Hybrid Rice Breeding

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ABSTRACT

In 2012, testing continued on breeding lines that had been identified as promising parents in previous years as well as new ones generated in 2011. Various hybrid combinations were evaluated for combining ability in yield and other traits such as height, lodging, disease resistance, grain type, and quality. Replicated tests of various 2- and 3-line combinations were evaluated at the University of Arkansas System Division of Agriculture Rice Research and Extension Center (RREC). Eight hybrids were entered in the Uniform Regional Rice Nursery (URRN) and the Arkansas Rice Performance Trials (ARPT). For 87 hybrid combinations, $F_1$ seed production was also evaluated.

INTRODUCTION

Lines developed for use in 2- and 3-line hybrids were tested in various combinations to evaluate their potential for breeding and commercially important traits. In 2011, several parent lines and hybrid combinations were identified as having good potential. In addition, several new lines were included in 2012 for testing. Evaluation of potential breeding lines requires testing various combinations as $F_1$ hybrids for yield and a broad array of traits necessary for a rice variety to be commercially acceptable including various agronomic, milling, and disease resistance traits. In addition, potential parent lines must be tested for seed production, which requires evaluating isolation planting schemes, synchronization of flowering, and pollen distribution, etc.
PROCEDURES

Yield Tests

Yield was evaluated on 23 hybrids in a replicated test at RREC, with 3 replications and included the checks Francis, Wells, and Ark-Flor, a newly released aromatic germplasm from Florida. Plots were drilled on 3 May. Seed were planted in 6-row plots, 3-m long and 1.5-m wide. In addition, 8 hybrids that performed well in 2011 were entered into the URRN to be tested in Ark., La., Miss., Texas, Mo., and in the ARPT to be tested around the state.

Hybrid Seed Production

Seed production was tested in 2 locations chosen for maximum isolation from other rice to reduce the chance of pollen contamination. A total of 87 combinations were tested. Site 1 (Woods) was isolated on 3 sides by woods and fallow land, which provided a relatively secluded location with less chance of uncontrolled pollination. It contained 8 bays, with each bay planted with a different restorer. Restorers were planted in single rows, 3-m apart, and 10-m long. Between the restorer rows, male sterile lines were transplanted on dates varying according to the entries’ heading dates. The male-sterile lines were 873A, 799s, 800s, 805s, 811s, and 810s. At Site 2 (Soybean), the location was near other rice fields and surrounded by soybean. Isolation was less than ideal, but it was a good contrast to the Woods site for observing uncontrolled outcrossing. Tests were planted with the same methods as in the Woods site, but used only 4 restorers. Corn was planted around the tests and between bays to help reduce chances for pollen contamination.

RESULTS AND DISCUSSION

Yield Tests

In the replicated yield test, Francis was the highest yielding check variety (7,826 lb/acre), so all comparisons are made with that check (Berger et al., 2013). Twenty-two of the hybrids had yields greater than Francis and 2 hybrids yielded less than Francis. Of these, 11 had yields exceeding that of Francis by 20% or more. For some of the tested hybrids, this was the second year in which they exceeded the check in yield. One interesting observation was that by mating a certain restorer with various male-steriles, heading dates could be shifted by about 3 to 4 day increments.

Of the 8 Arkansas hybrids in the URRN, 5 were in the top 25% in yield for the 200 entries in the test (Table 1). Entry 176, which ranked 2nd in the test is a 2-line hybrid with smooth leaf and long grain. In Louisiana, where blast was very bad, all 8 University of Arkansas hybrids exhibited very good resistance.
Seed Production

Seed production was refined after the experience in 2011. Synchronization of flowering was improved. Hybrid seed production is known to have low yield, but seed yields were at acceptable levels in some combinations.

Until F₁ seed are grown, an assessment of the outcrossing at each site cannot be made. Seed production overall ranged from essentially nothing in some combinations to a high of 2,254 lb/acre. Most combinations averaged about 350 lb/acre, and were fairly consistent across restorers and male-steriles. Seed production will improve as we are able to mechanize more and gain more information on the flowering and management of parent lines.

Seed was increased in isolation for male-sterile lines. The lines 236s, 811s, 873s, and 874s produced well in the field at Stuttgart. The fact that environmental male-sterile lines set seed well, may be attributed in part to the origin, development, and selection of those lines all being done at that location.

SIGNIFICANCE OF FINDINGS

This year’s tests added valuable information about both the general and specific combining ability of selected lines. Grain yield and other traits were improved over the previous year. The preliminary evaluations of selected hybrids for both yield and seed production in 2012 were very informative. Selected hybrids will be tested in replicated, multi-location tests in 2013. Seed production schemes will continue to develop with improved synchrony between parent lines.

ACKNOWLEDGMENTS

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LITERATURE CITED

Table 1. Performance of selected University of Arkansas hybrids in the 2012 Uniform Regional Rice Nursery (URRN) grown at Stuttgart, Ark.; Crowley, La.; Stoneville, Miss.; Campbell, Mo.; and Beaumont, Texas.

<table>
<thead>
<tr>
<th>Hybrid</th>
<th>Rank&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Yield</th>
<th>Milling&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Height</th>
<th>Heading</th>
</tr>
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<tbody>
<tr>
<td></td>
<td></td>
<td>(lb/acre)</td>
<td>(%)</td>
<td>(cm)</td>
<td>(days)</td>
</tr>
<tr>
<td>176</td>
<td>2</td>
<td>10,201</td>
<td>44/66</td>
<td>110</td>
<td>85</td>
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<td>58/67</td>
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<td>48/65</td>
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<tr>
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<td>59/70</td>
<td>104</td>
<td>86</td>
</tr>
</tbody>
</table>

<sup>a</sup> Rank is relative to 200 entries.

<sup>b</sup> Milling is head rice/total rice.