Advancing hybrid wheat production through the use of novel pathways for male sterility

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Project Description

Male sterility is common in natural species, functioning to promote outcrossing. Control of pollen production by plant breeders is a fundamental technology that underpins hybrid seed production in many crops and generates hybrid vigor, the major biological factor contributing to high yield.

We aim to develop novel approaches for male sterility in wheat, particularly environmentally inducible (conditional) male sterility, as a means to facilitate production methods for hybrid wheat. The wide-scale use in production systems of hybrid wheat should boost yields by over 15%. We and others have extensive preliminary data demonstrating the importance of small RNA (sRNA) pathways for male fertility, with a strong connection to both temperature and photoperiod. Genetic male sterility in wheat would reduce the use of chemical gametocides, while boosting yields and/or protection of yield.

Both photoperiod and temperature-sensitive genic male sterility systems (PGMS & TGMS, types of environmental-sensitive genic male sterility, EGMS) exist in rice, the former preferable since unanticipated temperature variation can result in self-pollination. P/TGMS systems are used in a two-line system, with growth conditions controlling male fertility, in a simplified seed production process. Two-line hybrid rice has been planted in China since 1993, accounting for ~1/3 of total 2012 hybrid rice planting area. A conditional male sterile system is widely used in hybrid rice production, the genetic basis of which is the 21-nt, pre-meiotic phasiRNAs triggered by miR2118. One aspect of our proposal is to alter this pathway with the overarching goal of achieving the same trait in wheat.