Title: Helping Arkansas rice farmers exploit market opportunities by improved use of soybean, wheat, and corn in rice rotations.

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Summary: Best net returns for 1999 were \$34.76 a^{-1} using Pioneer 31B13 at a standard fertility level. All no-till plots grew poorly in 2000 and sustained significant damage from the top-dress nitrogen application. Overall yields dropped to 73 bu a^{-1} with much of that drop being attributed to extremely low no-till yields (42 bu a^{-1}). Results elsewhere have shown that corn does not yield well when planted after rice which might be the reason for some of the yield drop. Corn did have a positive impact on a following rice crop with the highest individual treatment rice yield of 224 bu a^{-1} coming from a rice following corn treatment. A current wheat crop following corn is showing outstanding growth when compared to wheat following rice or soybeans. In total these results suggest that wheat and rice benefit from having a corn crop before them in a rotation and that corn yields are low following rice.

Procedures: Field #8 was selected for this study in early 1999. In February 1999 this field was cut to a 0.15% slope. Plots measuring 250' x 40' were laid out in a north-south direction. These plots were then divided in half east-west with each side randomized as conventional or no-till treatments. Each tillage treatment was then split into a standard and high fertility treatment. Two varieties of each crop species were planted in a continuous strip across the conventional-and no-till treatments. As a result of field leveling all plots were tilled in 1999 and the no-till treatments started in 2000. Following harvest of the 1999 crops all no-till treatments were cut with a rotary chopper. Levees were constructed around those plots not having wheat in the winter to impound water. Prior to planting soil samples were collected for fertility measurements. The following rotations that were started in 1999 were continued: 1) continuous rice, 2) rice-soybean, 3) soybean-rice, 4) rice-corn, 5) corn-rice, 6) rice (wheat) rice (wheat), 7) rice (wheat)-soybeans (wheat), 8) soybeans (wheat)-rice (wheat), 9) rice-corn-soybeans, 10) rice-corn (wheat)-soybeans. Two fertility levels (table 1) and two varieties were used for each plot. The corn plots (rotations 4, 9, 10) were sown into 30 in rows on April 21using a standard John Deere row crop planter. Weed control in the corn consisted of one Atrazine application at 1.25 lbs ai a^{-1} post emergence. Corn harvesting was completed on 6 September.

Results and Discussion:

Net returns for 1999: With only a 2 bu a^{-1} difference between varieties differences in net returns ere more related to input costs. For both varieties the lack of yield response to increased fertilizer inputs resulted in a lower net profit. The following net returns were calculated:

Variety	Tillage	Fertility	Net returns a^{-1}
Pioneer 31B13	NA	standard	\$34.76
N75-T2(90)	NA	standard	\$31.25
Pioneer 31B13	NA	enhanced	\$13.71
N75-T2(90)	NA	enhanced	\$11.95

These returns were calculated at a corn price of \$2.08 bu^{-1} and a 25% land cost. Because the field was leveled in the spring of 1999 it was impossible to have a tillage comparison. Net returns on corn were less than for rice and soybeans in 1999. These results highlight one of the major constraints to expanding corn in rice systems. More than any other crop in this study it is going to be important to balance inputs with yield potential. This is illustrated by a nearly 1/3 reduction in profits from the plots receiving increased fertilizer.

2000 crop results: All plots were planted on April 21, 2000. This was the first year that it was possible to make a conventional-till and no-till comparison. All no-till treatments this year were into plots that contained rice in 1999. Emergence was slower in the no-till plots and there were some problems where the planter did not place the seed sufficiently deep. Black cutworm insect damage was observed with damage levels much higher in the conventional tillage plots when compared to the no-till plots. Corn growth was extremely slow in the no-till plots throughout the season. Initially this was thought to be a soil temperature problem, however it persisted well into the season and is now attributed to excessive soil moisture. Extended rainy periods along with a substantial soil mulch from the previous rice crop resulted in prolonged wetness in the no-till plots. Following the top-dress nitrogen application we experienced a number of rainy days which resulted in near death to the no-till plots. Leaf symptoms indicated a possible molybdenum deficiency which could not be confirmed. Tissue analysis did indicate low nitrogen and phosphorus levels when compared to the conventional till plots. It is now postulated that excessive soil moisture and possible nitrate poisoning might have caused the plants to nearly die. It was observed that those plots at the bottom of the field where there was more top soil performed much better. Throughout the season Pioneer 31B13 grew much better than N75-T290 in the no-till plots while the varieties were similar in the conventional till plots.

Harvesting was completed on September 6, 2000 with the following results for the main plot effects:

All plots	73 bu a^{-1}
No-till plots	42 bu a^{-1}
Conventional tillage plots	103 bu a^{-1}
Enhanced fertility plots	75 bu a^{-1}
Standard fertility plots	70 bu a^{-1}
Pioneer 31B13 plots	85 bu a^{-1}
Nevartis N75-T2(90)	61 bu a^{-1}

These results represent a significant decrease in grain yields from the previous year. Much of this decline came from the introduction of no-till plots. Similar work in Missouri is showing a marked decline in corn yields when it is planted after rice when compared to being planted after soybeans. If true, this could account for some of the yield decrease. The highest grain yield recorded from a no-till treatment was 70 bu a^{-1} which highlights a need to better understand this system. Highest overall yield was 113 bu a^{-1} which is unlikely to make a profit. Unlike the previous year there was a benefit to increasing fertility. This result was primarily due to increased yields in the conventional tillage plots as plant damage observed in the no-till treatment following the nitrogen top-dress application resulted in decreased yields in these plots. While both varieties performed similarly in the conventional tillage plots Pioneer 31B13 was clearly better adapted to the no-till conditions.

Rotation effects: Results from rice crops following corn indicate an advantage to having corn in a rice based rotation. Rice growth was better in all conventional tillage plots following corn when compared to those following rice or soybeans regardless of fertility level. Highest rice yield (224 bu a^{-1}) was from a conventional tillage plot, at standard fertility, using the rice variety Wells, and following corn. As a result of these findings we have, in collaboration with the soil physics staff at Fayetteville, collected a number of soil samples to determine possible differences in soil physical and chemical properties.

Wheat planted following this years corn crop appears to be much healthier than that following rice or soybeans. This is particularly true in the no-till plots. We will not know if this observed trend is translated into higher wheat yields and profits until the wheat is harvested in spring 2001.

Significance of Findings: Results indicate that it will be difficult to grow corn after a rice crop in a rotation sequence and expect reasonable profits. No-till corn after rice has a host of problems and should not be attempted on a shallow rice soil until it is determined if there are varieties or management practices that can assure a reasonable yield. Following corn with rice appears to be a good cropping sequence; particularly in a conventional till system.

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Table 1. Nitrogen, phosphorus, and potassium levels used to establish standard and enhanced rates for each crop species.

Crop	Element	Standard (lbs a^{-1})	Enhanced (lbs a^{-1})
Corn	N	200	300
	P_2O_5	60	80
	K_2O	100	150
Soybeans	N	0	20
	P_2O_5	40	60
	K_2O	60	120
Rice	N	100	150
	P_2O_5	40	60
	K_2O	60	90
Wheat	N	100	150
	P_2O_5	30	60
	K_2O	30	60