High-throughput phenotyping of pea physiological traits for drought stress tolerance

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Introduction

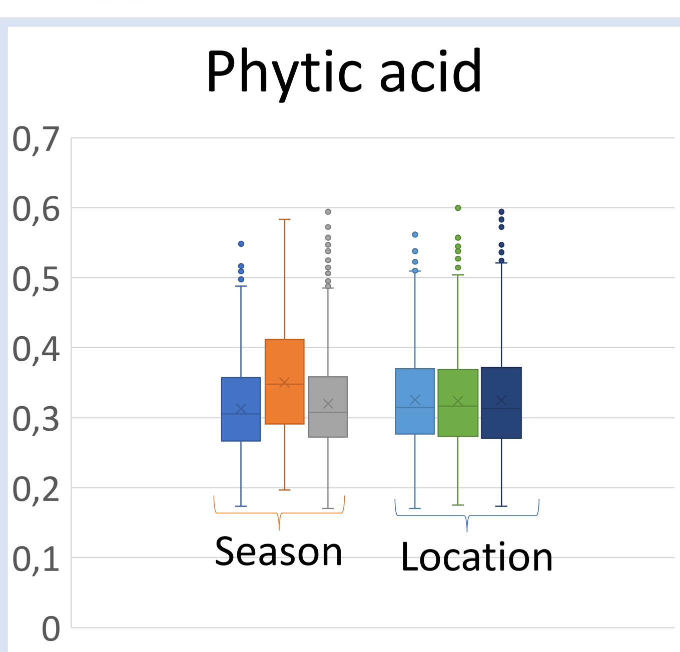
Drought is increasingly frequent in the context of climate change and is considered a major constraint for crop yield. **Pea (*Pisum sativum*)** is a temperate grain legume rich in protein, fibre, micronutrients, and bioactive compounds that can benefit human health. The development of **new cultivars with increased drought tolerance** is critical for sustaining genetic gains in crop improvement programs.

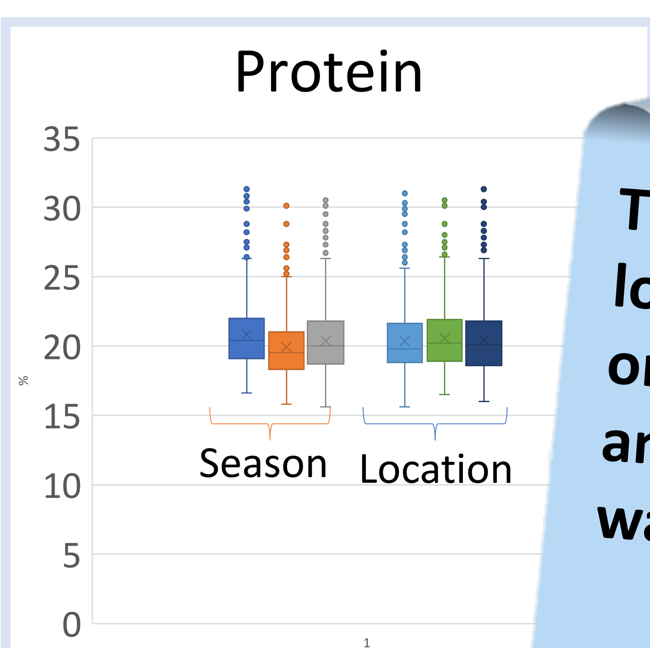
This study aimed to profile a **pea collection** with 325 accessions. These were grown in three different locations, and in different seasons, and the interaction effect of **Genotype× Environment (G × E) on seed quality** was investigated. Also, the present study aimed at understanding the **morpho-physiological mechanisms behind drought stress tolerance** in pea plants using high-throughput phenotyping tools.

Methods

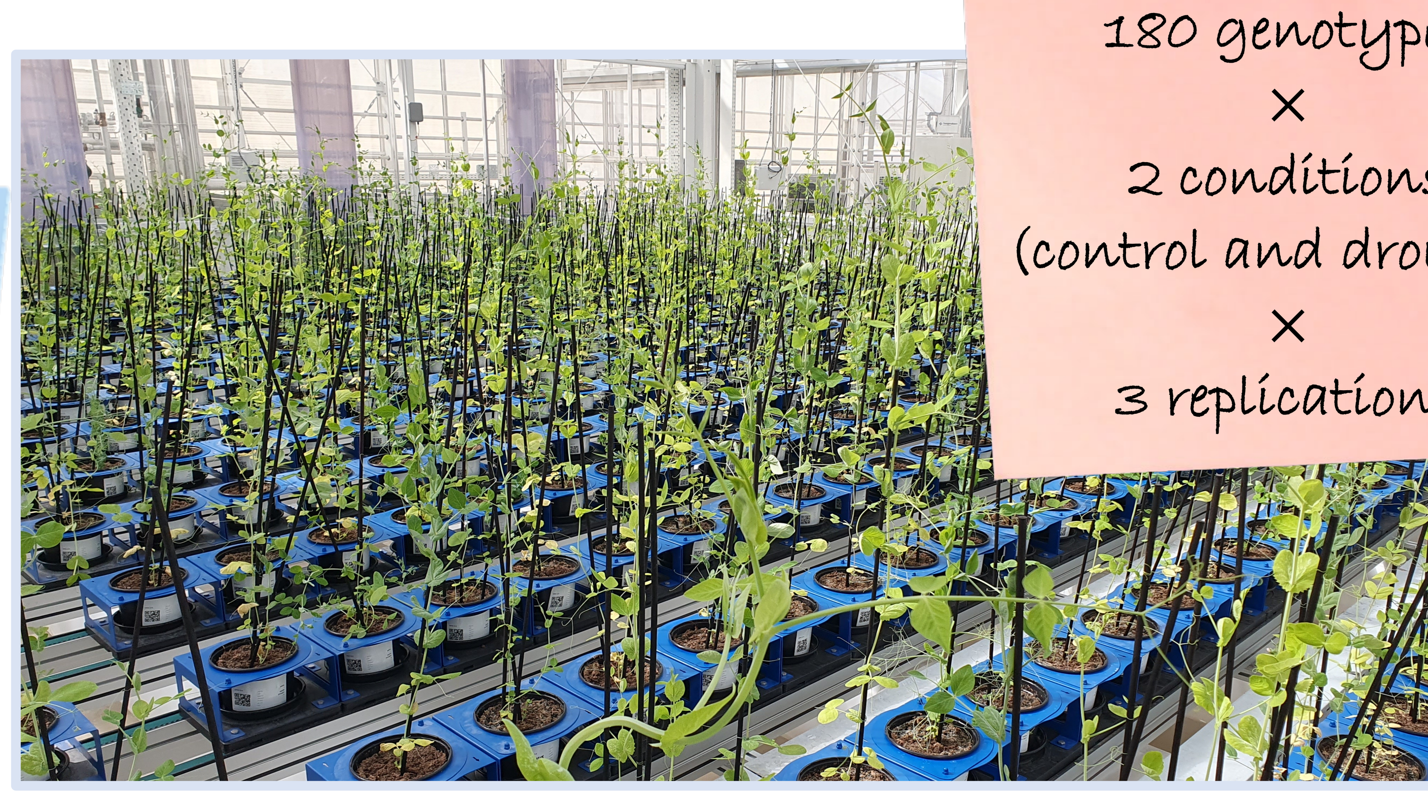
The pea collection was screened for their **protein** and **phytic acid** content, allowing the selection of **180 accessions** high in protein and with low phytic acid content. These were grown at a conveyor system in **NPEC** (Netherlands Plant Eco-phenotyping Centre) greenhouse, and different morphophysiological traits were evaluated under both **well-watered** (70% of field capacity) and **drought** (30% of field capacity) conditions. Plants were imaged every 48 hours, with different camera systems, allowing the monitoring of plant height, specific leaf area and biomass of all accessions. **Five tolerant and five sensitive genotypes were selected**.

Results

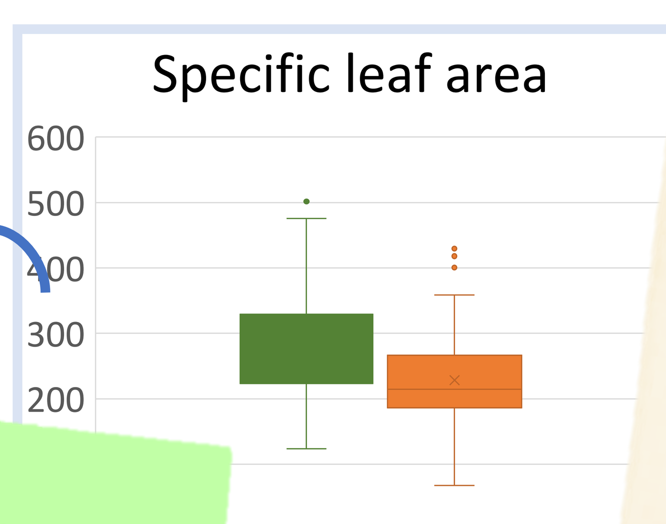


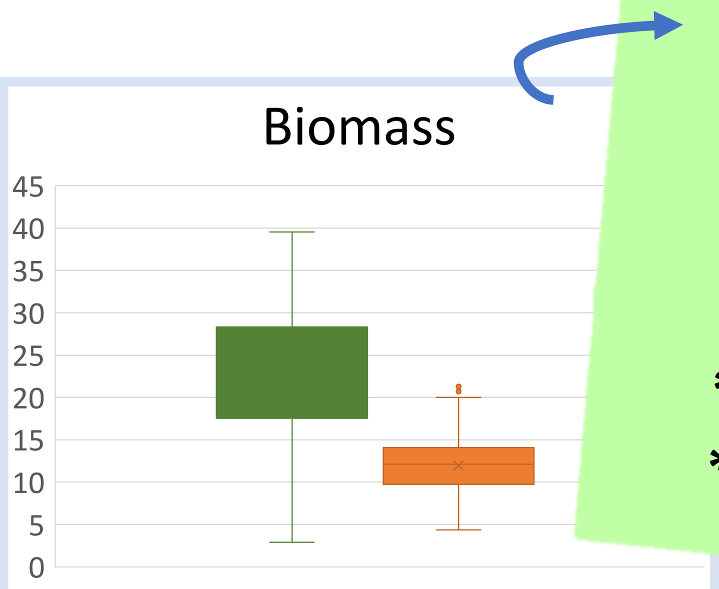


The effect of different locations and seasons on peas' phytic acid and protein content was not significant



180 genotypes
×
2 conditions
(control and drought)
×
3 replications





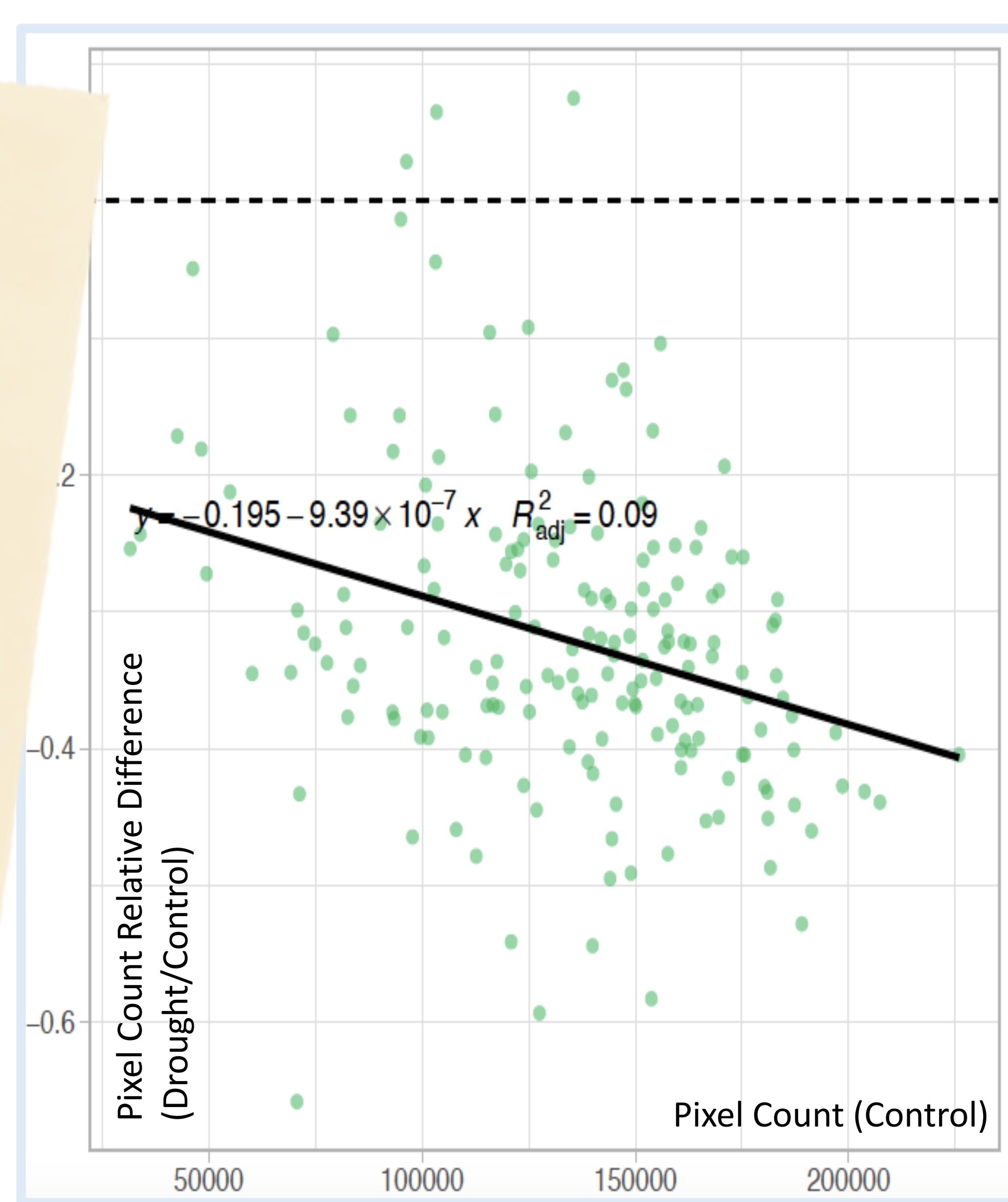
<u>Drought stress</u> significantly decreased, in all genotypes:

***Plant height,**
***Biomass and**
***Leaf area**

Based on image analysis:

*** The median of pixel counts was used for biomass prediction**

*** More vigorous plants (higher performance in control) suffer more under stress than less vigorous plants**



Conclusions

- Water stress negatively impacted the morpho-physiological traits evaluated in the 180 pea accessions, but the severity of the impact differed **depending on genotype**.
- The effect of drought on pea nutritional traits needs to be further elucidated to **support food production under future climate change scenarios**.
- Incorporating **drought-tolerant alleles** into elite cultivars can be a key approach to developing genotypes that are better adapted to abiotic stress.

Acknowledgments

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