UNIVERSITY OF MISSOURI

Effect of Cultivars, Fertilizers, and Plant Hormones on Chalkiness in Rice

Gene Stevens, Matthew Rhine, Johanna Nelson, and Josh Harrington

Introduction

Rice marketability is dictated by two traits- proportion of broken grains after milling and amount of chalkiness (opaque spots) in whole grains. Both traits are the result of uneven packing of amyloplasts in the rice seed endosperm which causes weak and brittle grains. Broken grains in cooked rice detract from its aesthetic value and chalkiness hurts the taste. The most valuable rice grains are translucent. Typically, rice grains from the bottom of panicles (heads) mature latest in the season and have more chalk and broken grains than grains from the top.

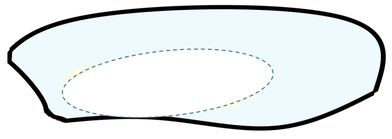

Figure 1. Buyers have given chalky rice the derogatory name, “white bellied”, referring to white areas on the lower edges of the grains.

In recent years, chalkiness has become an obstacle for selling USA rice in Turkey and Latin America countries. Research has shown that changes in plant hormones (gibberellic acid and kinetin) from stresses, such as potassium and nitrogen deficiency, high nighttime temperature, and water stress, can increase rice grain chalkiness. In Missouri, high yielding varieties such as CL151 and hybrids often have more grain chalkiness than varieties such as RoyJ and Lakast.

Objective

The objective of this study was to evaluate chalkiness in rice cultivars and develop nutrient and hormone programs to reduce the proportion of broken grains and chalkiness in rice and increase it marketability to consumers..

Materials and methods

Fields were conducted in 2015 and 2016 at the Missouri Rice Farm at Qulin, MO and University of Missouri-Fisher Delta Research Center at Portageville, MO. A factorial design (genetics and management) with four replications was used. Eight culitvars and three hybrids were planted (Roy J, Jupiter, CL151, Lakast, Gemini 214CL, Caffey, Mermentau, CLXP766, CLXL745, and XL573). Each rice received management treatments with an untreated check, soil applied potassium, soil applied calcium silicate, and internode elongation applied potassium fertilizer. Chalkiness was also evaluated with plots fertilized with 134, 168, and 220 kg N ha^{-1}. Foliar treatments were gibberellic acid and kinetin applied at 50% heading. Before harvest, panicles from CL151 were harvested, cut into three parts by location (bottom, middle, and top) and milled.

MBZ-2 whiteness meter

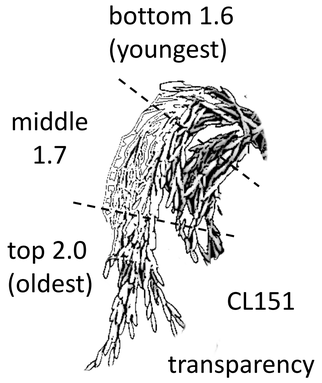

Figure 2. The greatest amount of chalkiness occurred in the lower grains of the panicles which matured last.

Plots were harvested with a combine for yield and grain milling properties. Percent broken grains was determined and percent transparency was measured with a MBZ-2 whiteness meter for each rice variety/hybrid and management treatment.

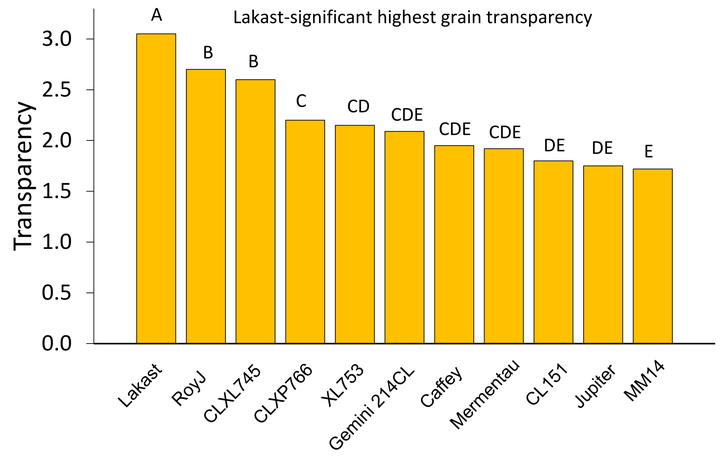

Figure 3. Transparency of grain from rice cultivars averaged over nitrogen rates in 2016.

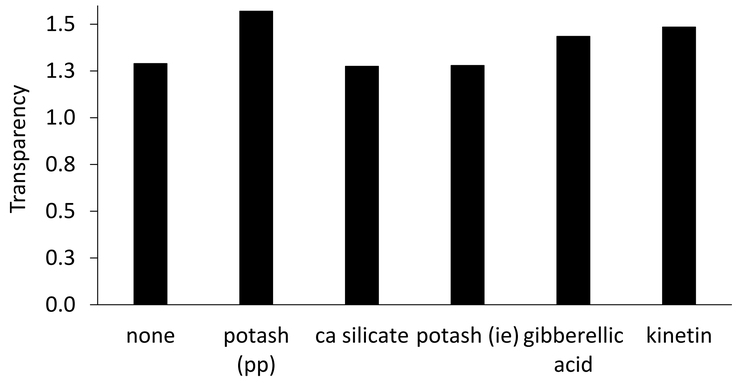

Figure 4. Transparency of grain from rice receiving fertilizer and hormone treatments.

less downed rice occurred in potash and kinetin plots

Conclusion

1. Chalkiness occurred most in lower grains on panicle
2. Cultivars and hybrids varied in grain transparency
3. Potash and hormones did not affect chalkiness
4. Potash and kinetin reduced lodging in 2016.