

SUMMARY OF ANNUAL REPORT  
WHEAT RESEARCH AND PROMOTION BOARD  
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TITLE: Breeding for Improved Wheat Cultivars

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OBJECTIVES:

Develop and release wheat cultivars with high yield potential, high test weights, straw strength, winter hardiness, early maturity, and resistance to diseases common to Arkansas through pedigree, bulk population, and backcross breeding methods.

Cooperate with other public programs to identify lines adapted to Arkansas which can be released through the Foundation Seed Program and join other institutions in joint releases.

ABSTRACT:

The planting season was ideal for wheat last fall. The breeding trails and Cultivar Performance test was planted at Keiser on October 11 with the head-row material (F<sub>4</sub> and F<sub>5</sub> lines) being planted at Fayetteville on October 14. The breeding yield trails and variety test were planted at Marianna on October 12 and the Cultivar Performance test at Rohwer was planted on October 13. The planting of the Cultivar Performance test in Stuttgart was planted on October 19, with the breeding trials being planted on October 20 and 25. The variety test at Kilber was planted on October 26 with the variety test at Hope being planted on November 7. All of these planting dates were optimum. The F<sub>4</sub> and F<sub>5</sub> lines at Fayetteville grew very well and the inoculation with stripe rust and leaf rust was effective. Although, the infection was not as severe as in the past it allowed for an evaluation of resistance among the lines for the disease. Of the more than 20,000 lines planted, about 400 resistant F<sub>5</sub> lines were harvested for future yield testing. Approximately 9,000 individual plants were also selected to be used to produce F<sub>5</sub> lines for selecting in 2006-07.

The first N application was applied on Feb 16 at Stuttgart and concluded at Marianna on March 1. The second application began on March 7 and concluded at Fayetteville on March 20. Plant establishments were optimum at all locations. Harvest of the Cultivar Performance Trails and the breeding nurseries began on May 25 at Rohwer and concluded on June 14 at Kibler. The head rows at Fayetteville were harvested on June 16. The results from the most advanced nursery are given in Table 1. Table 2 gives the performance of lines in the Advanced Wheat Strains (AWS) nursery at Keiser. Almost all of the experimental lines outperformed the check varieties in the test. However, all the check varieties performed poorly at this location for some reason. While this is true, many of the experimental lines did perform very well. The AWS test was also harvested at Marianna.

During the winter the crossing program to produce future lines was expanded. There were over a hundred successful crosses in four efforts: 1) standard variety development, 2) scab-resistant varieties, 3) stripe rust and leaf rust resistant varieties, 4) specialty types (white wheats). The objective of the crossing efforts are to stress yield potential, test weight, value-added traits, and disease resistance.

## MATERIALS AND METHODS:

Parents are chosen for their high-yield potential and adaptation to Arkansas conditions. Crosses are being made between genotypes with complementary traits in the greenhouse at Fayetteville. The F<sub>1</sub> generation is also grown in the greenhouse. Beginning with the F<sub>2</sub> generation, a combination of pedigree and bulk breeding methods are followed until sufficient homozygosity is reached to increase seed for yield testing.

Selected lines are then tested and re-selected in replicated yield plots. Lines selected move in a step-wise progression through the following nurseries: Wheat Observation (2 locations with one replication per location), Advanced Wheat Strains (2 locations), and Elite Wheat Lines (3 locations). Locations include Kibler, Stuttgart, Keiser, Marianna, and Rohwer. Numerous locations are used to help ensure selection of genotypes that are adapted to a number of soil types and environments. All lines in the nurseries are harvested for yield, and data is taken on test weight, lodging, maturity date, plant height, and winterhardiness. Reaction type and level of severity of diseases present is also recorded each spring. Lines that appear to have potential as cultivars are entered in the Arkansas Commercial Variety Test. The seed of each line in the Elite Wheat nursery is sent to the USDA Soft Wheat Quality Lab to be tested for baking and milling quality to ensure that the lines released from the program meet industry standards.

Other Universities in the soft wheat region have variety development programs. Evaluation of public lines initially takes place in regional uniform nurseries and then through the commercial variety test. Released lines adapted to Arkansas will be introduced through the foundation seed program to seedsmen.

## RESULTS AND DISCUSSION:

### 1) NEW AND FUTURE RELEASES:

Recent releases continue to perform well. AR850-1-1 was licensed through an agreement with Petrus Seed Company which will have exclusive rights to market the variety in Arkansas. It is a full-season maturing variety and has good resistance to stripe rust and Fusarium Head Blight. All available foundation seed of Pat was sold this year. Certified seed sales of both have been good.

This year we are purifying and increasing seed of two selections from the cross Jackson/Pioneer 2643 (AR96077). They are being tested in the State Variety Test and regional yield trials this year in anticipation of possible release.

## 2) YIELD NURSERIES

The most advanced experimental lines were planted in the Elite Wheat Lines (EWL) nursery at Keiser, Stuttgart, and Marianna. Yields were relatively high at and several experimental lines had yields higher or comparable to the commercial checks. AR 97044-10-2 was entered in the USDA Eastern Regional yield nursery. The experimental lines AR96077-10-1 and AR96077-7-2 were entered in the 2006-07 Arkansas State Variety Test. AR96077-10-1 was entered in the Southern Regional and AR96077-7-2 in the Eastern Regional yield trials for the 2006-07 growing season. These lines have excellent yield potential and stripe rust resistance. AR 124-4-2 which has good Fusarium Head Blight resistance and also has a comparable grain yield with Pat is also being tested in cooperative regional trials.

The results of Advanced Wheat Strains nursery averaged over the Keiser and Stuttgart locations showed 16 experimental lines had higher yields than the commercial cultivar Delta King 9410. Several of these lines that appeared promising were advanced to the Elite test for further testing in 2006-07.

The Wheat Observation Yield nursery was planted at Stuttgart and Keiser. This represents the first yield data from lines selected from  $F_6$  head rows in 2004-05. Several experimental lines that appear promising were advanced to the Advanced Wheat Strains test for further testing in 2006-07.

To enhance disease resistant to Fusarium Head Blight (Scab) a special nursery is conducted to screen experimental lines for agronomic traits as well as scab resistance. Several lines possess the same level of resistance as the resistant check 'Ernie' but have yields similar to 'Pat'.

## 3) EARLY GENERATIONS

During the winter the greenhouse crossing program to produce future lines was continued. There were 88 successful crosses in four efforts: 1) standard variety development, 2) scab-resistant varieties, 3) imidazolinone herbicide resistant varieties and, 4) specialty types (white and waxy wheats). The resulting offspring of last year's crosses (113  $F_1$ ) were grown in the greenhouse over the winter to increase seed. The next three generations ( $F_2$ ,  $F_3$ , and  $F_4$ ) were grown as bulk populations in the field at Stuttgart. This year there were 109  $F_2$  populations, 196  $F_3$  populations, 159  $F_4$  populations and 172  $F_5$  populations produced. Individual plants were selected from the  $F_6$  generation at Fayetteville to produce experimental lines which will be planted at Stuttgart and Keiser this fall to begin yield testing.

## CONCLUSIONS:

The breeding project has made strides in a number of areas. Approximately 800 experimental lines were tested throughout the state to determine genetic potential for Arkansas wheat producers. For future testing nearly 20,000 new lines were evaluated in the field. In order to produce new experimental lines, over 1200 genetically segregating populations were grown in the field as well as making approximately 100 crosses in the greenhouse to produce new populations. Some specific highlights from this year's work:

- Certified seed of Pat sold.
  
- AR 910 marketed as Delta King Seed GR9108.
  
- AR 850-1-1 released and licenced to Petrus Seed.
  
- Three lines advanced to Regional Soft Wheat testing
  
- Breeding lines of herbicide-tolerant wheat for Hoelon-resistant ryegrass.
  
- Five scab resistant lines advanced for regional testing.
  
- Identification of lines resistant to stripe rust.
  
- Work in developing speciality (white and waxy) wheat for Arkansas continued.