Update of No-tillage in Louisiana

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Despite encouraging results from research by Louisiana Agricultural Experiment Station (LAES) scientists[1] and the operation of a demonstration conservation farm near Cade, La., by the University of Southwestern Louisiana (USL), only a small acreage in Louisiana is planted with no-till or conservation-tillage planting techniques. The Conservation Tillage Information Center (CTIC) and the No-Till Farmer Acreage Survey estimated that 50,000 to 65,000 acres were planted no-till, and 215,000 to 230,000 acres were planted with reduced-tillage planting techniques in Louisiana in 1985. In these categorizations "no-till" refers to "slot-planting" or planting into soil left undisturbed prior to seeding with planting completed in a narrow seedbed usually 1 to 3 in wide; and "reduced-tillage" to any planting system in which tillage is more extensive than no-till but which leaves at least 30% residue cover on the soil surface after planting. The ASCS cost shared no-till planting on 2600, 3000, and an estimated 7300 acres in Louisiana during 1984, 1985, and 1986, respectively (J. B. Louray, personal communciations).

Soybean-Wheat Double Cropping

Soybeans is the row crop with the largest acreage in Louisiana, and soybean-wheat double-cropping systems have received the widest no-till research attention. Table 1 identifies the factors investigated in LAES experiments conducted in 1984 and/or 1985 which included soybeans no-till planted after wheat. Several of these experiments have compared factorial combinations of: tillage vs no-tillage before soybean planting, wheat straw burning vs not burning, and differential irrigation treatments. Other management factors which have been investigated include: sole-crop soybeans vs double-crop soybeans, soybean row spacing, soybean variety, herbicide combination, lime application, and P_2O_5 and K_2O fertilizer rate and timing.

Investigations of straw management ahead of soybeans in double-crop systems have yielded mixed results. The effect of stubble height was investigated at the Rice Research Station, Crowley, and Northeast Research Station, St. Joseph, during 1982 and 1983. Neither wheat straw stubble heights from 3" to 20", nor straw spreading or removal, consistently affected soybean yields. Similarly, straw burning has not had a consistent effect on yield. A straw mulch appears to be beneficial on soils prone to drought

[1] Dabney, S. M. et al. 1984. Reduced tillage research in Louisiana. Louisiana Agricultural Experiment Station Bulletin 8765.

stress. For example, the Winnesboro branch of the Northeast Research Station is located on soils with an acid fragipan beginning at depths of 14 to 18 inches. At this iocation straw burning has lowered yields of non-irrigated soybeans in 3 out of 4 years (Table 2). The lack of response in 1983 coincided with an especially dry year. In contrast, the St. Joseph branch of the Northeast Research Station is located on deep soils derived from recent Mississippi alluvium. At this location from 1976 to 1984 yields of no-till planted soybeans were increased in 3 years, unaffected in 5 years, and decreased in 1 (the driest) year by straw burning. In the absence of tillage, large amounts of straw residues can interfere with some types of no-till planting equipment and can reduce the efficacy of certain herbicides. Thus while a straw mulch may under some circumstances increase available soil moisture, on deep soils and in south Louisiana where rainfall is usually well distributed or even excessive, this benefit may be marginal. Long term effects of straw burning on soil properties and soil erosion rates may be more important than short term yield effects, but these aspects have not been measured in Louisiana.

Preplant tillage for double-cropped soybeans has yielded mixed results. At the Dean Lee Research Station, Alexandria, La., over 4 years no-till and reduced-till double-crop soybeans yielded 35 bu/acre while conventionally-tilled sole-crop beans planted the same day yielded 44 bu/acre. Over 5 years in similar study at the Iberia Research Station, Jeanerette, both no-till double-crop beans and conventional-till sole crop beans averaged 46 bu/acre. At the St Joseph location, tillage increased the yield of non-irrigated double-crop soybeans an average of 5 bu/acre over 9 years, although the decrease has averaged only 2 bu/acre during the last 3 years. No significant difference in yields have been noted due to tillage before double-crop soybean planting at Baton Rouge over 5 years, at the Rice Research Station over 4 years, at the Red River Research Station, Bossier City, over 7 years, or at the Winnesboro location over 4 years. Recent improvements made in no-till planters have rendered no-till planting more reliable where weed control is adequate and compacted soil conditions are avoided.

No significant interactions have been reported between tillage and soybean varieties, herbicide combinations, fertilizer rates or timing, lime application, or irrigation treatments examined. Narrow row spacings (20 inches or less) appear to be superior to wide rows (40 inches) if chemical weed control is good. Irrigation has increased soybean yields at the Red River and Northeast Research station locations in northern Louisiana, but no response was seen in Baton Rouge from 1983 to 1985. Entomological studies[2] have indicated that bean leaf beetle and banded cucumber beetle are found in higher populations in tilled than in no-ti11 double-crop soybeans, while threecornered alfalfa hopper and green clover worm are more abundant under no-till conditions.

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[2] Troxclair, N. N. and D. J. Boethel. 1984. Influence of tillage practices and row spacing on soybean insect populations in Louisiana. J. Econ. Entomol. 77:1577-1579

Other No-Till Systems for Grain and Silage Production

Other no-till cropping systems which were investigated during 1984 and/or 1985 are identified in Table 3. Soybeans, corn, sorghum, rice, and forages have all received attention. Three systems which have been studied for several years or at several locations will be discussed.

Mono-crop soybeans

Sole-crop soybeans planted with reduced tillage have received limited attention. One study at the Red River Research Station indicated that there were no effects due to tillage, while at the Southeast Research Station, Franklinton, no-till was demonstrated to be superior. At the Northeast Research Station conventionally planted beans proved to be superior. As with all no-till studies, results are highly influenced by the available planting equipment, its adjustment, soil conditions at planting, and weather conditions after planting. At the producer level there appears to be considerable interest in adopting a "stale seedbed" form of planting. In this system, the soil is worked and smoothed well ahead of planting. Weeds are then allowed to germinate. Planting is done without further tillage and weeds are desiccated with a herbicide applied at a low rate.

Cover crops

Several studies have investigated using winter cover crops ahead of no-till planted summer-crops. Corn, sorghum, soybeans and rice have all been tested following legumes, ryegrass, and/or wheat cover crops. Stand establishment of corn, sorghum, and soybeans has been poor following several legumes and re-planting has often been necessary. Rice has successfully been established with no-till drill planting following legumes. Limited data indicate only a small response of sorghum following legumes to fertilizer N. Rice following clover has responded to 50 lbs N/acre and yield and total N uptake has been higher than with rice receiving higher rates of N fertilizer without a cover crop. In 1984, subterranean clover successfully reseeded following both flood and sprinkler irrigated rice crops yielding over 140 bu/ac.

Corn silage production in perennial grass sods

Research has been conducted at the Southeast Research Station to develop and evaluate methods of no-till planting of corn and sorghum for silage production on coastal plain soils. Several no-till planter arrangements have been evaluated for planting these crops into dormant bermuda and bahia sods, into ryegrass stubble, and into non-sod areas. In the perennial-sod plantings, the objectives are to manage the timing of seeding and the timing and rate of herbicide application to suppress the sod sufficiently to allow the silage crop to dominate, and yet leave the sod alive and capable of producing grazing or hay after silage is removed. Results indicate that no-till production of silage from corn planted in sod or non-sod and from sorghum planted in ryegrass stubble offers much promise. Three years continuous no-till silage production has been found to effectively eliminate an established bahia sod, with its replacement by common bermudagrass. A summary of corn silage dry matter production during 7 years of field plantings is presented in Table 4.

No-till Establishment of Forages for Winter Grazing

Winter annuals are an important component of Louisiana's livestock industry. Conventionally, winter annuals are planted into a prepared seedbed. Seedbed preparation, however, poses a serious erosion hazard on many areas devoted to grazing. Research at the Dean Lee Research Station demonstrated that ryegrass could be successfully relay planted into soybeans by aerially seeding it into the beans at one-half leaf drop. Sod seeding winter annuals into summer perennial grass sods has received attention at the Rice, Southeast, and Rosepine Research Stations. Factors examined include: summer perennial grass species, winter forage species, herbicide use, residue mowing, residue burning, drill vs. broadcast planting, and tillage. Bahiagrass, bermudagrass, and dallisgrass sods have been evaluated. In general, it has been found that seeding winter annuals into summer-perennial sods can increase total annual forage production 50-100%. Rye, oats, and ryegrass fertilized with N has usually produced more and earlier dry matter production than legumes. Ryegrass has produced the most total cool season dry matter, but rye and oats produced forage earlier. Legumes usually yielded more digestible dry matter during late spring than ryegrass. Ryegrass and legumes have their peak productivity after the normal initiation of sod regrowth in the spring. They can thus suppress regrowth although the decrease is usually more than offset by cool-season forage production. Reduced tillage planting methods often result in less early season (Fall) growth than that attained by the same species planted into a prepared seedbed. Drilling winter annual seed has been shown to be superior to broadcasting seed with or without subsequent disking. No real advantage has been shown between the use of clipping, herbicides, and/or burning prior to drilling winter annual forages into sod.

Future Directions

A number of different planters have been used in no-till studies, but these have seldom been directly compared. Several available planters and alternative tillage systems will be evaluated in future research. Recently a comparison of a John Deere "Max-emerge" and two in-row subsoiling planters was initiated at the Southeast Research Station. Other systems under consideration include the use of the Paraplow without subsequent disking, ridge tillage planting systems, and controlled traffic field management systems. Because of past recommendations relative to the value of deep plowing to prevent hardpan formation, many people feel regular tillage is needed. Questions are being asked on how long, in the absence of severe rutting, can a soil may be subjected to minimum or no-till procedures before soil physical conditions begin to cause decreased crop yields. An integrated state-wide effort is needed to determine the effectiveness of our several planters and tillage techniques on different soil types in different resource areas. Ridge tillage, for example, may afford too little erosion control on some rolling soils, but may be beneficial on some heavy, imperfectly drained soils in Louisiana where soil loss seldom exceeds tolerance values even with conventional tillage.

Cotton will receive a larger no-till research effort in the future. Development of conservation tillage systems for cotton was identified as the number one research priority by the Delta Area Soil Conservation Service Research Needs Committee in 1983. Research by L. W. Sloane at the Northeast

Research Station in the early 1970's demonstrated cotton could be successfully no-till planted into hairy vetch. There has been little follow-up research. Studies are planned to evaluate the combination of ridge tillage and legume cover crops for cotton production in Louisiana.

Future research efforts in Louisiana will be increasingly interdisciplinary. A need is recognized to monitor not only yield but also weed, insect, disease and nematode pressures; physical and chemical soil properties; and the nutritional status of our crops. Questions of how to take soil samples and how to interpret soil test results and make fertilizer recommendations for no-till culture will be addressed.

Table 1. Factors examined in reduced-tillage soybean-wheat double-crop experiments in Louisiana during 1984 or 1985.

Researcher Location	Till vs. no-till	Burn vs. nc burn	Irrig. vs. none	Row spacing	Soybean variety	Lime or fertil.	Weed control
Baton Rouge	X				X		
Baton Rouge	X						X
Baton Rouge	X	X	X				
Baton Rouge	X		X			X	
Baton Rouge	X					X	
Dean Lee	X			X			
Iberia	X						
N.E. (St. Joseph)	X	X	X				
N.E. (Winnsboro)	X	X	X				
Red River	X	X	X				
Red River					X		

Table 2. Effects of burning wheat residue, tillage and irrigation on yield on doublecrop Centennial soybeans, Winnsboro, La. 1982-1985.

	Yield, bushels/acre				
Treatment	*1982*	*1983*	*1984*	*1985*	4-year average
Irr-Burn-Till	*39.0*	*39.0*	*37.6*	*26.6*	*35.6*
Irr-Burn-No Till	*40.5*	*40.6*	*35.4*	*21.4*	*34.5*
Irr-No Burn-Till	*39.1*	*39.8*	*39.0*	*29.4*	*36.8*
Irr-No Burn-No Till	*39.0*	*39.0*	*40.2*	*27.6*	*36.5*
Non Irr-Burn-Till	*25.9*	*19.0*	*26.6*	18.1	*22.4*
Non Irr-Burn-No Till	*25.1*	*20.6*	*24.3*	*15.7*	*21.4*
Non Irr-No Burn-Till	*32.4*	*17.3*	*30.3*	*25.4*	*26.4*
Non Irr-No Burn-No Till	*32.7*	*20.6*	*32.6*	*29.8*	*28.9*

Table 3. Factors examined in experiments involving no-till grain and silage production for cropping sequences other than soybean-wheat double-crop in Louisiana during 1984 or 1985.

Researcher Location	Crop¶	Cover Crop	Irrig.	N Fertil.	Crop Rotation	Deep Tillage	Weed Control
Baton Rouge	c	X		X			
Baton Rouge	gs	X		X			
Baton Rouge	r	X		X			
aaton Rouge	r		X		X		
Baton Rouge	s,gs	X			X		
N.E. (St. Joseph)	s						X
N.E. (St. Joseph)	s,gs	X		X			
Rice	s,gs	X					X
Rice	r	X	X	X			
Southeast	c	X				X	X
Southeast	fs	X					

¶ c=corn, fs=forage sorghum, gs=grain sorghum, r=rice, s=soybean.

Table 4. Mean effect of seeding method, averaged over hybrids, on silage yield of corn, Franklinton, La. 1979-1985.¶

Seeding method, field condition§	Dry yield, tons/acre							
	1979	1980	1981	1982	1983	1984	1985	7-yr. mean
Prepared bed	3.1	2.6	5.5	4.6	4.9	4.2	5.3	4.3
No-till, non-sod	5.5	***3.0***	7.0	3.8	5.1	5.6	5.5	5.1
No-till, sod#	3.8	3.0	6.0	3.4	2.9	3.3	5.7	*4.0*

¶ Data from field plantings of multiple acreages of several hybrids each year.
§ Seedings on prepared bed made with conventional 4-row planter. No-till seedings in 1979, 1980, and 1981 were made with 3-row Brown-Hardin Superseeder, in 1982, 1983, and 1984 with 4-row Cole no-till planter, and in 1985 with a 4-row John Deere Max-emerge adapted no-till.
# Averaged over plantings in bahia and bermuda sods.