A Preliminary Study of Cold Tolerance in Maize Landraces

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Abstract

Following maize domestication, several lineages differentiated into populations that were adapted to their local environments and/or identified by farmers as having distinct characteristics. These populations are collectively known as landraces. Maize landraces have a plethora of genetic diversity that may help today's commercial hybrids adapt to challenging environmental conditions.

OBJECTIVE

Our objective was to identify regional groups of landraces that had high levels of fitness when grown under cool conditions in a growth chamber.

MATERIALS AND METHODS

Six accessions of landraces were chosen per region. Seeds were treated with Baytan® to prevent fungal infections. Two seeds were germinated from each accession at room temperature in the laboratory.

Seven days after sowing the seeds, they were planted into pots and placed in a growth chamber. The day temperature was set at 23°C and the night temperature was 11°C. The photoperiod was set at 12.5 hours for day length and 11.5 hours for night length.

Height measurements were taken in ten day increments after transplanting.

RESULTS

Fig. 1. Seedlings directly after transplanting into growth chamber

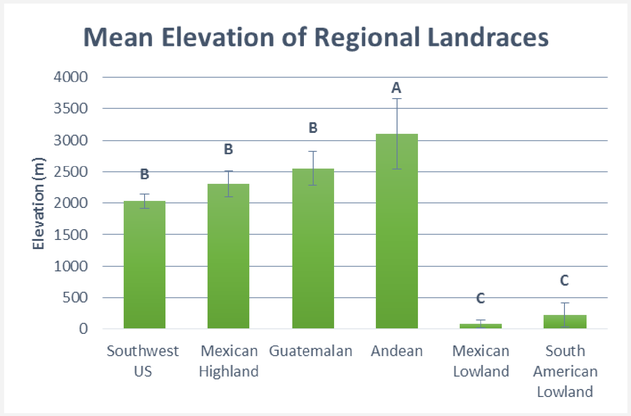

Fig. 2. (Vigouroux et al., 2008) Letters representative of Mean separation by Tukey's honestly significant difference test at $P \leq 0.05$ were performed on all data by using JMP v. 11 (SAS Institute, Cary, NC).

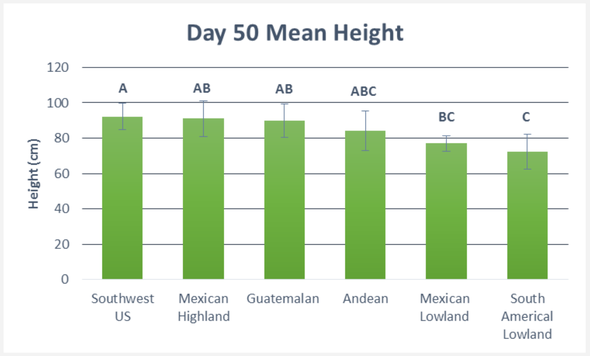

Fig. 3. Letters representative of Mean separation by Tukey's honestly significant difference test at $P \leq 0.05$ were performed on all data by using JMP v. 11 (SAS Institute, Cary, NC).

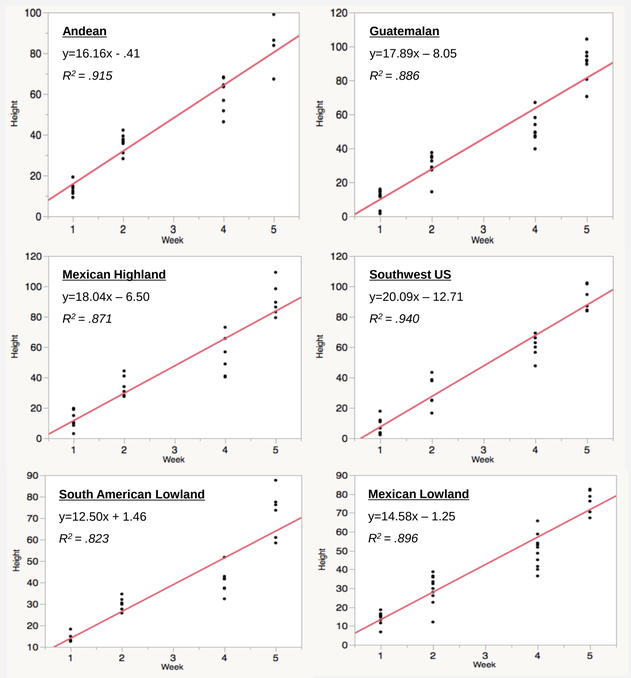

Fig. 4. Bivariate fit of height by period. P ≤ .0001 performed on all data by using JMP v. 11 (SAS Institute, Cary, NC).

Mean Height of Regional Landraces

	Day 10	Day 20	Day 40	Day 50
Southwest US	14.197 a	36.058 a	60.382 a	92.290 a
Mexican Highland	14.019 a	34.290 a	60.365 a	91.020 a-b
Guatemalan	13.613 a	31.010 a	54.293 a-b	89.895 a-b
Andean	11.014 a-b	29.858 a	51.435 a-b	84.138 a-c
Mexican Lowland	10.971 a-b	29.710 a	49.499 a-b	76.963 b-c
South American Lowland	6.914 b	29.546 a	40.731 b	72.390 c

Fig. 2. Letters representative of Mean separation by Tukey's honestly significant difference test at $P \leq 0.05$ were performed on all data by using JMP v. 11 (SAS Institute, Cary, NC).

Discussion

While fitness (*i.e.*, reproduction) could not be measured directly due to space limitations, we measured plant height as a proxy for fitness over several weeks following germination.

The mean elevation from which each accession was collected from did not directly correlate to fitness under cool conditions. The Andean accessions were significantly higher in elevation but not in fitness.

Should certain landraces show evidence of cold tolerance, these may be good resources for crop improvement. Identification of cold tolerance is an important starting point for isolating genes underlying this trait.

Summary

Landraces from the Southwest US, Mexican Highland, and Guatemala were found to have significantly higher levels of fitness when compared to South American Lowland landraces.

Acknowledgment

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Literature Cited

Vigouroux, Y., J. C., Glaubitz, Y., Matsuoka, M. M. Goodman, J. G., Sánchez, and J. Doebley. 2008. Population Structure and Genetic Diversity of New World Maize Races Assessed by DNA Microsatellites. *American Journal of Botany* 95(10): 1240–1253.

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