FERTINNOWA – Technologies to improve fertigation. Management spatial variability

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Task 4.1 Identification of Gaps

Gaps in irrigation management are:
• Irrigation management tools and technologies require high level of knowledge
• Lack of automation and friendly systems to aid decision in irrigation time.
• Growers find irrigation management tools and technologies too expensive and not reliable.
• The heterogeneity of the soil and plant grown
• Technology designed by persons of the other sectors different of the agriculture.

Gaps in fertigation management are:
• DSS are not available for all crops, varieties and local conditions.
• Difficulties to select representative points to take samples.
• Crop monitoring techniques require reference values. A lot of time to know analysis results and too late to make the correction on the farm.
• The farmer does not take into account the different sources of nitrogen on the farm.
• Deficiencies in the fertigation system
• The grower prefers over-fertilizer to avoid possible deficiencies and with that lost production.
Perales Farm (200 hectares)

Trial plot (60 hectares) 2017
H1311 (Heinz Co) Variety
Transplant 15th April harvest 20th August
Subsurface drip irrigation
SOIL HETEROGENEITY     EMI Sensor

Apparent electrical conductivity (ECa)
CANOPY DEVELOPMENT HETEROGENITY

Satellite SENTINEL 2 images
Periodicity 5-10 days
Resolution 10 meters

http://apps.sentinel-hub.com/sentinel-playground

NDVI (Vegetation index) = \frac{(NIR-R)}{(NIR+R)}
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To know different management zones to selection the location of samples:

**CROP**

**SOIL**

**NDVI vs Crop Development**

**Eca vs soil texture**
Zone a: a1, a2 and a3 most crop development zone

Zone b: b1, b2, b3 and b4 medium crop development zone

Zone c: c1, c2 and c3 low crop development zone

<table>
<thead>
<tr>
<th>Zone</th>
<th>Depth</th>
<th>Texture</th>
<th>% OM</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>0-30 cm</td>
<td>Clay-Loam</td>
<td>0.74</td>
</tr>
<tr>
<td>a</td>
<td>30-60 cm</td>
<td>Clay-Loam</td>
<td>0.54</td>
</tr>
<tr>
<td>b</td>
<td>0-30 cm</td>
<td>Sandy-Loam</td>
<td>0.63</td>
</tr>
<tr>
<td>b</td>
<td>30-60 cm</td>
<td>Sandy-Loam</td>
<td>0.16</td>
</tr>
<tr>
<td>c</td>
<td>0-30 cm</td>
<td>Sandy-Loam</td>
<td>0.61</td>
</tr>
<tr>
<td>c</td>
<td>30-60 cm</td>
<td>Sandy-Loam</td>
<td>0.23</td>
</tr>
</tbody>
</table>
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- Soil Samples
  - Soil texture and NPK concentration
  - Soil Samples

- Leaf Analysis
  - NPK in plant

- Canopy Ground Cover
  - Effects on crop development
  - Canopyo App
  - Cropcircle 470 spectral sensor
  - Sentinel 2 Satellite image

- Spectral Analysis
  - Early detection nitrogen and water deficit
  - SPAD sensor
  - DUALEX sensor
  - Pump-up sensor
“zone a” showed a bigger development regard to others zones. The NDVI values are smaller at the beginning in the “zone a”, same that % ground cover, due to the days of difference in transplantation, but it reaches a greater development in the phase of rapid growth (flowering and fruit set).

NDVI in the area a and c, of the same that was observed in the other two methodologies of measurement, it can be indicated the periods where the difference of development took place between both zones, it is also observed what is the moment and the dynamics in the phase of plant senescence.
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The total production obtained were greater in the "a" zone, as has been demonstrated in the different data obtained in the development of the crop and as it was identified with the measures of variability made before the transplanting.

The total yield data from control points were correlated with NVDI images from sentinel 2 satellite, near of harvest ($R^2 = 0.81$) and one moth before ($R^2 = 0.74$). This information to permit elaborate a map with total yield to all field test.
CONCLUSIONS

• Results showed that spatial variability had an important influence on the sampling and measurements of nutritional status in a processing tomato farms.

• Satellite images allowed to identify zones of different crop development and production, this can be good tools to select a sample points in the farm.

• With Satellite technology, farmers can identify the zones with different crop development to select zones of control of water and nutritional status during the crop cycle, allowing to make adjustments of the irrigation and fertilizer doses in each zone of the plot.

• The satellite image to permit identify a more and less productive zone in the farm thirty days before harvest.
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