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# NUTRIENTS EFFICIENCY IN THE FATIMA PROJECT

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## Introduction

One of the main mission in FATIMA project is to develop precision agriculture knowledge based on UAV and Satellite images for the assessment of water and fertilization necessities. Nitrogen (N) is a key nutrient for crops and the estimations of crop N status allow adjusting the fertilization levels to crop requirements, while reducing the environmental costs and optimizing the benefits for farmers. This work proposes a methodology that uses remote sensing (RS) images to obtain the NITROGEN NUTRITION INDEX (NNI. Lemaire et al., 1997) which brings a valuable information about optimum N crop uptake for the all pixels in the image during the entire growing season.

## Material an Methods

The work has been carried out on a commercial irrigated plot of bread wheat (coordinates 39.25º N, 1.99º W) during 2016 with an extent of 41 ha. The crop has been monitored along all the growing cycle, from January to July. It is located in the South-East of Spain in the province of Albacete (Figure 1).

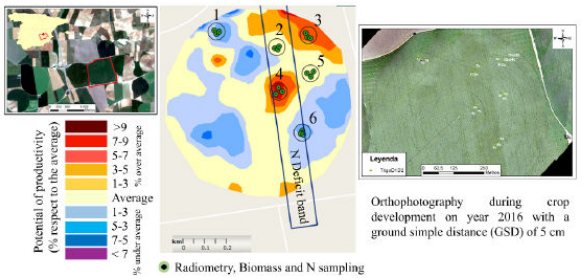


**Fig 1. Commercial plot used for trials location in the South-East of Spain (left). The figure in the center shows the sampling points and the potential of productivity map calculated from cumulated transpiration from remote sensing during the last years. An orthophotography of the plot is shown on the right, where can be identified the N deficit band.**

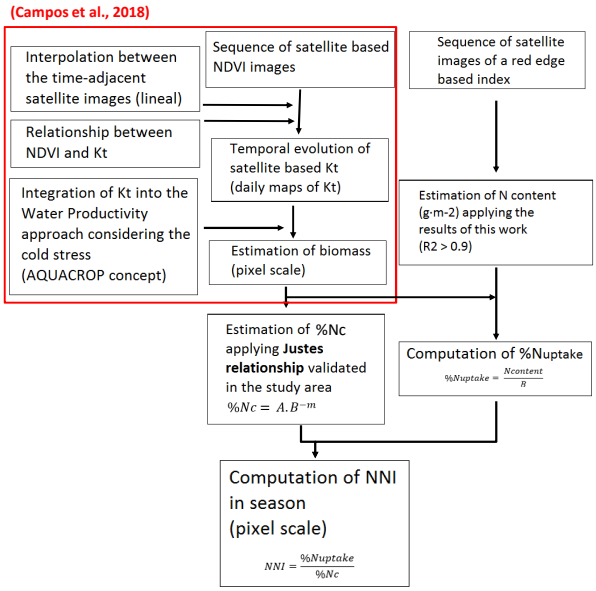


**Fig 2. Flow diagram of the methods followed for the estimation of the relationships of %Nc, %Nuptake and computation of NNI. The results of the procedures within the red box were developed in the context of FATIMA framework (Campos et al., 2018) but are not discussed in this work.**

## Results and discussion

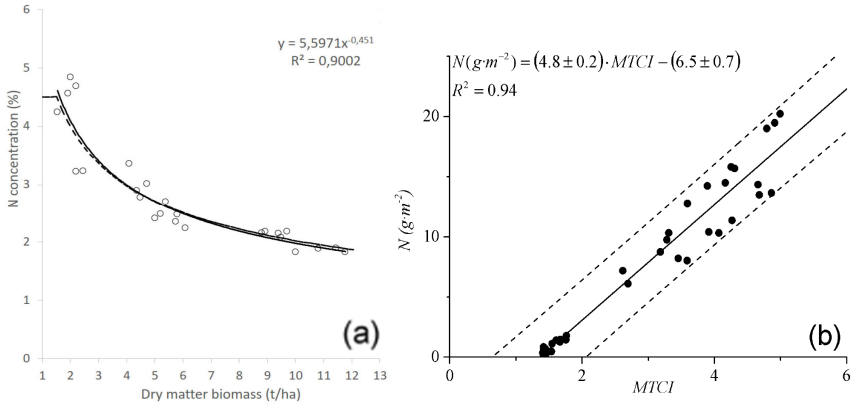


**Fig 3. a) Correlation between nitrogen (N) concentration and biomass along the growing cycle. The dotted lines represent the critical values of N concentration for wheat according with Justes et al (1994). The solid line represent the relationship obtained for the experimental data. b) Linear fit of the selected index versus N content (g·m-2). It is shown at the 95% confidence prediction level.**

According with the results shown in figure 3a, this Nc-Biomass relationship can be considered valid for the assessment of the optimum concentration in the study area and this relationship was used for the estimation of %Nc absorption along the growing cycle.

The selected index (figure 3b) MERIS terrestrial chlorophyll index (MTCI, Dash and Curran (2004)) shows a linear tendency in all cases with respect to the total N content (g·m-2) and this relationship was used for the estimation of optimum %Nuptake. This correlation became little bit worse ( R2>0.9 ) when passing from the narrow band of the radiometer with less than 2 nm bandwidth to 20 nm that is the case of Sentinel-2.

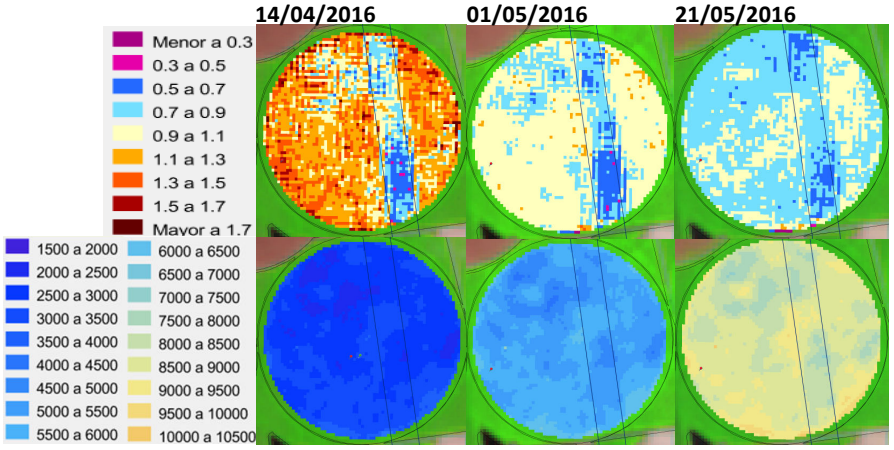


**Fig 4. Temporal evolution of the NNI (upper row of plots) and the biomass (lower row of plots) in the study area in three selected dates in 2016.**

## Conclusions

The decision support systems based on Remote Sensing data and agronomic and management information can be used to define optimum fertilization amounts, increasing the efficiency in use of N. The NNI maps obtained provide valuable information for the implementation of variable rate strategies, adapting the fertilizers to the actual crop requirements and increasing management efficiency.

The selected red-edge vegetation index can be implemented to feed the models for monitoring the crop N status. The direct way is to provide the N content, which can be seen in this experiment and can be estimated in an operational way. All the studied indices can be applied to remote sensing data (satellite and aerial platforms) in order to provide large scale maps of N content. The empirical method shown in this paper should be validated along time and space, in other areas and checking the stability of these relationships along time.

## Major references

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