Transgenic alteration of ethylene biosynthesis and ethylene sensitivity increases grain yield in maize under filed drought-stress conditions

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Lack of sufficient water is a major limiting factor to crop production worldwide, and the development of drought-tolerant germplasm is needed to improve crop productivity. The phytohormone ethylene modulates plant growth and development as well as plant response to abiotic stress. Recent research has shown that modifying ethylene biosynthesis and signaling can enhance plant drought tolerance. First, a transgenic gene-silencing approach was used to modulate the levels of ethylene biosynthesis in maize (Zea mays) and determine its effect on grain yield under drought stress in a comprehensive set of field trials. Analysis of yield data indicated that transgenic events had significantly increased grain yield over the null comparators, with the best event having a 9 bushel/acre increase after a flowering period drought stress. Analysis of secondary traits showed that there was a consistent decrease in the anthesis-silking interval and a concomitant increase in kernel number/ear in transgene-positive events versus nulls. Second, we discovered novel negative regulators of ethylene signal transduction in Arabidopsis (Arabidopsis thaliana) and maize. These regulators are encoded by the ARGOS gene family. In transgenic maize plants, overexpression of ARGOS genes reduces ethylene sensitivity. Moreover, field testing showed that UBIQUITIN1:ZmARGOS8 maize events had a greater grain yield than nontransgenic controls under both drought stress and well-watered conditions.