures of that field visit can be found back in the end of the report page 26+27.
- The only conclusion we could make was that the field and its potatoes were lost completely for this year.

- Based on the information we received during this year's trial we can see an effect from the Herbali in the field.  
More in the beginning of the season the effects were not good visible until the Herbali was 2 times sprayed and the plants started to show some effects of those spraying moments on the full treatment zone.
- We can say that the Herbali treatment zone managed to keep vital a bit longer compared to the not treated areas of the field what can result in a longer growing period for the potatoes on those plants.  
Without potato tuber samples or harvest data we are not able to grant those predictions for 100%. Because we have no idea what the effect would be in the treatment zone.  
It is possible that the number of tubers slightly increases because of the stronger and longer growing process in the Herbali treatment zone.  
Although it is also possible that the number of tubers is the same as not treated areas of the field because the beginning phases in the field didn't show a lot of variation between the treated and not treated zones. The size/length of the present tubers could be bigger due to the longer growing period where the plants in the Herbali treatment zone looked more vital compared to other parts of the field on September 10<sup>th</sup>.
- For this year without further ordered/collected data from the trial field we can not make a final conclusion of the effect from Herbali on our potato trial field, we are looking forward to expanding the collaboration with Herbali in the next years to test out the effects during the growing season and ripening off the potatoes during a field trial. Hopefully with more potato size and yield measurements!

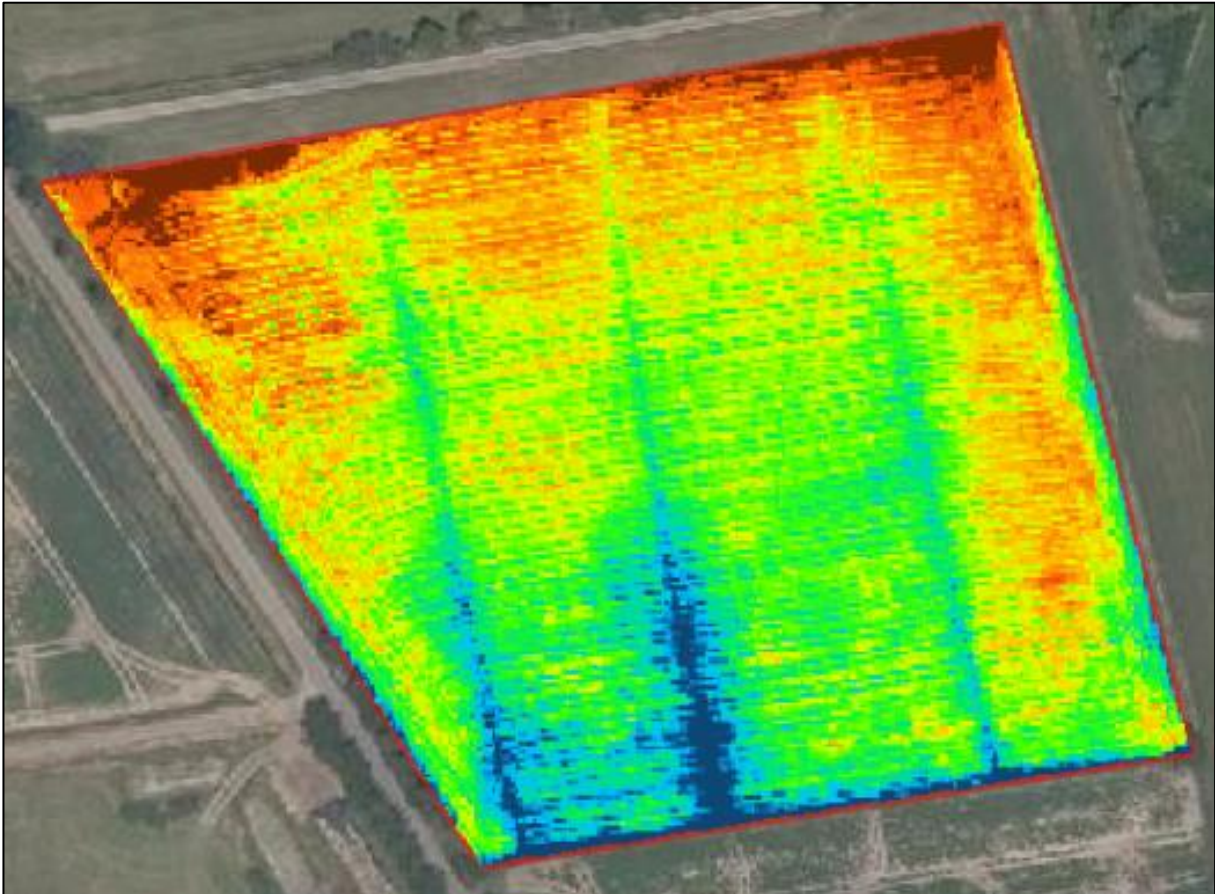
For more information concerning your trial, you can contact [dieter@vandenborneaardappelen.com](mailto:dieter@vandenborneaardappelen.com).












## List with figures and tables

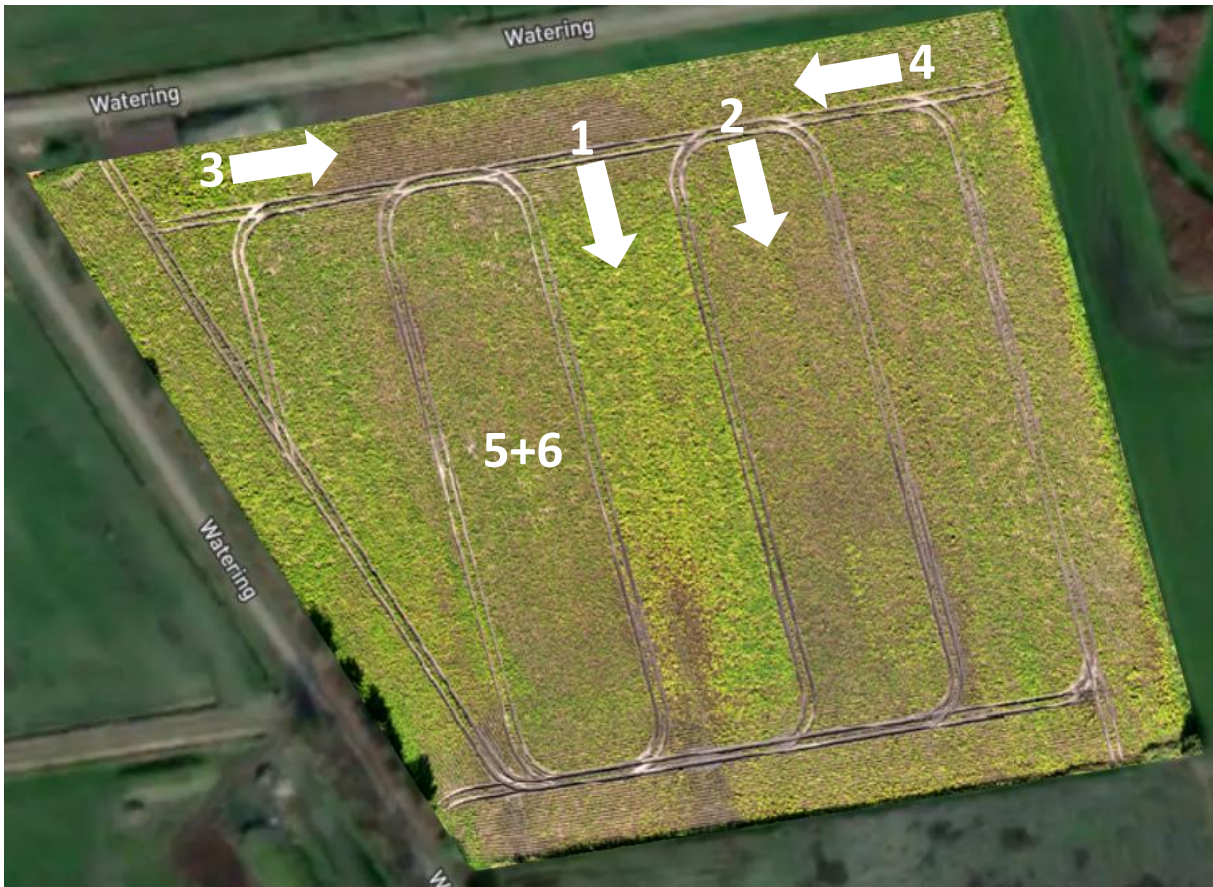
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## Attachments

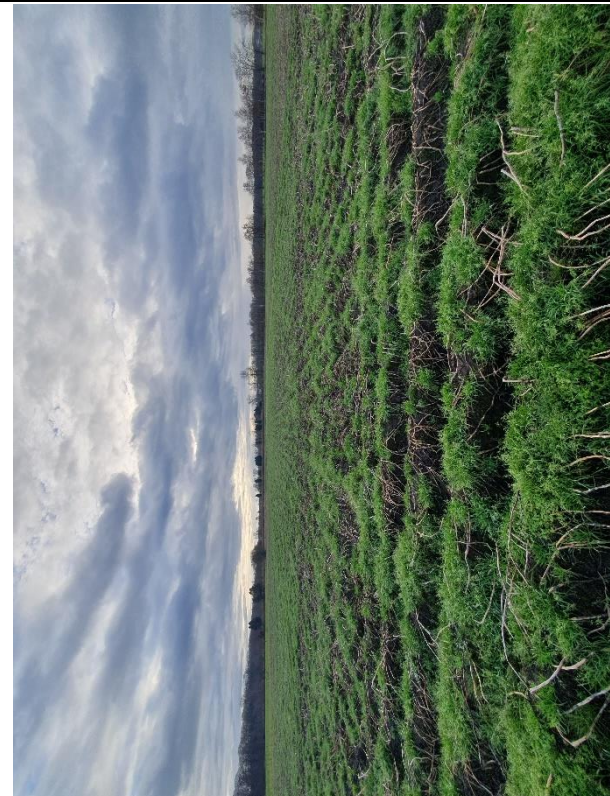


	Hoogte (m)
	27,84 — 27,91
	27,77 — 27,84
	27,70 — 27,77
	27,63 — 27,70
	27,56 — 27,63
	27,49 — 27,56
	27,42 — 27,49
	27,35 — 27,42
	- — 27,35

Field visit 12-12-2023 picture locations.



**1** **2**

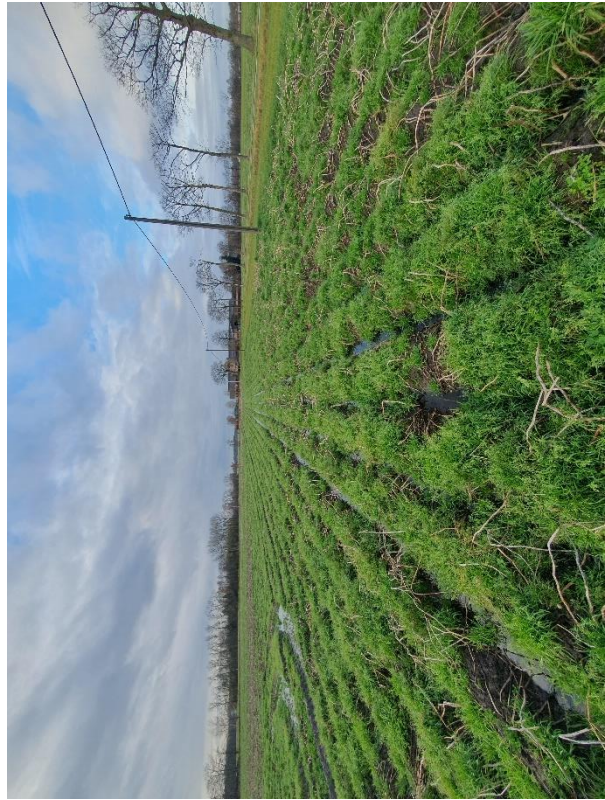




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