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Trends in Stomatal Density and Area-Size in Pioneer Era Maize Hybrids Representing a Period of 100 Years*

Abstract

Maize hybrid breeding started over 100 years ago and has resulted in significant increases in yield and vigor. This progress has been supported using fertilizers and pesticides, higher plant densities, and the mechanization of agriculture. Understanding how maize hybrids respond to breeding and environmental changes is essential for predicting how maize stomata may adapt to climate change. Stomata are the pores through which plants exchange gases, and they are expected to change in response to increased CO₂ level and temperature. However, the impact of long-term maize breeding over the past century on stomatal traits and their responses to climate factors remains unclear.

In our study, we measured the impact of long-term breeding on stomatal traits during the seedling stage across 27 maize hybrids released between 1920 and 2022 in a growth chamber. Our findings revealed that newer hybrids generally exhibited a lower total stomatal pore area on leaves compared to older hybrids (ERA) developed over the past century and there was a negative correlation between stomatal area-size and density.

We expected to find increased stomatal density and reduced stomatal size in more modern hybrids, as these adaptations would enhance stress tolerance and water use efficiency amid rising CO₂ levels and temperatures over the past 100 years. As a result, the currently observed changes in stomatal traits in maize can result mainly from untargeted evolutionary processes or breeder selection as well as adaption acclimatization.

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