Influence of Nitrogen Rate and Seeding Rate on Grain Yield of Roy J Rice Grown at Two Locations in Arkansas—First Year Results

D.L. Frizzell, J.T. Hardke, E. Castaneda-Gonzalez, R.J. Norman, and M.W. Duren

ABSTRACT

Seeding rate recommendations for rice grown in Arkansas are based on achieving an optimum stand density of 10 to 20 plants/ft² for conventional varieties. The current recommendation of 30 seed/ft² is a baseline and actual seeding rate is adjusted based on considerations such as planting date, seedbed preparation, soil type, seeding method, or pest pressure. For various reasons, primarily due to environmental conditions, the recommended seeding rate for a given planting situation at times does not result in an optimum stand density. In these situations, often a recommendation is made to increase nitrogen (N) rates with the goal of increasing tillering in the plants. Previous studies using older cultivars have shown grain yield could be increased in thin stands by increasing the amount of fertilizer N applied preflood, but it is unclear if the findings from those studies can still be applied to newer, more vigorous cultivars grown today. Therefore, the objective of this study was to examine the relationship between rice seeding rates and N application rates of a currently grown cultivar. A study was initiated during 2014 at the University of Arkansas System Division of Agriculture’s Northeast Research and Extension Center (NEREC) near Keiser, Ark., on a Sharkey clay soil and at the Rice Research and Extension Center (RREC) near Stuttgart, Ark., on a DeWitt silt loam soil using the conventional rice variety Roy J. Four treatments were utilized at each location that consisted of combinations of two seeding rates (44 or 88 lb seed/acre) and two preflood-N rates (90 or 150 lb N/acre). At NEREC, the higher preflood-N rate resulted in greater grain yields regardless of seeding rate. At RREC, the lowest grain yield was observed with the 44 lb/acre seeding rate and 90 lb/acre of preflood-N rate combination, but grain yield increased as either seeding rate...
or N rate was increased with the highest grain yield observed when 150 lb N/acre was applied to rice seeded with 88 lb seed/acre. This initial dataset indicates an increase in preflood-N rate applied to rice seeded at a lower than optimum seeding rate may have a positive effect on grain yield of newer cultivars.

INTRODUCTION

Seeding rate recommendations for rice grown in Arkansas are based on achieving an optimum stand density of 10 to 20 plants/ft\(^2\) for conventional varieties and 6 to 10 plants/ft\(^2\) for hybrids (Wilson et al., 2013). The current recommendation for conventional varieties of 30 seed/ft\(^2\) is a baseline and actual seeding rate is adjusted based on considerations such as planting date, seedbed preparation, soil type, seeding method, or pest pressure. For various reasons, primarily due to environmental conditions, the recommended seeding rate for a given planting situation at times does not result in an optimum stand density. In these situations, often a recommendation is made to increase N rates with the goal of increasing tillering in the plants. This recommendation for additional N is based on previous studies that have shown grain yield could be increased in thin stands by increasing the amount of fertilizer N applied (Counce and Wells, 1990; Counce et al., 1992; Wells and Faw, 1978).

Work done by Wells and Faw (1978) using Starbonnet rice seeded on a DeWitt silt loam at rates of 60, 120, and 270 lb seed/acre and preflood-N rates of 60, 120 and 180 lb N/acre determined that both N rate and seeding rate influenced grain yield each year of the study. During 1972, grain yield increased with each increase in N rate at the 60 lb/acre seeding rate, but only increased at the 120 lb/acre seeding rate when N rate was increased up to 120 lb N/acre. Grain yield declined with an increase in preflood N from 120 to 180 lb N/acre. During 1973, grain yield was maximized with the combination of 120 lb N/acre applied to either the 60 or 120 lb/acre seeding rate.

Counce and Wells (1990) noted a significant interaction between initial plant population density and preflood-N rates for Lemont and Newbonnet on a Sharkey clay soil across the two-year study. Grain yield increased with each increase in N rate at the lowest seeding rate of 5 seed/ft\(^2\) and increased at the 40 or 125 seed/ft\(^2\) seeding rate with N rates up to 70 lb N/acre. Grain yield at each of those seeding rates remained somewhat similar when N rate increased from 70 to 100 lb N/acre. Results from the yield component portion of the study showed that at the lowest seeding rate, grain yield increase with each subsequent increase in N rate was mainly due to additional tillering. As seeding rate increased to 40 or 125 seed/ft, increased grain yield was due to increased number of grains per panicle. Results from a study conducted by Counce et al. (1992) at the same location using Lemont rice seeded at 5, 25, and 45 seed/ft\(^2\) were in agreement with the earlier study in that both years showed a greater preflood-N requirement for the two lower seeding rates than for the near optimum seeding rate of 45 seed/ft\(^2\). The optimum seeding rate for rice varieties at that time was considered to be somewhere around 40 seed/ft\(^2\).

In contrast, a study conducted at several locations in Louisiana, Mississippi, and Missouri using newer varieties Cheniere and Wells seeded at 15, 30, and 60 seed/ft\(^2\),
and preflood-N rates of 60, 120, and 180 lb N/acre, found grain yield is influenced by seeding rate and also by N rate but there was no interaction between N rate and seeding rate (Bond et al., 2008). Similar results were observed in a study using Cheniere and Jupiter seeded into a Crowley silt loam at rates of 15, 30, 45, and 60 seed/ft² (Harrell and Blanche, 2010). Nitrogen rates of 90, 120, 150, and 180 lb N/acre were applied preflood as urea. There was no interaction of N rate and seeding rate for either Cheniere or Jupiter, only the main effect of N rate or seeding rate influenced grain yield of the two cultivars.

On-going work is conducted each year to evaluate the effect of N rate or seeding rate on rice grain yield in Arkansas, but there has been no known work done within the University of Arkansas looking at the combined effect of N rate and seeding rate on grain yield. Recent work conducted in surrounding states regarding the effect these two parameters have on grain yield has been in contrast to findings of previous studies. It is unclear if the data obtained from work with older cultivars can still be applied to newer, more vigorous cultivars grown today. Therefore, the objective of this study was to examine the relationship between rice seeding rates and nitrogen (N) application rates of a currently grown cultivar.

**PROCEDURES**

A study was initiated during 2014 at the University of Arkansas System Division of Agriculture’s Northeast Research and Extension Center (NEREC) near Keiser, Ark., on a Sharkey clay soil and at the Rice Research and Extension Center (RREC) near Stuttgart, Ark., on a DeWitt silt loam soil. Four treatments were utilized at each location that consisted of combinations of two seeding rates (44 or 88 lb seed/acre) and two preflood-N rates (90 or 150 lb N/acre). The treatments were arranged in a randomized complete block design with three replications. The conventional rice cultivar, Roy J, was drill-seeded into a conventionally tilled seedbed on 7 May at NEREC and 12 May at RREC in plots 9 rows (7-inch spacing) wide and 15 ft in length. Seed was treated with CruiserMaxx Rice seed treatment to reduce impact of early-season insects and seedling disease. All N treatments were applied as urea onto a dry soil surface at the 4- to 5-If growth stage. The permanent flood was established within 2 days of N application and maintained until rice reached maturity. At maturity, the center five rows of each plot were harvested and the moisture content and test weight of the grain were determined. Grain yields were adjusted to 12% moisture and reported on a bushels/acre (bu/acre) basis. A bushel of rice weighs 45 pounds (lb). Statistical analyses were conducted using PROC GLM SAS v.9.4 (SAS Institute, Inc., Cary, N.C.) and mean separations were conducted based upon Fisher’s protected least significant difference test ($P = 0.10$) where appropriate.

**RESULTS AND DISCUSSION**

During 2014 at NEREC, the higher preflood-N rate of 150 lb N/acre resulted in greater grain yields regardless of seeding rate (Fig. 1). At RREC, the lowest grain yield
was observed with the 44 lb/acre seeding rate and 90 lb N/acre preflood-N rate, but increased as either seeding rate or N rate was increased and reached a maximum of 161 bushels when 150 lb N/A was applied to plots seeded with 88 lb seed/acre.

Treatment effects were also noted for other parameters at the two locations during 2014. At NEREC, lodging was greater when 150 lb N/acre was applied preflood to both seeding rates (Fig. 2). Lodging was minimal when 90 lb N/acre was applied to the 44 lb/acre seeding rate. Lodging was not at factor at RREC during 2014.

Treatment combinations did not have an effect on harvest moisture at NEREC likely due to the low overall moisture of the trial, but harvest moisture was higher at RREC with the higher preflood-N rate (Fig. 3). Maturity of rice is delayed as the N rate increases, therefore higher harvest moisture would be expected for the rice receiving the higher preflood-N rate.

Test weight (lb/bu) of grain harvested at NEREC was similar between the two preflood-N rates within the 44 and 88 lb/acre seeding rates (Fig. 4). The treatment combination of the 44 lb seed/acre rate fertilized with 90 lb N/acre resulted in greater test weight than either treatment seeded at 88 lb seed/acre. The test weight of the 44 lb seed/acre rate fertilized with 150 lb N/acre was similar to the 88 lb seed/acre rate fertilized at both preflood-N rates. Although numerical test weight differences are evident at the RREC during 2014, the variability of the test weight data did not enable treatment differences to be significant.

**SIGNIFICANCE OF FINDINGS**

This initial dataset indicates an increase in preflood-N rate applied to rice seeded at a lower than optimum seeding rate may have a positive effect on grain yield of newer cultivars. The study will be continued in 2015 and will include evaluating the effect these treatment combinations may have on milling yield in addition to the current parameters of grain yield, harvest moisture, test weight, and lodging. Stand density will be measured to identify low plant populations.

**ACKNOWLEDGMENTS**

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**LITERATURE CITED**


![Fig. 1. Influence of seeding rate and nitrogen (N) rate on grain yield of Roy J during 2014 at the University of Arkansas System Division of Agriculture's Northeast Research and Extension Center (NEREC) and Rice Research and Extension Center (RREC). Means within a location with similar letters are not significantly different (P < 0.10).](image-url)
Fig. 2. Influence of seeding rate and nitrogen (N) rate on lodging of Roy J during 2014 at the University of Arkansas System Division of Agriculture’s Northeast Research and Extension Center (NEREC) and Rice Research and Extension Center (RREC). Means within a location with similar letters are not significantly different ($P < 0.10$).

Fig. 3. Influence of seeding rate and nitrogen (N) rate on harvest moisture of Roy J during 2014 at the University of Arkansas System Division of Agriculture’s Northeast Research and Extension Center (NEREC) and Rice Research and Extension Center (RREC). Means within a location with similar letters are not significantly different ($P < 0.10$). NS indicates not significant.
Fig. 4. Influence of seeding rate and nitrogen (N) rate on test weight of Roy J during 2014 at the University of Arkansas System Division of Agriculture’s Northeast Research and Extension Center (NEREC) and Rice Research and Extension Center (RREC). Means within a location with similar letters are not significantly different ($P < 0.10$). NS indicates not significant.