The Effect of Artificial Selection on Phenotypic Plasticity

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G2F MEETING 12/5/17

Overview

➢ Background on GxE and Project Objectives

➢ Genetic Materials

➢ Results

➢ Conclusions

➢ Future Work

$$P = G + E + \boxed{GxE}$$

➢ **Phenotypic plasticity:** the ability of a single genotype to produce different phenotypes in response to different environments

➢ **G x E:** genotypes differ in their performance across environments

➢ **Stability analysis**: reaction of a genotype, relative to other genotypes, to different environments
    ➢ Slope & Mean Square Error (MSE) calculations

Has selecting for high yielding varieties of maize affected stability?

Germplasm Used: Iowa Stiff Stalk Synthetic Population (BSSS)

Groupings	# of Lines
BSSS C0 + Founders	25
BSSS C1	17
BSSS C2	15
Synthetic (lines recombined 6 key BSSS inbred lines)	20
Ex-PVP	23

6 Founders and random BSSS Cycle 0 lines

Germplasm Used

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BSSS C0 + Founders	25
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Synthetic (lines recombined 6 key BSSS inbred lines)	20
Ex-PVP	23

1st cycle inbreds (B14, B37, B73, N28, etc.)

Germplasm Used

Groupings	# of Lines
BSSS C0 + Founders	25
BSSS C1	17
BSSS C2	15
Synthetic (lines recombined 6 key BSSS inbred lines)	20
Ex-PVP	23

2nd cycle inbreds (A632, A679, H122, N217, etc.)

Germplasm Used

Groupings	# of Lines
BSSS C0 + Founders	25
BSSS C1	17
BSSS C2	15
Synthetic (lines recombined 6 key BSSS inbred lines)	20
Ex-PVP	23

Germplasm Used

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Recently released Ex-PVPs

Experimental Design

➢ 15 locations

➢ 2 replications per location in a randomized complete block design (RCBD)

Red: BSSS

Orange: Other G2F Locations
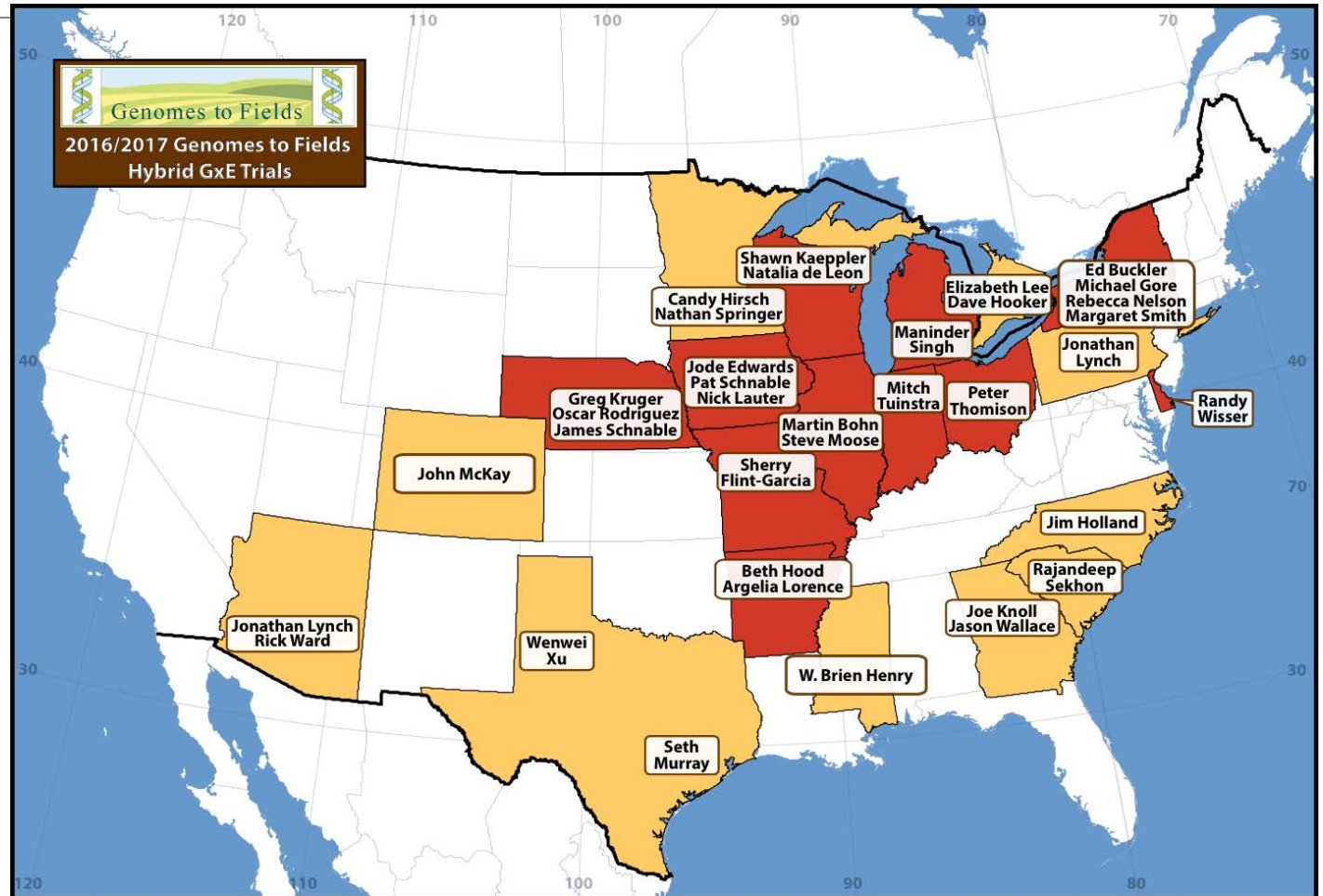
Agronomic and phenological traits collected

Plant Morphology
➢ Plant Height (cm)
➢ Ear Height (cm)

Agronomic
➢ Stand count (# plants/plot)
➢ Root lodging (# plants/plot)
➢ Stalk lodging (# plants/plot)
➢ Days to anthesis/silking (later converted to Growing Degree Units, GDU)

Productivity
➢ Grain moisture (%)
➢ Test weight (lbs/bu)
➢ Plot weight (lbs)
➢ Grain yield (bu/A)

Agronomic and phenological traits collected

Plant Morphology
➢ **Plant Height (cm)**
➢ Ear Height (cm)

Agronomic
➢ Stand count (# plants/plot)
➢ Root lodging (# plants/plot)
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Productivity
➢ Grain moisture (%)
➢ Test weight (lbs/bu)
➢ Plot weight (lbs)
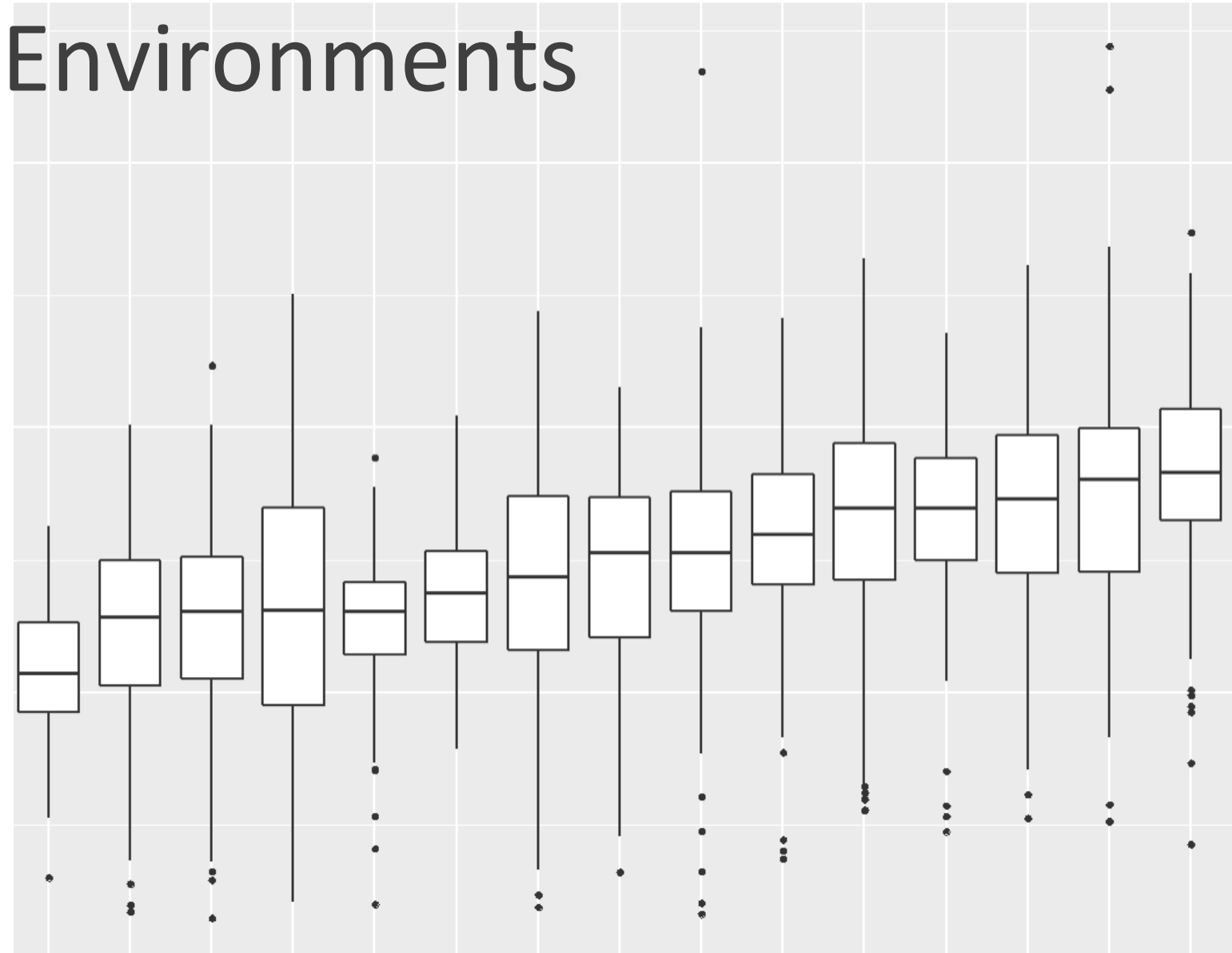➢ **Grain yield (bu/A)**

Percent Variance

	Pollen	Silk	Plant Height	Ear Height	Yield
Environment	90.71	88.13	81.06	55.87	24.89
Genotype	2.86	5.00	4.43	12.00	23.52
GxE	0.50	0.49	1.64	3.08	14.67
Rep Within Environment	3.81	3.05	0.97	2.17	2.48
Residual	2.12	3.32	11.20	26.24	34.44

2016 Environments

Stability Analysis

$$P_{ijk} = \mu + g_i + t_j + \delta_{ij} + e_{ijk}$$
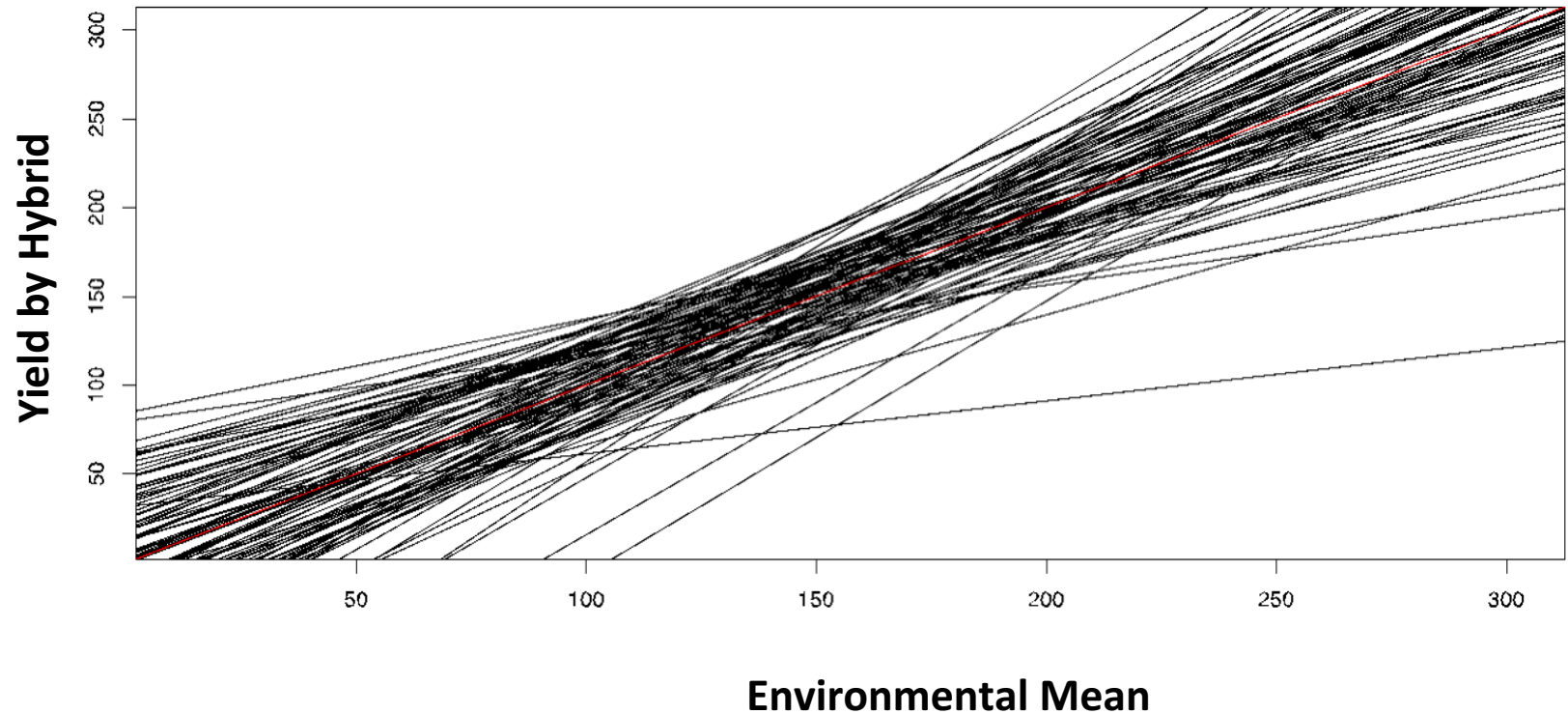
P_{ijk} : Phenotypic value

μ : Overall population mean

g_i : Overall genotypic effect

t_j : Environmental effect

δ_{ij} : Genotype x environment
        interaction
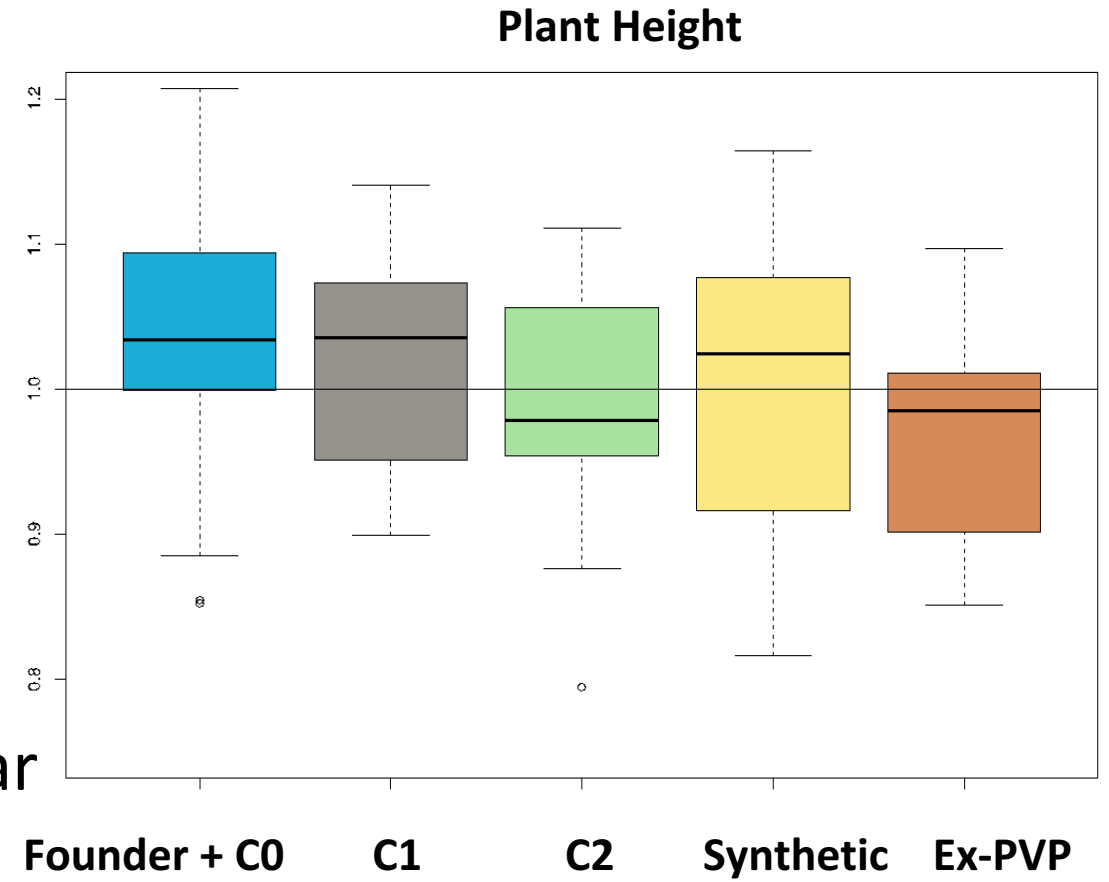
e_{ijk} : Within environment error

Slope

Type I
➢ Genotype performance is constant across environments; slope is near 0

Type II
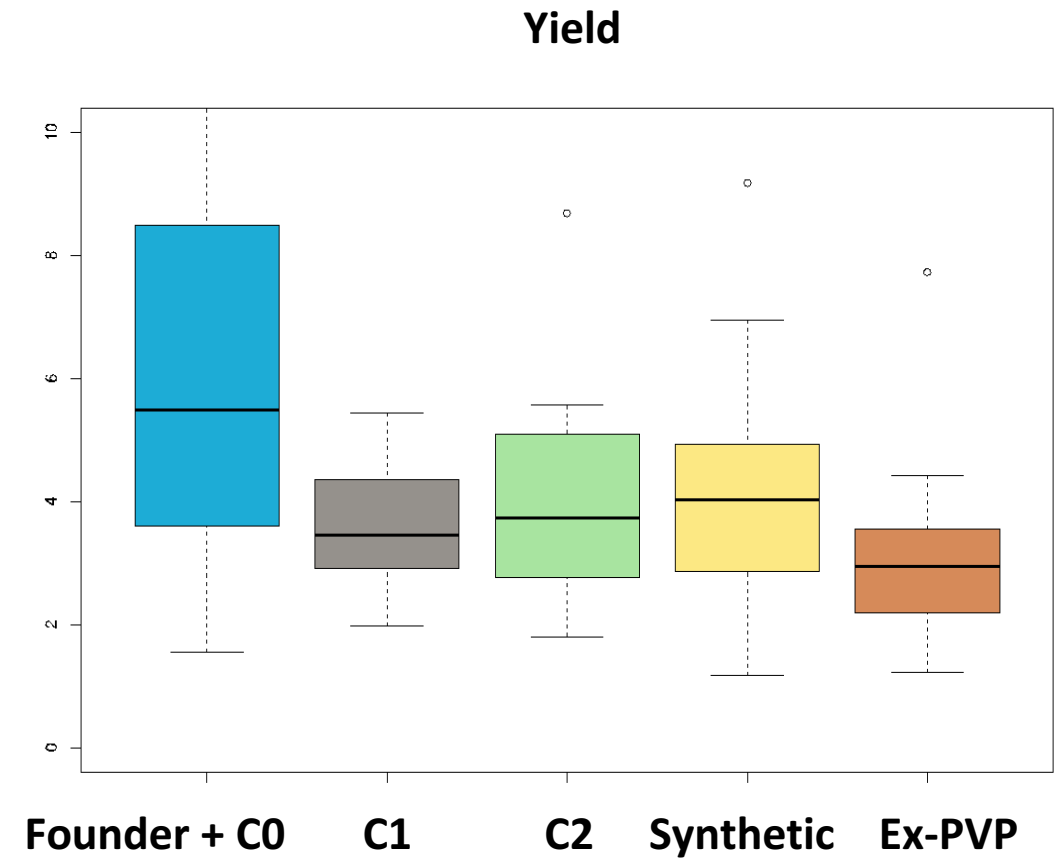➢ Genotypes respond similarly across changing environments compared to checks; slope is near 1

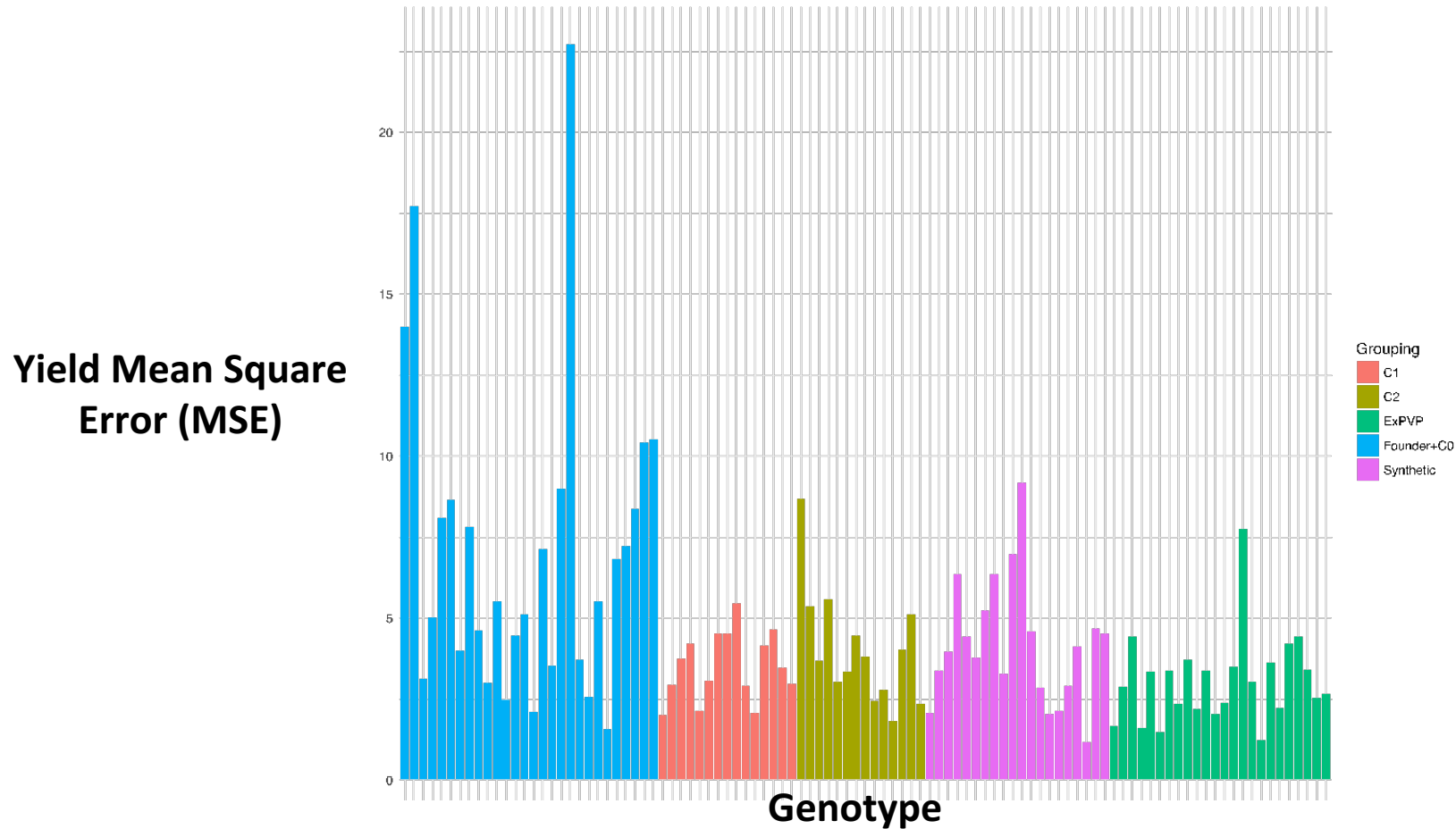**Plant Height**

MSE

Type III
➢ Genotypes have little variation around regression line based on environmental indices; low MSE

Yield

Range of Grouping Responses

Groupings	# of Lines
BSSS C0 + Founders	25
BSSS C1	17
BSSS C2	15
Synthetic	20
Ex-PVP	23

Conclusions

➢ Has selecting for high yielding varieties of maize affected stability?

  ➢ Yes- it has <u>reduced</u> instability

  ➢ Groupings that have undergone more selection have a slope more close to 1 (Type II stability) and a reduced MSE (Type III stability)

Moving forward on the BSSS GxE Project

➢ Working to compile data from 2017 season to determine how artificial selection for high performance has affected GxE across multi-year, multi-location trials.

➢ In 2018, plan to use managed environments to allow for associations to be made between certain environmental locations and component traits.

Thank you!

- ➢ Celeste Falcon
- ➢ Joe Gage
- ➢ Naser Alkhalifah
- ➢ Shawn Kaeppler
- ➢ Natalia de Leon

References

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Questions?