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Tu campo desde el cielo

COMMERCIAL WHEAT FERTILIZATION BASED ON NITROGEN NUTRITION INDEX AND YIELD FORECAST

Carmen Plaza, María Calera, Anna Osann, Jaime Campoy, Vicente Bodas, Alfonso Calera

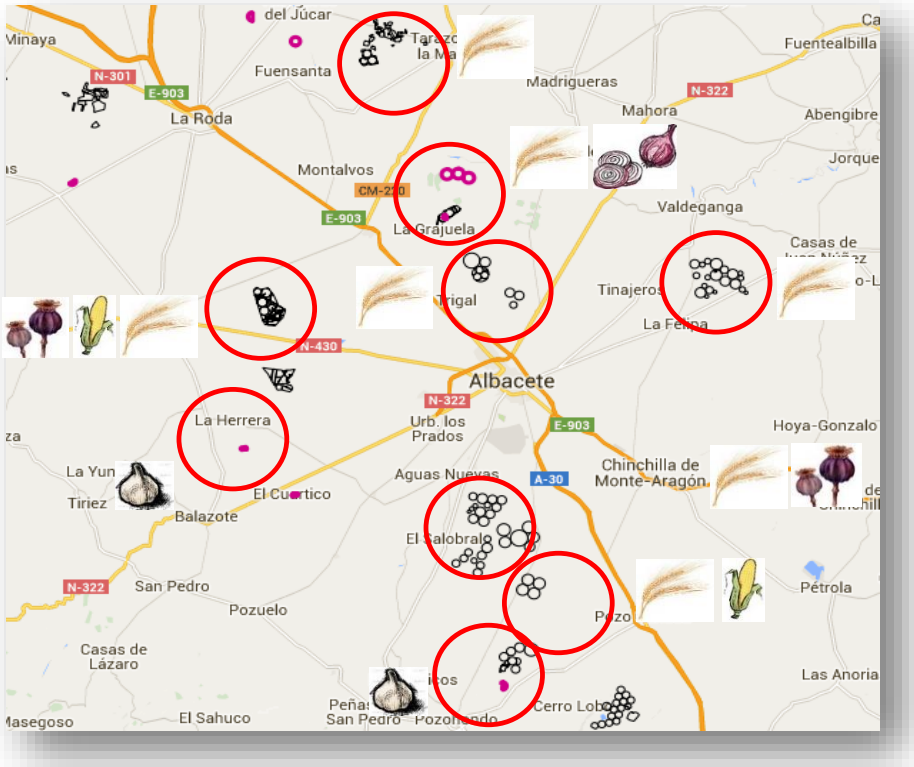
EGU General Assembly 2020

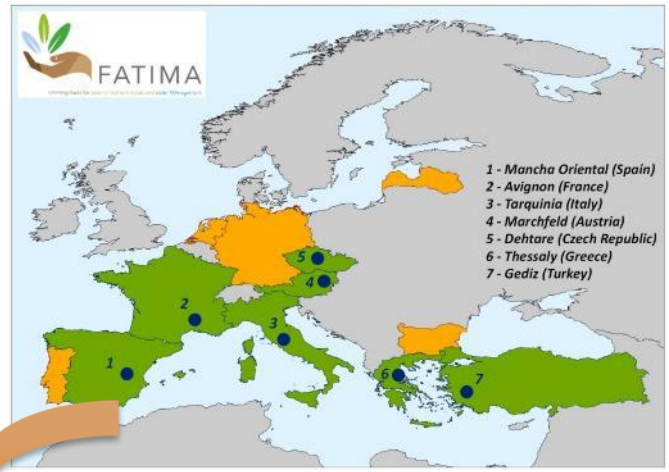
European Geoscience Union
4 – 8 May 2020

Framework

FATIMA

FArming Tools for external nutrient Inputs and water MAnagement





http://fatima-h2020.eu/

ALBACETE
Southeast of Spain,
semi-arid climate

23 plots

2 field campaigns

> 800 ha

5 crops

3.168 soil samples

3.112 biomass samples

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In season Diagnostic Tool: Fine-tunning of N supply

Nitrogen Nutrition Index

Ratio between the actual nitrogen concentration (%Na) over the critical nitrogen concentration (%Nc) for the crop analyzed *(Justes et al., 1997)*

$$NNI = \frac{\%Na}{\%Nc}$$

$$\%Na = \frac{QNa}{B}$$

Biomass

$$\%Nc = A \cdot B^{-m}$$

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Estimation of biomass and yield

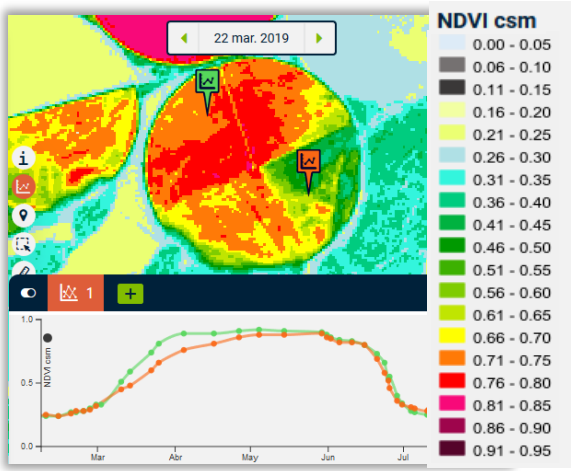
NDVI → Kt → Tpot → BIOMASS → YIELD

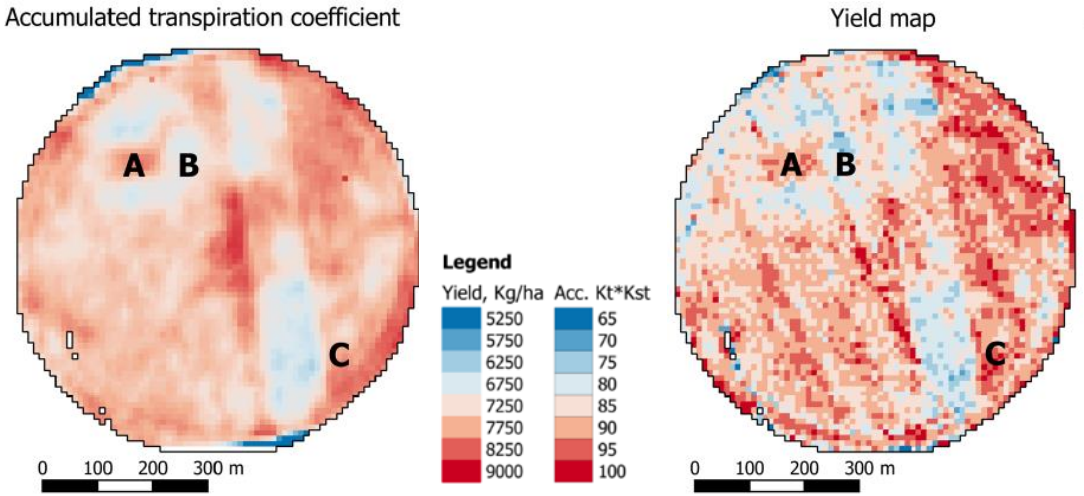
$$Kt = 1.5 \cdot NDVI - 0.2$$
(*Campos et al.* 2018)

$$T_{pot} = ETo \cdot Ks \cdot Kt$$

$$B = \int WP \cdot T_{pot} \cdot dt$$

HI





Good correlation between RS based yield map and measured yield monitoring map

Contents lists available at ScienceDirect

Field Crops Research

journal homepage: www.elsevier.com/locate/fcr

Remote sensing-based crop biomass with water or light-driven crop growth models in wheat commercial fields

Isidro Campos[a,*], Laura González-Gómez[a], Julio Villodre[a], Jose González-Piqueras[a], Andrew E. Suyker[b], Alfonso Calera[a]

In season Diagnostic Tool: Fine-tuning of N supply

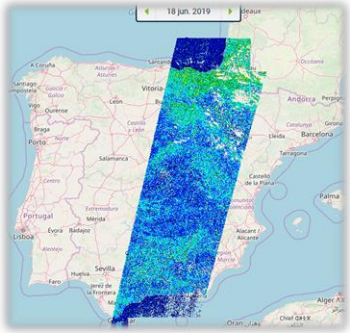
Nitrogen Nutrition Index

$$NNI = \frac{\%Na}{\%Nc}$$

$$\%Na = \frac{QNa}{B}$$

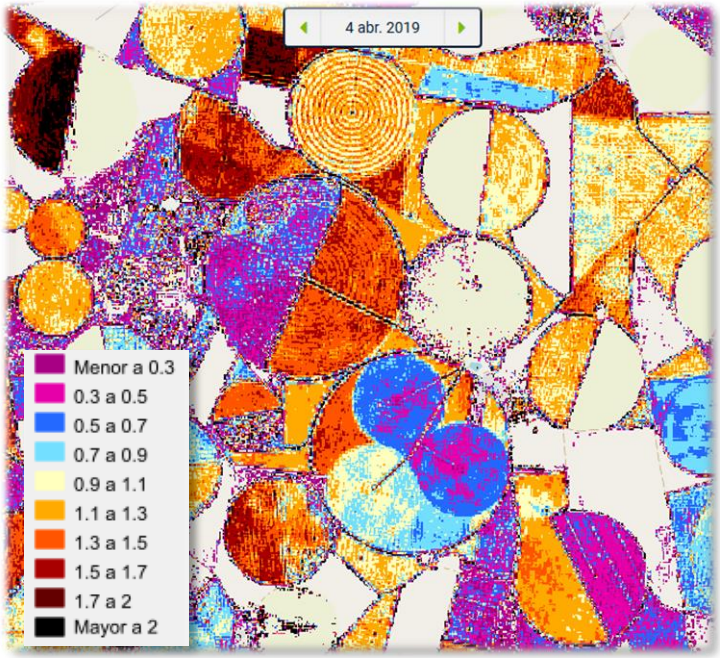
$$QNa = 38.56 \cdot MTCI - 56.707$$

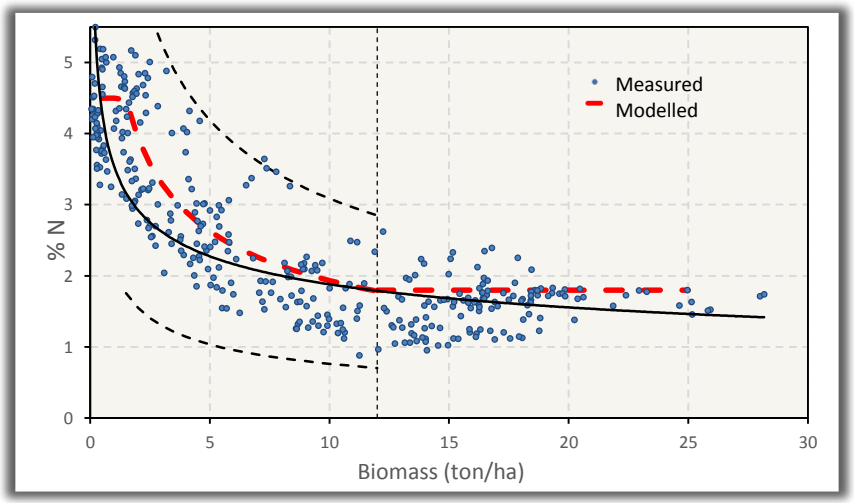
MERIS Terrestrial Chlorophyll index
(Dash & Curran, 2004)
Spectral bands 6, 5 and 4 of Sentinel 2A and 2B



$$\%Nc = A \cdot B^{-m}$$

$$\% \text{ Nc} = 5.35 \cdot \text{B}^{-0.442}$$





Justes, E., Mary, B., Meynard, J.-M., Machet, J.-M., Thelier-Huches, L., 1994. Determination of a critical nitrogen dilution curve for winter wheat crops. Annals of Botany 74, 397–407.

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Practical application in a farm

Campaign 2019

354 ha

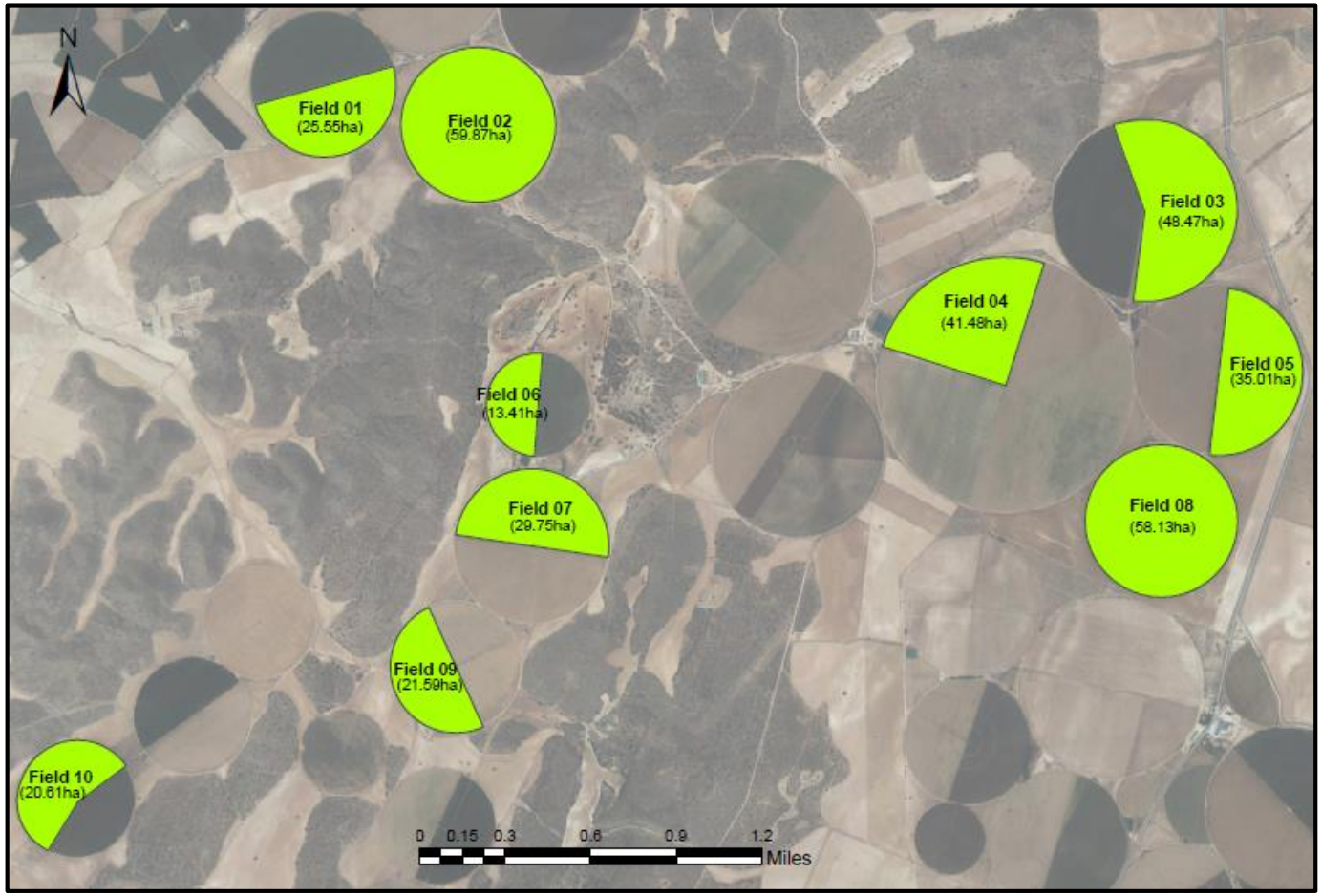
Wheat

10 Irrigated plots

Albacete

Semi-arid climate

Shallow soils



- Target yield: 10 ton/ha
- Protein content: 14 - 15%
- N uptake: 32 Kg N/ton (320 Kg N/ha)
- Fertilizer: UAN-32, 5-6 split applications

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Practical application in a farm

PLANNING OF FERTILIZATION

FERTILIZATION	N (Kg/ha)
Pre-sowing	53
Top dressing	187
TOTAL	**240**

14 May (flowering): + 32 Kg N/ha

11.328 NFU (total surface)

Is it necessary to apply more N?

LET´S ANSWER SOME QUESTIONS

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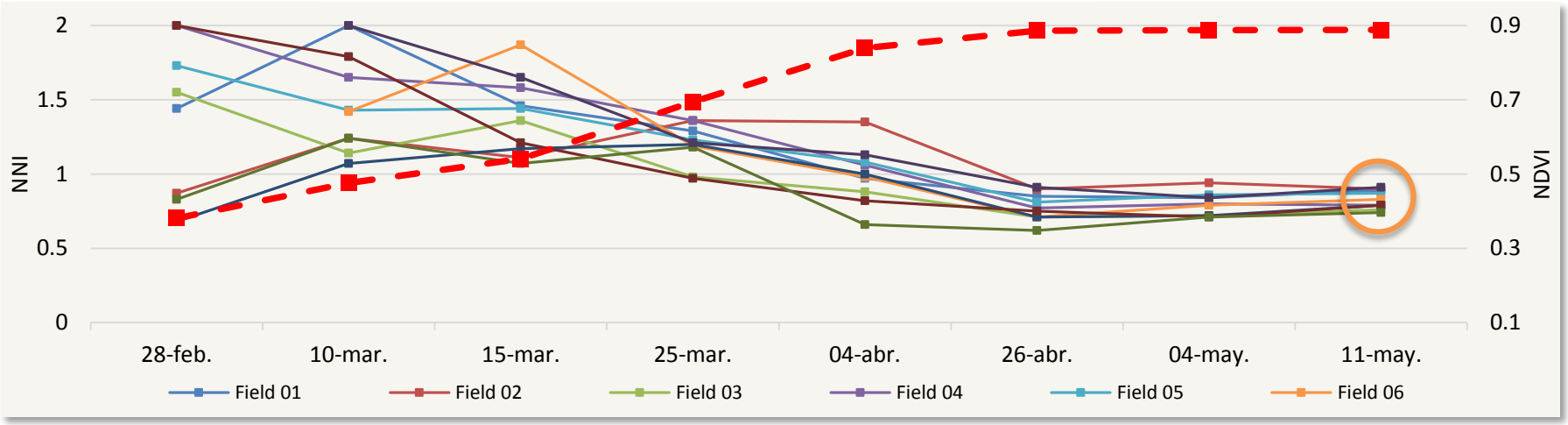
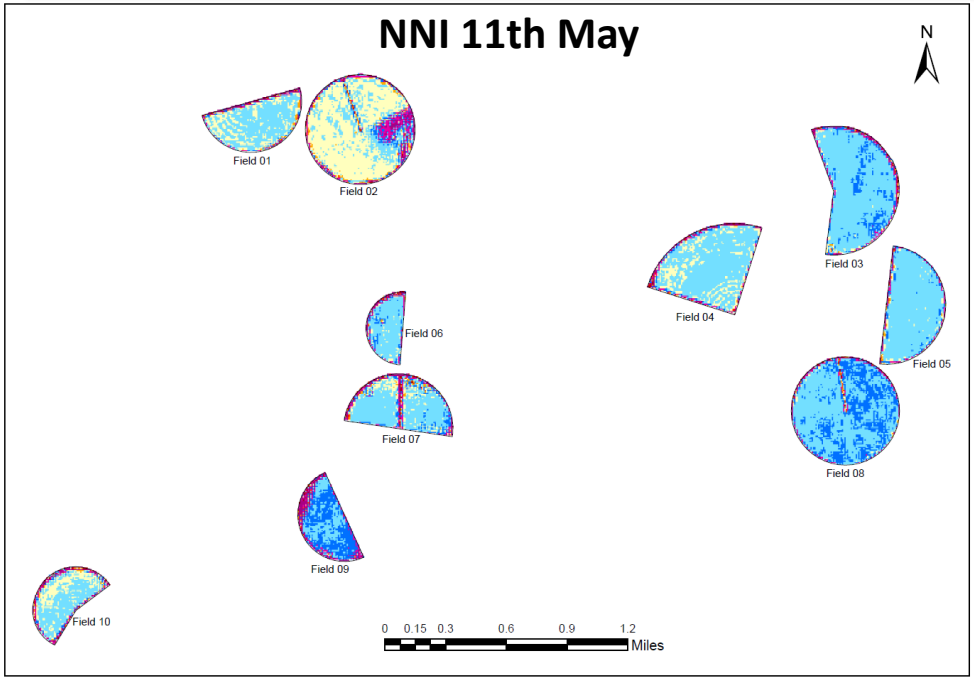
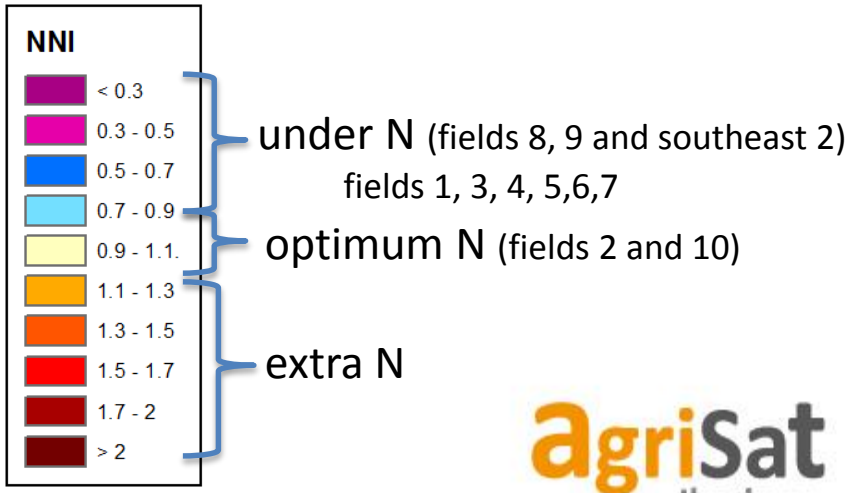
Practical application in a farm

1.- What is the NNI level in each plot?







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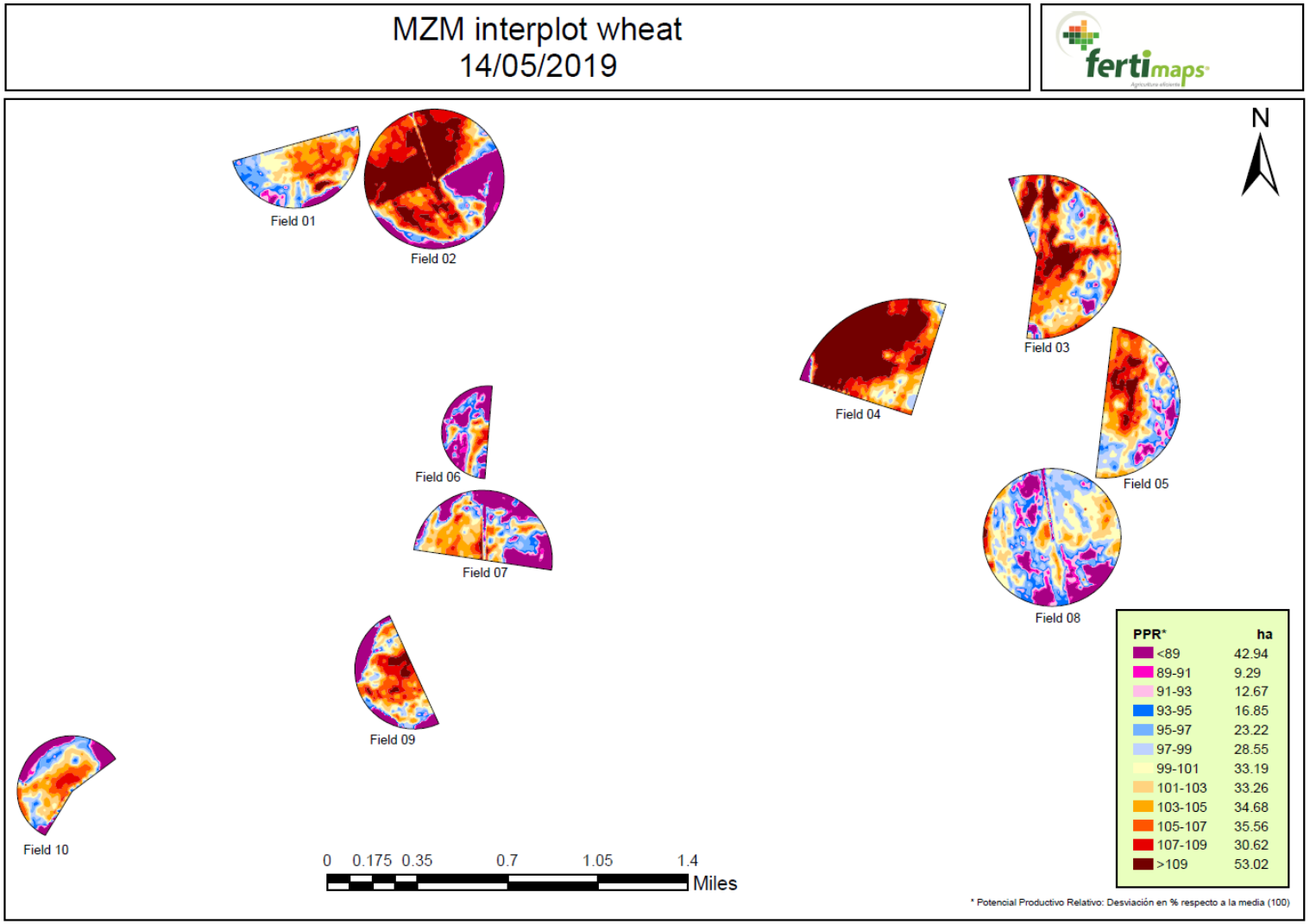
2.- What is the spatial distribution of productive potential?



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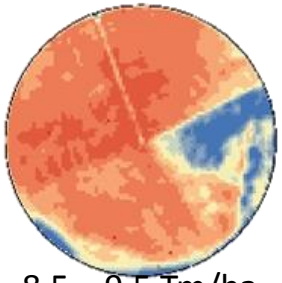
3.- What is the expected yield in each plot?

FORECAST HARVEST

Field 01

8,3 – 9,3 Tm/ha

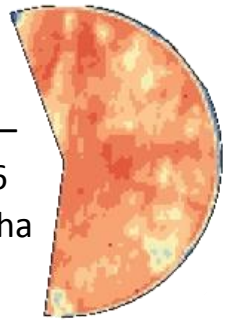
Field 02



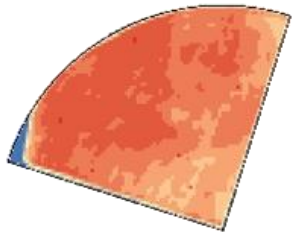
8,5 – 9,5 Tm/ha

Field 03

8,6 – 9,6 Tm/ha



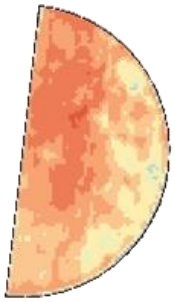
Field 04



9,1 – 10 Tm/ha

Field 05

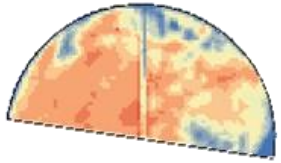
8,5 – 9,5 Tm/ha



Field 06

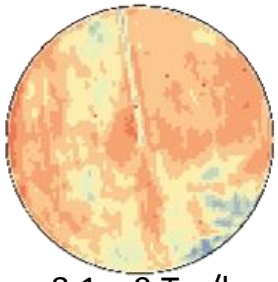
7,5 – 8,4 Tm/ha

Field 07



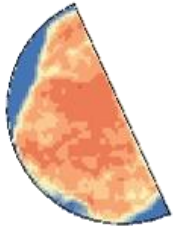
7,8 – 8,7 Tm/ha

Field 08



8,1 – 9 Tm/ha

Field 09



7,9 – 8,8 Tm/ha

Field 10

7,9 – 8,8 Tm/ha

Yield (Kg/ha)

- 0 - 5000
- 5000 - 5500
- 5500 - 6000
- 6000 - 6500
- 6500 - 7000
- 7000 - 7500
- 7500 - 8000
- 8000 - 8500
- 8500 - 9000
- 9000 - 9500
- 9500 - 10000
- > 10000

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Practical application in a farm

4.- What is the necessary amount of N to obtain these yields?

Field	01	02	03	04	05	06	07	08	09	10
Yield forecast (tm/ha)	8,8	9	9,1	9,6	9	8	8,2	8,5	8,3	8,3
N uptake (Kg/ha)	**282**	**288**	**291**	**307**	**288**	**256**	**262**	**272**	**266**	**266**
Applied N (Kg/ha)	**240**	**240**	**240**	**240**	**240**	**240**	**240**	**240**	**240**	**240**
Pending N (Kg/ha)	**42**	**48**	**51**	**67**	**48**	**16**	**22**	**32**	**26**	**26**
NNI evolution 11-may	0.89	0.9	0.76	0.79	0.87	0.83	0.79	0.79	0.74	0.91
04-may	0.84	0.94	0.72	0.8	0.86	0.79	0.72	0.71	0.71	0.84
26-abr	0.85	0.9	0.71	0.77	0.81	0.71	0.71	0.75	0.62	0.91
04-abr	0.97	1.35	0.88	1.06	1.08	0.98	1	0.82	0.66	1.13
25-mar	1.29	1.36	0.98	1.36	1.23	1.19	1.2	0.97	1.18	1.21
15-mar	1.46	1.11	1.36	1.58	1.44	1.87	1.17	1.21	1.07	1.65
10-mar	2	1.24	1.14	1.65	1.43	1.42	1.07	1.79	1.24	2
	Apply 32 NFU		Apply 64 NFU		Apply 32 NFU	Not apply				

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Usual management vs NNI strategy

		USUAL MANAGEMENT		NNI STRATEGY		RESULTS	
Field	Surface (ha)	N (Kg/ha)	N (Kg)	N (Kg/ha)	N (Kg)	Real yield (Tn/ha)	Protein (%)
01	25,6	32	819	32	819	**9,9**	**15,4**
02	45		1440	32	1440	**8,3**	**14,6**
02	15		480				
03	48,5		1552	64	3104	**8,4**	**15,6**
04	41,5		1328	64	2656	**9,9**	**15,2**
05	35		1120	32	1120	**8,7**	**13,6**
06	13,4		429			**6,6**	**13,6**
07	29,8		954			**8,1**	**14,5**
08	58		1859			**8,2**	**14,3**
09	21,6		691			**6,8**	**14,2**
10	20,6		659			**7**	**13,8**
		11.331 Kg N		**9.139 Kg N**			

Savings of 2.192 Kg N → **6.850 Kg fertilizer (UAN32)** → **€ 1.750 (1 application)**

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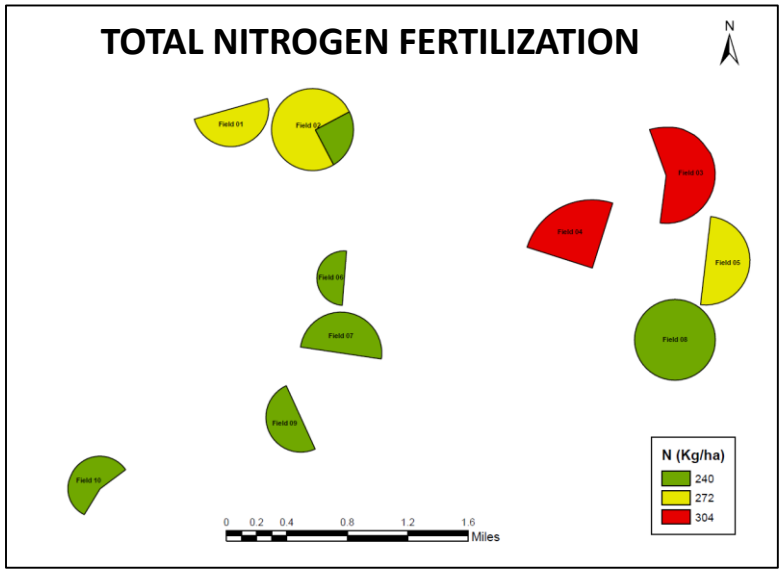
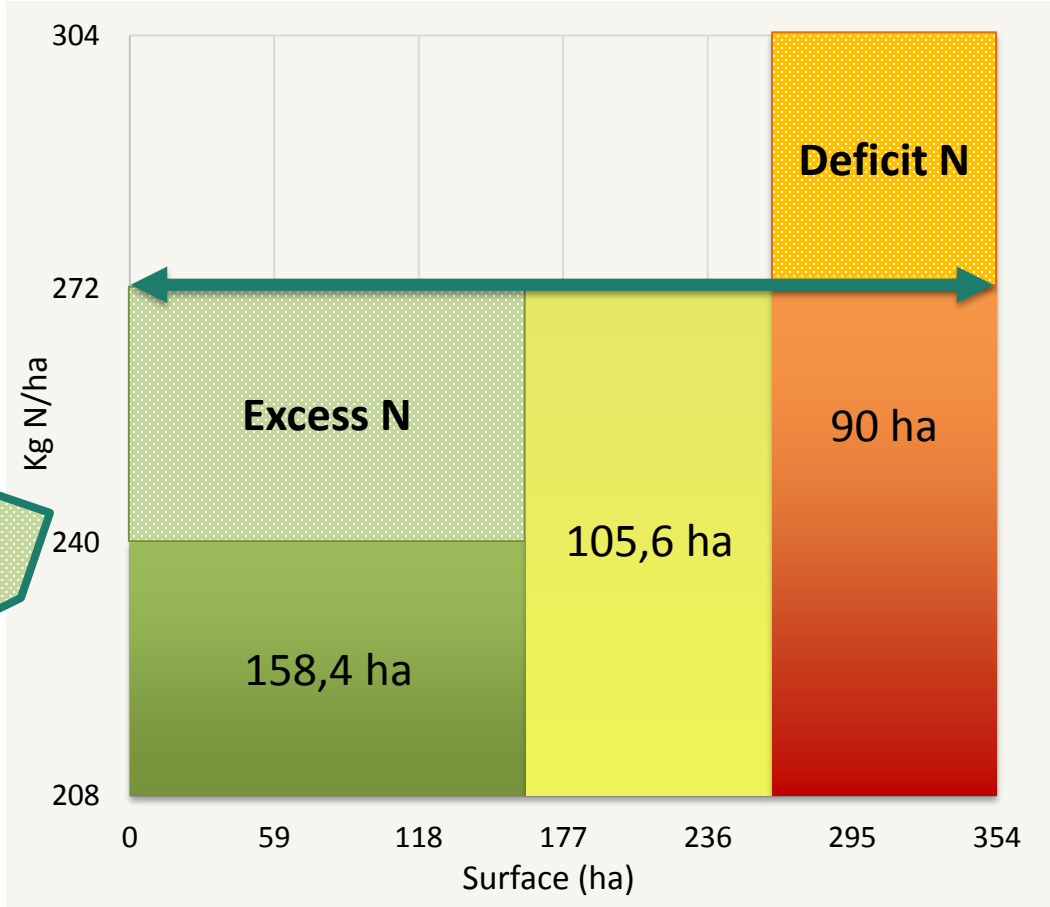
Environmental savings





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Conclusions

- ✓ ***EO time series*** *are the main input to estimate* ***yield forecast*** *and the* ***NNI*** *generation. Boths products are crucial to* ***make the fertilization decission****.*
- ✓ *The methodology manages to* ***reduce N amounts****:* ***environmental*** *and economic benefits.*
- ✓ ***Excellent protein content****, the highest value in the history of the farm (14,5 % average for the total).*
- ✓ ***Operational procedure****, at low cost for farmers.*

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THANK YOU!

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