Management of the Wheat Crop and Wheat Stubble in Double-Cropping Soybean

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INTRODUCTION

Growers in Arkansas double-crop almost all the wheat acreage with soybeans. The most accepted practice has been to burn the wheat straw, disk and plant. State laws were passed in 1990 making a grower liable for automobile accidents caused by burning wheat straw. Conservation compliance has caused many growers to begin investigating alternatives to burning wheat straw.

In recent years there have been unsubstantiated reports that growing wheat on raised beds results in increased yields. Other research has shown that wheat straw residues can be detrimental to soybean production.

Experiments were initiated in fall of 1989 to evaluate different stubble management and tillage practices used in wheat planted on flat or raised seedbeds.

MATERIALS AND METHODS

Experimental sites were selected at three Arkansas locations: Northeast Research and Extension Center (NEREC), Keiser; Southwest Research and Extension Center (SWREC), Hope; and the Cotton Branch Experiment Station, Marianna. Experimental details are given in Tables 1 and 2. Seed bed preparation consisted of bedded (on 38-in. centers) and flat for wheat and five different stubble management treatments (Table 3) for the double-cropped soybeans. The experimental design was a split split plot. Rainfall and other weather data were recorded at the local experiment station weather station. Soil moisture measurements were taken at stand establishment for the soybeans. Soybean canopy development data were taken during late R3 or early R4 growth stages on the soybeans.

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RESULTS AND DISCUSSION

Wheat was planted in the fall on flat and on raised 38-in. spaced seedbeds at Keiser, Marianna and Hope. The wheat at Marianna died in spots as a result of planting too deep, but the remainder as well as that from replanting generated enough straw for the subsequent stubble management test. Wheat grain yields were lost at Hope due to the continual spring rains. Wheat grain yield at Keiser was 44.5 and 46.0 bu/acre on 38-in. raised beds and on conventional flat plantings, respectively.

Soybean data were collected at NEREC and the Cotton Branch Station. Data were lost at SWREC due to deer grazing the plots of double-cropped soybeans. Data collected earlier on canopy development showed that narrowing the rows to 19 in. resulted in good canopy closure at maturity on most treatments. For example, at Keiser the gap was 2 and 25 in. between canopies for 19- and 38-in. row spacings, respectively. Corresponding gaps were 2 and 18 in. at Marianna. The canopy developed essentially the same regardless of the soybean variety or the stubble management treatment. It was obvious from observing the plots that differences in soil resulted in areas of lesser canopy development and growth. This nonuniform development suggests that even closer row spacing could be advantageous to grain yields, especially in a production field.

Soybean grain yields showed a strong response to either burning or leaving the straw, row spacing and variety. At Keiser (Table 4), grain yields ranged from 14 to 42 bu/acre. The best yield was obtained with burned straw, narrow rows and a Group V soybean variety. At Marianna (Table 5), grain yields ranged from 9 to 27 bu/acre. The best yield was obtained by incorporating the straw, narrow rows and using a Group VI soybean variety. The only commonality between the two locations for increasing yield was narrow rows.

The straw load at Keiser was very large compared to that at Marianna. The day after planting there was a rain in excess of 3 in. at Marianna. Disking in the straw allowed these Marianna plots to store this water instead of it running off as surface drainage.

Table 1. Soil test values for wheat experiments.

Location	Analysis												
	pH	OM	P	K	Ca	Na	Mg	Fe	Mn	Cu	Zn	S	EC
		-%-	lb/acre										mmhos
Marianna	5.5	1.0	117	215	1276	151	122	282	214	5	4	26	47
Keiser	6.1	2.9	55	912	8521	271	1923	484	238	2	8	3 8	6 7
Hope	7.0	1.2	54	187	2250	148	—	103	142	3	2	24	61

Table 2. Soil classification, planting and harvest dates, planting rates and varietal information for each experiment

Location	Soil series	Variety	Planting		Harvest date
			Date	Rate	
Marianna	Memphis silt loam	Wheat			
		Caldwell	11/1/89	110 lb/acre	Not Applicable
		Soybeans			
		Asgrow 5403	6/17/90	8 to 10 viable seed/ft	10/30/90
		Uoyd	6/17/90	8 to 10 viable seed/ft	11/8/90
Keiser	Sharkey silty clay	Wheat			
		Caldwell	11/1/89	110 lb/acre	6/14/90
		Soybeans			
		Asgrow 5403	6/16/90	8 to 10 viable seed/ft	10/27/90
		Uoyd	6/16/90	8 to 10 viable seed/ft	11/4/90
Hope	Bowie fine sandy loam	Wheat			
		McNair 1003	11/6/89	110 lb/acre	Not Applicable
		Soybeans			
		Asgrow 5403	6/21/90	8 to 10 viable seed/ft	Not Applicable

Table 3. Stubble management treatments used for double cropped soybeans at NEREC, SWREC and Cotton Branch Station.[1]

Straw burning	Seedbed preparation		
	Bedded	Flat	Flat-Disked
	Treatment #		
Yes	1	3	---
No	2	4	5

[1]NEREC = Northeast Research and Extension Center, Keiser, Arkansas: SWREC = Southwest Research and Extension Center, Hope, Arkansas; Cotton Branch Experiment Station, Marianna, Arkansas.

The difference in varietal response at the two locations could have been due to the varietal tolerance to wheat straw or to differences in maturity occurring when water, sunlight and temperature are conducive to pod fill.

CONCLUSIONS

Conclusions based on one year's data are always questionable for crop production. This year's results show that wheat yields do not respond to planting on 38-in.-wide beds on clay soil. Soybean responses or components of yield increases reflect straw management (burning or leaving), seedbed preparation, row width and soybean variety. Through proper selection of straw management, row spacing, seedbed preparation and variety for the soil and climatic environment, yields can be increased dramatically (Table 6). Note that Table 6 is an interpretative attempt to give realistic values to factors found to increase yield in 1990.

Table 4. Double-cropped soybean vlelds followlna different stubble management treatments at **Kelser,** Arkansas.

Straw management	Row spacing	Bedded		Flat		flat & Inc.		x̄
		Asgrow	Uoyd	Asgrow	Uoyd	Asgrow	Uoyd	
	in.	bu/acre						
Burned	19	42	25	35	35	--	--	34
	38	24	29	27	24	--	--	26
						Burned Mean		30
Left	19	26	24	20	24	22	20	23
	38	15	15	14	10	15	16	16
						Non-Burned Mean		20
						19-in. Row Spacing Mean		29
						Sin. Row Spacing Mean		21
	x	27	23	24	25	--	--	
		Bedded Mean		flat Mean				
		25		25				

Table 5. Double cropped soybean yields followlng different stubble management treatments at Marianna, Arkansas.

Straw management	Row spacing	Bedded		Flat		Flat & Inc.		x̄
		Asgrow	Uoyd	Asgrow	Uoyd	Asgrow	Uoyd	
	in.	bu/acre						
Burned	19	16	22	9	19	--	--	17
	38	14	13	10	14	--	--	13
						Burned Mean		15
Left	19	22	23	15	22	25	27	23
	38	11	11	11	18	15	23	15
						Non-Burned Mean		19
						19-in. Row Spacing Mean		20
						38-in. Row Spacing Mean		14
	x̄	16	17	11	18	--	--	
		Bedded Mean		Flat Mean				
		17		15				

Table 6. Yield component analysis for double-cropped soybeans at Kelser and Marlanna. Arkansas.

Estimated base yield lowest	Keiser	Marianna
	bu/acre	
Lowest yielding treatment combination	15	9
Positive yield component added by		
Burning Straw	+11	0
Leaving Straw	0	4
Incorporating Straw	0	7
Planting Asgrow 5403	0	0
Planting Uoyd	0	4
Using 19-in. Rows	0	6
Instead of Sin. Rows		
Estimated best yield	34	30
Measured best treatment combination	34	27