SANCHO'S THIRST

the effects of cover crops on multiple ecosystem services in woody crops of semiarid areas

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Gustave Doré, 1863

EJP SOIL
European Joint Programme

Annual Science Days
Riga. 2023

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1 . BAU. Consequences

Ploughing (2 to 6 times per year, 15 to 30 cm depth)

- Bare soil
- Weak soil structure
- Low SOC
- Erosion
- Nutrient and water loss

In the long term:

- Low productivity
- Land Abandonment and poverty

2 . Benefits of Cover Crops

What is a CC?

One of the management practices to improve soil protection and soil health

In woody crops (olive orchards, vineyards, almond orchards etc.) they can be:

sown grasses, legumes (o mixed) or spontaneous

- In the middle of the strips
- Alternate strips
- Aromatic plants/shrubs
- Covering the whole area

Mulching with wood chips or shredded wood

The European Commission includes this practice for the CAP in 2023.

Area under **olive trees** in the EU → 4.6 Mha
Spain (2.5 Mha), Italy (1.4 Mha)

Area under **vineyard** in the EU → 3.2 Mha
Spain (0.9 Mha), Italy (0.7 Mha)

Wine or Oil quality? not clear

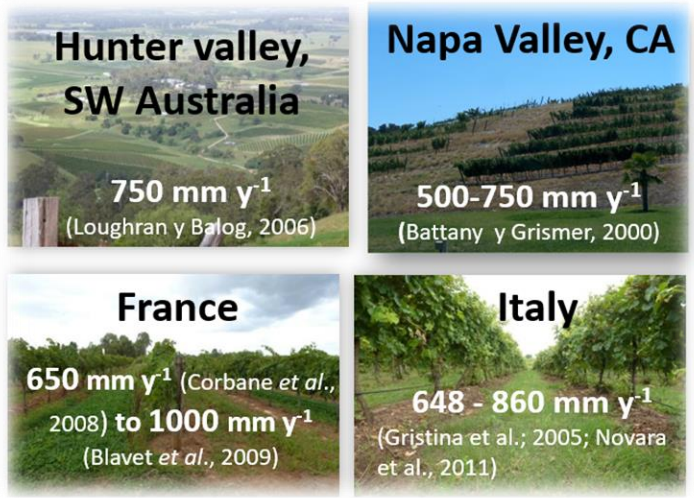
Balance of benefits

Cover crops

1. Water deficit for quality wines
2. Erosion control
3. Promote infiltration
4. Increase SOM
5. Improve soil structure
6. Improve biodiversity
7. Facilitate workability
8. Save money

Tillage practices BAU

1. Traditional and well known
2. In general, increase production
3. Maintain soil moisture in spring



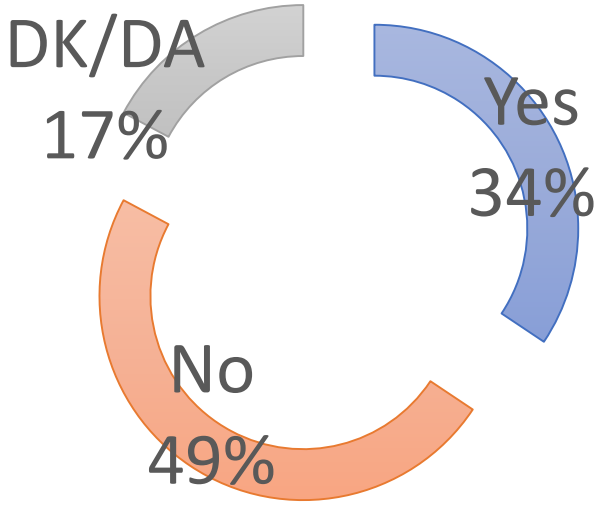
3 . Implementation of CC

The opinion of farmers

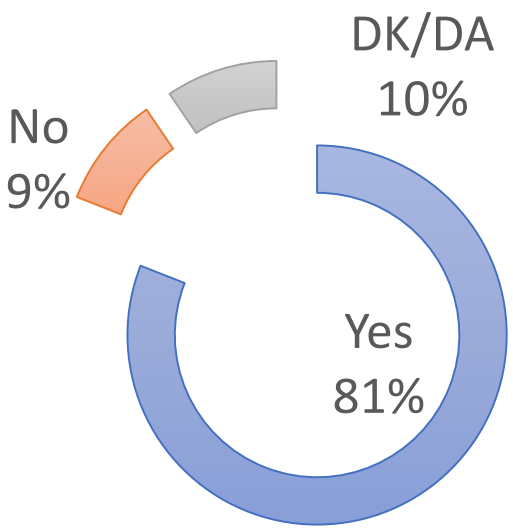
Survey 64 farmers

Regions:
Madrid
Castilla La Mancha

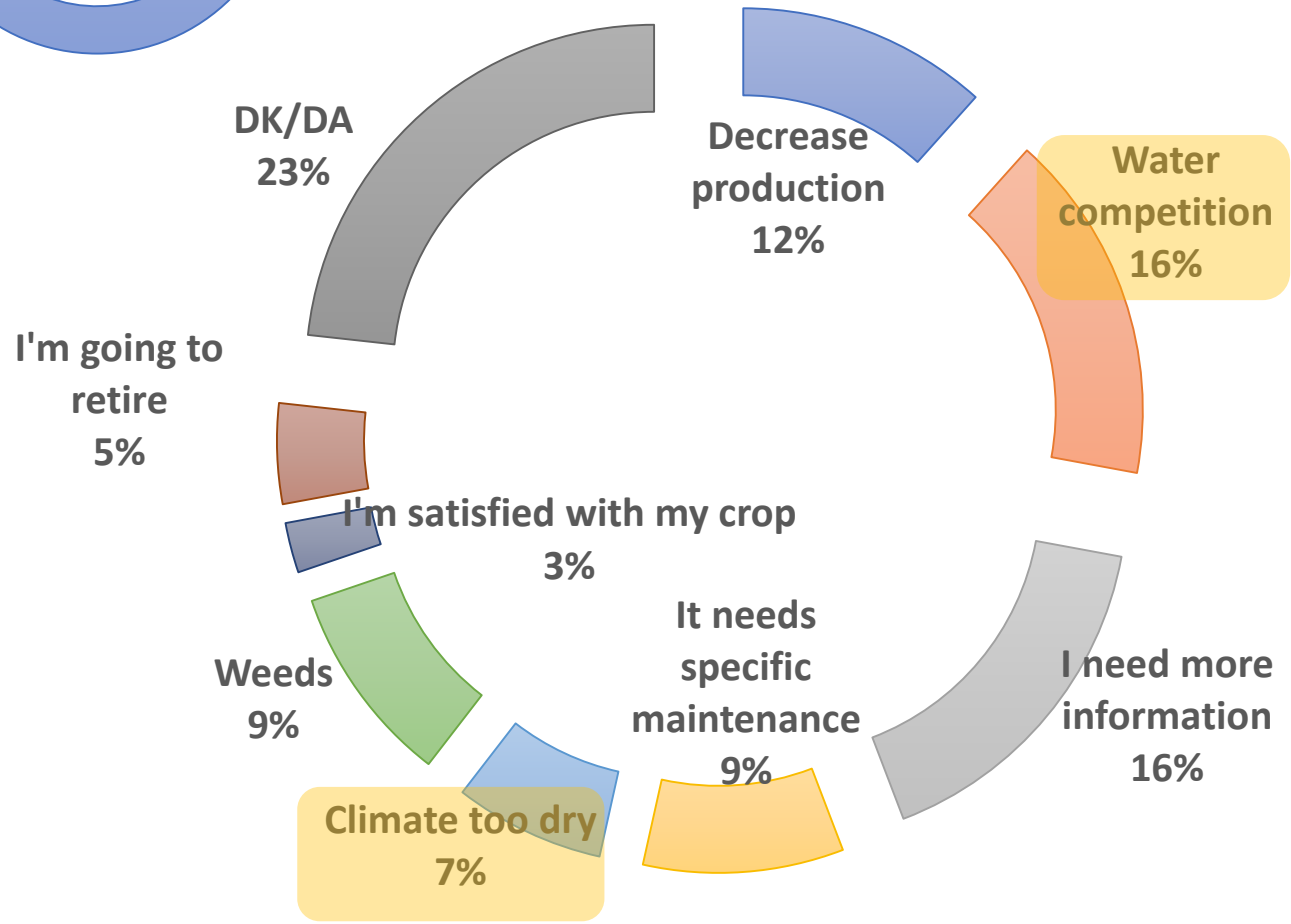
Would you change to CC since they promote soil conservation?



Are you worried about soil erosion?

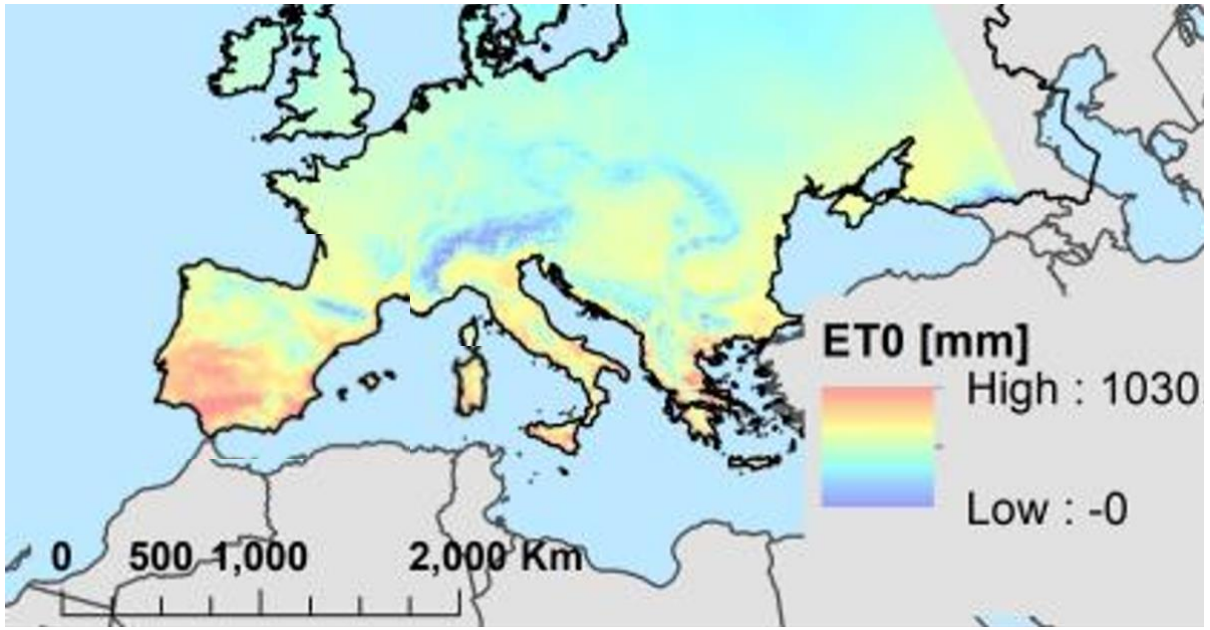


Why?



Marques MJ, Velasco A., Ruiz-Colmenero M., Cuadrado, J., Bienes R. 2010.

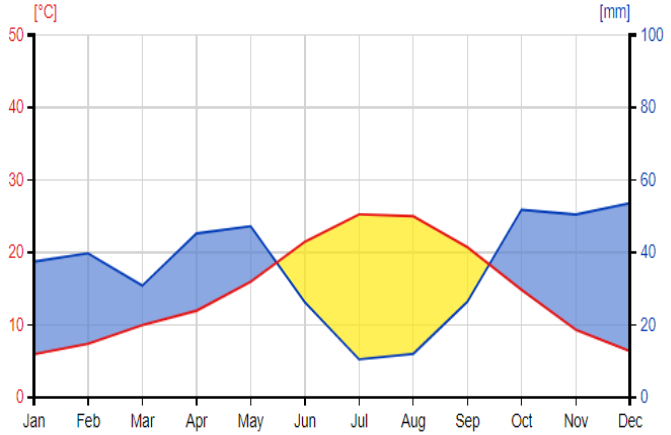
Central Spain



Sardinia, Italy

Aranjuez, Madrid, Spain

39.972N, 3.577W | Elevation: 631 m | Climate Class: Cfa | Years: 1975-2004



Month	Temp	Precip
Jan	6.0	37.4
Feb	7.4	39.7
Mar	10.0	30.9
Apr	12.0	45.2
May	16.0	47.2
Jun	21.4	26.3
Jul	25.2	10.5
Aug	25.0	12.0
Sep	20.7	26.4
Oct	14.8	51.8
Nov	9.3	50.5
Dec	6.4	53.6

Temperature Mean: 14.5 °C Precipitation Sum: 431.4 mm

Rain

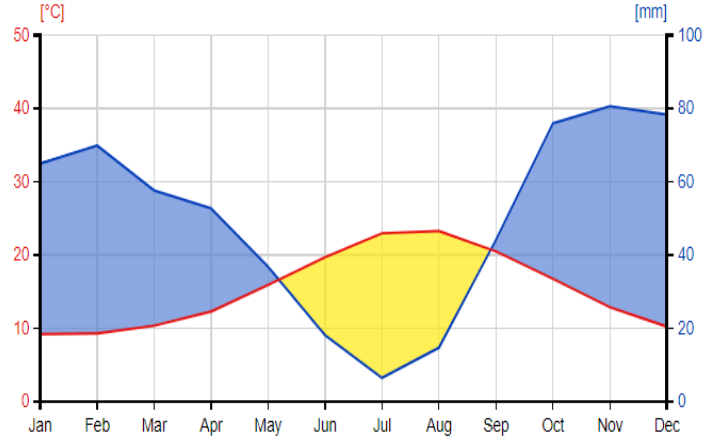
400- 600 mm/yr

ETP

800-1000 mm/yr

Sassari, Sardinia, Italy

40.722N, 8.545E | Elevation: 160 m | Climate Class: Cfa | Years: 1967-1996



Month	Temp	Precip
Jan	9.2	64.9
Feb	9.3	69.8
Mar	10.4	57.6
Apr	12.3	52.7
May	15.9	36.8
Jun	19.7	18.1
Jul	23.0	6.5
Aug	23.3	14.7
Sep	20.5	44.1
Oct	16.8	75.9
Nov	12.9	80.6
Dec	10.2	78.3

Temperature Mean: 15.3 °C Precipitation Sum: 600.1 mm

Charts: https://climatecharts.net/

Map: 10.3390/atmos13050772

4. Objectives **SANCHO'S THIRST**

- What are the effects of **CC** for different Ecosystem Services?
- Can we see these effects by remote sensing?
- Regarding climate change adaptation/mitigation, what will happen in the future? **CC** vs BAU
- Can we recommend **CC** in semiarid areas?

5 . Partners & Tasks

UAM
Universidad Autónoma de Madrid

iMiDRA
Instituto Madrileño de Investigación y Desarrollo Rural, Agrario y Alimentario

utad
UNIVERSIDADE DE TRÁS-OS-MONTES E ALTO DOURO
CITAB

uniss
UNIVERSITÀ DEGLI STUDI DI SASSARI

Silesian University of Technology

AgroParisTech
université PARIS-SACLAY

INRAE
la science pour la vie, l'humain, la terre

INRAE, l'Institut national de recherche pour l'agriculture, l'alimentation et l'environnement

L'INSTITUT agro Rennes Angers

Location of **private vineyards and olive groves** (**30 to 40 sites, Spain and Italy**) to monitor soil health, with and without **CC**

Select **experimental farms** **(2 sites in Spain and Italy)** to measure soil health and grape and olive production and phenology over two years, with and without **CC**

- SOM characterization, SOC, forms of N
- Available water
- Mineral composition
- Spectro radiometric analysis
- Biotic indicators → Enzymatic Activity

To determine if **CC** promote more efficient and long-term C sequestration by the **isotopic signature of soils**

- Isotopic signatures → ^{13}C and/or ^{15}N and ^{14}C on bulk fraction

To identify and quantify the **Ecosystem Services indicators** associated with **CC**.
Development of a composite indicator

- Provisioning
- Regulating
- Cultural
- Support

To **model over time** the influence of **CC** on Ecosystem Services, including edaphic and productive parameters, in different climate change scenarios

- Experimental farms: Phenological cycle of vine and olive tree (flowering, fruit set, development, ripening, harvest, dormancy) by Growing Degree Days GDD

To **improve remote sensing tools**, to map SOC & water content, considering disturbing physical-chemical factors

- Influence of texture
- Influence of iron oxides
- Monitoring and influence of soil moisture
- Influence of rougness

Dissemination and demonstration campaigns

- + Video documentary and MOOC

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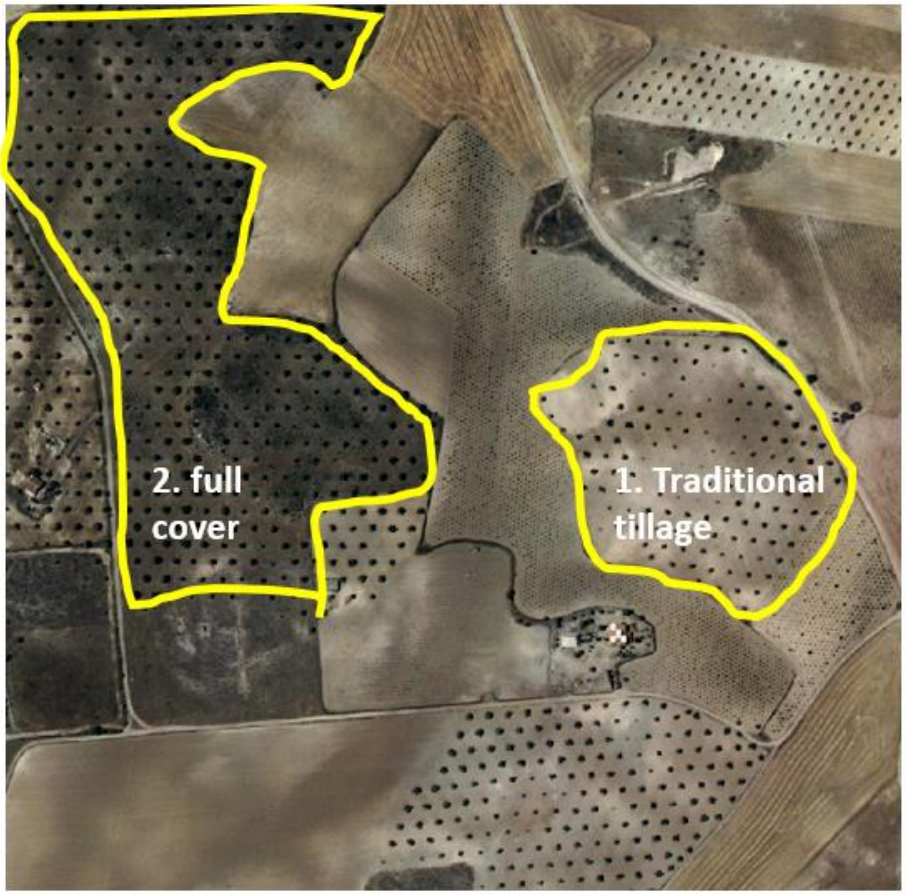
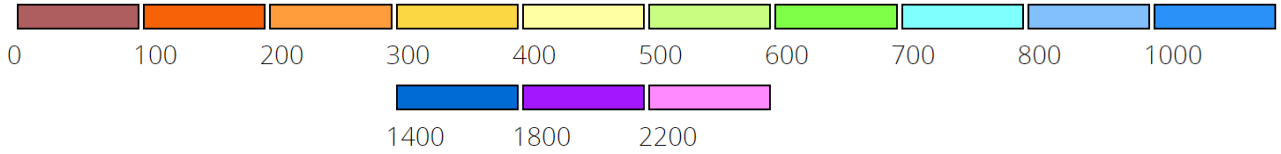
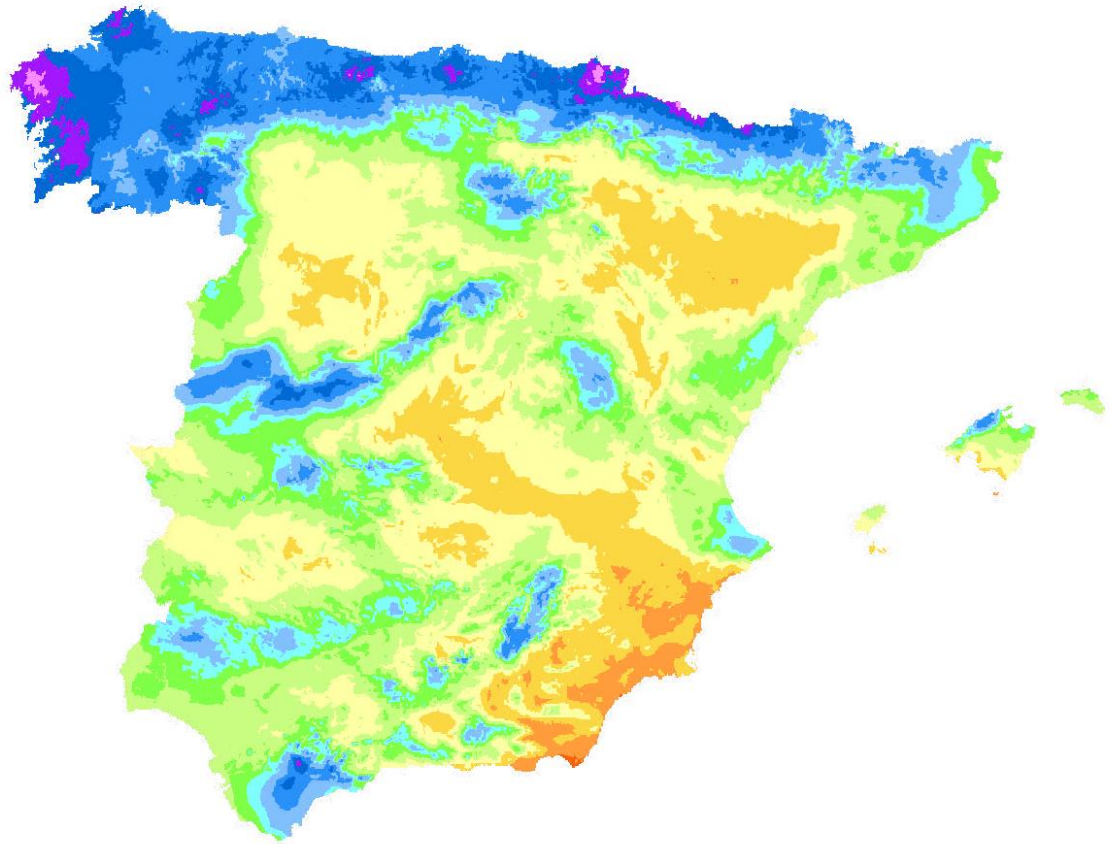


SAMPLING SITES

1. Contact farmers with **CC** (*many years*)
2. Sample the CC plot
3. Sample a TILLED plot around

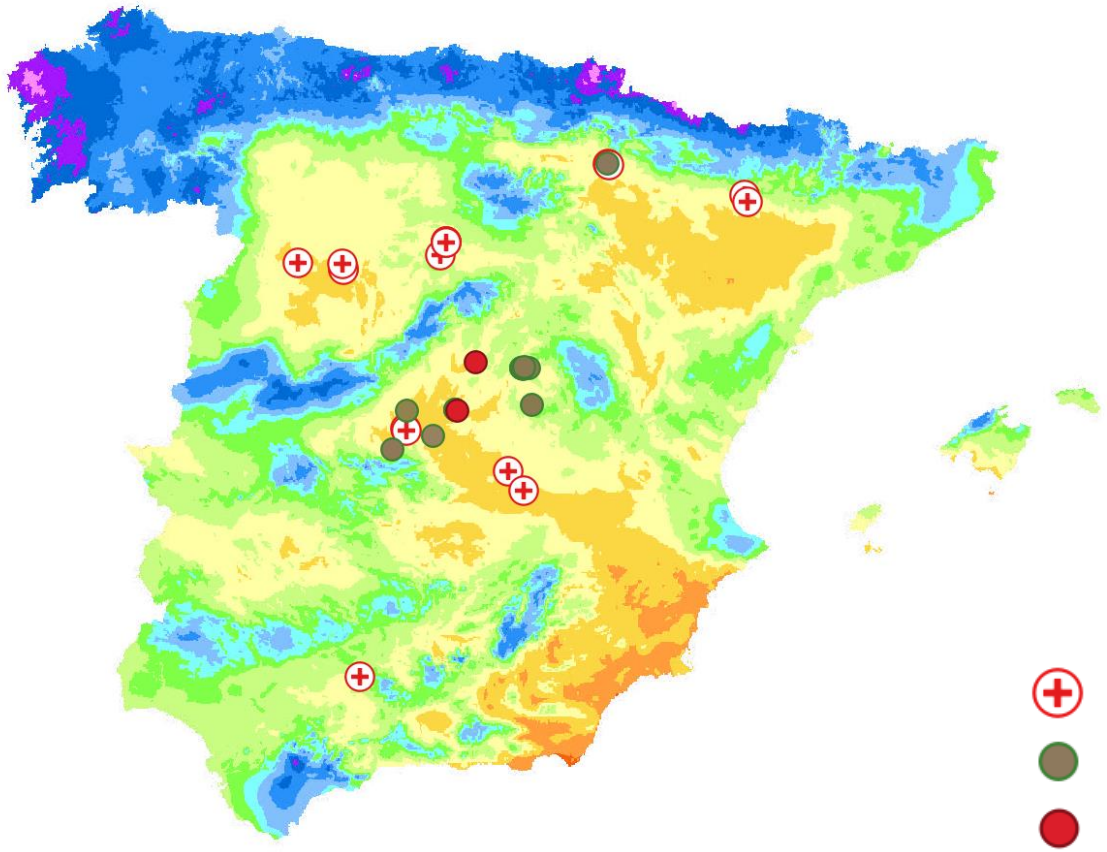
Annual Rainfall (mm)





Annual Rainfall (mm)

0 100 200 300 400 500 600 700 800 1000 1400 1800 2200



Vineyards

Olive groves

Experimental farms

More than 5 years of **CC**

Experimental farms

Finca El Encín, Alcalá de Henares
Viticulture

Finca La Chimenea, Aranjuez
Olive growing


Bodegas Ochoa, Navarra


Alma del olivo, Toledo


César Peribáñez, Burgos


La Común, Guadalajara


Bodegas Ochoa, Navarra


Bodegas Robles, Córdoba


Gálvez, Toledo


Thank you for your attention
Lagar Quixote, Ciudad Real

Provisioning services

Goods produced or provided by ecosystems

- Food
- Fuel wood
- Fiber
- Timber

Regulating services

Benefits from regulation of ecosystem processes

- Water partitioning
- Pest regulation
- Climate regulation
- Pollination

Cultural services

Nonmaterial benefits from ecosystems

- Spiritual
- Recreational
- Aesthetic
- Educational

Support services

Factors necessary for producing ecosystem services

- Hydrological cycle
- Soil formation
- Nutrient cycling
- Primary production

Source: Adapted from MEA 2003.

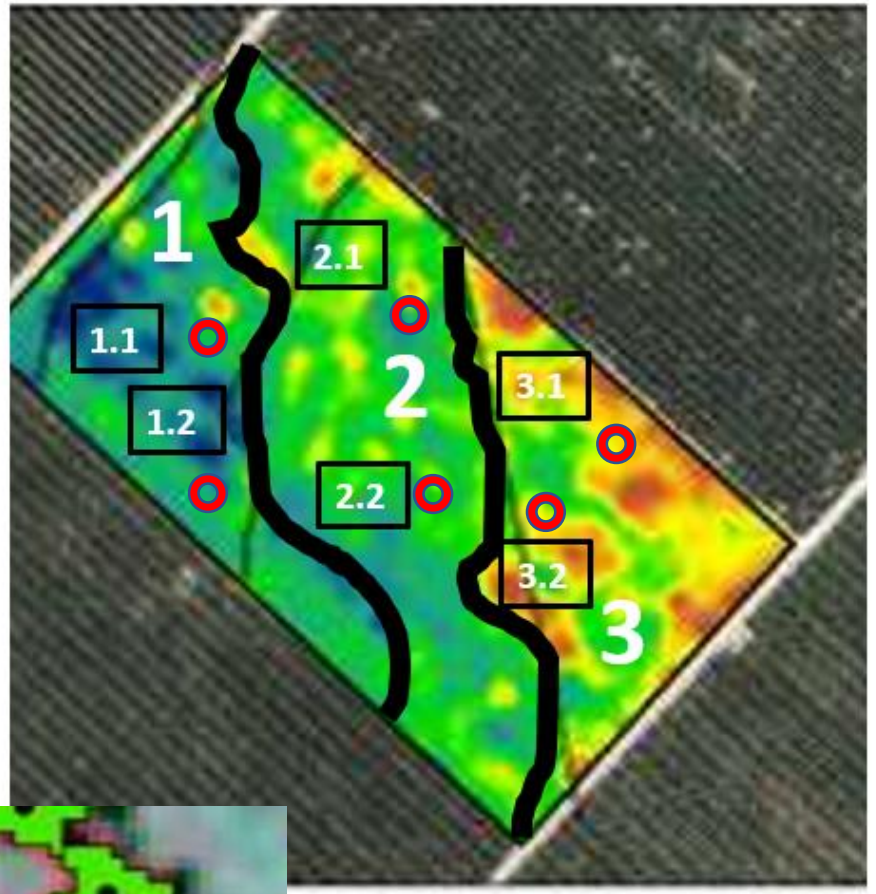

Aranjuez, España


Titulcia, España


16
Coordenada 437563 4598806
Escala 1:7422
Amplificador 100%
Rotación 0,0 °

Example.

The colors of the plot represent different values for NDVI. According to this indicator this plot could be divided in three stratums 1, 2 and 3 (this is the most complex alternative, homogeneous plots with one stratum are preferable)

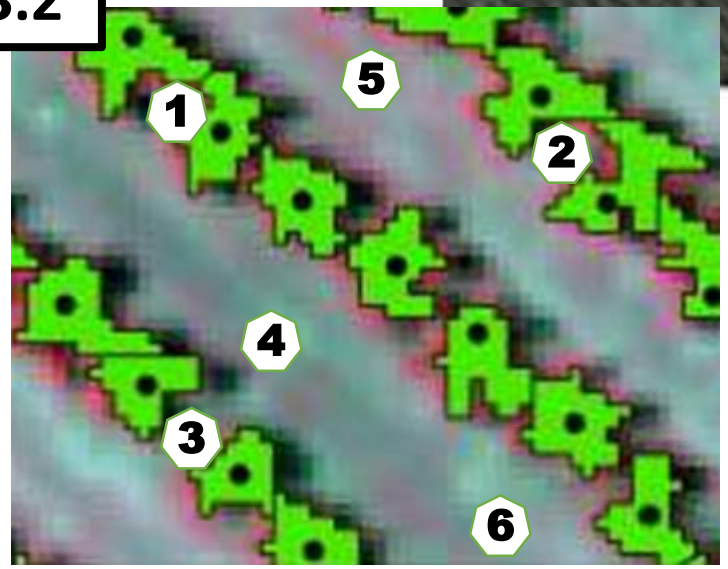


At each stratum, two composite samples should be taken:

1.1, 1.2
2.1, 2.2
3.1, 3.2

Each one of these composite samples is obtained with 6 sub-samples, for example 3.2

3.2



The composite sample 3.2 has 6 sub samples, 3 in the inter-row and 3 under the canopy

Each sub-sample has to be sampled at
0-10 cm depth
10 to 30 cm depth

- **Bulk density samples in this case will be:**
  2 per stratum and depth, so
  3 stratum x 2 samples x 2 depths = 12 cylinders

This plot will result in this number of laboratory analysis:
3 stratums x 2 composite samples x 2 depths = 12 bags