Conservation Tillage: A Force Changing Southern Agriculture

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INTRODUCTION

There are many forces that affect Southern farmers. Several of these are essentially outside farmer control, including weather, water, production costs, habit and government regulations. As few as 20 years ago there were other forces that farmers had little control over. These included soil erosion, pesticide and fertilizer losses, water pollution, weed control, conservation compliance and sometimes profitability. Today these forces must be recognized and evaluated before proper response can be planned and implemented.

The use of conservation tillage is rapidly increasing and is an alternative to several of the factors mentioned above. Indeed, the use of conservation tillage is a force of change in Southern agriculture. In a survey conducted in West Tennessee in 1985, a large percentage of farmers indicated that they were not aware of erosion problems on their own farm but thought that their neighbors had erosion problems (Leuthold, 1987). Popularity of conservation tillage has come to the forefront because it is a cost-effective means of achieving both agricultural production objectives and soil and water conservation goals. Joint efforts from research, extension and the pesticide and equipment industries have rapidly developed practical and applied methods for utilizing conservation tillage.

FORCE OF HABIT

Before bragging about how conservation tillage acreage, which includes no-tillage, minimum tillage and ridge till has increased, let us examine the reasons why the various tillage operations have been performed. Many farmers are reluctant to accept conservation tillage because it contradicts traditional tillage practices to which they are accustomed. Tillage operations have been performed since the first settlers started growing crops for food and sale in America over 200 years ago. Tillage has been repeated several times a season for the following reasons: 1) pest control (including weeds, insects and diseases); 2) seedbed preparation (all good plant and soil science text books recommend starting with a firm, clean seedbed); 3) fertilizer incorporation; 4) herbicide incorporation (although most modern crop herbicides are applied preemergence and postemergence); and 5) that is the way Dad did it.

In many situations, these reasons are now antiquated, and in a very short time they will be obsolete on the majority of cropable acres. Most tillage operations are not justifiable and may be performed for reasons of emotion, security or recreation (expensive recreation). Farmers may justify tillage operations with thinking such as the following:

1) I would love to have a big tractor like.....
2) That black field sure is pretty.
3) All the neighbors are out.
4) I would rather be on the tractor than doing this.
5) It's such a nice day I think I'll make a few rounds.
6) The neighbors will think I'm lazy if I don't.
7) Just one more pass to smooth up the....
8) That should bury those little....
9) If I don't bury the trash it will plug the....
10) Fall fertilizer has to be incorporated.

To justify tillage and cultivation of our crop land, one must question the rationale of each tillage operation and determine the cost and benefit to the crop and environment as well as the budget.

FORCE OF EROSION

In 1977 it was estimated that 2 billion tons of soil were lost to erosion in the United States. In 1981 estimates ran as high as 6.4 billion tons, which is enough to cover Arkansas with a layer of soil 1 in. thick. There are 18 states in which average soil losses are greater than the maximum tolerance of 5 tons/acre/year. These losses range from 5.15 tons in Indiana to 14.12 tons in Tennessee. In Missouri, soil loss averages 11.38 tons/acre/year, which translates to one dump truck load per acre or 640 truck loads/mi^2. Combinations of rainfall, soil series, topography, crop and conventional tillage practices make soil losses in West Tennessee among the highest in the nation. Because of this, researchers have con-

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ducted experiments at the University of Tennessee Milan Experiment Station since 1962 in conservation tillage production techniques with emphasis on no-till. Long-term soil erosion and runoff studies have been conducted continuously since 1980.

Conservation tillage operations leave at least 30% of the soil surface covered with residue prior to planting. No-till is a form of conservation tillage characterized by the elimination of seedbed preparation and the addition of coulters or offset double disc openers to slice through crop residues and create a furrow for seed placement. Conventional tillage consists of using a plow or disk to invert and vigorously stir the soil's surface layer, thus mixing any residue with the soil. Weed control in conventional tillage is accomplished by cultivation(s) and/or herbicide applications, whereas only herbicides are used to control weeds in no-till systems.

No-till has proven to be the most effective method for controlling soil erosion as indicated in Table 1, which illustrates the effects of cropping/tillage systems on soil loss from 0.25-acre plots for selected natural and simulated storms that occurred within the April-July periods of 1980-86. The cropping/tillage systems evaluated over the seven-year period included (1) conventional till, single-crop soybeans; (2) conventional till, double-crop soybeans after wheat; (3) drilled, single-crop soybeans; (4) no-till single-crop soybeans; (5) no-till, double-crop soybeans after wheat (Shelton, 1987).

FORCE OF ECONOMICS

Some producers say it costs more for no-till than for conventional till, while other producers say just the opposite. Who is right? Both--depending upon the costs considered and whether or not there are "problem weeds" in the particular field. However, recent reductions of burndown herbicide prices have reduced the costs of controlling these weeds. Also, variable costs for no-till fields are lower when machinery depreciation and interest on machinery investments are calculated. The reduction of fixed costs may not be fully realized because farmers will likely keep most of their tillage equipment. However, when existing equipment is replaced, it can be replaced with smaller equipment, and thus some cost advantages are realized due to lower investments in machinery.

Table 2 shows the estimated production costs per acre (excluding land costs) for no-tillage and conventional tillage of corn and cotton. Table 3 shows the diesel fuel requirements for various field operations (Hudson, 1987). No-tillage requires 4.8 gal. less fuel per acre compared to the standard cultural practices with conventional tillage.

FORCE OF YIELD

Research and field demonstrations at the Milan Experiment Station and other research centers indicate no significant difference in yields of corn, cotton, soybeans and grain sorghum under no-tillage versus conventional tillage on well- to moderately well-drained soils. Table 4 shows comparisons of cotton yields for conventional till versus no-till planted into wheat or rye over a period of 10 years at the Milan Experiment Station, Milan, Tennessee.

Presently no-till double-crop soybeans is a proven and recommended practice. Table 5 illustrates the average yields of no-till and conventional till soybean in 20 years of research at the Milan Experiment Station (Bradley, 1991).

FORCE OF CONSERVATION TILLAGE

The Conservation Technology Information Center (CTIC) started conducting surveys of conservation tillage acreage 19 years ago. Nationwide, con-

Table 1. Mean rainfall, runoff, cover/management factor and soil loss associated with selected soybean cropping/tillage systems during April-July study periods. Milan Experiment Station, University of Tennessee.

System	Rainfall	Runoff	C-factor	Soil loss
	in.	% of rain		tons/acre
Conventional-till, single crop[1,3]	2.21	43	0.442	3.34
Conventional-till, double crop[1,3]	2.24	41	0.080	0.75
Drilled, single crop'	2.28	47	0.267	3.33
No-till, single crop[2,3]	2.22	31	0.004	0.05
No-till, double crop[1,4]	2.21	46	0.006	0.04

[1] 17 storms, 1980-1986
[2] 12 storms, 1980-1983
[3] 40-in. rows
[4] 20-in. rows

Table 2. Estimated costs per acre (excluding land) of conventional and no-tillage corn and cotton (April, 1991).

	Corn		Cotton	
Item	No-till	Conv.	No-till	Conv.
	$			
Variable Costs				
Seed	14.40	12.00	10.20	9.00
Fertilizer & lime	38.60	38.60	37.70	37.70
Herbicides	22.18	13.10	45.00	24.02
Fungicides, insecticides & defoliant			24.48	24.48
Ginning			60.00	60.00
Mach. Reprs.	10.92	16.71	20.37	38.11
Fuel	3.45	6.68	6.08	15.15
Labor	5.60	11.44	14.00	22.04
Int. Op. Cap.	5.37	5.22	12.66	12.78
Total V.C.	100.52	103.75	230.49	243.28
Fixed Costs				
Mach. Int.	9.60	13.20	20.40	24.00
Mach. Depr.	24.44	36.02	52.75	82.26
Total F.C.	34.04	49.22	73.15	106.26
Total Costs	134.56	152.97	303.64	349.54

Table 3. Diesel fuel requirements by field operations at the Milan Experiment Station, University of Tennessee.

Operation	gal./acre
Heavy disking	.79
Chisel plowing	1.80
Light disking	.69
Seedbed finishing (Do-All)	.77
Planting	.44
Cultivating (two times)	.90
Total, conventional till	5.39
Total No-till planting	.59

Table 4. No-till versus conventional tillage mean cotton lint yields in variety trials planted into wheat or rye. Milan Experiment Station, University of Tennessee.

Year	No-till	Conventional till
	lb/acre	
1981	273	382
1982	940	937
1983	508	336
1984	1071	1146
1985	1040	1048
1986	854	853
1987	919	987
1988	767	690
1989	902	949
1990	992	889
10-year ave.	827	822

Table 5. Mean no-till and conventional till soybean yields at Milan Experiment Station, University of Tennessee, 1971-1990

	No-till		Conventional	
Years	Acres[1]	Yield	Acres[2]	Yield
		bu/acre		bu/acre
20	1787	35.1	2784	33.0

[1]All no-till soybean planted wheat stubble after 10 June.

[2]All conventional soybean planted prior to 10 June.

servation tillage is increasing at an average rate of 6% each year. In 1990, conservation tillage was practiced on 42% of all cropland in the United States. This compares to 31% in 1989. In 1972, when the first survey was conducted, 3.4 million acres was no-tilled. Last year 14.2 million acres was no-tilled, representing a 446% increase. Last year United States farmers used minimum tillage on 6.9% of cropland, giving a total of 61.6 million acres that was farmed with ridge tillage and mulch tillage practices.

Leading the way with the most no-till acreage for 1990 was Illinois with 2.1 million acres. They also had the highest total acres of conservation tilled land of any state with 8.2 million acres (CTIC, 1990)., In addition, nine other states no-tilled over 500,000 acres last year. These include Ohio, Missouri, Nebraska, Virginia, Pennsylvania, Michigan, Maryland, North Carolina and Tennessee. Note that only two of these states are participants at the Southern Conservation Tillage Conference. Tennessee conservation tillage acres are shown in Table 6.

Conservation tillage and no-tillage are definitely here to stay. Technology, resources and proven research are available to support conservation tillage. It is up to us as professionals in research, extension, soil conservation, farming, TVA and agricultural industry (seed, chemical and equipment) to enlist this technology on bur farm land with a variety of crops. Thousands of farmers around the South have already proven that conservation tillage can work and that money spent for labor, fuel and machinery *can* be reduced while producing excellent yields and maintaining quality of soil and water, two of our most valuable natural resources.

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Table 6. Tennessee conservation tillage average: > 30% residue or 1000 lb small grain equivalent

Annual crops	Total acres	No-till	Ridge-till	Mulch-till	Cons.-Till'
Corn (FS)[2]	652,225	150.277	200	129,538	280,015
Corn (DC)	59,525	20,034	0	16,360	36,394
Small Grain (SpSd)	23,834	4,210	0	4, 560	8,770
Small Grain (F1Sd)	636,818	71,420	0	207,312	278,732
Soybean (FS)	891,494	72,146	0	114,351	186,497
Cotton	540,579	11,410	550	4,400	16,360
Grain Sorghum (FS)	63.789	2,993	0	8,682	11,675
Soybean (DC)	445,744	257,335	0	78,179	335,514
Grain Sorghum (DC)	7,520	3,245	0	1,340	4,585
Forage Crops[3]	89,235	19,395	xxx	11,700	31,095
Other Crops[4]	122,446	2,055	0	5,170	7,225
Total Planted Acres	3,533,209	614,520	750	581,592	1,196,862

'Cons. till is the sum of no-till, ridge-till and mulch-till

[2]FS = full season; DC = double crop; SpSd = spring seeded; F1Sd = fall seeded.

[3]Forage crops reported in seeding year only.

[4]Other crops include vegetable & truckcrops (e.g. peanuts, tobacco, etc.)