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Fluids Shine in Rice Trials

Texas studies show both the agronomic (yield) and economic advantages of fluid fertilizers.

Summary: *The combination of early flood (4-leaf stage) establishment and all-fluid-fertilizer (FF) applications during planting increased both nitrogen (N) uptake and rice yield in 2003. In 2004, early flood establishment effects were not significant. However, subsurface banding all-FF during planting continued to improve N uptake and rice yields. Calculated economic benefits of subsurface banded FF during planting compared to conventional 3-way split dry fertilizer treatments, ranged from $25 to $57/A and averaged $40/A.*

Current basic rice production practices in Texas, and most of the southern U.S., consist of drill planting rice in dry soil and establishing a 4-inch deep flood 25 to 30 days later when rice seedlings have approached the 6-leaf growth stage. The first fertilizer application is applied near planting, followed by at least two more aerial applications of nitrogen (N). Delaying flood establishment increases the amount and number of herbicide applications to control weeds. Delaying flood establishment (6-leaf stage) also increases the potential of N fertilizer loss through ammonia volatilization, nitrification, and denitrification.

In the past, multiple aerial N applications improved N efficiency compared to one application. However, current aerial application cost of about $8/A, for applications of less than 110 lbs/A of urea, can be higher than the cost of N fertilizer on a per pound basis. It appears that the subsurface banding of all-FF at planting, coupled with earlier flood establishment, has potential to reduce rice production costs in three areas: fewer aerial herbicide applications, lower N application costs, and lower N rate through improved N uptake. The improved economics of rice production through early flood and subsurface banding of all-FF at planting assumes this combination of practices does not negatively affect rice yield.

Therefore, our objective in this study was to compare all-FF (subsurface banded while planting) with conventionally applied dry fertilizer when flood irrigating at the 4- or 6-leaf stage.

N uptake

2003. Table 1 shows that all-FF increased mid-season N uptake over that of dry urea from 82 to 103 lbs/A and from 66 to 93 lbs/A under the 4- and 6-leaf flood stages, respectively. Note that at the 4-leaf flood stage both fluid and dry showed improved N uptake versus the 6-leaf flood stage.

2004. Early fl ood establishment did not increase N uptake in 2004 possibly because of early-season rain on clay soil and high native N supply on the silt loam soil. Therefore, N uptake data in Table 1 are the average N uptake for the 4- and 6-leaf flood treatments on each soil. On the clay soil, N uptake for the all-FF treatment was 152 lbs/A or approximately 50 percent higher zutthan the three other N treatments, which averaged about 105 lbs/A of N uptake. On the silt loam soil, N uptake for the all-FF treatment was 142 lbs/A, which was on a par with that of the three-way split of dry fertilizer and higher than the dry fertilizer at planting.

Yield

2003. Figure 1 shows that the non-fertilized rice plants yielded 2,100 and 1,500 lbs/A when flooded at the 4- and 6-leaf stages, respectively, suggesting that the 4-leaf flood created conditions of maximum yield and/or increased soil N uptake. The fertilized rice plants also yielded signifi cantly more when flooded at the 4-leaf rather than the 6-leaf stage, possibly because 6-leaf flood prolonged the soil condition that encouraged denitrification. N treatment effect on rice yield was most evident under the 6-leaf flood, which caused rice yield to range from 5,200 to 6,200 lbs/A, the all-FF treatment applied during planting being the highest. N source effect on rice yield under the 4-leaf flood was less pronounced, ranging from 6,200 to 6,939 lbs/A. All-FF treatment applied during planting yielded 6,939 lbs/A, on a par with all dry fertilizer at planting.

2004. Since floodwater management did not significantly influence yield of N fertilized rice plants, yields in Figure 2 are the average of the 4- and 6-leaf flood yields on each soil type. On clay soil, all-FF applied at planting yielded 6,430 lbs/A, which was similar to rice for the 2-way split and about 500 lbs/A more than dry fertilizer at planting. On silt loam, soil yields were higher but N treatment effects were similar to those on clay soil. The higher yields on silt loam soil were probably because of better climatic conditions and because silt loam produced significantly more yield without N fertilizer (Figure 2). All-FF applied during planting yielded 8,440 lbs/A, which was on a par with 2-way N split.

Economic effects

Assumptions. Fertilizer and application costs in Figures 3 and 4 were derived from the following assumptions:

1) FF applied at $4/A in subsurface band at planting
2) $7.65/A aerial cost when applying less than 55 lbs/A, $8.15 when applying 56 to 110 lbs/A, and $7.65/cwt when applying more than 111 to 165 lbs/A

Treatments — 150 lbs/A of N:	2003 (clay soil) 4-leaf	2003 (clay soil) 6-leaf	2004 Clay	2004 Silt loam
1) Fluid at planting	103	93	152	142
2) Dry prior to planting	82	66	104	126
3) 2-way split (70% at planting 30% at mid-season)	—	—	105	113
4) 3-way split (dry 17% at planting + 50% at flood + 33% at mid-season)	—	—	105	143
5) Check	10	—	24	45

Table 1. N uptake (lbs/A) at mid-season on clay soil flooded at the 4- or 6-leaf stage. In 2004, N uptake at booting averaged for 4- and 6-leaf floodwater management.

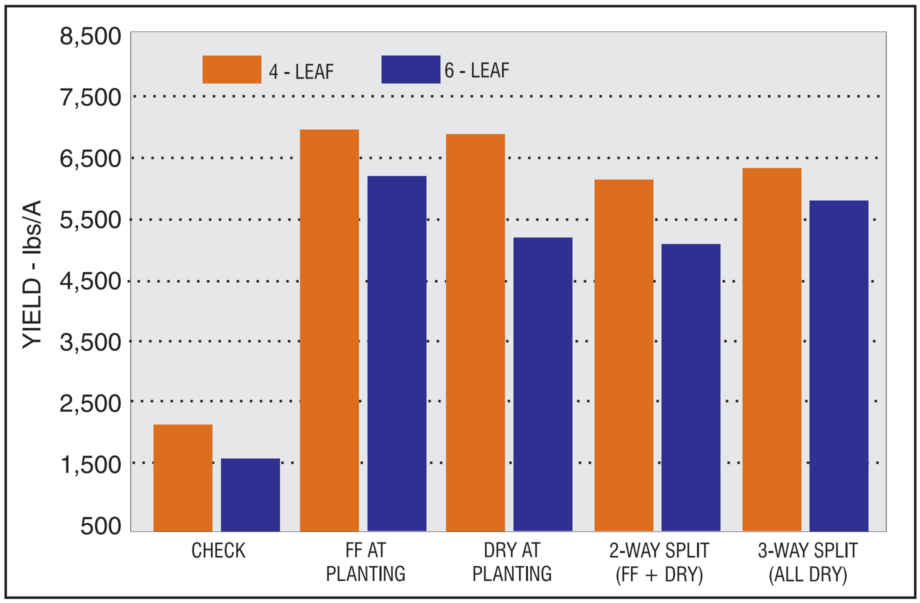

Figure 1. Fertilizer treatment effects on yields at 4- and 6-leaf flood stages, 2003.

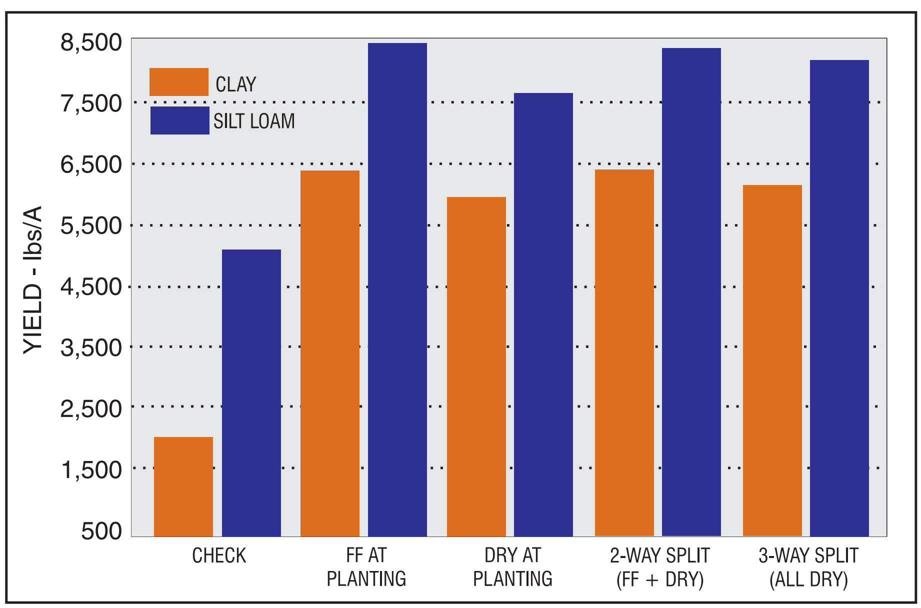

Figure 2. Fertilizer treatment effects on yield on clay and silt loam soil, 2004.

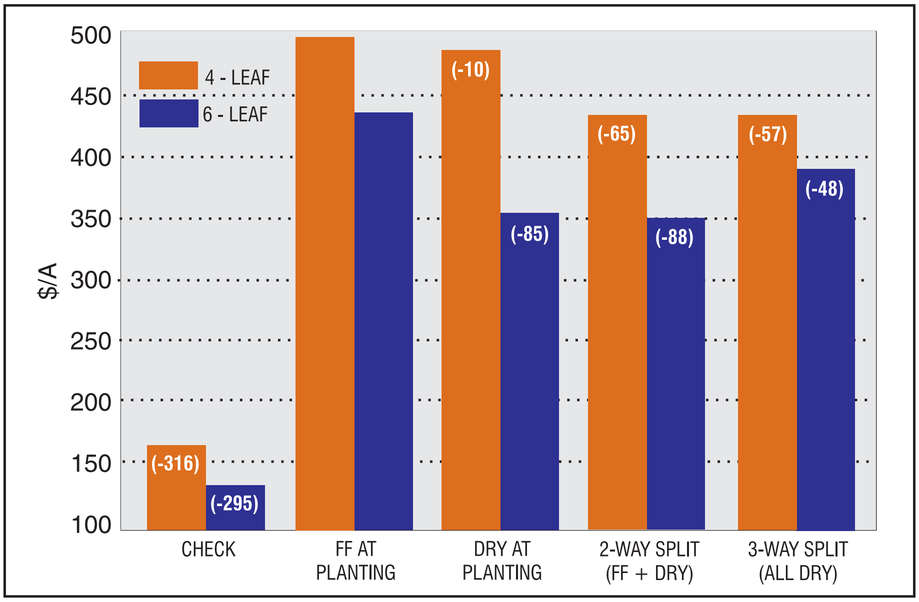

Figure 3. Gross returns/A minus fertilizer and application costs. Numbers in ( ) represent the per acre economic advantage of treatments 2, 3, and 4 relative to treatment 1, 2003.

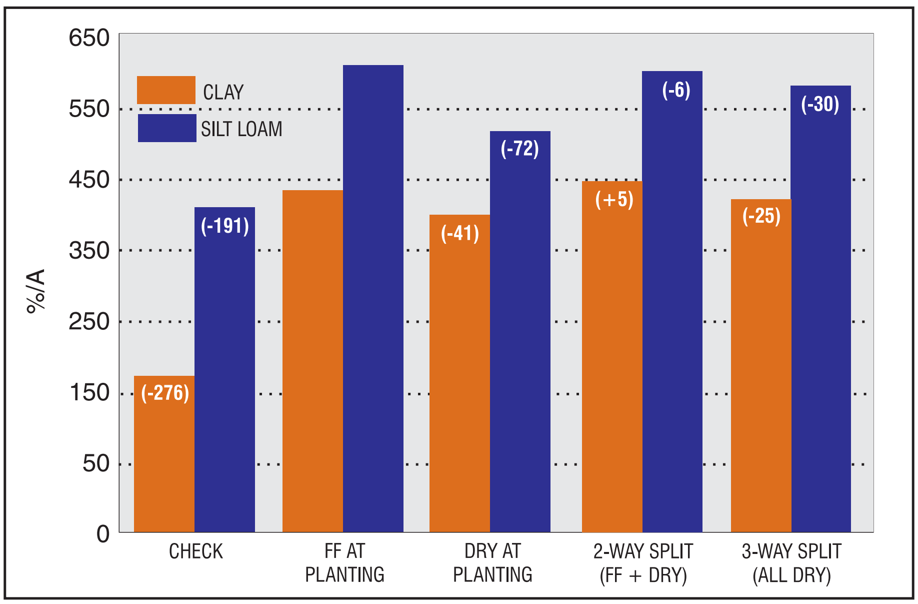

Figure 4. Gross returns/A minus fertilizer and application costs. Numbers in ( ) represent the per acre economic advantage of treatments 2, 3, and 4 relative to treatment 1, 2003.

3) costs for four 2003 fertilizer treatments were $60.06/A, $65.08/A, $65.71/A, and $73.95/A; in 2004, fertilizer + application cost for 150-30-20 varied by only $5.90/A for the 4 fertilizer treatments.

2003. All-FF applied at planting and flooded at 4-leaf was on an economic par with dry applied during planting, but had a $57/A advantage over the conventional 3-way split of dry and a $65/A advantage over 2-way split FF plus dry. All-FF showed additional economic benefits when flooded at the 6-leaf stage (Figure 3). These data show all-FF applied during planting had economic advantages of $85, $88, and $48/A over the 1-, 2-, and 3-way split fertilizer treatments.

2004. The 4- and 6-leaf effects on yield were not significantly different, so yields were averaged for each soil type and only one economic benefit is shown (Figure 4). Subsurface banded all-FF was either on a par with or was the most economical fertilizer treatment.

On clay soil, the all-FF treatment was on a par economically with the 2-way split and showed a $41/A and $25/A economic advantage over the 1-way and 3-way fertilizer splits, respectively. On the silt loam soil, which had a high N supply, the all- FF treatment and yield exceeded the at-planting dry treatment yield and was on a par with the 2- and 3-way splits. The all-FF economic advantage over the 1-, 2-, and 3-way fertilizer splits calculated at $72, $6, and $30/A, respectively, based on current fertilizer and application costs.

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