

Addressing Lima Bean Yield Loss to Heat Stress Through Breeding



E G Ernest

Why Lima Beans?



→ Lima bean production value is ~\$11 million per year in Delaware

→ Key to an economically important regional vegetable processing industry.

→ High night time temperatures (> 21 C, 70°F) associated with yield loss, split pod sets and delayed harvest.



HELLO
my name is

Phaseolus lunatus



Methods

- Experiments conducted in greenhouse chambers
- Inbred lines grown under hot and cool night temperature conditions
- RCBD with five blocks/replications



Genotypes

Heat Sensitive

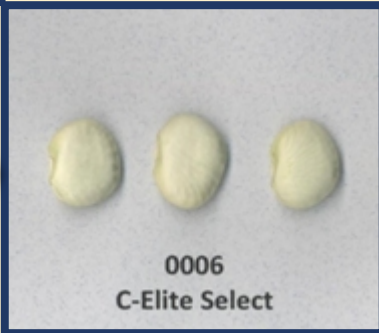


Fordhook 242

Cultivar, USA
Andean

C-elite Select

Cultivar, USA
Mesoamerican



Heat Tolerant



Dixie Butterpea

Landrace, USA
Mesoamerican

Cave Dweller

Landrace, USA
Mesoamerican



Bush FL Butter

Cultivar, USA
Mesoamerican



G27525

Landrace, Haiti
Mesoamerican

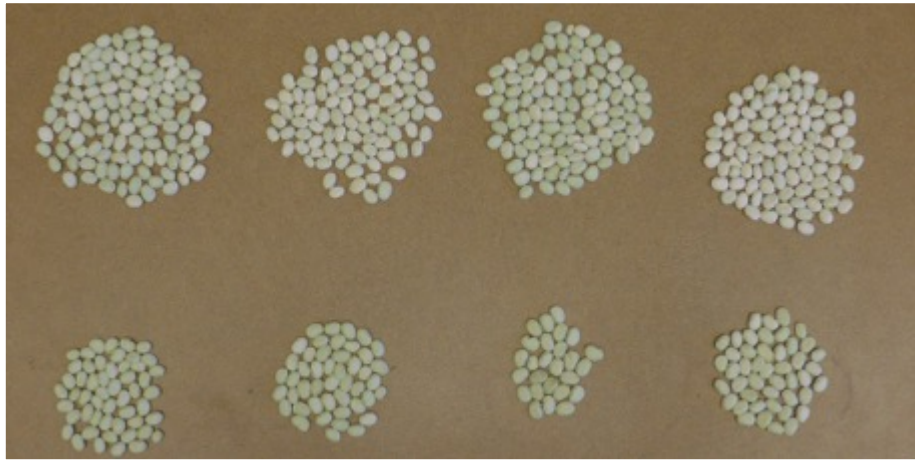
Henderson

Landrace, USA
Mesoamerican

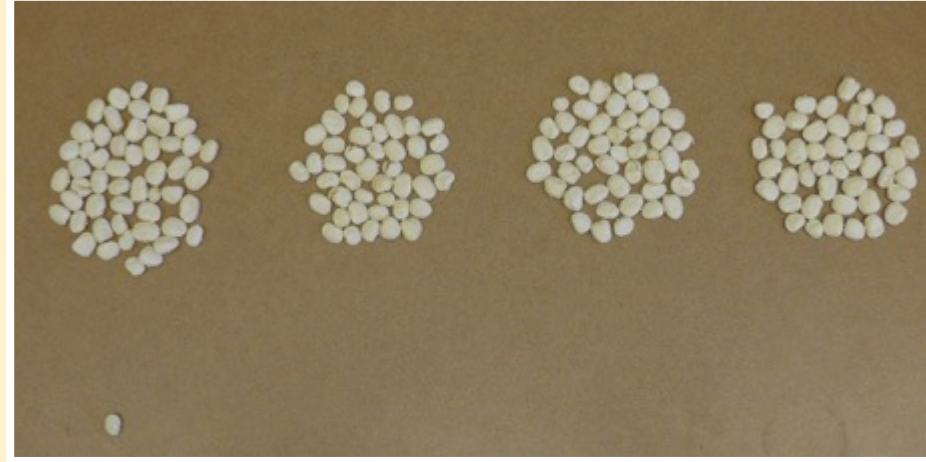


How Does Heat Stress Affect Yield?

Heat Sensitive

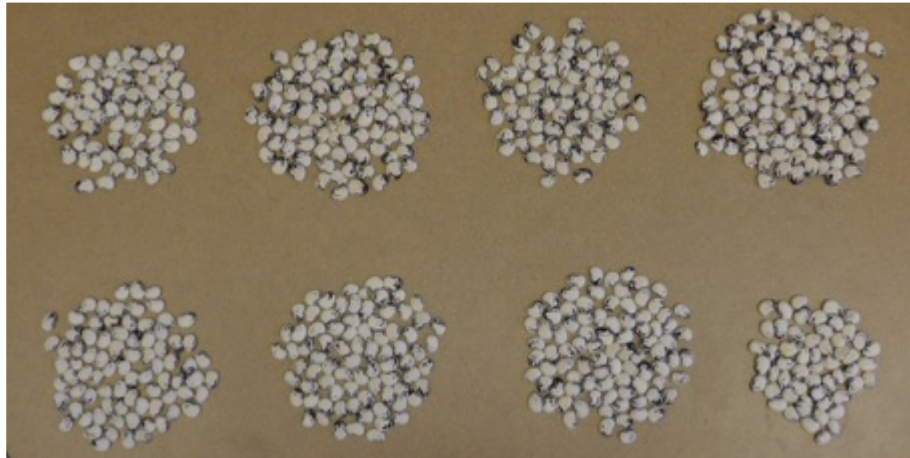


C-elite Select

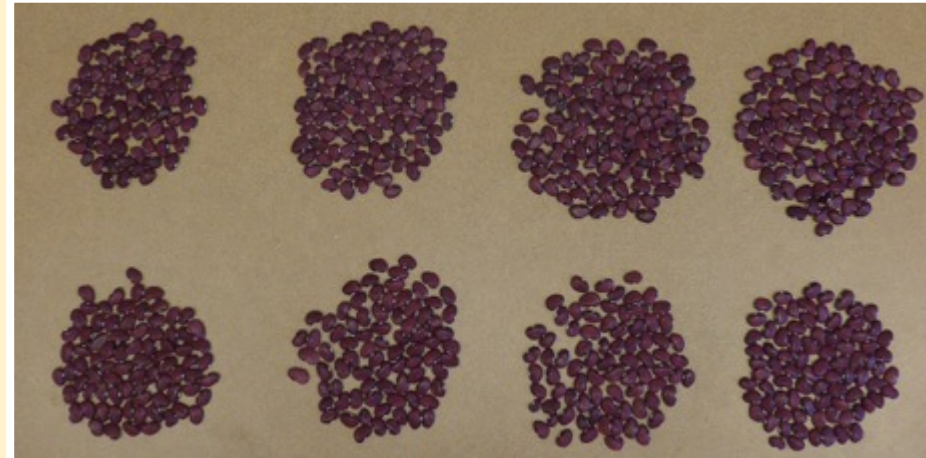


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Heat Tolerant



Bush Florida Butter



Cave Dweller



flower initiation



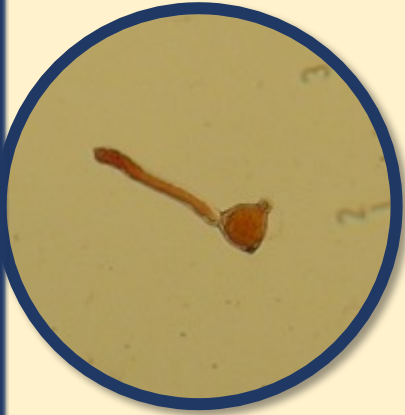
ovule development

flower morphology



anther function

pollen viability & pollen tube growth



stigma function



embryo development



seed growth & maturation



photosynthesis & carbohydrate availability



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Hot Night Temp



Cool Night Temp



Heat Stress Changes Flower Morphology



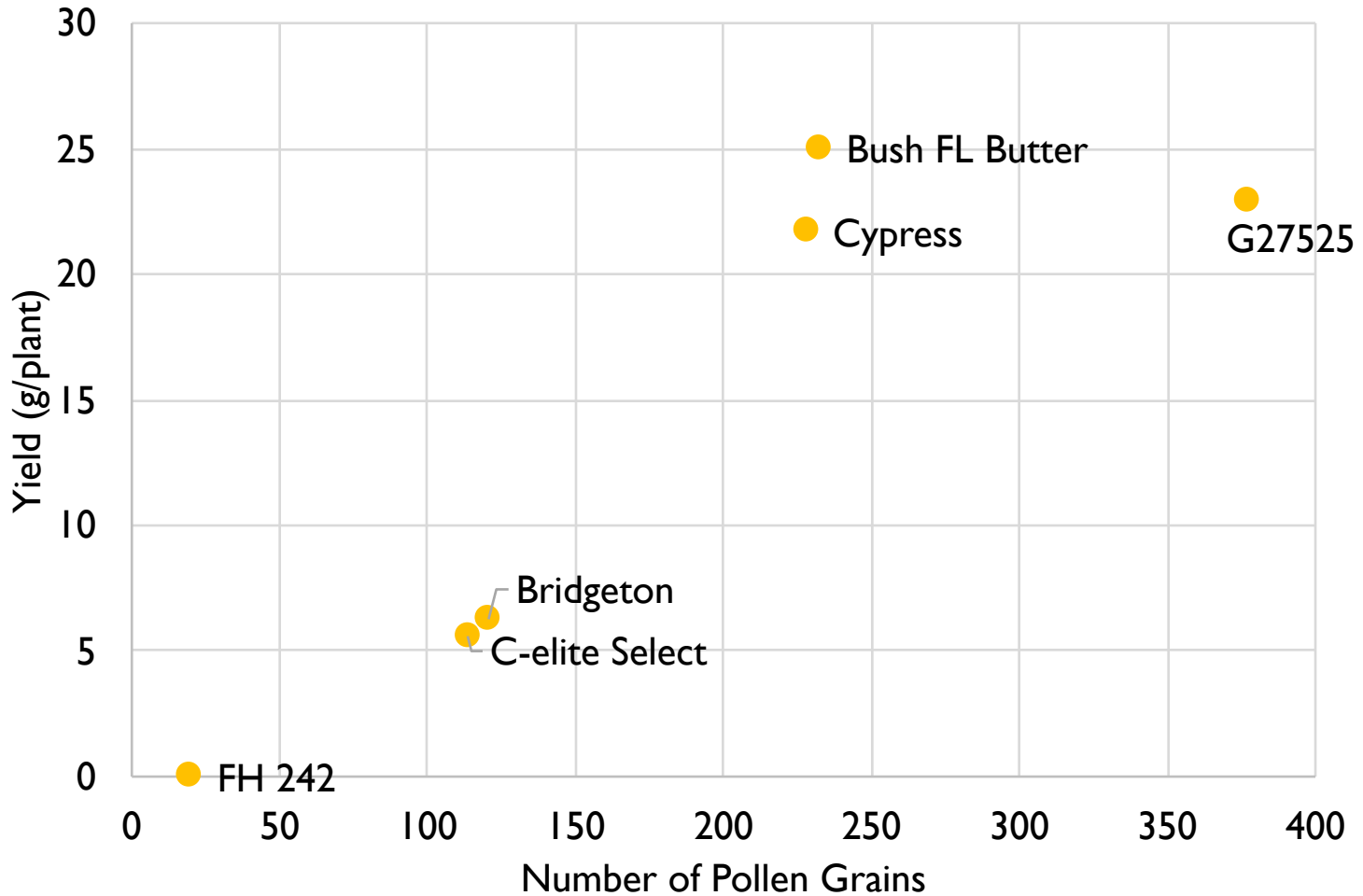
Normal



Deformed

Heat Stress Effects on Pollen

Heat Stress Yield vs Heat Stress Pollen Number



Pearson's Correlation Coefficient = 0.885



Henderson

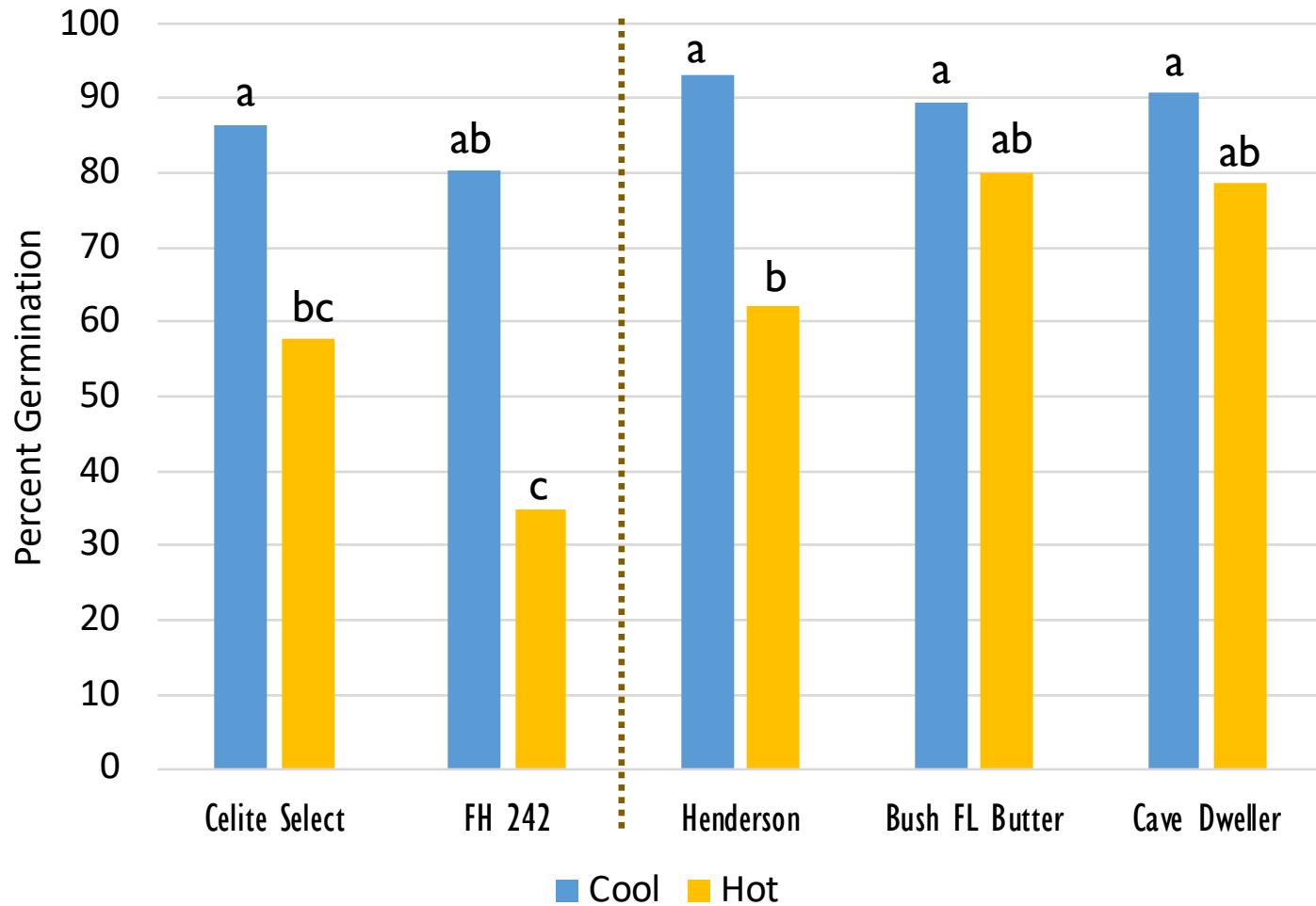


Cave Dweller

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Heat Stress Effects on Pollen

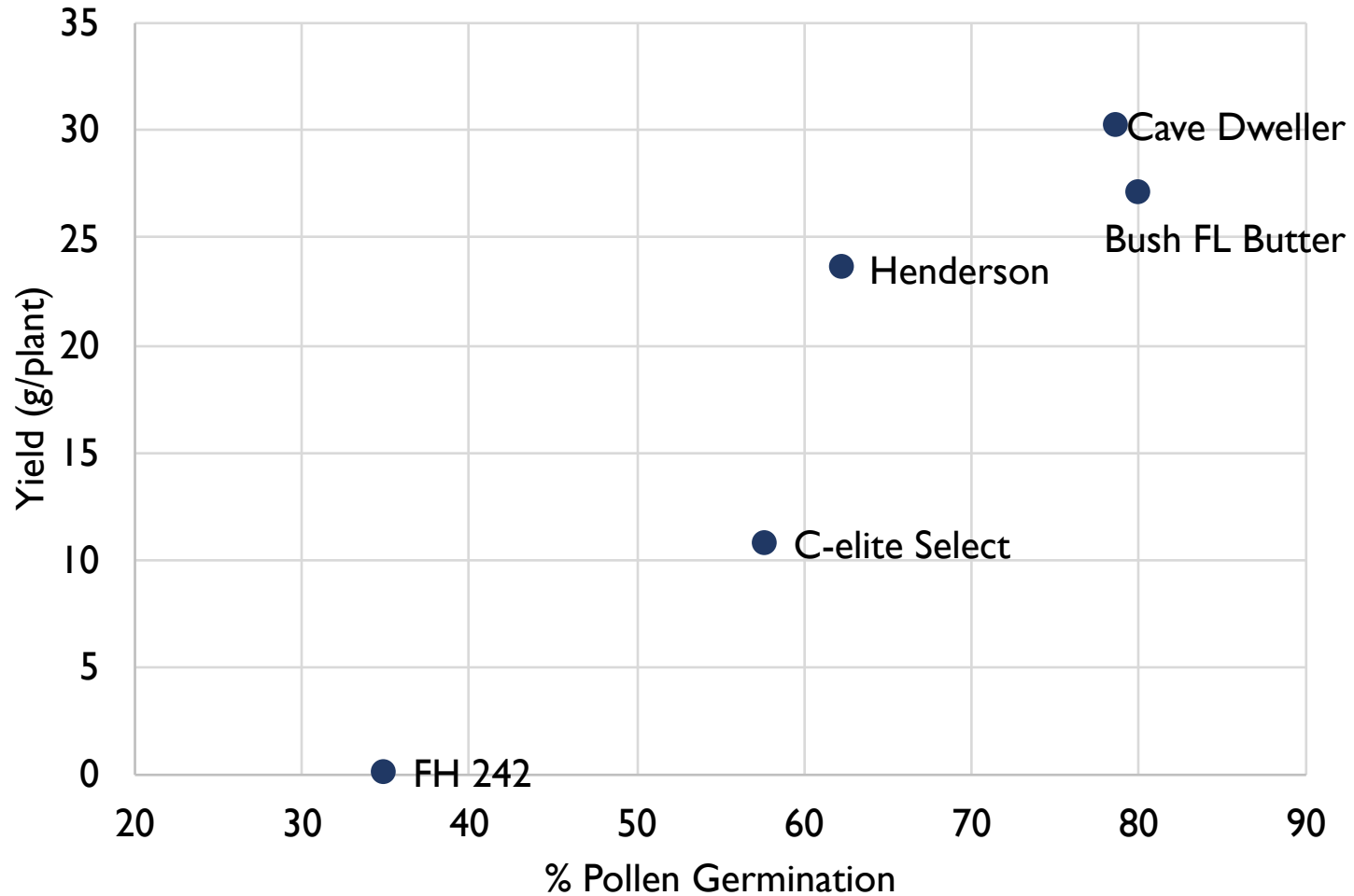
In Vitro Germination of Pollen from the Pistil



Mean separation using Tukey's HSD

Heat Stress Effects on Pollen

Heat Stress Yield vs Heat Stress Pollen Germination



Pearson's Correlation Coefficient = 0.953

The Biology → So What?

High night temperatures are most damaging to yield



Used screening environments with sustained high night temperatures

Pollen quality and release and flower morphology are negatively impacted by heat stress



Developed techniques to evaluate these factors under heat stress

Photosynthesis is minimally impacted by heat stress



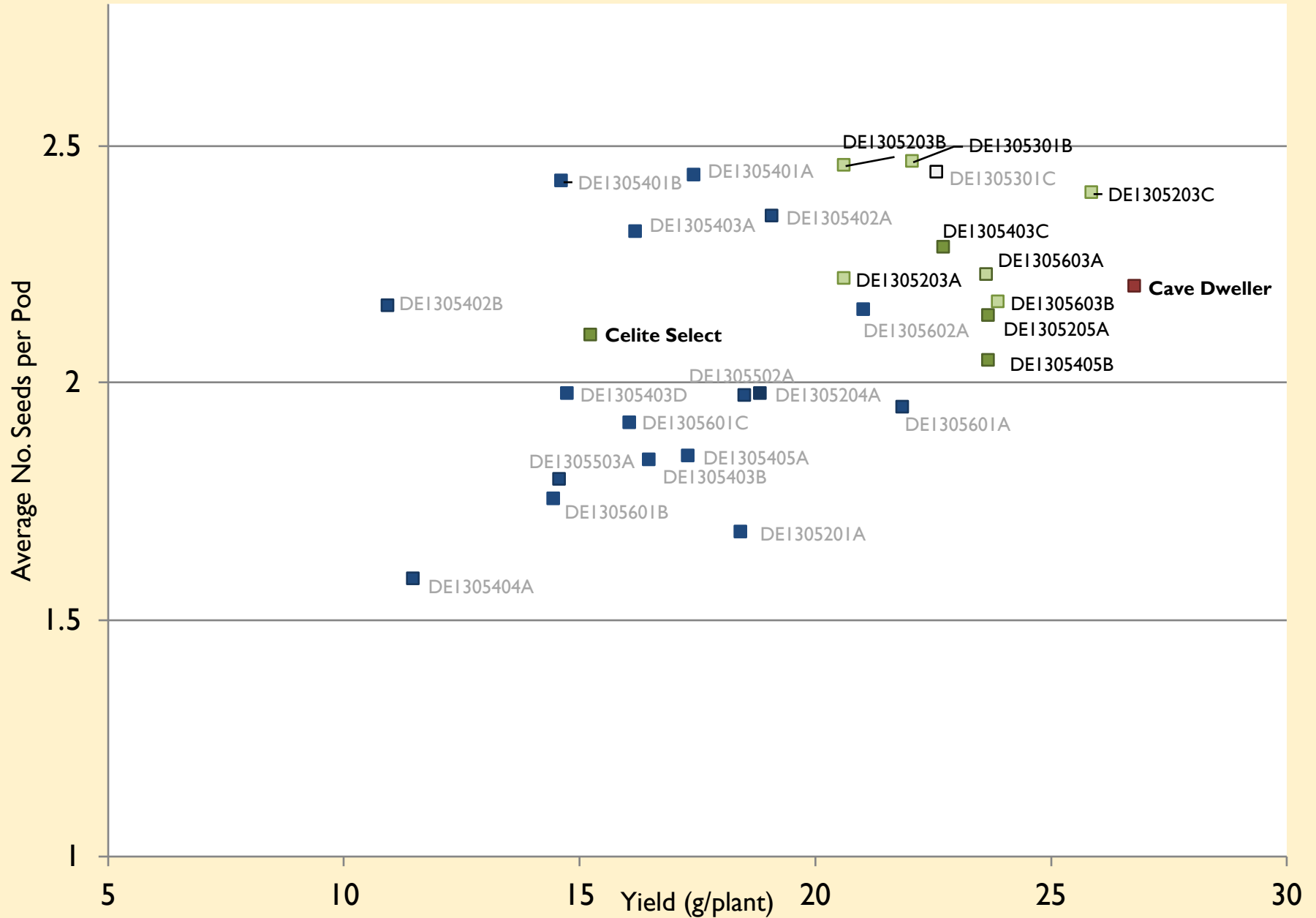
Daytime plant canopy temperatures and measures of photosynthesis will probably not be useful screening tools

Some genotypes are more heat tolerant than others



Heat tolerant lima bean varieties can be developed through breeding!

Breeding Progress...



Thanks!



Funding

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