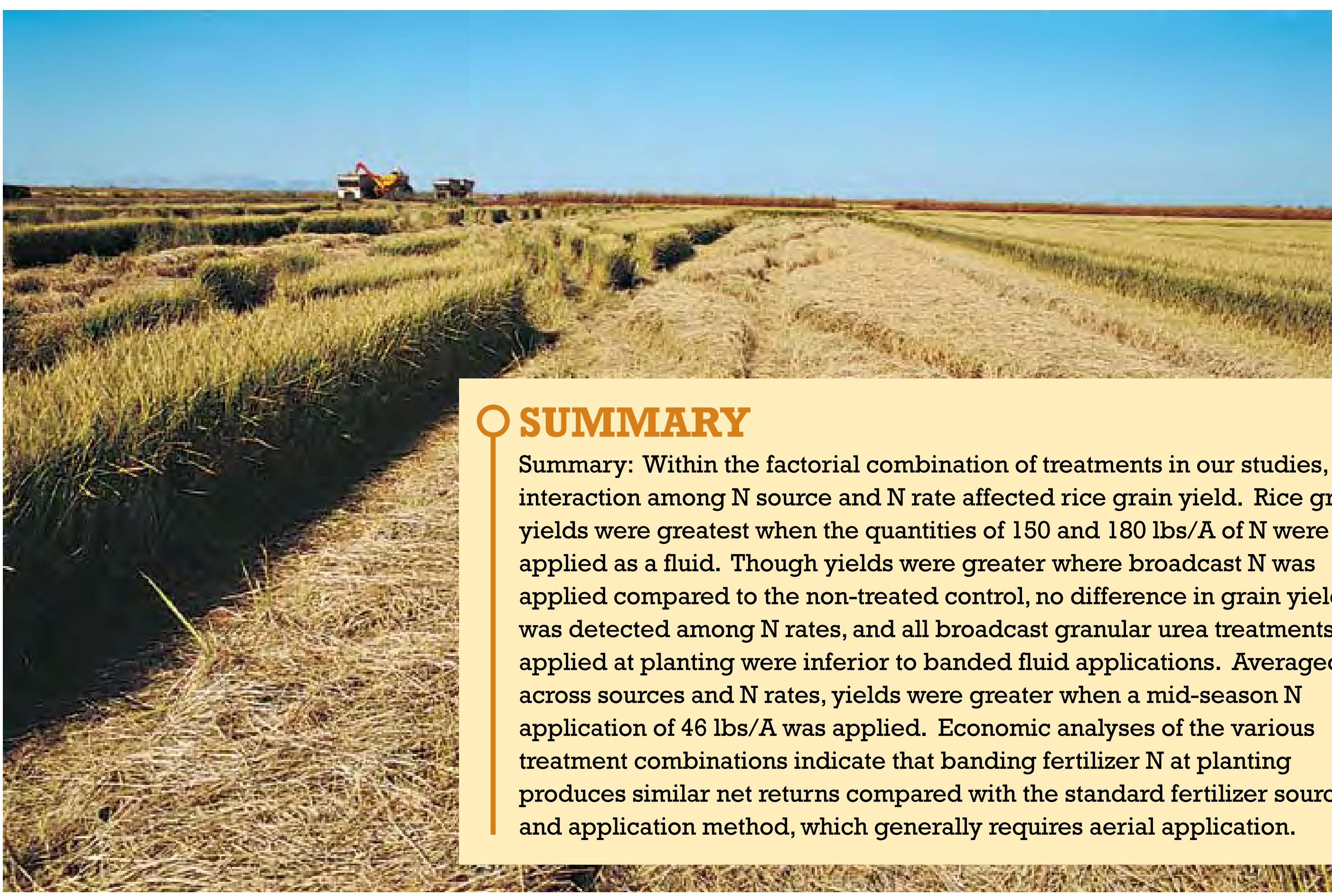
DRS. TIMOTHY WALKER, STEVEN MARTIN, JASON BOND, NATHAN BUEHRING

Fluid Fertilizer Technology Proving Adaptable To Rice Cultural Practices

Mississippi studies show yields greatest when fluids are band applied.

In the USA, rice is produced in either water-seeded or delayed-flood/dry-seeded cultural systems. For rice produced in the mid-southern USA, dry-seeding is the predominant seeding method. In this system, rice is typically drill-seeded into soil and grown as an upland crop until the rice reaches the four- to five-leaf stage. Upon reaching this growth stage, a flood is established and maintained until approximately two weeks prior to harvest. The flooded environment has advantages and disadvantages for rice production. Benefits include increased P, K, Ca, Si, and Fe availability and weed control. One disadvantage is that N management is complicated because of N loss mechanisms that accompany the flooded soil environment. Published data indicate that the efficiency of N fertilizers applied to rice can be as low as 20 percent or as high as 70 percent, depending on the environmental conditions present during application. In the



SUMMARY

Summary: Within the factorial combination of treatments in our studies, an interaction among N source and N rate affected rice grain yield. Rice grain yields were greatest when the quantities of 150 and 180 lbs/A of N were applied as a fluid. Though yields were greater where broadcast N was applied compared to the non-treated control, no difference in grain yield was detected among N rates, and all broadcast granular urea treatments applied at planting were inferior to banded fluid applications. Averaged across sources and N rates, yields were greater when a mid-season N application of 46 lbs/A was applied. Economic analyses of the various treatment combinations indicate that banding fertilizer N at planting produces similar net returns compared with the standard fertilizer source and application method, which generally requires aerial application.

mid-southern USA, optimum N fertilizer use efficiency has been achieved by applying at least 50 percent of the total N immediately prior to permanent flood (PF) establishment, and the remaining N during the interval between internode elongation (IE) and 10 days following IE of 0.5 inch, commonly known as midseason (MS). However, recent work in Arkansas has shown that some new rice cultivars produce yields that are comparable and sometimes greater, following a single PF application as opposed to a two- or three-way split of the total applied N.

Limited research has been conducted for the practice of banding plant nutrients in a drill-seeded, delayed-flood rice culture. Preplant (PP) banding N on a clay soil in Texas has shown promise. The most commonly used N application strategies in Mississippi consist of three to five applications per season. Once rice reaches MS, N is topdressed either in one or two applications to supply 45 to 90 lbs/A. Most of the fertilizer is applied with an aircraft. Research has shown that to obtain optimum N efficiency, the PF application should be made to dry soil and the field flooded within 5 to 7 days. When fields take longer than 7 days to establish a permanent flood, N is more prone to loss via volatilization.

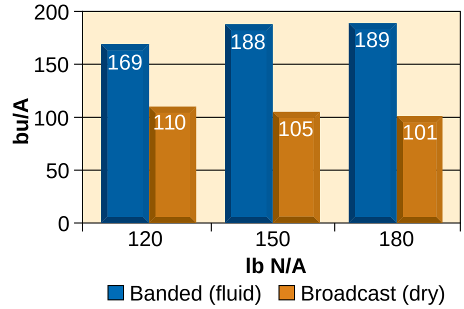


Figure 1. Mean rice grain yield as affected by an interaction among N rate and source.

More recently, Mississippi State University Extension Service economists are learning that banding fluid fertilizer can potentially reduce applications costs fivefold. Banding fluid fertilizer, they are discovering, could potentially provide growers with a more economical option to produce rice yields that are equal to or greater than the standard method of application, with less environmental risks. These factors deem this potential practice worth investigating. The objective of this research is to evaluate the potential

Table 1. Treatment number, N source, N rate, MS N rate, yield and net return after fertilizer and application costs.

Treatment #	Source	Timing	N Rate lbs/A	MS N Rate	Yield bu/A	Net Return $/A
1	Fluid	Planting	120	0	158 c	$630 e
2	Granular	Planting	120	0	105 def	$414 fg
3	Fluid	Planting	150	0	179 b	$708 b-d
4	Granular	Planting	150	0	99 ef	$380 g
5	Fluid	Planting	180	0	181 b	$704 cd
6	Granular	Planting	180	0	98 f	$366 g
7	Granular	Preflood	120	46	189 ab	$738 a-d
8	Fluid	Preflood	150	0	188 ab	$759 a-c
9	Fluid	Planting	120	46	179 b	$700 d
10	Granular	Planting	120	46	115 d	$437 f
11	Fluid	Planting	150	46	197 a	$764 a
12	Granular	Planting	150	46	111 de	$412 fg
13	Fluid	Planting	180	46	198 a	$761 ab
14	Granular	Planting	180	46	104 def	$372 g
15	Granular	Preflood	150	0	195 a	$768 a-b
16	Non-treated	--	--	--	66 g	$278 h

Means in the same column followed by different letters are different at the $P \leq 0.05$ confidence interval.

of fluid technology as an alternative N source for rice.

Fluids shine

For the factorial combination of treatments, grain yield was greatly affected by an interaction among N rate, source, and MS rate in our studies. Rice grain yields were greatest when fluid N source was banded at planting at rates of 150 and 180 lbs/A. Rice grain yields were not different across N rates when granular urea was broadcast and incorporated immediately prior to planting. However, yield for all granular urea applications broadcasted at planting were inferior to banded fluid applications (Figure 1). When averaged across at-planting N rates, grain yields were increased when a MS N application of 46 lbs/A was applied (Figure 2).

Banded fluid N applications at the rate of 150 and 180 lbs/A with a MS application of 46 lbs/A produced grain yields and net returns statistically equal to a standard PF application of 150 lbs/A either as a granular or a fluid and a standard PF application of 120 lbs/A followed by a MS application of 46 lbs/A (Table 1).

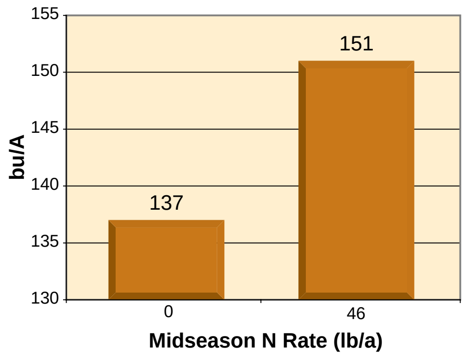


Figure 2. Rice grain yield response when comparing no mid-season N to 46 lbs/A of mid-season N. Data are responses to midseason N averaged across all N rates and application methods.

Conclusions

As the margin between inputs and returns has decreased, growers are forced to evaluate their production practices. If technology allows, considerable savings could be realized in reducing fertilizer application costs. The data indicate that fluid fertilizer technology has potential to be adopted into rice cultural practices either by applying N at planting or by applying it with ground applicators immediately prior to flood establishment. For farms that have precision-leveled fields, the latter may be more feasible. However, for contour-levee fields, banding fluids at planting may be a viable option. Nitrification inhibitors still should be evaluated further for planting applications because the time lag between planting and flooding can be up to six weeks. Furthermore, the practice of broadcasting granular urea just prior to planting is not feasible, even though application costs are less.

Drs. Walker and Bond are assistant research professors, Dr. Martin is associate extension professor, and Dr. Buehring is assistant extension professor at Mississippi State University.