sown on April 5, a much earlier planting date than in 2001. In 2003 another block was added for a total of five randomized blocks. The rice variety Cocodrie was sown on April 3. Each plot consisted of 18 rows spaced at 8 inches and 75 ft in length. In 2006, a large-scale drip study was begun that consisted of four randomized blocks, each with a single sub-surface drip irrigation plot and a conventionally flood-irrigated plot. Plots are approximately 1.15 acres each. Drip tubing used is Netafim Typhoon 636 with emitters spaced at 18 inches. Drip tubing was installed at a 6-inch soil depth and 30-inch row spacing. Cocodrie seed, treated with Release® LC, was drill-seeded onto all plots at 60 lbs ac-1 on March 8, 2006. Analysis of the yield data from 2001 to 2003 showed no significant difference between the drip-irrigated treatments and the flood-irrigated control. An interaction exist for year x treatment because both drip-irrigated treatments (16 and 32-inch spacing) had higher yields in 2001 than the flood-irrigated control, but in 2002 and 2003 that trend was reversed. Yield difference between years was highly significant. Average water use of the drip-irrigated treatments for the three year period was approximately 42% that of the flood-irrigated controls. Water usage for the 16 and 32-inch drip-irrigated treatments differed by less than 0.12 ac ft during the three-year period. Since no significant difference exists for yields or water usage between the 16 and 32-inch treatment, the 2006 large-scale blocks were setup with only one drip-irrigated treatment at 30-inch spacing. In order to combine, and for the purpose of analyses, the data collected from 2001 to 2003, 16 and 32-inch drip-irrigated treatments were considered simply as drip-irrigation. Yield analysis for the four-year period shows a significant interaction of year x treatment. This interaction is due to the drip-irrigated treatment having higher yields in 2001 and 2006 but lower in 2002 and 2003 compared to the flood-irrigated control. Difference between drip and flood-irrigated for yields were not significant. Yields were significantly different between years. Water use of the drip-irrigated treatment in 2006 was approximately 48% of the amount used for the flood-irrigated control, which was very similar to the 2002 and 2003 water usage (55 and 47%, respectively). Water usage in 2001 was only 17% of the amount used for the flood-irrigated control, due to the very short season and the amount of rainfall that year. Water usage for the drip-irrigated plots in 2006 was higher than required due to the fertilization scheme used. Approximately 30 days after planting, fertilizer was applied to the drip-irrigated plots in small amounts through the drip irrigation system three times a week. Due to heavy rains in April and early May there was standing water in the drip-irrigated plots, so only enough water was put through the sub-surface irrigation system to deliver the fertilizer. Observations made in early May showed plants growing directly over the irrigation tape were very green, but those growing between the tapes appeared yellow and stressed. A decision was made in late May to drain the standing water off of the drip-irrigated plots in order to get the fertilizer to spread further from the tape. By late May, a noticeable difference in plant height and color could be seen between plants growing directly over the irrigation tape and those between the tapes. After draining the standing water and increasing the amount of water applied during fertilizer applications, the yellowed or stressed plants began to 'green up'. An application of at least 0.3 inch of water was required to spread the fertilizer to a mid-point between the tapes. Yield sub-samples taken at harvest show a significant difference between the plants growing immediately over the drip irrigation tape, plants growing between the tape and plants in the flood-irrigated plots.

The Interaction Of Variety, Seeding Rate And Nitrogen On Sheath Blight Incidence And Severity

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Previous research has determined that optimum rice yields can be achieved at rice seeding rates of 15 to 30 seeds/ft^2 (approx. 30 to 60 lb/A). Lower seeding rates allow plants to produce more reproductive tillers than at higher densities. Our hypothesis for these experiments was that a lower plant density would allow for more air movement through the rice canopy, thereby impeding sheath blight (SB) development, and possibly negating the need for a costly fungicide application on otherwise susceptible varieties. The positive benefits of such a scheme would be reduced seed and fungicide costs, especially for more expensive rice varieties, such as CLEARFIELD* rice.

Two separate studies were established in 2006 at the Missouri Rice Farm near Glennonville, MO, to evaluate the interactions between variety, seeding rate and nitrogen rate on sheath blight incidence and severity. The first study evaluated the interaction of seeding rate and nitrogen rate on SB incidence and severity on 'Cocodrie' rice. Four seeding rates (7.5, 15, 30, and 60 seeds/ft^2), two preflood nitrogen rates (120 and 180 lb N/A), and three midseason nitrogen rates (0, 30, and 60 lb N/Ac) were evaluated. The second study evaluated the interaction of seeding rate and variety on SB incidence and severity. Four seeding rates (7.5, 15, 30, and 60 seeds/ft2) and four varieties ('CL131', 'CL161', 'Wells', and 'Banks') were utilized for this study. CL131 and CL161 were considered 'susceptible', while Wells and Banks were considered 'less susceptible.' A single preflood nitrogen application of 150 lb N/Ac was applied in the second study. In both studies, rice was drill-seeded using a cone drill with 9 drill rows on 7.5" centers. The studies were planted on May 16 and harvested October 4. Inoculum was applied to all plots at 1/2" internode. Inoculum consisted of sterilized oats infected with the *Rhizoctonia solani* pathogen. Subsequent disease incidence and severity ratings were taken 2 weeks and 4 weeks after inoculation and again at harvest. SB incidence was rated on a scale of 0 to 100%, with 0 being no infected stems, and 100% indicating all stems having SB infection. Disease severity was rated on a scale of 0 to 9, with 0 being no SB symptoms and 9 representing severe infection with lodging and lesions reaching the flag leaf. Plots were harvested with a small plot combine and weights were adjusted to 12% grain moisture.

Results

Study 1. The inoculum source used at both locations did not produce the expected amount of disease. Although disease was present in each plot, the severity of the disease did not reach a point to cause lodging or have a devastating effect on rice yield. This may have been due to the inoculum source or the weather conditions following inoculation. Minor differences in SB incidence were observed among the four seeding rates in the first study at each rating date (Table 1). These differences narrowed as the season progressed. Differences among SB incidence 2 weeks after inoculation (2 WAI) may have been due to the differences in plant density, whereby the lower plant density allowed for less infection. However, as the season progressed and the canopy was filled by reproductive tillers, these differences were minimized.

Differences in SB disease and severity were not related to midseason nitrogen rate and only significant 4 WAI from the main effect of preflood nitrogen. Yield and milling quality were not affected by any of the factors in the experiment. Although differences in SB severity were observed early after inoculation, these differences did not result in a significant yield loss. Previous research has shown that later-planted rice at low seeding rates will yield similarly to higher seeding rates, probably due to the increased germination probably due to higher soil temperatures and less seedling disease pressure.

Study 2. SB incidence was higher at the 60 seeds/ft^2 seeding rate 2 WAI and at harvest (Table 2). Seeding rates between 7.5 and 30 seeds/ft^2 did not affect SB incidence at any rating date. SB severity, although statisically significant, did not differ much among the seeding rates. Rice yield was affected by seeding rate, whereby yield declined at the 60 seeds/ft^2 seeding rate, indicating that higher disease ratings may have reduced yield.

Variety had an effect on SB incidence and severity. CL131 and CL161 had a consistently higher SB incidence than Banks or Wells. Similarly, SB severity for CL131 and CL161 was higher 4 WAI and at harvest than it was for Banks or Wells. Yields of CL131 and Wells were similar, and higher than those of CL161 and Banks.

Discussion

Previous research has shown that variety selection and nitrogen are the most important factors leading to sheath blight infection. This research determined that preflood nitrogen rate had a significant effect on sheath blight incidence 2 and 4 WAI, but had no effect on SB severity at any point in the season. Seeding rate was similar to nitrogen rate in that SB incidence was lower 2 and 4 WAI at the lower seeding rates of 7.5 and 15 seeds/ft^2; however, SB severity was not affected by seeding rate. These findings provide more evidence of the compensatory nature of rice to fill voids in the canopy by producing more biomass, effectively filling the canopy similar to higher plant densities. This fact may explain why disease severity did not differ during the course of the infection period.

Based on the findings of this research, it doesn't appear that seeding rate or midseason nitrogen rate has a large impact on SB incidence and severity. Variety selection appears to be the most predictable factor for disease, and should be considered when planting a field with a history of sheath blight. Further research is needed to determine the extent to which preflood nitrogen rate factors into SB incidence and severity.

Table 1. The main effects of seeding rate, preflood nitrogen rate, and midseason nitrogen rate on sheath blight (SB) incidence and severity on Cocodrie rice at the Rice Farm near Glennonville, MO, 2006.

Main Effect	SB Incidence			SB Severity			Yield	Milling	
Seeding rate (seeds/ft^2)	2 WAI	4 WAI	Harvest	2 WAI	4 WAI	Harvest		Whole	Total
	------------ % -------------			------------ % -------------			Bu/A	-------- % --------	
7.5	8	76	98	2	5	7	165	66	71
15	13	97	100	2	6	7	167	66	72
30	13	97	100	2	5	7	170	65	71
60	21	100	100	2	6	7	168	64	70
LSD (.05)	5	9	2	NS	1	NS	NS	NS	NS
Preflood N (lb/A)									
120	15	90	99	2	5	7	167	65	72
180	12	96	99	2	6	7	169	65	71
LSD (.05)	NS	6	NS	NS	NS	NS	NS	NS	NS
Midseason N (lb/A)									
0	14	94	99	2	5	7	168	65	72
30	14	94	100	2	6	7	168	65	71
60	12	90	100	2	5	7	167	65	71
LSD (.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 2. The main effects of seeding rate and variety on sheath blight incidence and severity at the Rice Farm near Glennonville, MO, 2006.

Main Effect	SB Incidence			SB Severity			Yield	Milling	
Seeding rate (seeds/ft^2)	2 WAI	4 WAI	Harvest	2 WAI	4 WAI	Harvest		Whole	Total
	------------ % -------------			------------ % -------------			Bu/A	-------- % --------	
7.5	11	91	66	1	5	5	167	62	70
15	10	95	68	1	6	6	166	61	70
30	10	93	77	2	6	5	164	59	69
60	18	97	80	2	6	6	149	62	71
LSD (.05)	7	NS	13	1	1	1	9	2	1
Variety									
CL131	15	100	99	2	7	8	175	63	72
CL161	16	97	92	2	7	7	151	62	70
Banks	7	88	44	1	5	4	145	56	67
Wells	11	91	56	2	4	4	175	62	70
LSD (.05)	6	7	14	1	1	1	9	2	1