Soybean-Wheat Doublecropping Systems for the Loessial Terrace Soils of Northeast Louisiana

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Soybean-wheat doublecropping offers the farmer a means of producing two crops per year on the same unit of land. In many instances, net yearly income can be increased significantly and seasonal cash flow can be improved. However, yields of doublecrop soybeans on the droughty silt loam soils of the Macon Ridge in northeast Louisiana are generally too low to offset production costs where conventional dryland production practices are used.

Inadequate rainfall for soybean stand establishment is often a problem when wheat residue is burned and the soil is tilled to prepare a seedbed for soybeans. A delay in soybean planting due to inadequate moisture for stand establishment will generally result in reduced soybean yields since yields usually decline drastically when planting is delayed past mid-June. In addition, inadequate rainfall during the vegetative and reproductive growth stages of doublecrop soybeans often limits vegetative growth and yields on these soils. On the other hand, if the wheat straw is not burned and tillage is eliminated, soil moisture is often adequate for soybean planting immediately following wheat harvest.

A 5-year study was conducted at the Macon Ridge Branch of the Northeast Research Station, Winnsboro, from 1982 through 1986, to determine the effects of burning wheat residue, spring tillage, and irrigation on productivity of doublecrop soybeans. All treatments were maintained in the same plots each year so that long-term effects of these practices on soybean productivity and soil properties could be evaluated. A split-plot experimental design with a factorial arrangement of wheat residue-tillage combinations with four replications was used.Main plots were irrigated versus non-irrigated regimes and subplots were burning-tillage combinations. Plots were 60 feet in length and 24 feet wide.

Coker 762 wheat was drill seeded in a prepared seedbed each fall after all plots had been double-disked and smoothed with a row conditioner. Wheat was harvested from mid-May through early June with a combine equipped with a straw chopper-spreader, which spread the straw uniformly across each plot. Cutting height for the wheat was approximately 10 inches. Wheat yields from 1982 to 1985 ranged from 34 to 50 bushels per acre with an average of 45 bushels per acre. No wheat was harvested in 1986 because a hail storm completely destroyed the wheat after heading.

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After wheat harvest each year, the appropriate plots were burned and tilled. Tillage consisted of double-disking and smoothing to prepare a seedbed for planting soybeans. The entire test area was then planted with a no-till planter equipped with ripple coulters and double-disk seed furrow openers on a 20-inch spacing. A seeding rate of five seeds per linear foot of row was used each year and dates of planting ranged from late-May through mid-June. Weeds were controlled effectively in all plots with a combination of burndown, preemergence, and postemergence over-the-top herbicides.

Water was applied to irrigated treatments on an as-needed basis with a lateral-move overhead sprinkler system. Soil moisture status was determined by tensiometer and neutron probe readings. Total amounts of water applied to the irrigated soybeans were 7.0 inches in 1982, 11.0 inches in 1983, 7.5 inches in 1984, 5.8 inches in 1985, and 11.3 inches in 1986. Most of this water was applied from mid-July through late-September. However, in 1984, 1985, and 1986, irrigation (1.5 to 2.3 inches) was needed during the early-June through early July period.

Yields

Yields of tilled and non-tilled soybeans were similar each year of the study (Table 1). However, in 1986, the non-tilled plots slightly, but significantly, outyielded the tilled plots by about 2 bushels per acre. The 5-year average yields for tilled and non-tilled plots were 30.4 and 30.8 bushels per acre, respectively. No significant interactions were noted involving tillage and burning or tillage and irrigation.

Irrigation increased yields significantly 4 out of 5 years (Table 2). In 1985, a numerical increase of 4 bushels per acre

Table 1. Effect of spring tillage on yield of doublecrop Centennial sovbeans grown on a Gigger silt loam soil: 1982-1986.

Tillage treatment	1982	1983	1984	1985	1986	5-year average
	-------------Yields, bushels per acre'-------------					
Tilled	34.1	28.7	33.4	24.9	31.1	30.4
No Till	34.3	30.2	33.1	26.3	32.9	30.8
Significance	N.S.	N.S.	N.S.	N.S.	*	N.S.

'Yields are averaged across burned vs. non-burned and irrigated vs. non-irrigated conditions.
'5tatistically significant at the 0.05 level of probability.
N.S. Not statistically significant at the 0.05 level of probability.

was observed with irrigation. However, this yield increase was not statistically significant. Several weeks of rainy weather delayed harvest and caused severe yield and quality losses in 1985. It is likely that these conditions cancelled much of the actual yield increase obtained with irrigation. The largest yield increase with irrigation, 20.3 bushels per acre, was observed in the extremely dry year of 1983. Yield increases of about 10 to 12 bushels per acre were noted in 1982, 1984, and 1986.

Burning significantly reduced yields each year except in 1983. Yield reductions from burning averaged across irrigation and tillage regimes ranged from less than 1 bushel per acre in 1983 to 7.7 bushels per acre in 1985.

In addition, significant irrigation x burning interactions were noted in 1982 and 1985. Under irrigated conditions in 1982, yields of burned and non-burned plots were similar, but under dryland conditions burning reduced yields by more than 7 bushels per acre or about 22 percent. Similar results were obtained in 1985 when burning reduced yields by 4.5 bushels per acre under irrigated conditions compared with 10.7 bushels per acre under non-irrigated conditions.

The consistent yield advantages observed when the wheat residue was not burned were likely a result of the favorable effect of crop residue on soil water conservation. Several studies have demonstrated that the presence of crop residue on or near the soil surface aids in decreasing soil temperatures and reducing the rate of evaporative water loss from the soil surface. Neutron probe and tensiometer data from these studies (data not shown) have consistently shown more favorable soil moisture status in non-burned plots compared with burned plots.

Table 2. Effects of burning wheat residue and irrigation on yield of doublecrop Centennial soyeans averaged over tilled and non-tilled conditions: 1982-1986.

Burn Regime	Irrigation regime: Irrigated	Non-irrigated	Mean
	---	bushels/acre ------- ------	
1982			
Burn	39.8	25.5	32.6 a
No Bum	39.1	32.6	35.8 b
Mean	39.4 a	29.1 b	
LSD (0.05) Burn x Irrigation interaction = 3.4			
1983			
Bum	39.8	19.8	29.8 a
No Bum	39.4	19.0	29.2 a
Mean	39.6 a	19.3 b	
LSD (0.05) Bum x Irrigation interaction = N.S.			
1984			
Burn	36.5	25.5	31.0 a
No Bum	39.6	31.5	35.5 b
Mean	38.1 a	28.4 b	
LSD (0.05) Bum x Irrigation interaction = N.S.			
1985			
Bum	24.0	16.9	20.4 a
No Bum	28.5	27 6	28.1 b
Mean	26.2 a	22.2 a	
LSD (0.05) Bum x Irrigation interaction = 2.1			
1986			
Bum	37.4	24.I	30.8 a
No Bum	38.6	28.1	33.4 b
Mean	38.0 a	26.1 h	
LSD (0.05) Bum x Irrigation interaction = N.S.			
1982-1986 Average			
Bum	35.5	22.4	28.9 a
No Bum	37.0	27.8	32.4 b
Mean	36.2 a	25.1 b	
LSD (0.05) Bum x Irrigation interaction = 1.0			

'Values within columns or rows and within the same year followed by a common letter are not significantly different at the 0.05 level of probability according to the F test.

Organic Matter

Small increases in soil organic matter content can contribute greatly to the water infiltration rate and moisture holding capacity of soil. Analyses of soil samples taken from this study in 1983, 1985, and 1986 indicated that soil organic matter content has declined gradually with time (Table 3). However, data from 1985 and 1986 indicate that organic matter content of non-burned plots was significantly higher than in burned plots. Irrigation and tillage had no significant effect on soil organic matter content.

Plant Growth

The number of days required from planting to canopy closure is an indirect measure of early vegetative growth. Early canopy closure is associated with rapid vegetative growth, an important consideration from a weed control standpoint. Once the canopy is completely closed, the crop

Table 3. Effects of irrigation, burning wheat residue and spring tillage on soil organic matter content of a Gigger silt loam soil.

Treatment	Percent organic matter *0-6* inch depth: 1983	1985	1986
Irrigated	1.30	1.17	1.01
Non-Irrigated	1.17	1.11	0.99
Significance	N.S.	N.S.	N.S.
Bum	1.22	1.07	0.96
No Burn	1.25	1.21	1.04
Significance	N.S.	*	*
Till	1.27	1.14	1.02
No Till	1.20	1.14	0.99
Significance	N.S.	N.S.	N.S.
Irrigation x Burn	N.S.	N.S.	N.S.
Irrigation x Till	N.S.	N.S.	N.S.
Bum x Till	N.S.	N.S.	N.S.
Irrigation x Burn x Till	N.S.	N.S.	N.S.

N.S. = Not significant at the 0.05 level of probability
*Significant at the 0.05 level of probability.

Table 4. Effects of irrigation, burning and tillage on number of days from planting to canopy closure of doublecrop Centennial soybeans, 1982-1986.

Treatment	Days from planting to canopy closure				
	1982	1983	1984	1985	1986
Irr-Burn-Till	48	64	52	59	47
Irr-Burn-No Till	49	64	55	69	41
Irr-No Burn-Till	50	66	54	51	38
Irr-No Burn-No Till	51	66	53	53	38
Non Irr-Burn-Till	47	—	53	—	—
Non Irr-Bum-No Till	48	—	56	—	—
Non Irr-No Burn-Till	51	—	55	59	48
Non Irr-No Burn-No Till	51	—	55	55	45

should be virtually safe from late emerging weeds. In 1982, the first year of the study, rainfall was near optimum during the vegetative growth period and irrigation had no effect on the number of days from planting to canopy closure (Table 4). However, burned plots reached full canopy closure 3 to 4 days earlier than non-burned plots.

In 1983, a very dry year, none of the non-irrigated treatments reached full canopy closure due to poor growing conditions from late June through blooming. Under irrigated conditions the burned treatments reached canopy closure 2 days earlier than the non-burned treatments. In 1984, irrigation and burning had little effect on canopy closure.

In the last 2 years of the study (1985 and 1986), both irrigated and the non-burned conditions resulted in earlier canopy closure. Under non-irrigated conditions the burned treatments never reached full canopy closure due to inadequate rainfall in late June and early July.

These data suggest that the effects of burning versus not burning of wheat residue are cumulative and that several years may be required before the benefits of leaving the wheat residue unburned are fully realized. Tillage generally had little effect on canopy closure. However, under irrigated conditions slightly earlier canopy closure was noted in tilled plots than in non-tilled plots. Under non-irrigated conditions, tillage tended to slightly delay canopy closure in the later years of the study. This may have been a result of soil moisture losses associated with the tillage operations.

Summary

Irrigation was very useful in increasing soybean yields and minimizing yield variations caused by inadequate rainfall. Yield response to irrigation varied considerably from one year to the next and was often influenced by burning regimes. Irrigation increased soybean yields by an average of 13.1 and 9.2 bushels per acre under burned and non-burned conditions, respectively.

Burning of wheat residue generally reduced yields more under non-irrigated conditions than under irrigated conditions. Under non-irrigated conditions, the average yield reduction from burning was 5.4 bushels per acre compared with 1.5 bushels under irrigated conditions.

Tillage generally had no significant effect on yields under irrigated or non-irrigated conditions.

Irrigation generally resulted in earlier and more complete canopy closure. In the early years of the study, soybeans in burned plots tended to reach canopy closure earlier than those in non-burned plots. However, in later years earlier canopy closure was noted in non-burned plots. This is an extremely important consideration since earlier canopy closure may eliminate the need for one or more expensive herbicide applications.

At the conclusion of the study, soil organic matter content was found to be 8-12 percent higher in non-burned plots than in the burned plots. Soil moisture status was usually more favorable in non-burned plots than in burned plots.

These data indicate that alternate systems for producing doublecrop soybeans, including no-till planting in wheat residue, may improve yields and profit potential for soybean growers in northeast Louisiana. Growers should, however, carefully consider production costs for each system since equipment, labor, and herbicide costs could vary considerably.