

Field Performance of Selected Hybrid Rice at Five Louisiana Locations



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ABSTRACT

In the southern United States, hybrid rice (*Oryza sativa* L.) acreage has been increasing rapidly since its first commercialization in 1999 by RiceTec Inc. There is very limited public information on the yield advantage of hybrid rice over inbred cultivars under southern U.S. conditions. Therefore, a field research was conducted at five Louisiana locations during 2006 and 2007 to evaluate grain yield, milling quality, maturity, plant height, reactions to diseases, and lodging susceptibility of the latest hybrids, along with leading commercial inbred rice cultivars. Our results indicated that hybrid rice had a significant grain yield advantage over inbred cultivars. In 2006, the average yield of the four hybrids was 9.97 Mt ha⁻¹ compared with the averaged 8.34 Mt ha⁻¹ for long-grain inbred cultivars. A similar yield advantage was observed in 2007 when the average grain yield of five hybrids was 9.87 Mt ha⁻¹ compared with 7.32 Mt ha⁻¹ for inbred cultivars. The hybrids had a significantly lower whole rice yield than the inbred cultivars, even though the total milled rice yield was similar between the two. The average whole milled rice yields of hybrids were 598 and 580 g kg⁻¹ compared with 632 and 599 g kg⁻¹ for inbred cultivars for 2006 and 2007, respectively. Hybrid rice had similar maturity but was significantly taller than inbred cultivars. The average plant heights of hybrids were 110 and 117 cm compared with 93 and 97 cm for inbred long-grain cultivars for 2006 and 2007, respectively. Hybrid rice was susceptible to lodging, with an average incidence of 18%. Nevertheless, hybrid rice had better resistance to both sheath blight and bacterial panicle blight.

INTRODUCTION

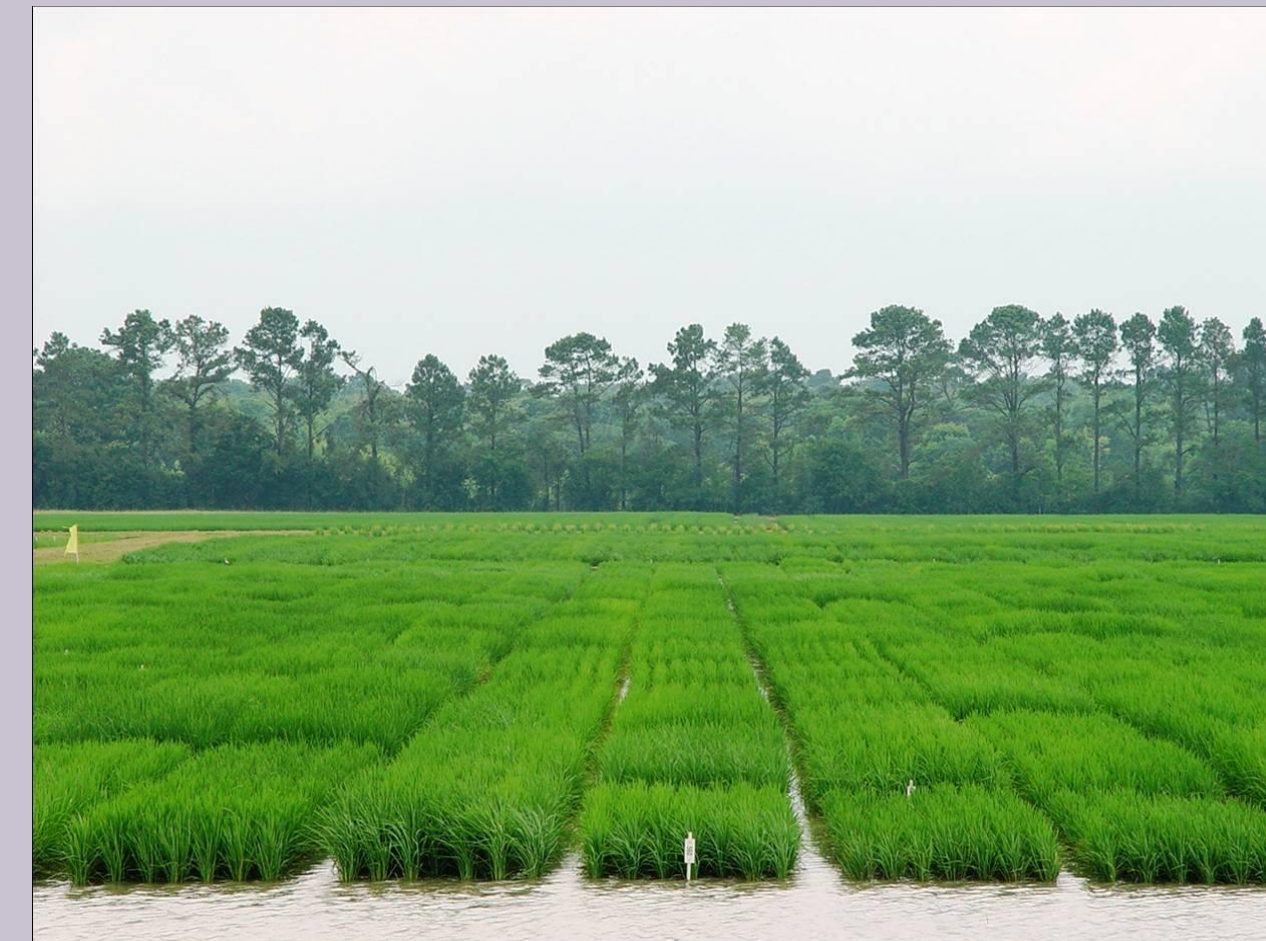
Hybrid rice is one of the technological breakthroughs that have revolutionized the southern U.S. rice production since early 2000. First developed and commercialized in China in 1976, hybrid rice has currently been grown on about 50% of its rice acreage but accounts for about 60% of annual production (Yuan, 2003). Using the Chinese technology, RiceTec Inc. (Alvin, TX) commercialized the first three-line rice hybrid XL6 for the southern United States in 1999, which has since been replaced with two-line hybrids (Andrews, 2001; Walton, 2003). A 9 to 20% yield advantage of hybrid rice over inbred cultivars has been well documented in China, Philippines, and other Asian countries, where rice is produced on small farms and involves extensive labors (Virmani, 2005; Yuan, 2003). Nevertheless, there is limited public information available regarding yield advantage of hybrids over inbred cultivars in the United States (Ottis and Talbert, 2005; Sha and Linscombe, 2007; Walker et al., 2008).

OBJECTIVE

This study was carried out to compare all commercially available hybrid rice with leading inbred cultivars across years and locations in regard to grain yield, milling yield (head and total milled rice), plant height, lodging susceptibility, maturity, and disease reactions to sheath blight and bacterial panicle blight.

MATERIALS AND METHODS

Four hybrids (CLXL8, XL723, CLXL730, and XP729) were tested in 2006, while five (CLXL729, CLXL730, CLXP745, XL723, and XP744) in 2007. Along with the hybrids, seven widely grown inbred cultivars were also tested, which included three Clearfield® cultivars (CL131, CL151, and CL161) and four conventional cultivars (Cheniére, Cocodrie, Trenasse, and Wells). Field experiments were carried out at three southwest Louisiana locations (Acadia, Evangeline, and Vermilion), as well as two northeast Louisiana locations (Morehouse and Richland). A complete randomized block design was applied with three blocks for each site. The Proc Mixed procedure of SAS version 9.1 was used in the data analysis (SAS Institute, Cary, NC). Because of the different genotypes being tested, separate analyses were carried out for 2006 and 2007 data, as well as for individual cultivar/hybrid and cultivar types (hybrid and inbred). Cultivar, cultivar type, and location were treated as fixed effects, while replication and any interaction involving replication were treated as random effects. All fixed effects and their interactions were tested by Type III statistics, and a significance level of 0.05 was used for mean separation.



Field trials were carried out at five Louisiana locations during 2006-2007. Each plot consisted seven rows measuring 1.5 m wide and 4.8 m long.

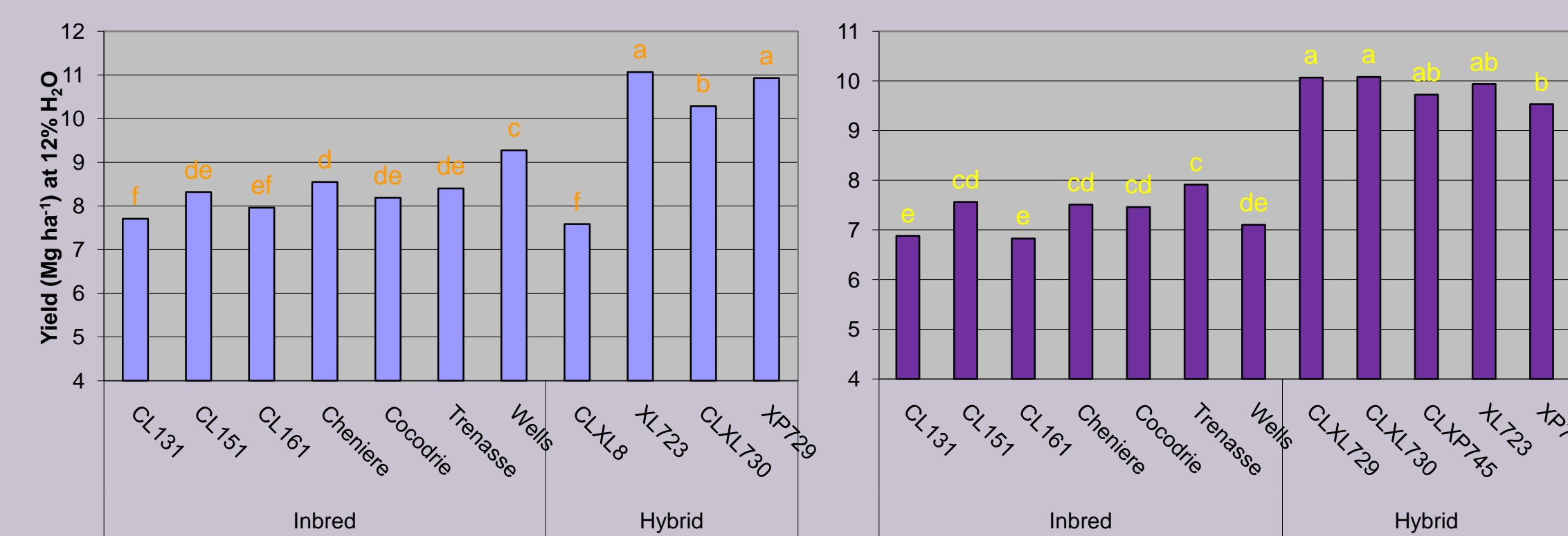


Figure 1. Average grain yield of RiceTec hybrids and leading inbred long-grain rice cultivars in 2006 (left) and 2007 (right).

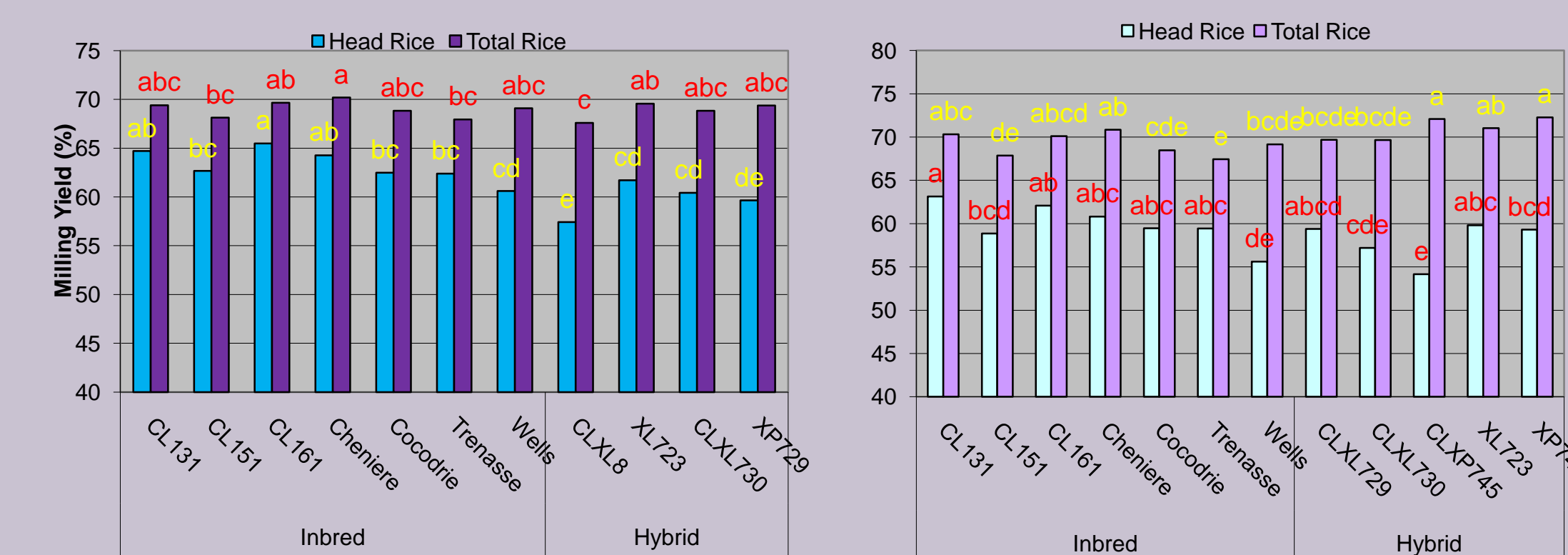


Figure 2. Average milling yield of RiceTec hybrids and leading inbred long-grain rice cultivars in 2006 (left) and 2007 (right).

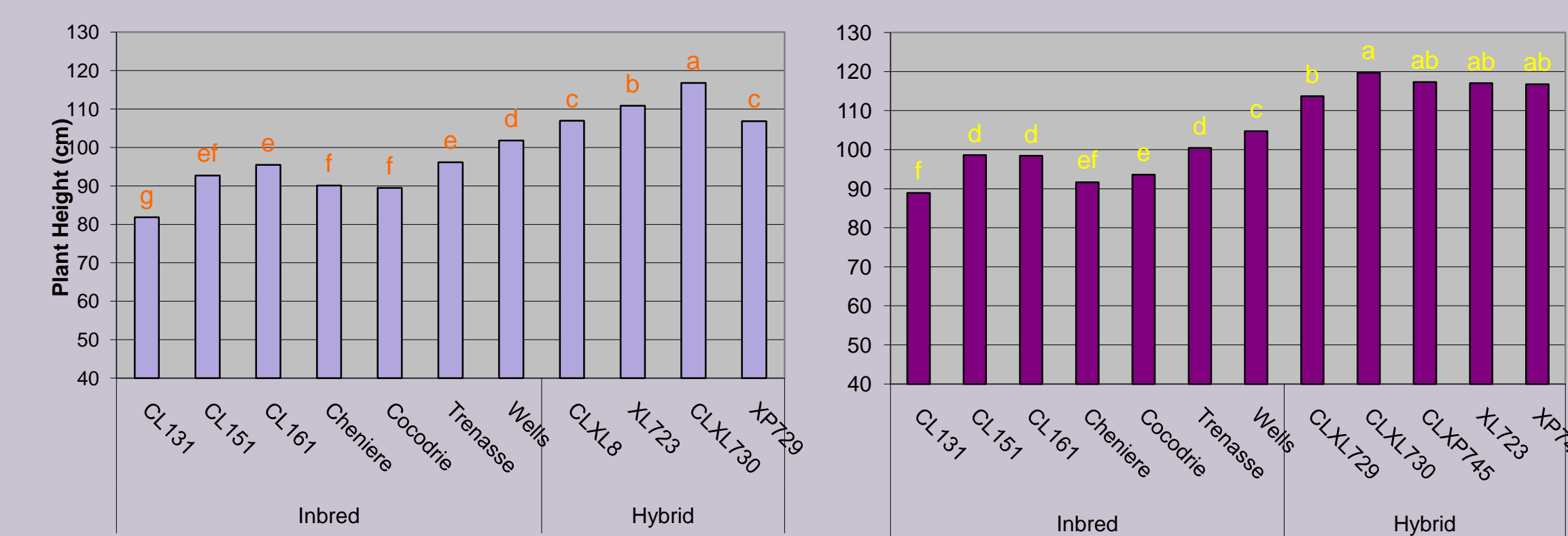


Figure 3. Comparison of plant height between RiceTec hybrids and inbred rice cultivars at five Louisiana locations, 2006(left) and 2007 (right).

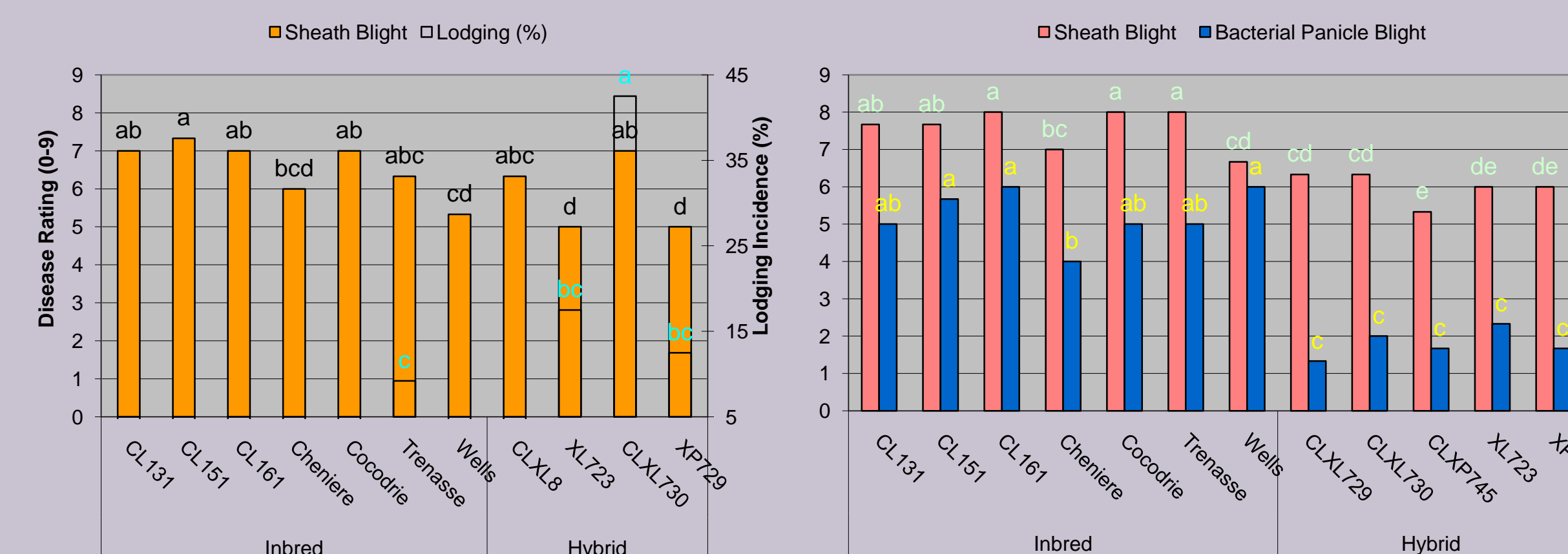


Figure 4. Comparison of sheath blight and bacterial panicle blight reactions and lodging incidence between RiceTec hybrids and leading inbred long-grain rice cultivars at five Louisiana locations in 2006 (left) and 2007 (right).

RESULTS

- In 2006, the average grain yield of hybrids was 9.97 Mg ha⁻¹ compared with 8.34 Mg ha⁻¹ for inbred cultivars, which was equivalent to a 19.5% yield advantages. Such yield gaps were widening in 2007, when hybrids produced 34.8% more rice than inbred cultivars (Figure 1).
- Hybrids in general had lower head rice yields than inbred cultivars, but such a difference was significant (P=0.0573) only in 2006. The average head rice yield of hybrids in 2006 across locations and genotypes was 34 g kg⁻¹ (5.4%) less than inbred cultivars. However, the head rice yield difference between hybrids and inbred cultivars was much smaller in 2007, when hybrids produced 19 g kg⁻¹ (3.3%) less head rice than inbred cultivars (Figure 2).
- In both 2006 and 2007, no significant difference on total milled rice yield was detected between different cultivar types, even though a significant (P=0.0124) difference in total milled rice yield did exist among individual cultivar/hybrid in 2007 (Figures 2).
- Difference on maturity measured by days to 50% heading between hybrids and inbred cultivars is negligible in 2006. However, in 2007, hybrids were 1.2 days earlier than inbred cultivars.
- Nevertheless, hybrids were significantly (P<0.001) taller than inbred cultivars. The average plant heights of hybrids were 110 cm in 2006 and 117 cm in 2007, which were 18 and 20 cm taller than inbred cultivars in 2006 and 2007, respectively (Figure 3).
- Lodging occurred in 2006 but not in 2007. Averaged across genotypes and locations, hybrids showed an 18% lodging incidence compared with 1% for inbred cultivars (Figure 4).
- Sheath blight was more severe in 2007 than in 2006 (Figure 4). The average sheath blight ratings of hybrids were 5.8 and 6.0 compared with 6.6 and 7.6 of inbred cultivars for 2006 and 2007, respectively.
- The average bacterial panicle blight rating of hybrids was 1.8 compared with 5.2 for inbred cultivars (Figure 4).

CONCLUSIONS

- A 19.5 to 34.8% yield advantage of hybrid rice over inbred cultivars was observed in our yield trials that were conducted at five Louisiana locations during 2006-2007.
- Hybrids produced 3.3 to 5.4% less head rice than inbred cultivars.
- Hybrids had similar maturity to current leading inbred cultivars. However, current hybrids were 18 to 20 cm taller and more susceptible to lodging than inbred cultivars.
- Hybrid rice was significantly less susceptible to sheath blight and much more resistant to bacterial panicle blight.

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