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Fluids Reduce Costs Versus Dry In Drill-Seeded Rice Production

Banding of fluid fertilizer and early flood improved mid-season N content of plants receiving all fertilizer at planting.

Summary: *Our objective was to compare a three-way split of conventionally applied dry fertilizer with subsurface banded fluid fertilizer for rice production on clay soil near Beaumont, Texas. When all fertilizer was applied at planting and the flood irrigation established at the 6-leaf stage, the midseason nitrogen (N) content of plants receiving banded fluid fertilizer was 93 lbs/A of N or 27 lbs/A more of N than the 66 lbs/A of N in dry fertilized plants. When all fertilizer was applied at planting and the flood established at the 4-leaf stage, the midseason N content of plants receiving banded fluid fertilizer was 103 lbs/A of N or 21 lbs/A of N more than the 82 lbs/A of N in dry fertilized plants. Under the 6-leaf flood, dry fertilizer applied all preplant or in a 3-way split yielded 5,200 and 5,800 lbs/A, respectively, compared to 6,200 lbs/A for banded fluid fertilizer. The 4-leaf flood system yielded higher than the 6-leaf system with the 3-way split dry fertilizer yielding 6,400 lbs/A compared to 6,900 lbs/A for both all preplant dry or banded fluid fertilizer. The banded fluid fertilizer likely would have yielded higher than the dry fertilizer had the N rate been lower than 150 lbs/A, since the banded fluid fertilizer plant contained 21 lbs/A more N at midseason. Subsurface banding of fluid fertilizer at planting, coupled with establishing the flood at the 4-leaf stage, optimized yields and N uptake. The combination of banding and early flood increased N efficiency, reduced application cost, and improved production economics by allowing fewer flush irrigations and less herbicide. This initial research is being expanded to include silt loam soils.*

In flood-irrigated rice production, N fertilizer enters a unique environment that can fluctuate between aerobic and anaerobic conditions in which losses of N and mechanisms of N losses vary greatly from those of upland crops. Whereas upland crops frequently use 40 to 60 percent of the applied N, flooded rice crops typically use only 20 to 40 percent. Research in Arkansas has shown that N fertilizer efficiency of granular urea on rice can be as high as 70 percent when applied under ideal conditions by airplane in multiple applications. However, aerial applications waste energy and can cost $25 to $35/A. Banded fertilizer, on the other hand, has proven effective for most crops and will likely improve fertilizer efficiency in rice production and reduce fertilization application cost by as much as 70 percent, especially when the fluid applicator is attached to the drill and subsurface banded while planting rice.

Our overall objective of our project as reviewed in this discussion was to evaluate fluid fertilizer as a means to increase profitability of rice production in the southern U.S. We proposed to couple all innovations in fertilizer management (subsurface banding of fluid fertilizers) with innovations in water management (early flood and all the benefits associated with early flood) to reduce rice production costs.

We realized that most Texas rice farmers use some of these innovations, but few used the complete package of cost-saving production practices available. The upside of fluids N in plant. Banding fluid and broadcasting dry N at 150 lbs/A at planting, plus early flood irrigation at the 6-leaf stage, improved midseason N in rice plants when all N fertilizer was applied at planting. Midseason N content of fluid-banded plants was 90 lbs/A. N content of plants receiving all dry broadcast fertilizer contained only 66 lbs/A. The additional 27 lbs/A of N in the fl uid-applied plants was the result of increased N uptake by banding fl uid N compared to broadcasting dry N. Flood irrigation at the 4-leaf stage increased N uptake across all treatments. Plant N uptake was 103 lbs/A for banded fluid and 82 lbs/A for plants receiving dry applications at planting.

Yield. Figure 1 shows that the check treatment yielded 2,100 lbs/A when flooded at 4-leaf and 1,500 lbs/A when flooded at the 6-leaf stage. The 600-lb/A advantage with 4-leaf flood suggests this stage improved conditions for maximizing rice yield and/or increasing soil N uptake efficiency. The 4-leaf flood also maximized yields of all treatments when fertilizer was applied. When 150 lbs/A of N were applied under the 4-leaf flood stage, the 3-way split of dry fertilizer yielded 6,400 lbs/A, while both dry and fl uid fertilizer applied all preplant yielded 6,900 lbs/A. Under 6-leaf flood the 3-way split of dry fertilizer yielded 5,800 lbs/A while all the all-preplant dry and preplant fluid yielded only 5,200 and 6,200 lbs/A, respectively. Thus, the more efficient banded fluid N produced higher rice yields than the dry N under 6-leaf flood where conditions were more favorable for N denitrification. Banded fluid would likely have produced higher yields than the all-preplant dry N under the 4-leaf flood stage even if the N rate had been lower than 150 lbs/A.

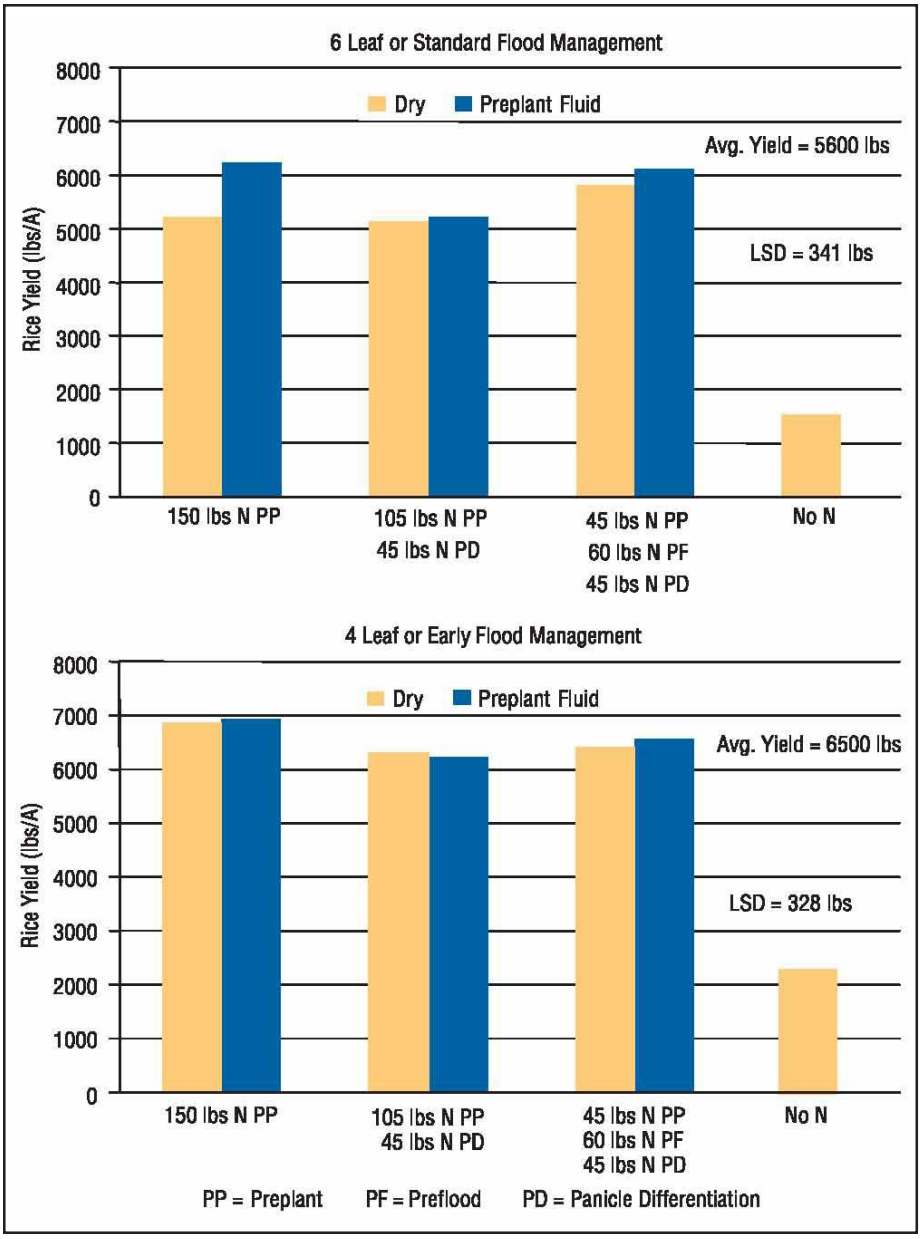

Figure 1. Rice grain yield for standard and early flood, comparing dry versus fluid N. When fluid N was applied as a 3-way split, only the PP application was fluid. The PF and PD application was dry.

Economics

6-leaf flood. As shown earlier, banded fluid N yielded 6,200 lbs/A, which was 400 lbs/A more than the best dry fertilizer treatment (i.e., the 3-way split yielding 5,800 lbs/A). The 400-lb/A higher yield represented an income improvement of $32/A. Estimated application cost for banded fluid N was no more than $6/A compared to at least $25/A for the 3-way split dry. This represented a $19/A reduction in application cost. Therefore, total per acre advantage for banded fluid over dry was estimated at $51/A ($19 + $32/A).

4-leaf flood. As shown earlier, banded fl uid N yielded 6,900 lbs/A, which was about 500 lbs/A higher than the 6,400 lbs/A yield of the 3-way split dry N. That would create about a $40/A advantage for banded fl uid N verses dry N, based on $8/cwt of rice. Thus, banded fluid N would have a $19/A

application advantage over the conventional 3-way split dry N as calculated above. Total per acre advantage of banded fluid N over 3-way split dry N would be $40/A plus $19/A or $59/A under 4-leaf flood stage.

On clay soil. Rice yields averaged 5,600 lbs/A for the 6-leaf flood and 6,500 lbs/A for the 4-leaf flood stage (Figure 1). The 900-lb/A higher yield created by the 4-leaf flood stage would increase income about $72/A based on a $8/cwt of rice. Less herbicide and less flush-irrigation prior to establishing the flood would reduce production cost $15 to $20/A. Therefore, the 4-leaf flood practice could improve net income as much as $90/A. We plan to expand this initial research to include other soils.

Methodology

Location. Research plots were located at the Texas A&M Research and Extension Center near Beaumont, Texas.

Soil was a league clay.

Treatments were evaluated using either "early" (flooding at 3- to 4-leaf growth stage) or "standard" (flooding at 6 to 7-leaf growth stage) water management systems.

Application. Fluid N was applied in bands just prior to planting approximately 2 to 3 inches below the soil's surface of the prepared seedbed. Applicator knives were spaced 16 inches apart to provide a band of fluid N between every other 8-inch row of the eight-row drillseeded plots.

Fertilizers. The form of fluid fertilizer was 15-3-2 urea-based ammonium phosphate. The dry fertilizer was a mixture of urea, 0-46-0, and 0-0-60 broadcast and incorporated at planting.

Timing. Plots were flooded on May 8 and May 19 for the early and standard flood water management systems, respectively, and remained flooded until about 10 days prior to harvest.

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