Fertilizer and Hormone Applications at Heading to Reduce Chalkiness in Rice Grains

Gene Stevens and Matthew Rhine

Rice marketability is dictated by two traits- proportion of broken grains after milling and amount of chalkiness (opaque spots) in whole grains (Fitzgerald, 2009; Fig. 1). Both traits are the result of uneven packing of amyloplasts in the rice seed endosperm which causes weak and brittle grains (Lisle et al., 2000). 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. White areas in grain are chalky.

Economic impact: In recent years, chalkiness has become an obstacle for selling USA rice in Turkey and Latin America countries. Buyers have given chalky rice the derogatory name, "white bellied", referring to white areas on the lower edges of the grains. 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 (Lanning et al., 2011; Ray and Choudhuri, 1980; Wang et al., 2007; Yang et al., 2001). In Missouri, high yielding varieties such as CL151 and hybrids often have more grain chalkiness than varieties such as Jazzman. At the Delta Center in 2014, we observed less chalkiness in rice grain samples from fertilized plots with calcium silicate (Fig. 2). Rice breeders have mapped regions on chromosomes linked to increased chalky grains. However, genetic improvement will not be the complete solution. High night time temperatures in the summer of 2010 caused chalkiness in nearly all the varieties in Arkansas (Perez et al., 1996).

Objective: To develop nutrient and hormone programs to reduce the proportion of broken grains and chalkiness in Missouri rice and increase it marketability to consumers in the United States and foreign countries.

Procedure: Test fields will be selected at the Missouri Rice Farm and University of Missouri-Fisher Delta Research Center with low or medium soil test potassium. A factorial design (genetics and management) with four replications will be used. Five varieties and three hybrids will be planted (Roy J, Wells, Jupiter, Jazzman 2, CL151, RT CLXL729, RT XL573, and RT CLXL745). Each rice will receive management treatments with an untreated check, soil applied potassium, soil applied calcium silicate, and internode elongation applied potassium fertilizer. Chalkiness will also be evaluated with plots fertilized with 120, 150, and 180 lb N/acre. Foliar treatments will be gibberellic acid and kinetin applied at 50% heading. Plots will be harvested with a

combine for yield and grain milling properties. Percent broken grains will be determined and percent chalkiness measured with SigmaScan software for each rice variety/hybrid and management treatment (Fig. 3).

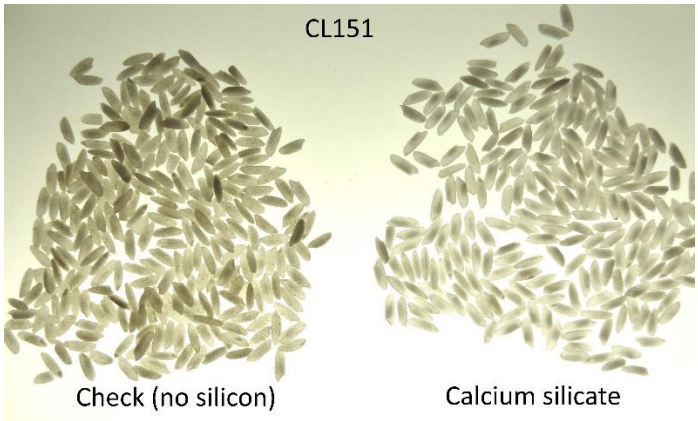

Figure 2. Milled CL151 variety rice on light table showing differences in chalkiness between rice with and without calcium silicate fertilizer. Chalk spots show up as dark areas in grains because light cannot pass through them.

Program quantifies chalk area in grains.

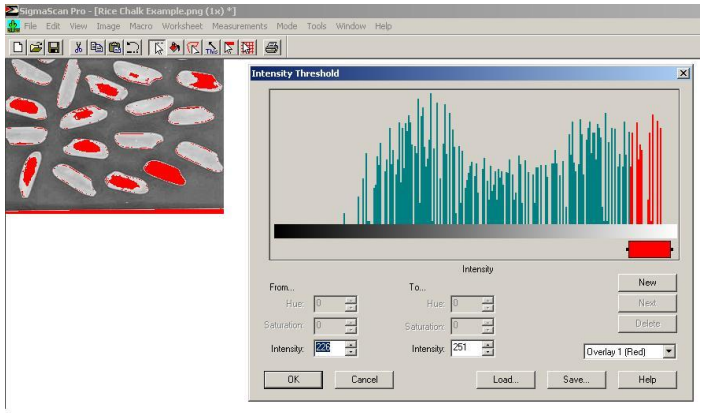

Figure 3. Software used to measure % chalkiness from images of rice grains from treatments.

References

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Proposed Budget

	2015	2016	2017	Total
Labor- research assistant	$12,000	$12,000	$12,000	$36,000
Supplies and travel	$1500	$1500	$1500	$4,500
Total	$13,500	$13,500	$13,500	$40,500