



Improvements in the sustainability of industrial hemp plantations by remote sensing and modelling of agro-biochemical parameters

J.J. Puente-Sandoval¹, M. Vallbé¹ and M.D. Grau¹

¹Department of Mining, Industrial and ICT Engineering, School of Engineering Manresa, Universitat Politècnica de Catalunya (UPC-Manresa)
juan.jose.puente@upc.edu | marc.vallbe@upc.edu | dolors.grau@upc.edu

HEMP: THE ONLY EUROPEAN SUSTAINABLE FIBER

Recent technological advances allow **remote sensing** to be applied affordably to extensive crops, improving their efficiency and sustainability. At the same time, **industrial hemp** is re-emerging as a novel product with innumerable applications. The high added value products obtained, as well as the low-tech of agricultural practices, make remote sensing very useful during hemp cultivation.

The so-called **precision agriculture** uses preventive techniques based on vegetation indices allows the early detection of detrimental occurrences, such as plagues, lack of nutrients, or inadequate humidity. Thus, those indicators enable a prompt solution application, which only targets the specific crop areas at risk. All in all, promoting **more precise, sustainable and economically efficient** agriculture.

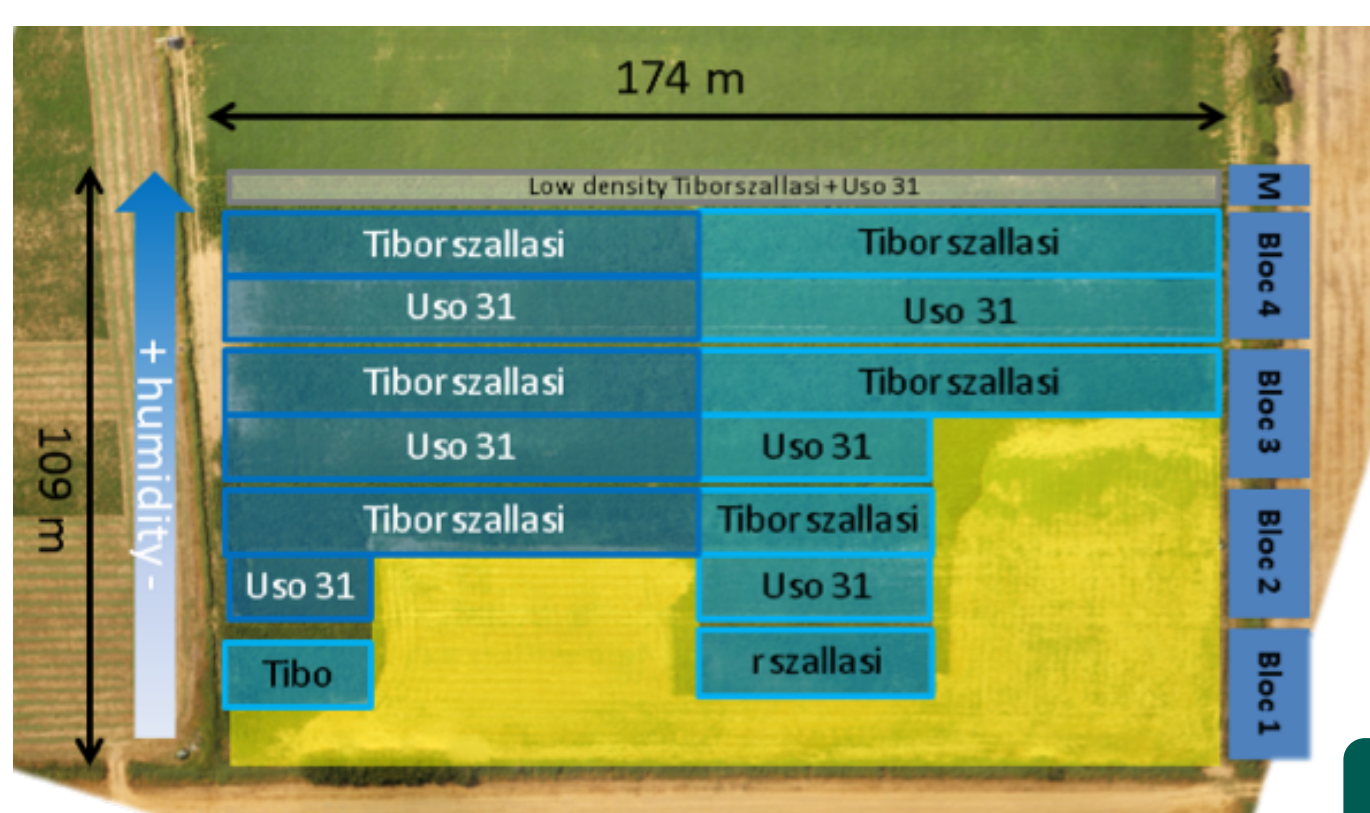
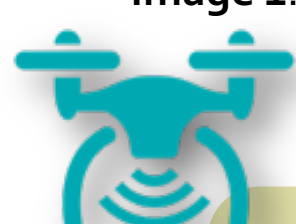


Image 1. Trial layout of the experiment on orthophoto

2 ha in Girona
2 varieties
2 irrigations
4 repetitions
Low density zone

OBJECTIVES |

- Modelling of agro-biochemical parameters measurable by **remote sensing** of hemp plantations.
- Application of **preventive techniques** that detect plagues, humidity, lack of nutrients...
- Creation of **predictive models** that will forecast productivity and indicate necessary changes to maximize its benefits



- Drone: DJI Phantom 3
- Camera: Parrot Sequoia:
 - Red, NIR, RedEdge, Green
 - RGB
- Calibration panel: Airinov



- OpenDroneMaps:
 - Orthomosaic
- Pix4D
 - Calibration
 - MDS, volume
 - Vegetation indices
- QGIS:
 - Data analysis

Trial definition

Drone measures

Data Analysis & Index calculations



Ground measures

- 2 samples/parcel
- Bi-weekly measurements
 - Mass and height
 - Fiber amb hempseed
 - Direct NIR

Data Analysis & Interpretation

Satelital data

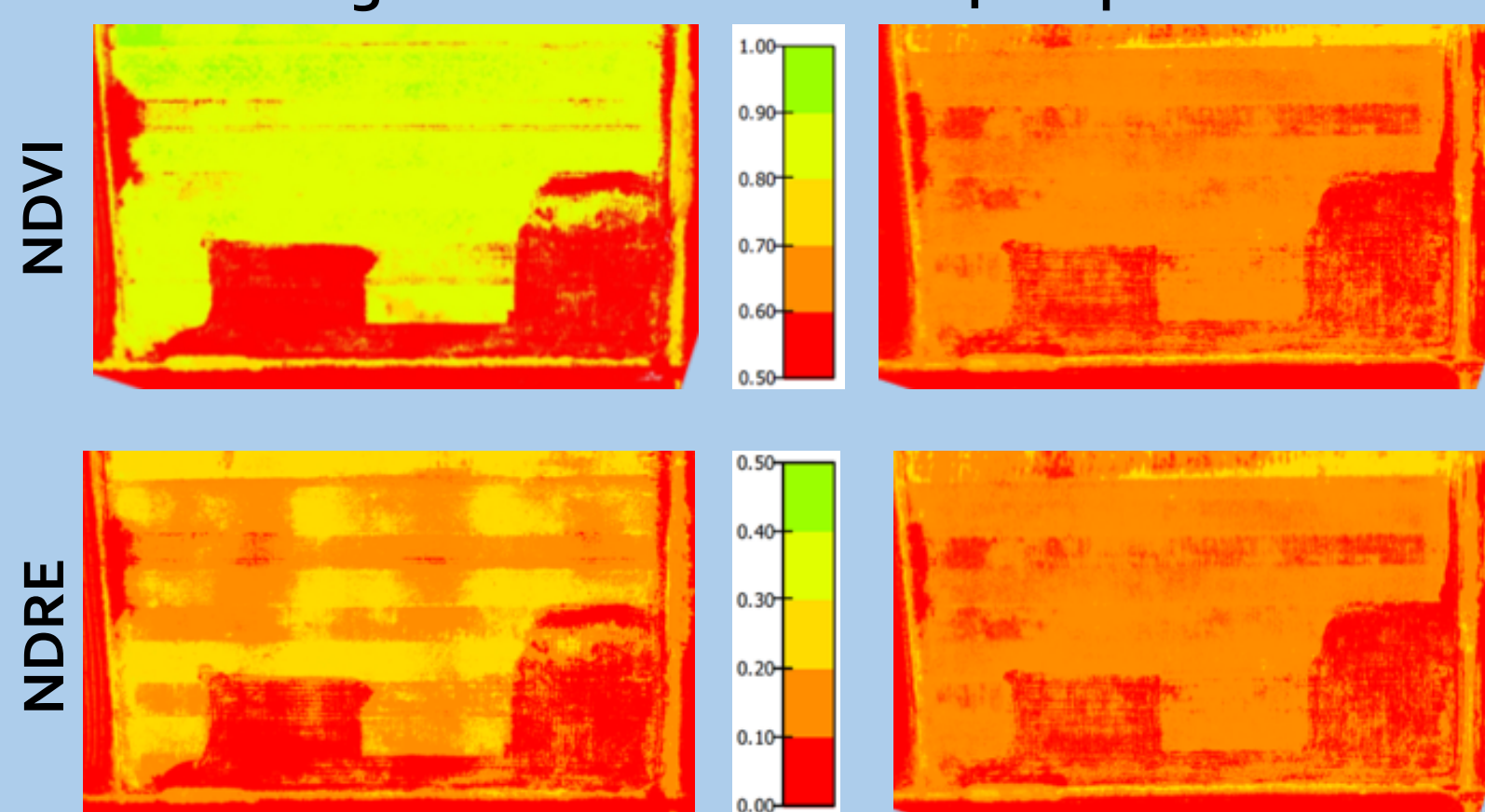
Parameter correlation

Model creation

FIRSTS RESULTS |

8th August 2022

14th September 2022



MDS orthophoto

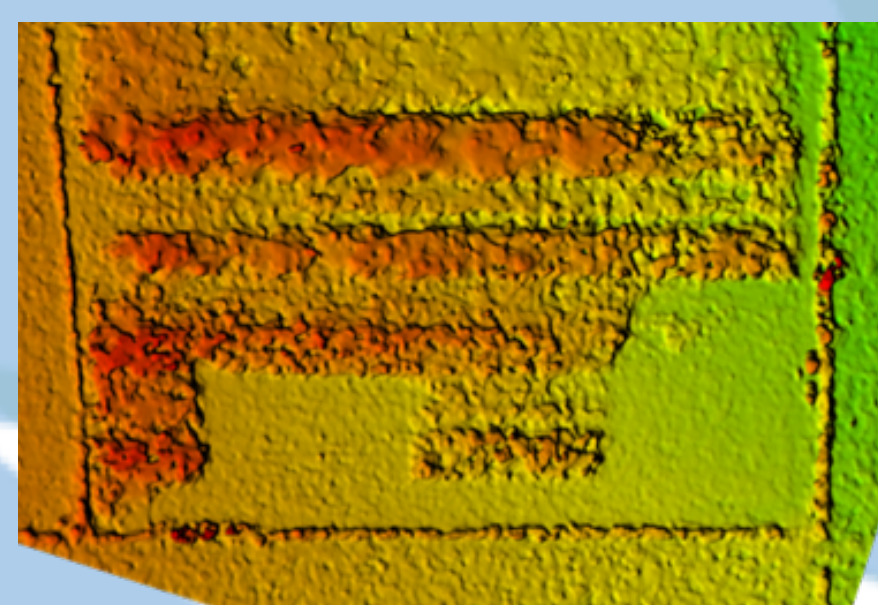


Table 1. Vegetation indices NDVI and NDRE from 1st flight (left) and 2nd flight (centre). MDS orthophoto (right).

The first results analysed show a **strong correlation** between humidity, greenness indexes and plant productivity. These preliminary calculations strongly validate the thesis hypothesis.

Hence the next natural step is **coupling the agriculture indices together with the production efficiency** of harvesting period to create the first round of **predicting models**. In the next two years these models will be validated and improved with the analysis of future plantations.

CONCLUSIONS |

This thesis will extend the EU's leadership in the development of local plant fibres and proteins and **reduce its dependence** on the external market, while reducing the pollution and losses generated in the transport of these products.



Thesis financed by the program for the incorporation of research personnel in training (FPI-UPC 2021).



UNIVERSITAT POLITÈCNICA DE CATALUNYA BARCELONATECH

Organitza:



formaBAGES

InnoBages

Amb el Suport de:



Aquesta acció està subvencionada pel Servei Públic d'Ocupació de Catalunya i l'ESE en el marc dels programes de suport al desenvolupament local.