Calrose-lineage cultivar improvement by the Rice Experiment Station: I. Yield increase rate

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Introduction

In the United States, commercial rice grain yields in California are the highest and these have increased from 5,353 kg/ha in 1960 to a national record-high 9,966 kg/ha in 2015 (USDA, Economics, Statistics and Market Information System, 2015; USDA, National Agricultural Statistics Service, 2016). Yield gains in commercial medium grain rice production in California were estimated to be 42 kg/ha/yr for the 1981 to 2011 period and 74 kg/ha/yr for the 1996 to 2011 period (McKenzie et al., 2014).

The Rice Experiment Station (RES) of the California Cooperative Rice Research Foundation, Inc. (CCRRF) at Biggs, CA, has been breeding for high yielding and high quality rice cultivars since 1912, and Calrose is a tall traditional cultivar that it released in 1948. In 2015, RES released two new cultivars, M-209 (Andaya, 2014) and Calmochi-203 (Samonte, 2014). Maximum grain yields attained by M-209 and CM-203 were 12,260 and 13,470 kg/ha, respectively, in the Statewide Yield Tests from 2010 to 2014.

To evaluate for the presence of a yield plateau, the objective of this study was to determine the yield increase rate based on 31 semi-dwarf rice cultivars released in California from 1976 to 2015.

Materials and Methods

Thirty-one semi-dwarf rice cultivars that were released in California from 1976 to 2015 were evaluated in yield tests in 2014 and 2015. These consisted of conventional long (L-201, L-202, L-203, L-204, L-205, and L-206), medium (Calrose 76, M7, M9, M-201, M-202, M-102, M-103, M-204, M-104, M-205, M-206, M-207, M-208, M-105, and M-209), and short (S-201, S-101, S-301, and S-102) grain types, and premium quality medium (M-401 and M-402) and waxy short (CM-201, CM-202, CM-101, and CM-203) grain cultivars. The yield tests were conducted in RES (Biggs, California), and cultivars were evaluated in 20-m^2 plots that were replicated four times. Data on grain yield and yield-related traits were estimated. This poster focused on grain yield trends, and estimated the yield increase rate (kg/ha/year) due to the release of cultivars. Yield increase rates were estimated from the 2014, 2015, and the combined 2014 and 2015 data.

Results and Discussion

There were significant differences among the grain yields of 31 semi-dwarf cultivars in the 2014, 2015, and the combined 2014 and 2015 yield tests. When averaged across 2014 and 2015, Calrose 76 (released in 1976) yielded 7,690 kg/ha, while CM-203 and M-209 averaged 10,160 and 10,520 kg/ha, respectively. The average difference between 2015- and 1976-released cultivars was 2,650 kg/ha or 34%.

Grain yield increase rates were estimated to be 36, 54, and 42 kg/ha/year from the 2014, 2015, and combined 2014-2015 yield tests, respectively (Fig. 1). These positive yield increase rates indicated the absence of a yield plateau in the improvement of semi-dwarf cultivars in California.

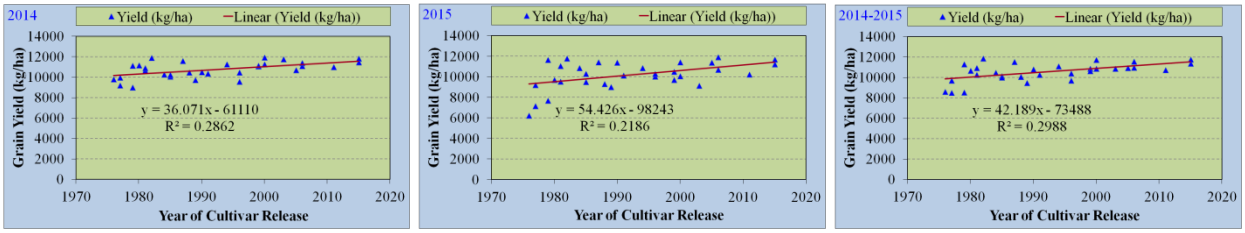

Fig. 1. Grain yields of 31 semi-dwarf cultivars released in California from 1976 to 2015 at Biggs in 2014, 2015, and the combined 2014-2015.

There is potential to further improve grain yield, as top breeding lines have surpassed the 14,000 kg/ha level in local and statewide yield tests. However, grain and cooking quality are important objectives of rice breeders at RES and new cultivars have to be at par or better than Calrose-lineage check cultivars.

Conclusion

Grain yield increase rates due to the release of cultivars were estimated to be 36, 54, and 42 kg/ha/year from the 2014, 2015, and combined 2014-2015 yield tests, respectively. The positive yield increase rates indicated the success in continuously improving grain yields of semi-dwarf cultivars.

This study is useful in tracking the performance of released cultivars and in accounting for genotype x environment interactions that are common in yield trials. It is also useful in planning and breeding cultivars for the future.

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