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# Agronomic resilience of grain legumes to drought stress using rainout shelters

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## Introduction

- Grain legumes are vulnerable to changes in climate
- Quantifying abiotic processes affecting yield and quality are needed
- Impact of drought across warm- & cool-season species are unclear

## Objectives

(i) Investigate the yield and grain quality responses of different grain legume species to imposed drought stress under field conditions
(ii) Assess the effect of drought stress during flowering and pod-filling

## Materials & Methods

- Field experiment during 2023-2025 (first year results presented)
- Sandy soil with 530 mm average rainfall in northeastern Germany

The factors in the experiment were:

- Legume species: Soybean, chickpea, field pea, yellow lupin, white lupin and grass pea (with 1-2 varieties)
- Water availability: Irrigation, rainfed, rainfed + rainout shelter during flowering, and rainfed + rainout shelter during pod-filling

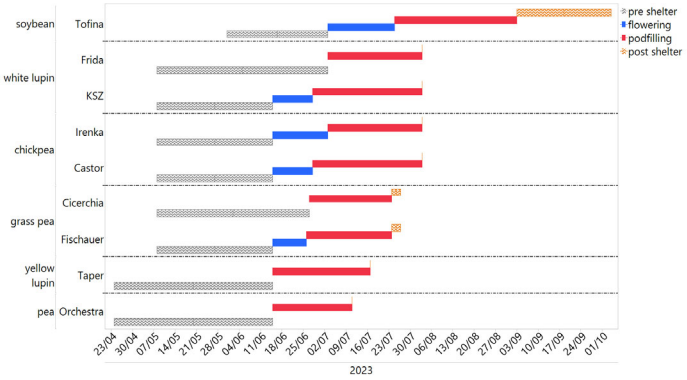


Figure 1. Temporal use of the rainout shelters during the reproductive periods of the crops. Bars indicate the pre-shelter period from start of sowing (grey), shelter during flowering (blue), shelter during pod filling (red), and in some cases a pot shelter period until the harvest (orange). In some crops not all shelter periods could be implemented.

- Plot size was 3 x 8 m for irrigated and rainfed treatments
- Rainout shelters covered 2.5 × 2.5 m and had a height of 1.60 m
- To control for potential side effects, one square meter is investigated
- Shelters were constructed following the guide by Kundel et al. (2018)

## Results

- Varying yield response to drought across the grain legume species
  - Chickpea was affected by drought stress during flowering but not pod filling
  - Soybean and yellow lupin were affected by drought during pod filling
  - White lupin cv. KSZ showed no drought impacts and cv. Frida matured better with drought during pod-filling

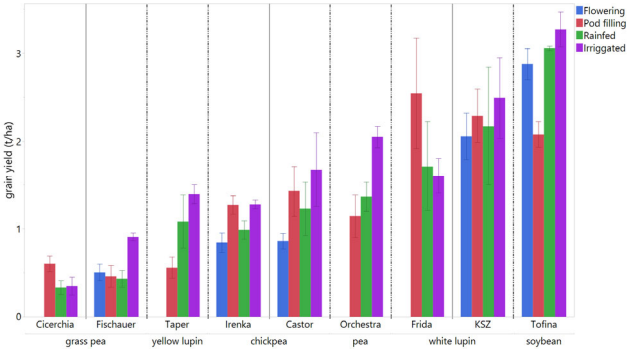


Figure 2. Grain yield of legume species across four treatments, i) drought stress at flowering, ii) drought stress at pod filling, iii) rainfed condition and iv) irrigation.

- Variations of yield components could partly explain yield responses, e.g.
  - Soybean had a lower TSW under drought
  - Chickpea had less pods per plant after drought during flowering
  - Yellow lupin had less seeds per pod after drought at pod filling

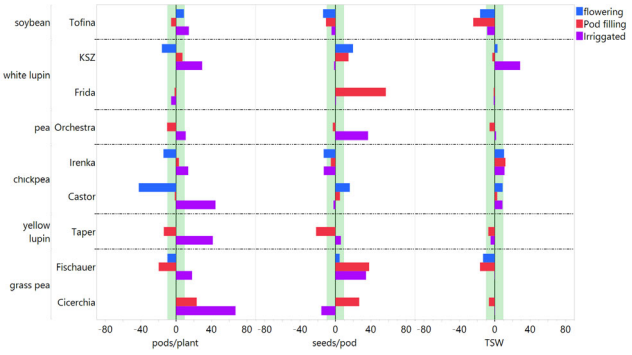


Figure 3. Variation (in %) in yield components, comparing treatments with the rainfed system as the baseline. Green areas represent a range between 10% and -10% of difference.

## Conclusion

- Grain legumes show varying yield response to drought that support and don't support our expectations for established and novel species
- White lupin (determinate variety) was among the most productive and resilient species
- Impacts on grain food quality characteristics will be important (planned)

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