IWYP International Wheat Yield Partnership
Research to Deliver Wheat for the Future

IWYP SCIENCE BRIEF

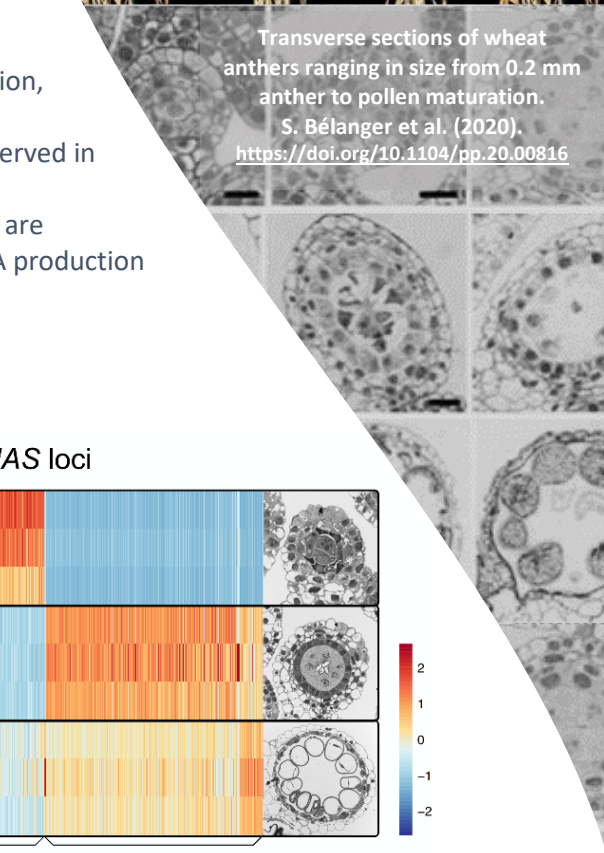
NUMBER 24 FEBRUARY 2022

Supported by USDA United States Department of Agriculture National Institute of Food and Agriculture

Male Fertility and Pollen Production in the Triticeae: Nothing to Sneeze At

Male-sterility is common in plant species and functions to promote outcrossing. Control of pollen production by plant breeders is a fundamental technology that underpins hybrid seed production in many crops. Hybrids typically exhibit hybrid vigor, a major biological factor that results in higher yield. A project, "**Advancing hybrid wheat production through the use of novel pathways for male-sterility**", led by Blake Meyers at The Donald Danforth Center, USA, including postdoc S. Bélanger, and UK collaborators A. Martín, M. Smedley, S. Hayta and G. Moore, aims to develop novel systems for male sterility in wheat, particularly environmentally inducible (conditional) male-sterility, as a means to facilitate efficient production of hybrid wheat seed. Preliminary data demonstrate the importance of small RNA (sRNA) pathways for male-fertility in grass species, with some evidence suggesting connections to both temperature and photoperiod. Genetic male-sterility in wheat could reduce the need for chemical gametocides or labor intensive CMS systems, while boosting yields and/or protecting yield through exploitation of heterosis.

Screening durum wheat TILLING mutants for defects in male fertility



Transverse sections of wheat anthers ranging in size from 0.2 mm anther to pollen maturation. S. Bélanger et al. (2020). https://doi.org/10.1104/pp.20.00816

What Solutions have been Identified?

- An annotated catalogue of phased small interfering RNAs (phasiRNA) producing (*PHAS*) loci in wheat (12,821) and barley (2,897), at high resolution, over the course of anther development.
- A large group of premeiotic, 24-nucleotide (phasiRNAs) not previously observed in rice or maize discovered in wheat (**Fig. 1**).
- Characterized durum and bread wheat lines mutant for several genes that are involved in the biogenesis of 21- and 24-nt phasiRNAs pathways, phasiRNA production and anther development.

Anticipated Impact of this Research?

- The production of a set of photoperiod sensitive genetic male-sterile (PGMS) lines in diverse wheat genetic backgrounds that could be important for hybrid wheat breeding.
- Transfer of this technology to breeders in private and public wheat breeding programs.

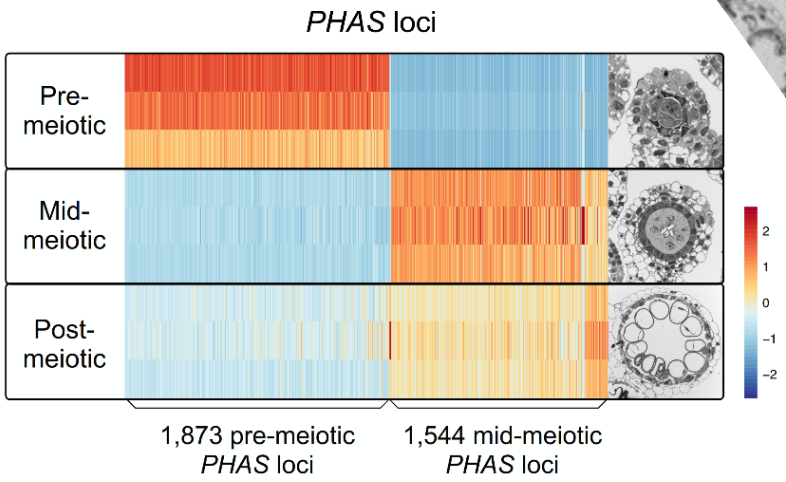


Figure 1. Two groups of *PHAS* loci produce abundant 24-nt phasiRNAs timely correlated to pre- and mid-meiotic developmental stages of anthers.

E-AP11: B. Meyers, Donald Danforth Center (lead); G. Moore, John Innes Centre. https://www.org/aligned-projects-2/. Supported by NIFA Grant Number: 2019-67013-29010