Breeding resilience oats in Mediterranean environment through phenotyping and modeling approaches

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Oats in the Mediterranean Basin vs. Northern Europe: Cultivated Area

In the last 20 years...

Northern Europe

Mediterranean Basin

In the Mediterranean area for oat cultivation
Oats in the Mediterranean Basin vs. Northern Europe

Average data over the last 20 years (FAO, 2015)

Area

Production

Yield

Agroclimatic conditions in the North may favour high yields...

BUT

...there is plenty of room to increase yield under southern conditions
Oats in the Mediterranean Basin

Reasons for the large cultivated area

- good adaptation to a wide range of soil types
- on marginal soils, oats can perform better than other small-grain cereals (usually oats are grown in poorer soils than wheat, for example)
- relatively good results with low inputs

Reasons for low yield

- yield instability (biotic and abiotic stresses)
- limited adaptation of many of the varieties used
- Low breeding effort (low yearly gain)

![Graph showing yield trends from 1961 to 2012 for Spain, Ireland, and France.]

- Spain: 22 Kg/year
- Ireland: 112 Kg/year
- France: 52 Kg/year
Understanding oats’ requirements under Mediterranean conditions

**Low input system:**
- low water availability

Oats have an extensive root system that penetrates the soil well, however...

- Transpiration rates are higher than in other small grain cereals (e.g., Ehlers, 1989; Coffman and Frey, 1961; Peltonen-Sainio, 1999).

- Water requirements are higher than other small grain cereals

- Are especially susceptible to grain abortion caused by drought and heat

**Important target**

**Drought Tolerance**
Understanding oats’ requirements under Mediterranean conditions

- Low input system: can tolerate low water availability and poor soils
- Stresses cause yield losses and yield instability: abiotic and biotic stresses

- Rust is more important during warmer periods and powdery mildew during cooler periods
- Mechanisms of pathogen spread are very efficient, making crop management practices inefficient for their control

Important target: Disease resistance
- Establishment and characterization of a reference oat collection.

- Genopyte by environment interaction analysis to determine the effects of particular climate and soil variables on these traits and accessions.

to inform selection
Establishment and characterization of a reference oat collection and analysis of its genetic diversity

709 oat accessions from the Mediterranean basin
The collection was evaluated in three environments.

**Data recorded:**
- Agronomic (yield, disease resistance, etc.)
- Soil (organic matter, pH, nutrients, etc.)
- Climate (rain, temperatura, etc.)
How does environmental factors influence yield?
Redundancy analysis: Climatic variables

Rain pre flowering
Rain post flowering
Radiation pre flowering
Average temperature pre flowering

NOT SIGNIFICANT

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<th>Redundancy Analysis</th>
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<td><strong>F Pr(&lt;F)</strong></td>
<td><strong>r²</strong></td>
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<td>0.006 **</td>
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Canonical Correspondence Analysis

Axis 1

Axis 2

Rain pre flowering

Rain post flowering

Average Temperature post flowering

Radiation pre flowering
Redundancy analysis: Soil variables

Limestone

Organic matter

NOT SIGNIFICANT

Available potassium

NOT SIGNIFICANT

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</tbody>
</table>
Canonical Correspondence Analysis
¿How does environment influence oat yield?

**ENVIRONMENT** = 52.7%

** and *** indicate significant differences at P<0.01 and 0.001 respectively
Thank you

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