Cover Crop and Herbicide Burndown Effects on No-Till, Water-Seeded Rice

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ABSTRACT

The majority of no-till, water-seeded rice *(Oryza sativa)* in southwest Louisiana is planted into native vegetation grown over the winter months prior to spring planting. Cover crops that produce uniform growth, do not compete with the following rice crop during the critical stand establishment stage, and are easily controlled by burndown herbiidea could provide a more desirable seedbed in which to establish rice. A study was conducted in 1995 and 1996 to evaluate various cover crop and preplant vegetation management combinations for their potential use in no-till rice production. Nine cover crops included both clover and grass species, and four preplant vegetation management strategies included three burndown herbicides and a no-herbicide treatment. Significant interactions occurred between preplant vegetation management and cover crops for days to 50% heading, plant height, and grain yield. Maturity was delayed in most cover crops when no herbicide was used to control preplant vegetation and was most pronounced in the clover cover crops both years. Maturity was significantly delayed in a ryegrass *(Lolium multiflorum)* cover crop in 1995 and in both berseem clover *(Trifolium alexandrinum)* and ryegrass cover crops in 1996, regardless of preplant vegetation management treatment. Influence of mver crop and preplant vegetation management on plant height was less dramatic. Plant height reductions in 1995 generally occurred when no burndown herbicide was used to control preplant vegetation. In 1996, plant height reductions were also caused by some cover crops. Grain yields were reduced in most cover crop/no-herbicide mmbinations each year. Rice grain yields were also reduced with berseem clover and ryegrass cover crops, regardless of preplant vegetation management treatments each year. When burndown herbicides were used to control preplant vegetation, most cover crops behaved similarly to native vegetation. When no burndown herbicides were used, only spring triticale *(Triticosecale)* and wheat *(Triticum aestivum)* were suitable alternatives to native vegetation. Regardless of preplant vegetation management, berseem clover and ryegrass are the least desirable cover crops to use for no-till rice establishment

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INTRODUCTION

Rice *(Oryza sativa* L.) production in Louisiana with reduced tillage systems has steadily increased since 1990. Approximately 15% of the state's rice acreage is currently devoted to conservation tillage practices (J.K. Saichuk, 1997, personal communication). A small percentage is rice seeded drectly into crop residue from the previous season. The most popular practice, however, is to prepare a seedbed in the fall, allow it to revegetate with winter weeds, use a chemical bumdown in the spring two to four wk preplant, and either water seed or drill seed. The mild winters in Louisiana are very conducive to establishment of native vegetation in most years.

There has been little interest in utilizing a planted cover crop for no-till rice production. In a study conducted by Eastman (1986), crimson clover *(Trifolium incarnatum* L.) and subterranean clover *(Trifolium subterraneam* L.) were evaluated for their potential as a cover crop for rice. Stand densities were reduced four wk after rice establishment, but rice grain yields were affected at only one location in one yr. This study was conducted in a drill-seeded cultural system. The potential for stand reductions in rice no-tilled into preplant vegetation is greater in a water-seeded system (Bollich, 1996).

A disadvantage of native vegetation as a cover *crop* is that its composition varies due to previous tillage practices, soil area differences, and whether the rice field remains drained or flooded over the winter. Successful termination of preplant vegetation is dependent upon the ability of a bumdown herbicide to effectively control a wide array of weed species. Since the composition of native vegetation can range from easily controlled, small winter annuals to more difficult to control perennial weeds, complete control of all preplant vegetation is seldom achieved. A planted cover crop with modest winter growth potential that is easily controlled with a

preplant bumdown herbicide should provide a more uniform and problem-free seedbed into which no-till rice can be planted.

The objectives of this study were to: 1) evaluate clover and grass cover crops as alternatives to native vegetation in a water-seeded, no-till rice system, and 2) evaluate three bumdown herbicides and a no-herbicide control for preplant vegetation management.

MATERIALS AND METHODS

An experiment was conducted at the South Unit of the Rice Research Station, Crowley, LA, in 1995-1996 to evaluate the effects of cover crops and bumdown herbicides on no-till, water-seeded rice. Approximately 45 lb/a of P_2O_5 and K_2O were incorporated in the fall prior to cover crop establishment.

Various grasses and clovers were evaluated to determine their potential as alternatives to a native vegetation cover crop. In 1995, berseem clover *(Trifolium alexandrinum* L.), ladino clover *(Trifolium repens* L.), red clover *(Trifolium pratense* L.), rose clover *(Trifolium hirtum* All.), yellow sweetclover *(Melilotus officanalis* &.I Lam.), cereal rye *(Secale cereale* L.), ryegrass *(Lolium multiflorum* Lam.), and wheat *(Triticum aestivum* L.) were evaluated. In 1996, ladino clover, rose clover, yellow sweetclover, and cereal rye were replaced with white clover *(Trifolium repens* L.), 'Morey' wheat (a very short season wheat variety), spring triticale *(Tritosecale* Wittm.), and buckwheat *(Agropyronrepens).* Buckwheat is a cool-season forage sensitive to low temperature, and 6-wk after planting, an early frost terminated its stand. It was replaced with a multiple bumdown treatment (repeated herbicide applications to maintain a vegetation-free seedbed). Three bumdown herbicides and a no-herbicide control were evaluated in combination with each cover crop. Roundup (glyphosate), Liberty (glufosinate), and Gramoxone Extra paraquat) were applied at 1.0, 1.0, and 0.66 lb ai/a, respectively, 1 wk preflood and preplant. In the multiple-bumdown treatment, herbicides were also applied 3-wk preflood and preplant.

A shallow flood was established 2 d prior to seeding with pregerminated 'Cypress' rice and drained 3 d later. The experiment was flush-irrigated as needed, and the permanent flood was established 3-wk after seeding. Nitrogen (150 lb/a) was applied in three equal split applications at the 3-leaf, mid-tillering, and panicle initiation growth stages.

The experiment was designed as a randomized complete block with four replications in a factorial arrangement. Factors were preplant vegetation management and cover crops. Data were analyzed with the SAS System (SAS Institute, 1988). Analysis of variance with the GLM procedure was used to determine significance. Means were compared using Fisher's Protected LSD Test at the 5% level. Days to 50% heading, plant height, and grain yield were determined.

RESULTS

Main effect means are shown in Tables 1 and 2 for 1995 and 1996, respectively. Significant interactions occurred between cover crop and preplant vegetation management for days to 50% heading, plant height, and grain yield in each year of the study. These interactions are depicted in Figures 1 to 6. LSD values are listed in the figure captions, and the native cover crop is considered the control.

There were no differences in days to 50% heading due to preplant vegetation management with cereal rye, ryegrass, and wheat cover crops in 1995 (Figure 1). Days to 50% heading were significantly increased with all other cover crops when no herbicide was used to control preplant vegetation. Within a cover crop, there was generally little difference in maturity due to the three burndown herbicides with the exception of a Roundup and berseem cover crop cornbination. Maturity was delayed by 4 and 5 d when compared with Liberty and Gramoxone Extra, respectively.

Days to 50% heading were not affected by preplant vegetation management in the spring triticale, multiple burndown, or Morey wheat treatments in 1996 (Figure 2). Maturity was increased in the berseem, white, and red clover cover crops and in the ryegrass cover crop when no burndown herbicide was used. In the berseem, white, and red clover cover crops, maturity was significantly delayed by Roundup and Gramoxone Extra when compared with Liberty. Maturity was also delayed by Roundup in the ryegrass cover crop and by Gramoxone Extra in the wheat cover crop when compared with Liberty.

Cereal rye and ryegrass were the only cover crops for which preplant vegetation management influenced plant height in 1995 (Figure 3). Plant height was significantly reduced in these cover crops when preplant vegetation was not controlled with a burndown herbicide. Plant height within a cover crop was not affected by burndown herbicide.

Preplant vegetation management within a cover crop had no influence on plant height in 1996 (Figure 4). Plant height was similar among the three burndown herbicide and no-herbicide treatments.

The influence of cover crop and preplant vegetation management on grain yield in 1995 is shown in Figure 5. Grain yields were reduced when no

burndown herbicide was used on berseem, ladino, red, and rose clovers and in ryegrass and native vegetation cover crops. Rice yields from cereal rye and wheat were not affected by preplant vegetation management. In the yellow sweetclover cover crop, rice yield was reduced in the no-herbicide treatment when compared with the Gramoxone Extra treatment.

In 1996, grain yields were significantly reduced in the berseem white, and red clover cover crops and in the ryegrass cover crop when no burndown herbicide was used. In the multiple burndown treatment, yield was significantly reduced with Gramoxone Extra. Roundup and Liberty had no effect on grain production in this treatment. Yields in the spring triticale, Morey wheat, wheat, and native cover crops were not affected by preplant vegetation management.

DISCUSSION

The influence of cover crop and preplant vegetation management combination on days to 50% heading, plant height and maturity were quite variable each year. The use of a planted cover crop does provide more uniform and consistent preplant vegetation than can normally be expected from native Vegetation. The negative influence imposed by some cover crops on rice maturity, plant height, and grain yield does indicate that cover crops in general are not necessarily suitable alternatives to native vegetation. These influences were significantly greater when no herbicide was used to control preplant vegetation. Relying on natural senescence of the cover crops or their control with floodwater alone caused longer delays in maturity, reduction in plant height, and significant yield reductions in rice.

Delayed maturity and reduced grain yields experienced when rice is planted into some clovers and the ryegrass cover crops can be attributed to poor stand establishment and low stand densities. Density was not determined in this study, however, it was observed that in some treatments or treatment combinations, rice stands were significantly reduced. In these situations, there was a strong tendency for maturity to be delayed and yields to be decreased. Adequate plant populations in water-seeded rice are essential for optimum growth and yield (LSU Agricultural Center, 1987).

It is not fully known what mechanisms are involved for certain cover crops to negatively affect rice plant growth and grain yield. The type of vegetation, the amount of biomass produced, or allelopathic effects, either individually or in combination, could explain the interference observed. It was beyond the scope of this study to identfy these factors. It will be important to further evaluate the influence of cover crops on rice plant growth and grain yield. An understanding of the interactions involved will afford the opportunity to better manipulate cover crops to the benefit of no-till rice establishment.

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Table 1. Effect of preplant vegetation termination and cover crops on agronomic performance of water-seeded, no-till Cypress rice. Rice Research Station, South Unit, Crowley, LA. 1995.

Main effect	Days to 50% heading	Plant height	Grain yield at 12% moisture
		-(in)-	-(lb/a)-
Preplant vegetation management (PVM) Mean			
Roundup	88	36	6666
Gramoxone Extra	87	36	7029
Liberty	87	36	6918
None	94	35	4824
LSD (0.05):	1	1	437
Cover Crop (CC) Mean			
Berseem clover	92	35	4960
Ladino clover	89	37	7180
Red clover	91	36	6354
Rose clover	89	37	7152
Yellow sweetclover	86	36	7120
Cereal rye	84	35	7128
Ryegrass	102	34	2453
Wheat	84	36	7402
Native	87	37	7483
LSD (0.05):	2	2	656
CV %	2.82	2.52	14.71
PVM x CC	*	*	*

Table 2. Effect of preplant vegetation termination and cover crops on agronomic performance of water-seeded, no-till Cypress rice. Rice Research Station, South Unit, Crowley, LA. 1996.

Main effect	Days to 50% heading	Plant height	Grain yield at 12% moisture
		-(in)-	-(lb/a)-
Preplant vegetation management (PVM) Mean			
Roundup	91	33	7215
Gramoxone Extra	92	33	6914
Liberty	88	33	1863
None	95	34	6392
LSD (0.05):	1	1	275
Cover Crop (CC) Mean			
Berseem clover	105	34	3410
White clover	92	34	7819
Red clover	96	34	6923
S. Triticale	87	32	7864
Multiple burndown	87	32	8003
Morey wheat	87	32	7716
Ryegrass	96	34	6040
Wheat	88	33	7857
Native	87	31	8305
LSD (0.05):	2	2	413
CV %	2.49	3.42	8.28
PVM x CC	*	*	*

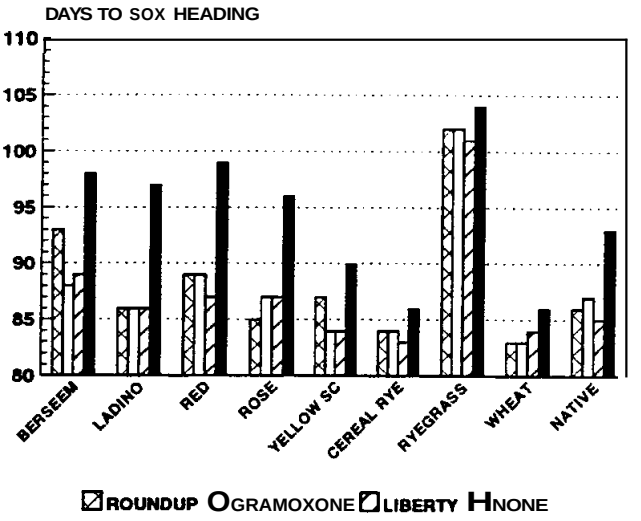

Figure 1. Influence of cover crop and preplant vegetation management on days to 50% heading of Cypress rice, 1995. LSD = 4 (P=0.05).

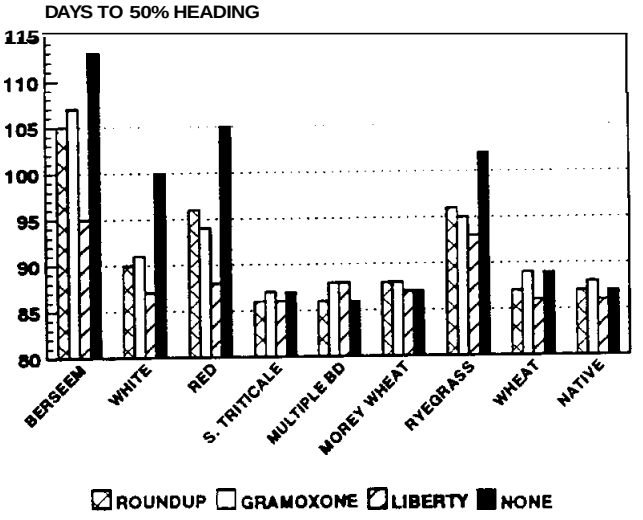

Figure 2. Influence of cover crop and preplant vegetation management on days to 50% heading of Cypress rice, 1996. LSD = 4 (P=0.05).

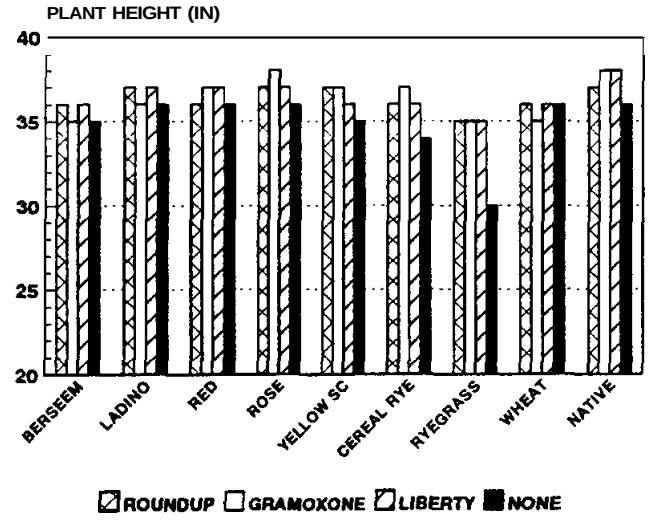

Figure 3. Influence of cover crop and preplant vegetation management on plant height of Cypress rice, 1995. JSD = 3 (P=0.05).

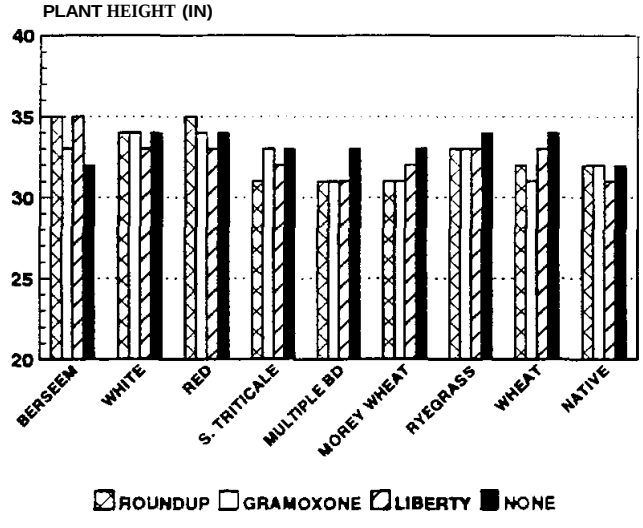

Figure 4. Influence of cover crop and preplant vegetation management on plant height of Cypress rice, 19%. JSD = 4 (P=0.05).

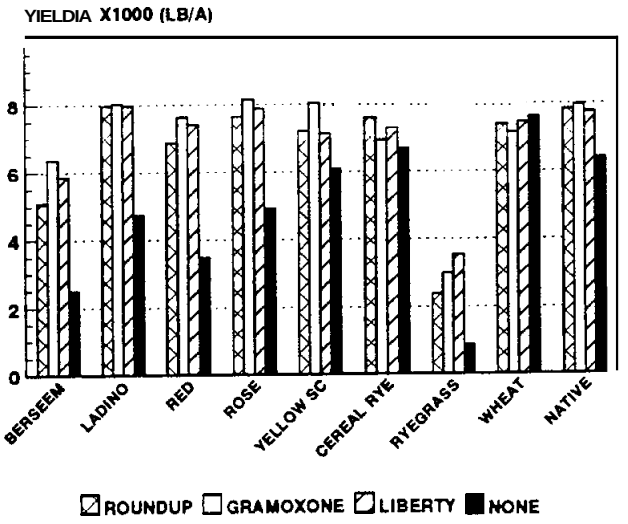

Figure 5. Influence of cover crop and preplant vegetation management on grain yield of Cypress rice, 1995. LSD = 1310 (P=0.05).

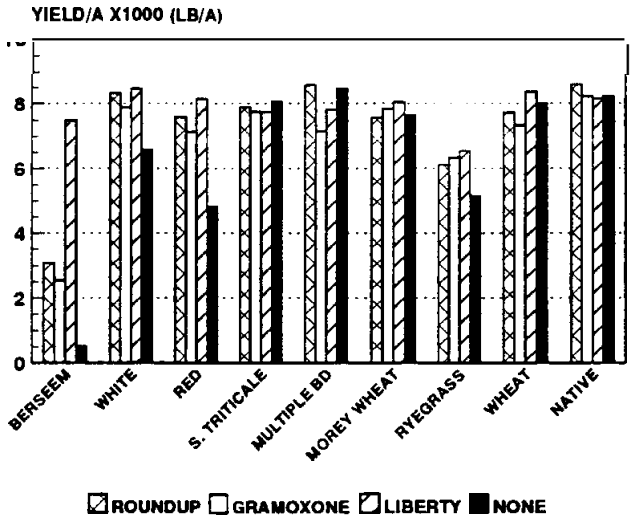

Figure Influence of cover crop and preplant vegetation management on grain yield of Cypress rice, 1996. LSD = 824 (P=0.05).