Local Adaptation of Maize Landraces to Highland Environments

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Abstract

As maize migrated from its center of origin in the Balsas River Valley of Mexico, it experienced diverse climates. Lineages of maize 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 are genetically diverse populations that may help today's commercial hybrids adapt to changing environmental conditions.

OBJECTIVE

Our objective was to identify regional groups of landraces that possess high levels of fitness when grown under highland conditions compared to lowland conditions.

MATERIALS AND METHODS

Six accessions of landraces were chosen per region. Seeds were treated with Baytan® 30 flowable fungicide. Two seeds were germinated from each accession at room temperature.

Seven days after sowing, the seedlings were planted into 4" pots and placed in the growth chamber. The highland chamber was set to a high of 23°C and a low of 11°C. The lowland chamber was set to a high of 32°C and a low of 25°C. The photoperiod was set at 12.5hr days for both chambers.

Height measurements were taken in ten day increments after transplanting to the nearest half cm.

RESULTS

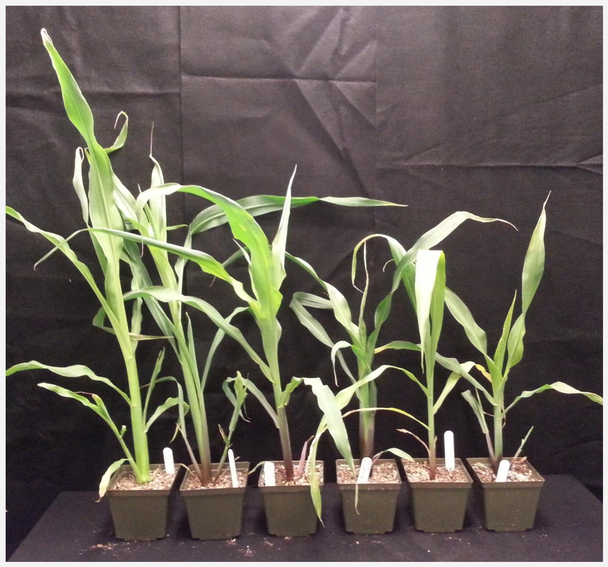

Fig. 1. Representative plants from each region at day 30 in highland growth chamber. From left to right: Highland Southwest US, Highland Mexico, Highland Guatemala, Highland South America, Lowland Mexico, Lowland South America

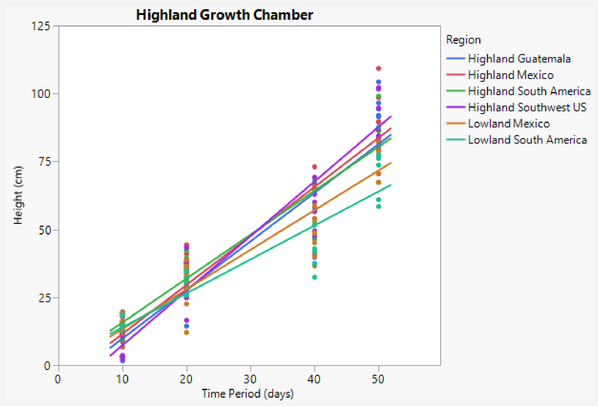

Fig. 3. Graphical representation of plant height by region for highland growth chamber.

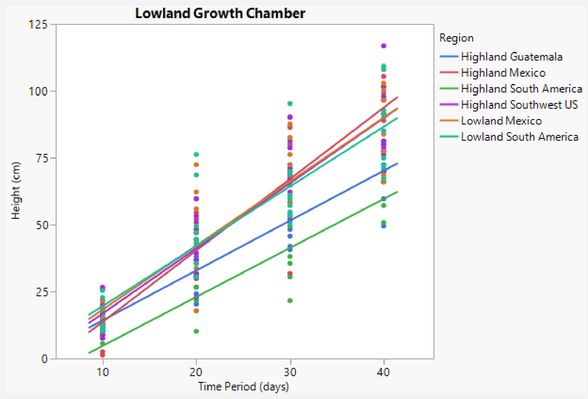

Fig. 5. Graphical representation of plant height by region for lowland growth chamber.

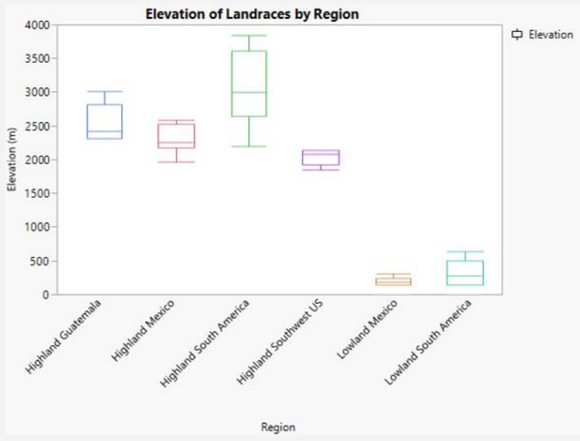

Fig. 2. Mean elevation of each region of landrace accessions. Elevation data from (Vigouroux et al., 2008).

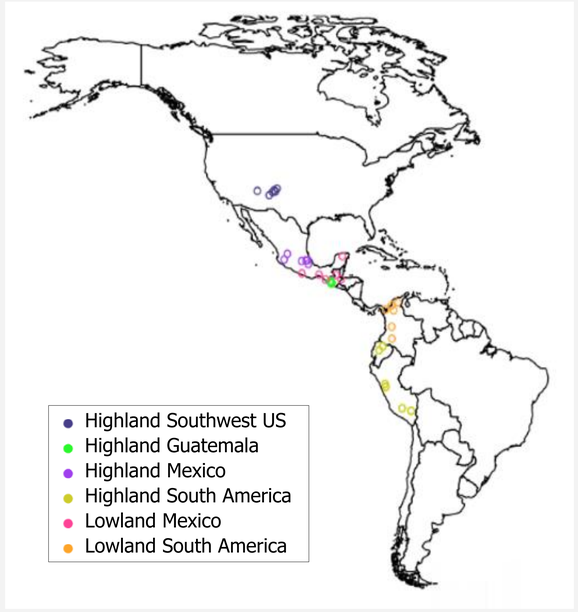

Fig. 4. Geographical distribution of landrace accessions used in growth chambers. Coordinates from (Vigouroux et al., 2008).

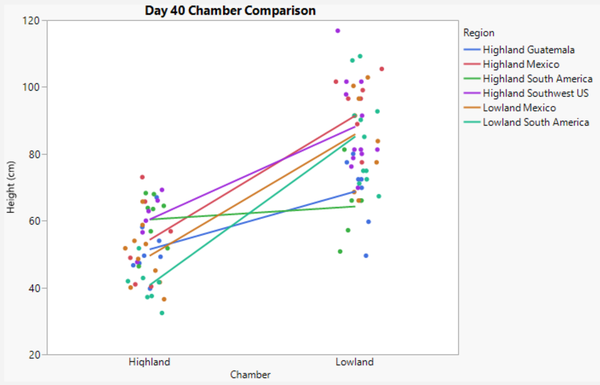

Fig. 6. Comparison between highland and lowland growth chamber day 40 heights.

Discussion

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

Highland populations tend to have high levels of anthocyanin in their tissues and high densities of macro-hairs on their leaf sheaths. These adaptations convey fitness benefits under highland conditions. The four highland populations had greater levels of fitness under highland conditions.

If evaluating landraces for breeding programs, Highland Mexico and Highland Southwest US should be considered due to high levels of fitness in both highland and lowland environments.

Summary

Landraces from Highland South America and Highland Guatemala showed local adaptation to highland environments. Landraces from Highland Mexico and Highland Southwest US did not.

Acknowledgment

We would like to thank Kathryn Kananen for assistance with generating figure 4.

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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