

## **Hard White Spring Wheat Breeding**

### **Principal Investigator:**

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There are several end-use and marketing advantages associated with white wheat. Along with a less bitter taste, and more favorable appearance to the final product, mills that utilize white wheat are generally able to achieve higher flour extraction rates. An increasing preference for white wheat in Asia seems to have contributed to a decline in U.S. wheat exports to this region. If white wheat production in the U.S. were to increase, we could potentially capture a greater share of the export market to this region. In addition, domestic interest in white wheat has steadily increased. Many hard red winter wheat breeding programs in the U.S. have shifted a significant portion of their resources to the development of hard white winter wheat varieties. In order to satisfy the desires of both domestic and international end-users, it is time for some hard red spring wheat breeding programs to begin focusing on the development of hard white spring wheat.

This proposal is intended to highlight and illustrate activities that have been initiated within our program to make the development of hard white spring wheat varieties a major focal point. Rapid release of a white spring wheat variety has become a significant goal. It is, however, important to note that, optimistically, a rapid variety release through traditional breeding methods remains 4 to 5 years away. Along with typical crossing, inbreeding, and line evaluation methods of variety development, two other approaches are being implemented to achieve our goal. First, thirty one advanced experimental white-seeded lines developed by CIMMYT (International Maize and Wheat Improvement Center) were acquired and underwent initial agronomic evaluation in SD during the 2007 growing season. Most of these lines were found to be extremely unfit for production in SD, although four of them were selected for additional evaluation by being tested within the 2008 Preliminary Yield Trial (PYT), which will be sown at seven locations. Secondly, efforts are currently underway within the program to create white-seeded double haploid populations from regionally adapted white-seeded parents. If this methodology can be successfully initiated, approximately five or six years can be removed from the time of crossing to eventual variety release.

### **Hard White Wheat Variety Development**

An approximate timeline is provided below to illustrate procedures taking place with respect to the beginning populations used to populate our newly initiated HWSW sub-program. Although not specifically described, additional early-generation populations created in 2006 and 2007 are progressing through the program.

#### **Winter 2007-2008**

One-hundred eighty white-seeded head-rows were harvested in bulk from the winter nursery giving rise to F4:5 experimental lines.

#### **Summer 2008**

The F4:5 lines will be used to initiate a first year of entirely white-seeded Preliminary Yield Trials (WPYT) at two locations in SD. At harvest, F4:6 seed will be collected in bulk. Four of the thirty-one CIMMYT lines initially evaluated in 2007 will be included within the 2008 PYT along with traditional red-seeded experimental lines.

### **Summer 2009**

Desirable WPYT entries will be used to initiate the first year of white-seeded Advanced Yield Trials (WAYT) at several SD locations. At this developmental stage, a fairly large amount of seed will be available with which to sow yield trial plots as well as larger seed increase and purification plots. In the conventional portion of the program, these increase plots are carefully rouged to remove undesirable off-type plants from the population. At this point, some of the CIMMYT lines may be included in the traditional Advanced Yield Trials (AYT) for a first year and Breeder seed will potentially be created for large-scale increase in anticipation of variety release.

### **Summer 2010**

Desirable WAYT entries will be tested for a second year of WAYT observation in SD. Larger seed increase plots will again be sown for additional rouging, if necessary, and to provide Breeder seed to the Foundation Seed Stocks manager. Depending on agronomic and quality performance, one of the CIMMYT-derived lines could potentially be released as a variety.

### **Winter 2010-2011**

With Breeder seed in hand, the Foundation Seed Stocks manager should be able to increase approximately 50 pounds of seed from second year WAYT entries to roughly 100 to 125 bushels through a winter increase in AZ or CA.

### **Summer 2011**

A large-scale seed increase could be initiated at this point giving rise to many bushels for release to Foundation seed producers during the following growing season.

## **Implementation**

To be competitive in the development of any plant variety, an absolute requirement is that agronomic potential must be gauged accurately. Our new HWSW variety development sub-program will therefore eventually require that additional testing locations be utilized. These locations need to be in areas where white-seeded varieties can realistically be produced (i.e., where pre-harvest sprouting is not typically an issue).

In SD, such environments might also possess high levels of soil selenium, which is common among many drier areas west of the Missouri River where HWSW might be best adapted. Consequently, additional West River testing environments are actively being sought. It is at the point where additional testing locations will be required and that additional field equipment will also likely be required. It is also important to note, however, that it is very likely that additional testing locations will benefit the entire program, as conventional HRS experimental lines could also be tested at new locations. This will serve to make all of our varieties more regionally competitive and thereby

provide an advantage to all SD wheat producers that sow varieties developed at SDSU. With the eventual utilization of new testing environments, it is most likely that additional harvesting equipment will be sought, as early as 2009 or 2010. Additional planting capacity is not as much of a priority because planting does not generally require as much time.

Our original intent was to hire a Research Associate II within the program to implement and oversee this portion of the program. As a more cost-effective alternative, technical staff within the program has been augmented through hiring a Doctoral level Graduate Research Assistant. The research assistant is charged with day-to-day operations associated with the white spring wheat variety development sub-program. It will be a few years before this becomes a full-time endeavor, however, in its current form; it is a great learning opportunity for an ambitious plant breeding student.

There are also several new program goals and projects that the research assistant will be charged with including completing Mixolab end-use quality tests for the HWS and HRS components. Similarly, before proceeding much further with the development of HWSW varieties, we must adopt and perfect a greenhouse or growth chamber screening procedure in which pre-harvest sprouting resistance may be gauged. Finally, we are working closely with Dr. Padu Krishnan to develop procedures for testing parameters associated with good end-use qualities as perceived by customers located within Asian countries.