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PROCEEDINGS

PREFACE

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Recently conducted research in Alabama has demonstrated the importance of topsoil depth in crop production. As topsoil depth decreases, crop yields rapidly decrease. In many areas of the Southeast, soil erosion losses average 9 to 10 tons per acre per year. In relative values, this loss is small (less t.han 0.06 inch per acre) and goes unnoticed in many fields. Unfortunately, accumulated soil losses over a few years can drastically affect soil productivity. On many soils, an erosion rate of 10 tons per acre per year can reduce yield potentials 1/2 to 1 bushel per acre per year.

In addition to soil losses, the lack of conservation tillage results in tremendous quantities of water runoff. The cost of water runoff results in yield reduction every year in almost every field. It is difficult to place a dollar value on an inch of water, but the operation costs of many irrigation systems exceed $10 per acre-inch. When irrigation is not available, the cost of water runoff can be even greater in terms of yield reductions.

In addition to soil and water losses, erosion can result in the loss of valuable nutrients that have to he replaced if economical yields are maintained. Research from several states has shown that the commercial value of nutrient losses from various conventional tillage systems can easily exceed $15 per acre per year.

Conservation tillage is an economical method of controlling soil erosion and water runoff. In addition, results from many studies suagest that yields from conservation tillage cap be as high or higher than yields from conventional tillage systems. Unfortunately, yields in conservation tillage systems are not always as high as yields from conventional tillage systems and sometimes production costs are excessive. During the past decade, many researchers realized that problems existed with conservation tillage systems on some soils and with some crops. They also realized that possible benefits from conservation tillage warranted extensive research programs designed to identify and solve problems associated with conservation tillage.

The extensive research programs conducted in recent years have led to development of management practices that will improve the economics of conservation tillage. These studies have shown that optimum tillage systems will vary among soils, crops, and cropping systems. Some of the management practices developed included herbicide management programs that greatly reduce costs of weed control; fertilizer management techniques that, do not increase production cost, but boost yields 10 to 30%; cropping and tillage systems that reduce energy cost and in some situation eliminate the need for in-row subsoiling on hardpan soils; and cropping systems with winter legumes that reduce and/or eliminate the need for N fertilizer for summer grains and cotton.

Generally, there is a 2- to 5-year delay in transmitting data from the researcher to the agricultural community. Since there is a critical need for the limited conservation tillage data that are available, the Southeastern No-tillage Systems Conference was established to provide a rapid means for communications among researchers and the agricultural community. The proceedings associated with this conference is one method being used to rapidly transmit research data. Some of the papers in this proceedings are from relatively new, but promising projects. Since several years of supporting data are not available on these new projects, firm conclusions cannot be formulated, and care and logical thinking should be exercised in drawing interpretations from these papers. Trade and commercial names are used in some papers for the readers benefit, but they should not be considered as an endorsement or preferential treatment.

The Southeastern No-tillage Systems Conference is hosted each year by agricultural agencies, organizations, and individuals in one of the Southeastern States. It is highly supported by the land-grant universities, Agricultural Experiment Stations, Cooperative Extension Services, Soil and Water Conservation Service, Conservation Districts, Farmers Home Administration, Agricultural Stabilization and Conservation Service, Tennessee Valley Authority, agricultural industries, Farm Bureau, and other agricultural associations.

CONTENTS

CORN PRODUCTION PRACTICES

COMPARISON OF DIFFERENT MULCHES FOR CONTINUOUS NO-TILL CORN[1]

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Continuous no-tillage corn is practiced on many farms where soybeans is not a good alternative due to a livestock system on the farm or because of soils with high erosion potential. Research in several southern states has shown that a properly utilized mulch can result in significant increases in yield of crops, greater conservation of soil water, reduced water run-off, reduced soil erosion and better weed control. When no-tillage corn is grown continuously without a winter cover crop or any soil disturbance, the corn stalk residue accumulates and weed control usually becomes more difficult and grain yields decline. Most farmers are not seeding winter cover crops in continuous no-tillage corn systems.

Research was initiated to determine the effect of a small grain cover crop on no-tillage corn grain yield on a poorly-drained and a well-drained soil. Rye and wheat were used as cover crops to determine the advantage of one over the other.

Soil Characteristics and Treatments

On farm field experiments were established on two different soils to determine the effect of a small grain cover crop on grain yield and weed control in a continuous no-tillage corn production system.

Cavode silt loam is poorly-drained with a clayey, slowly permeable sub-soil. The four treatments established on this soil were: (1) rye cover crop, (2) wheat cover crop, (3) corn stalk residue, and (4) conventional prepared seedbed (plowed and disked).

Maury silt loam is a deep, well-drained soil. This has a 2-6% slope and is severely eroded. Three treatments on this soil were: (1) rye cover crop, (2) wheat cover crop, and (3) corn stalk residue.

In the fall, the wheat and rye were broadcast seeded in strips, corn stalks were shredded, and the soil double-disked to disturb the upper soil layer (2-3 inches) and to cover the seed. The corn stalks were shredded in the fall on all plots. Each treatment was replicated four times.

Results and Discussion

Poorly Drained Soil -- The yield data for the first two years is shown in Table 1. It was quite evident that no-tillage was unsuccessful in this

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[1] This research was supported in part by Chevron Chemical Company by providing financial support and some materials used in this study.

soil when planting in the stalk residue. Since this soil has a high clay content, the wet conditions encountered when planting caused a slight pan barrier to be formed beneath the no-tillage double disk openers resulting in a poor stand and poor plant vigor. A loss of 40-50 percent stand occurred in the stalk residue plots. This treatment was discontinued after two years. The three year average yields (Table 1) indicated that the rye cover crop was equal to plowing the soil and both resulted in significantly higher yields than the wheat cover crop treatment. In 1983, chisel plowing replaced the moldboard plow in the plots. However, due to the severe drought of 1983 this data was meaningless.

The effect of the mulch on weed control is shown in Table 2. In 1981, the weed control was good in all plots except the stalk residue until late in the growing season. Fall panicum and giant foxtail developed late in the plowed and wheat mulch plots but did not affect final yields. The extra growth and cover from the rye helped in keeping these plots nearly weed free until harvest. Another factor on this wet soil is that more dry matter is produced by the rye as compared to wheat by early to mid-May when the corn is planted. This provides a better mulch cover for the no-till corn.

Table 1. Effect of a cover crop on continuous no-tillage corn yields in a Cavode silt loam soil.

Treatment	Yield (Bu/A) 1980	1981	1982	3 Year Ave.
Rye Mulch	163	97	130	127.1a[1]
Wheat Mulch	141	96	115	114.9b
Stalk Residue	97	55		
Plowed	162	91	150	131.9a

[1] Values within a column followed by the same letter are not significantly different at the 5% level according to DNMRT

Table 2. Effect of a mulch on weed control with continuous no-tillage corn.

Treatment	Cavode Silt Loam 1981	1982	Ave.	Maury Silt Loam 1981	1982	Ave.
Rye	1.2[1]	6.2	3.7	2.8[1]	3.8	3.3
Wheat	5.0	8.0	6.5	3.8	3.8	3.8
Plowed	4.0	1.0	2.5			
Stalks	9.0		9.0	5.1	6.7	5.9

[1] Weed pressure rated from 0 to 9 at harvest.
0 = No weeds.

Well Drained Soil -- The yield data from the Maury silt loam soil is shown in Table 3. The yield differences between the two cover crops and stalk residue were small on this soil. The rye mulch treatment consistently gave the highest yields each year and the stalk residue treatment produced the lowest yields. As shown in Table 2, there was better weed control in the mulch plots as compared to the stalk residue. Fall panicum was a serious problem in the stalk residue plots.

In another study by Wilbur Frye, Research Agronomist, University of Kentucky, on a Maury silt loam soil, rye was used as a cover crop in comparison with corn stalk residue. After six years of this study, the corn grain yields were 10.3 percent higher with a rye mulch as compared to the stalk residue for no-tillage corn.

Table 3. Effect of a cover crop on continuous no-tillage corn yields in a Maury silt loam soil.

Treatment	Yield (Bu/A) 1980	1981	1982	Ave.
Rye Mulch	89	100	88	92
Wheat Mulch	85	98	83	89
Stalk Residue	87	90	80	86

Conclusions

On heavy textured, wet soils, continuous no-tillage corn does not appear to be feasible unless a cover crop such as rye is seeded in the fall. Otherwise, some form of tillage may be necessary to get a good stand of corn, control weeds and obtain high yields. In Table 4 the percent yield above the stalk residue treatment shows a dramatic increase on the Cavode silt loam for all treatments.

On a well drained soil such as the Maury silt loam, no-tillage corn into a wheat or rye mulch produces a slightly higher yield (Table 4) as compared to continuous no-tillage corn planted into stalk residues. Advantages from the use of cover crops are to reduce erosion and obtain better weed control.

Table 4. The percent yield above stalk residue of continuous no-tillage corn.

Treatment	% Yield Above Stalk Residue: Cavode Silt Loam	Maury Silt Loam
Rye Mulch	70.5	8.3
Wheat Mulch	55.4	3.5
Plowed	66.1	

Where there is a need to grow continuous no-tillage corn, the use of a goodcovercrop to provide a good mulch will enhance potential yields. In Kentucky, climatic conditions are such that rye is a superior cover crop as compared to wheat.

USING WINTER LEGUME MULCHES AS A NITROGEN SOURCE FOR NO-TILLAGE CORN AND GRAIN SORGHUM PRODUCTION

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ABSTRACT

Nitrogen (N) fertilizer continues to be an expensive but necessary part of grain sorghum and corn production. Recent research has shown that winter legumes could provide most if not all nitrogen required for these grain crops produced no-tillage. The purpose of the no-tillage grain sorghum and corn demonstration/farm trial was to shaimanagement required and grain yield results using adapted legumes to provide N. Grain sorghum demonstration was conducted on an Fuquay loamy sand soil at the county high school. 'Vantage', 'Nova 11', 'Cahaba White', and 'Vanguard' vetch and 'Florida 301' wheat plots were established November 1981. 'Funks 522 DR' sorghum was no-tilled into these plots June 1982. N rates of 9 pounds per acre were used on vetch plots and 89 pounds per acre on the wheat plot. A corn demonstration was conducted on an Alaga loamy sand. 'Vantage' vetch and 'Tibbee' crimson clover plots were established November 1982. 'Northrup King PX 95' and "RingAround 1102' corn was no-till planted into the legume mulches and corn stubble March 1983. N rates of 104 and 219 pounds per acre were used on plots.

On the sorghum demonstration, highest grain yields were obtained by applying 89 pounds N per acre on the wheat stubble plot (62 lb/A). Grain yields from vetch plots ranged from 58 bu/A for 'Nova II' to 18 bu/A for 'Vanguard'. 'Nova II' probably was the only cost effective vetch variety.

On the corn demonstration, highest grain yields were obtained on corn stubble with 219 pounds N per acre (152 bu/A) with Northrup King PX95. Yields were depressed on both vetch (103 bu/A) and crimson clover (124 bu/A) at the same N fertilizer rate in spite

of an estimated 84 pounds and 133 pounds N fixed per acre by vetch and crimson clover, respectively. Yields were depressed from competition of legume mulch regrowth after paraquat applications.

INTRODUCTION

Winter legume mulches have been studied for their value as nitrogen sources in no-till sorghum (Touchton et a1 1982) and corn (Wright and Stanley, 1982). Use of early maturing winter legume mulches resulted in grain yields demonstrating legumes could provide most, if not the entire nitrogen needs of sorghum and corn grain crops.

In North Florida, Wright and Stanley (1982) reported higher yields for corn planted into 'Tibbee' crimson clover mulch. Vetch has also been used as a mulch for no-till corn as far north as North Carolina (Hudson, 1982). Nova 11, Cahaba White, Vantage, and Vanguard were four new nematode resistant varieties released by Auburn which looked promising (Donelly 1982).

There was a need to make grain producers in a north Florida county aware and familiar with using winter legumes as nitrogen sources for grain sorghum and corn no-tillage production.

The purpose of the no-tillage sorghum and corn demonstrations/ farm trial was to show the management required and grain yield resulting from using adapted legumes to provide N to grain sorghum and corn crops.

MATERIALS AND METHODS

Demonstration I:

A demonstration of sorghum no-tilled into stubble of four vetch varieties and one wheat variety was conducted during the 1981 through 1982 growing seasons at the Madison County High School FFA demonstration area to insure high visibility. The site is at the entrance of the school.

The soil was originally a Fuguay loamy sand (Arenic Plinthic Paleudult). Soil pH was 6.9. Soil test recommendation was to apply 30 pounds phosphorus and 160 pounds potash per acre. Five hundred pounds of a 0-10-30 analysis fertilizer were applied and harrowed in November, 1981.

Vantage, Nova 11, Cahaba White and Vangaurd vetch varieties were inoculated with rhyzobia and planted at the rate of 20 pounds seed per acre November, 1981. Florida 301 wheat was planted December, 1981 at the rate of 90 pounds seed per acre. All vetch varieties were allowed to develop seed for the following year. Wheat had also matured by June, 1982.

"Funks 522 DR' sorghum was no-tilled into vetch and wheat stubble at 9 pounds seed per acre rate June, 1982. Concept treated seed was used so metalachlor and paraquat was broadcast after planting at the rate of 1.5 and 0.5 pounds active ingredient. per acre, respectively.

Sorghum was side-dressed with a 3-9-18 analysis fertilizer at the rate of 300 pounds per acre July, 1982. Sorghum no-tilled into wheat stubble received an additional 80 pounds nitrogen per acre.

September, 1982 sorghum plots were hand harvested. Two acres 2.75 feet wide by 27.5 feet long were harvested per plot. Grain heads were threshed with a stationary thresher. The grain yield weighed and percent moisture recorded. Yields were corrected to 15.5% moisture.

Demonstration II:

A farmer/cooperator was selected in an area of intensive irrigated corn production to conduct a demonstration of corn no-tilled into vetch and crimson clover mulch during the 1982-83 growing season. The farmer had a center pivot irrigation system to insure adequate water to the crop and a paved road bordered one side of the field which insured high visibility. The soil was identified as an Alaga loamy sand soil (thermic quartzipsamment). The soil pH average 6.6. Soil tests recommended applying 210 pounds nitrogen, 35 pounds phosphorus and 70 pounds potash per acre.

November 1982, Vantage vetch and Tibbee crimson clover were inoculated with rhyzobia and drilled at the rate of 20 pounds seed per acre into corn stubble that had been harrowed. Plot size was 2.12 acres for each variety. No fertilizer was applied to the vetch and crimson clover plots during the winter growing season.

March 1983, 'Northrup King PX 95' arid 'Ring Around 1102' corn was no-till planted in four row replications over the legume mulches and the remainder of the field (which was in corn stubble).

An attempt at killing the legume mulch was made by broadcasting paraquat at the rate of 0.5 pounds active ingredient per acre after planting. An area 6.5 feet by 6.5 feet of paraquat killed mulch was harvested, overdried, weighed and analyzed for percent nitrogen at the state laboratory to estimate amount nitrogen provided by crimson clover and vetch mulches. Fertilizer was applied at the rate of 54 pounds nitrogen, 24 pounds phosphorus and 102 pounds potash per acre over the entire field. Atrazine plus crop oil was broadcast at the rate of two pounds active ingredient and one gallon 80/20 crop oil per acre over the entire field for weed and legume cover crop control April 1983. The same month 115 pounds nitrogen was applied to the field except the legume plots. A fina1 application of 50 pounds nitrogen was made in May over the entire field including the legume mulch plots.

Plots 12 feet wide by 1190 feet long of the two corn varieties planted into corn stubble, vetch mulch and crimson clover were harvested in August with a combine. Grain weight and moisture were recorded. Yields were corrected to 15.5% moisture.

RESULTS AND DISCUSSION

Grain Sorghum Demonstration. Vanguard vetch growth did not look promising. As shown in sorghum grain yields in Table 1, Vanguard vetch was probably not well adapted. Sorghum planted into Nova II vetch mulch yielded the most grain of all four vetch varieties (58 bu/A). This was only four bushels less grain than sorghum receiving an additional 80 pounds N per acre (62 bu/A). It cost $22.40 less per acre to produce sorghum planted into Nova II mulch than using an additional 80 pounds N on sorghum planted into wheat mulch. Sorghum planted into Nova II mulch was the most cost effective of the mulches. Sorghum planted into Vantage and Vanguard vetch mulches yielded 16 and 14 bushes less per acre than sorghum which received an additional 80 pounds N per acre. At 1982 sorghum grain prices of $1.80 to $2.00 per bushel, it would have been cost effective to have applied additional N to increase yields of sorghum planted into Vantage and Vanguard vetch mulches.

Corn Demonstration. Spring 1983 was unusually cool and wet. Paraquat did not effectively kill the vetch and clover plots. Corn seedlings were shaded by vigorous legume regrowth in spite of an application of atrazine. This was reflected in lower corn grain yields of Northrup King PX95 corn planted into vetch and crimson clover mulches, compared to the planting into corn stubble at the 219 pound N fertilizer rate (See Table 2). This was in spite of the high amounts of N measured in the vetch and clover mulches. (See Table 3). Evidence of stand loss, corn smut infection and atrazine injury of corn plants were also more pronounced in the legume mulch plots than in the rest of the field. In this trial, corn grain yields were apparently depressed by competition from the legume mulches rather than from a lack of N.

The results of these demonstrations showed that research using adapted cool season legumes as a nitrogen source for sorghum and corn grain crops is applicable to the North Florida area provided the legume mulch is killed before the grain crop emerges. Possibly more research needs to be done in this area before planting corn into legume mulches becomes a reliable cropping practice. Another area of research may be the reliability of using reseeding legumes in a multi-cropping system with grain sorghum or perhaps summer annual grass forages. One of the major problems using winter legumes as a N source is the cost of legume establishment. The cost of establishing the legume is about the cost of the N produced. By allowing reseeding legumes to mature and reseed each year before planting the summer annual crop, this cost can be reduced. Such a multicropping scheme has already been shown to be reliable over a three year period with grain sorghum production. (Touchton et al. 1982).

Finally the results of these demonstrations showed producers in their own county new research that could help reduce production costs, energy costs, and soil erosion. Management of legumes as well as the grain crops were demonstrated through an annual farm tour, newsletters, radio programs, newspaper articles, small plot demonstrations at the county high school entrance, and on farm trial signs to maximize visibility and adoption of no-till practices.

We would Like to than Ed Jowers, Madison County Extension Director for aid in planting and harvesting plots. Also, Bern Smith, Soil Conservationist, and Andrew Williams, Soil Technician, who provided help in soil classification. Ernest Washington, Gene Stokes, FFA Advisors, helped make the vetch small plots a success at the county high school. Archie Davis, farmer, made the farm trial possible.

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TABLE I. Grain yield of sorghum as affccted by applied nitrogen and cover crop.

Cover Crop	Applied N, lbs./A	
	9	89
Vetch:	Grain Yield bu/A	
Vantage	46*	--
Nova II	58	--
Cahaba White	48	--
Vanguard	18	--
Whcat:		
Florida 301	--	62

* Means of two sampled areas per cover crop.

TABLE 2   Corn grain yield as affected by corn variety, applied nitrogen and cover crop

Cover Crop	Corn Variety	Applied N	Grain Yield
		lbs/A	bu/A
Vetch	RA*	104	72
	NK	104	63
	NK	219	103
Crimson Clover	RA	104	73
	NK	104	87
	NK	219	124
Corn Stubble	NK	219	152

* Corn varieties were Ring Around 1102 and Northrup King PX95

TABLE 3. Estimated nitrogen fixed by vetch and crimson clover cover plots.

Cover Crop	Nitrogen Fixed
	lbs./A
Vetch	84
Crimson Clover	133

EVALUATION OF COVER CROPS FOR NO-TILL CORN SILAGE PRODUCTION IN LOUISIANA

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Materials and Methods

Research was initiated in 1982 to evaluate the potential. of winter legume cover crops ahead of corn (~~Zea maize~~) grown for silage production. Tibbie crimson clover (Trifolium incarnatum), Mt. Barker subterranean clover (Trifolium subterraneum), and Nova **II** common vetch (Vicia sativa) were planted November **10,** 1982. Wheat (Triticum aestivum) and fallow plots were included as checks. Cover crops were planted as main plots in a randomized block design with four replications. The experiment was conducted at Baton Rouge, La. on a Mississippi alluvial silty clay loam soil (Commerce/Mhoon series) with surface pH near 6.0 (increasing with depth). Fallow and wheat plots were split with, and without the application of 30 lbs. of N per acre as ammonium nitrate on March 4, 1983.

On March 14, 1983, Funk hybrid G-4611 corn was planted in 0.72 m rows using three drills of a Moore no-till grain drill. At this planting the cover crop plots were split into 9-row sub-plots for three different herbicide spraying patterns: (1) broadcast spraying, (2) 15" bands centered on the rows, and (3) no spraying. Paraquat and atrazine were sprayed in a volume of 240 1 per hectare (25 gallons per acre) at a rate of 0.56 and 3.36 kg ai/ha (0.5 and 3 lbs. ai/acre), respectively. The legume subplots were 7 meters long and the wheat and fallow subplots were 3.5 meters long. The corn was re-planted on April 21, 1983. For the April planting date all subplots received a band spraying of Paraquat ahead of the drill with Furadan applied in the row at a rate of 1.2 kg ailha.

The cover crops were sampled on March 14 and April 21, 1983 from 0.093 square meter areas using a shear and frame. Samples were taken from undisturbed areas on March 14 and from previously unsprayed sub-plots on April 21. The April 21 samples were analyzed for Kjeldahl nitrogen content by the Forage Quality Laboratory of the L.S.U. Southeast Research Station, Franklinton, La.

When 12 inches tall in late May, corn was sidedressed with 70 kg-N/ha supplied as liquid fertilizer (URAN-32) injected mid-way between the rows. At this time an attempt was made to control a serious infestation of johnsongrass with a hand spraying of Poast (sethozydim) directed in the row middles. Corn silage samples were harvested on July 28 and July 29, 1983. Samples were cut from a 3 meter length of a center row. These samples were separated into corn and johnsongrass components and the fresh weight of each component was obtained. Number of plants per sample and number of ears per sample were also recorded. These components were then re-combined and passed through a grinding machine and sampled for quality analysis. The composite silage samples (corn and johnsongrass) were analyzed for moisture content and Kjeldahl nitrogen. Ears were picked from an adjacent 3 meter length of row and were dried at 60 degrees C to determine grain yield.

Results and Discussion

The dry matter production of the cover crops on both sampling dates and the crude protein and total above ground nitrogen yield of the April sampling date are reported in Table 1.

Table 1. Cover crop dry matter and nitrogen yields from corn cover crop study.

Species	Variety	Yield (kg/ha) March 14 DM	April 21 DM	April 21 N	Crude protein@
Crimson	Tibbie	860	5020	124	15.5*
Sub	Mt. Barker	2230	3790	143	23.5
Vetch	Nova II	2800	3700	107	18.0*
Wheat	Coker 762 - N	1570	2075	23	7.4
Wheat	Coker 762 + N	1630	3970	51	7.7
fallow	- N	605	910	21	14.1
fallow	+ N	345	915	23	16.3
L.S.D.	(0.05)	1012	1130	37	4

* Mean of only 2 samples, mean used to estimate N yield of plots with missing crude protein values.
@ air dry basis

Common vetch produced the greatest early growth. It was interesting to note the poor early growth from the crimson clover relative to subclover when the species were planted in November. The winter of 1982 was milder than average in Louisiana. For the April sampling date, dry matter production was ranked as follows: Crimson > Sub = Wheat + N = Vetch > Wheat - N ≧ Fallow ± N. Crimson clover and wheat + N appeared to produce the largest proportion of their dry matter yield during a short period late in the spring. N fixation by the legumes and nitrogen recovery by wheat and weeds as measured by the yield of nitrogen per hectare was highest for subclover followed by crimson clover and vetch. Overall the subclover fixed the largest amount of nitrogen and retained by far the highest crude protein concentration of all the cover crops.

Visually the wheat appeared to respond to the March application of nitrogen, while the fallow areas (mainly annual bluegrass Poa annua) did not respond. This was reflected in the dry matter and nitrogen contents of the wheat and fallow plots at the April sampling date. Nitrogen fertilized wheat produced twice the nitrogen yield as unfertilized wheat but no differences were found between fallow treatments with and without fertilizer nitrogen. The fallow weeds were not effective in recovering applied fertilizer nitrogen. The crude protein percentage of the wheat was not effected by the application of nitrogen to the cover crop. The increased uptake was due to increased dry matter production.

The March 14 planting resulted in a stand failure. It appeared as though the corn germinated and emerged through the crops and it was pruned at the soil surface by insects or birds. Definative observations on this point, however, were not made and the effect could have also been due to kolines (allelopathy). At the time of the April replanting, stand counts were made of the existing corn plants. The mean stand count reported as plantsfha were strongly influenced by cover crop and were as follows: 29340, 12325, 4910, 2100, and 1785 plants/ha for the fallow, wheat, crimson, sub, and vetch treatments, respectively. The fallow treatment had by far the least vegetation and produced the best stand, but still not a satisfactory one. The re-planting was successful in most cases. Seed was not always well placed into the soil in the previously unsprayed plots due to inadequate adjustment of downward pressure on the coulter openers. At harvest the plant populations were: 57950, 53600, 46050, 43790 and 40015 plantsfha for the fallow, crimson, vetch, wheat and subterranean plots, respectively, with an LSD (0.05) of 11930.

Corn silage dry matter yield, plant population, moisture content at harvest, and total silage nitrogen uptake were significantly influenced by cover crop and spraying treatments. Percent corn in the silage and percent crude protein were influenced by cover crop treatments. Grain yields were low and were influenced only by spraying treatment. A summary of the results is reported in Tables 2 and 3. The crimson clover cover crop resulted in the greatest silage dry matter production. Corn silage produced following subclover had the highest crude protein concentration. Nitrogen uptake by corn following the various cover crops ranged from 38 to 83 kg-N/ha, much less than expected. The greatest recovery of nitrogen was for the three legume cover crops which averaged 78 kg-N/ha whereas the wheat and fallow treatments only averaged 49 kg/ha uptake. The low recovery of the applied fertilizer N and nitrogen contained in the cover crops at planting may be due to the fact that this was the first year for both legume cover crops and no-till corn planting at this location. Traditionally these fields have produced corn silages of lower nitrogen content than might be expected at other locations.

There was a statistically significant interaction of cover crop **by** spraying treatment on the percentage of corn in the silage sample and the percent crude protein of the silage samples. Examination of the data indicated that the interaction was mainly due to the different response of the wheat and the subclover treatments. When wheat (with or without preplant nitrogen) was not sprayed, corn only constituted 42% of the silage sampled and the silage averaged only 4.5% crude protein. On the other hand, when subclover was not sprayed, corn constituted 92% of the silage sampled and averaged 8.2% crude protein. The unsprayed subclover plots could visually be identified from all the other plots during the growing

Table 2. Corn silage yield and quality analysis as affected by cover crop.

Cover Crop	Dry matter Mg/ha	% Moisture at harvest	% Corn	N uptake (kg-N /ha)	% Crude protein*
crimson clover	10.1	59	63.2	83	5.0
Subclover	7.8	69	72.1	77	6.6
Common vetch	9.0	63	63.2	74	5.2
Wheat - N	6.9	66	56.8	50	4.6
Wheat + N	7.2	63	56.3	56	4.8
fallow - N	5.6	65	69.1	38	4.1
fallow + N	6.9	63	80.2	53	4.6
LSD (.05)	2.0	5.1	12.4	19	0.7

* dry matter basis

Table 3. Corn silage yield and corn grain yield

Spray 5 weeks prior to planting	Dry matter silage yield Mg/ha	Plants/ha	% Moisture at harvest	Grain yield* (kg/ha)
Broadcast	9.3	53710	60	2225
Strip	7.4	52260	65	1690
None	6.3	41095	66	1095
LSD (0.05)	1.3	7810	3.4	618

* 13% moisture

season due to the absence of johnsongrass. Although the stand was poor, the corn in these plots was also vigorous. It was considerably retarded in maturity compared to all the other treatments and was harvested before its optimum dry matter and grain yield had been achieved. It is felt that if the difficulties encountered in establishing a stand can be overcome, a subclover cover crop may be very beneficial to corn silage production.

Next year, the experiment is being modified in that subclover will be the only legume cover crop tested. The fallow treatments without nitrogen will be maintained. Wheat will be replaced with a conventional tillage treatment which will include fall sub-soiling. The broadcast, strip, and no-spray treatments will be applied about 3 weeks prior to expected planting date. Several rates of nitrogen fertilizer will be applied to subplots within the spray treatments to determine the nitrogen contribution of the clover to the system.

NO-TILL CORN PRODUCTION IN CRIMSON AND ARROWLEAF CLOVERS[1]

R. L. Stanley, Jr. and D. L. Wright[2]

ABSTRACT

No-till corn production was greater with crimson clover than with arrowleaf clover. Arrowleaf was more difficult to suppress, resulting in increased competition to the corn. Broadcasting the herbicide generally resulted in better yields than banding. Mowing the clover top growth prior to planting resulted in reduced corn yields compared to broadcasting the herbicide. When clover top growth was removed, corn yields were greatly reduced. No yield response for the corn in crimson clover was obtained by addition of N up to 200 lb/A. At higher yield levels and under different moisture regimes, results may differ.

Continued increases in the cost of fertilizer N have resulted in increased interest in the use of legumes to supply N to other crops. Simultaneously, the advantages of "no-till" farming have resulted in dramatic increases in this practice. Several experiments have been conducted at the North Florida Research and Education Center at Quincy with no-till corn production in clovers. Clovers were established in the fall with P and K applied according to soil test results. Soil test results were also used to determine P and K application to the corn. Corn was planted no-till with subsoiling to a depth of 14-16 inches. Irrigation was supplied to the corn to maintain soil moisture tension below 20 cb at the 6 inch depth.

Table 1 shows results from an experiment to evaluate the potential for producing corn in crimson and arrowleaf clovers using several methods to suppress the clovers. Corn was planted in 30 inch rows on 4-12 and no was added to the corn. For any given treatment, corn yields are lower with arrowleaf than with crimson. Only when the clover was turned under were yields with arrowleaf above 100 bu/A. Arrowleaf was in a rapidly growing stage at corn planting, recovered from the Paraquat, and resumed growth to compete with the corn seedlings. Crimson clover matures and begins dying back about 4-15, making it easier to control with herbicides than arrowleaf. With crimson corn yields from the treatments using Paraquat were no different from the treatment where the clover was turned under. When no herbicide was applied, corn production was lower than with any other treatments. From this experiment is appears that crimson is more suitable for corn production than arrowleaf clover.

1 Presented at Southeast No-Till Conference, Headland, Alabama, July 10, 1984.

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Table 1. No-till corn production when planted into 2 clovers with several methods of clover suppression. NFRE Center, Quincy Fla. 1979.

Treatment	Crimson	Arrowleaf
	Bushels/Acre	
Paraquat broadcast @ planting	140 a*	87 a
Paraquat banded @ planting	129 ab	33 bc
Paraquat band @ plant, PQ middles later	111 abcd	51 b
Clover turned under	127 abc	117 a
No treatment, plant direct	97 cd	7 c

*Means in a column followed by same letter are not significantly different at 5% probability by Duncan's MRT.

Table 2 shows data from a similar experiment the following year with some additional treatments to evaluate the effects of forage removal on subsequent corn production. The highest corn yields with both clovers was obtained when Paraquat was broadcast at planting. This treatment gave higher yields in 1980 compared to 1979, especially for arrowleaf clover. Paraquat was applied with 50 gallons of water per acre in 1980 which resulted in better coverage than in 1979 when only 25 gallons per acre were used. This gave better suppression of the arrowleaf in 1980 resulting in reduced clover competition. Banding the Paraquat caused reduced corn yields with arrowleaf, but, as in the previous year, yields with crimson clover was essentially as good with banding as with broadcast application. When clover top growth was mowed with a rotary mower and corn planted directly into the residue, yield was as high as with banding Paraquat on crimson clover. With arrowleaf, yields were reduced considerably compared to broadcasting but were higher than with banding. When forage was removed as hay and corn planted directly into the stubble, yields were reduced considerably compared to the previous three treatments for crimson, but with arrowleaf yields were as good as with banding the herbicide. When forage was removed and the stubble turned under with a moldboard plow before planting, further yield reductions were evident with both clovers.

Table 2. Effect of method of suppressing 2 clovers on subsequent corn production. NFRE Center, Quincy, Fla. 1980.

Treatment	Crimson	Arrowleaf
	Bushels/acre	
Broadcast Paraquat @ planting	166 a*	144 a
Band Paraquat @ planting	148 ab	91 de
Mow, plant direct	143 b	115 bc
Harvest hay, plant direct	116 c	94 cd
Harvest hay, moldboard, plant	95 d	**59** f

*Means in a column followed by same letter are not significantly different at 5% probability by Duncan's MRT.

Table 3 shows corn yields from an experiment to try to determine the amount of N crimson clover can supply to a following corn crop. Corn was planted no-till into the clover with Paraquat broadcast at planting. Corn yields were not affected by N applications up to 200 lb/A. From this and similar data it appears that corn yields above 1OO bu/A may be obtained with crimson clover without addition of any supplemental N under intense irrigation. For higher yields additional N will probably be necessary and results may be different with no irrigation or with different soil moisture management.

Table 3. Effect of N application on no-till corn production in crimson clover. NFRE Ctr, Quincy, Fla. 1979.

N Rate (lbs/A)	Corn Yield (Bu/A)
0	140 a*
50	120 a
100	139 a
200	143 a

*Means in a column followed by same letter are not significantly different at 5% probability by Duncan's MRT.

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PLANTING CORN INTO STRIP KILLED CLOVER

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Using winter legumes as a N source and mulch for no-tillage planted summer crops is increasing in popularity. Even in a fairly good growing season, the values of the N in the legume tissue can be greater than the production cost of the legume. Using reseeding winter legumes eliminates seed and seeding cost in subsequent years and is by far the most economical approach to cropping systems which include winter legumes grown as a N source for summer crops.

Grain sorghum works well with reseeded clover systems primarily because the clover will generally set seed prior to the expiration of the optimum planting period for sorghum. Unfortunately, optimum corn planting dates in most areas of the state occur prior to maximum N accumulation in the legume and prior to seed set.

During the past couple of years, some innovative cropping systems have been developed which permit corn to be planted during the optimum period without losing the reseeding potential of the legume. Strip killing narrow bands of clover for the corn row at planting is one of these systems. With this system, clover in the row middles will continue to grow, accumulate N, and produce seed. In 1983 a study with Autauga crimson clover was initiated at the Sand Mountain Substation to evaluate the feasibility of planting corn into immature clover. The clover was drilled into a prepared seedbed on 18 October 1982 at a seeding rate of 20 pounds per acre. The corn 'RA 1502' was planted in 36-inch row widths on 10 May 1983 when the clover was in the early bloom stage. Treatments at planting included paraquat kill strips 0, 9, 18, and 36 inches wide in the corn row. The 36-inch kill strip was a complete kill across the entire plot. Each strip plot was divided into two subplots; one received no sidedress N and the other received 60 pounds per acre of sidedress N, 3 weeks after planting. All plots were replicated four times and each one, regardless of the sidedress N rate, received 10 pounds per acre of N as a starter fertilizer at planting.

Oven-dry weight of the clover tissue at corn planting was 6,000 pounds per acre. Nitrogen in the above-ground tissue averaged 140 pounds per acre, which should be adequate to produce an acceptable corn yield. Higher corn yield with than without fertilizer N (Table 1) clearly indicates that a sufficient quantity of N was not released from the clover material, even when the clover was completely killed at corn planting. Inadequate release of N from the clover may have been partially due to extended droughts in July and August. Average rainfall for May, June, July, and August was 7.1, 4.4, 2.9, and 0.4 inches, respectively.

Higher yields when the clover was completely killed (36-inch kill strip) than when either 9 or 18-inch strips were killed illustrates that strip killing can severely reduce corn yields. Lower yields with the strip killed treatments than the complete kill treatment may have been due to slower or less N release from the clover tissue, but were most likely due to soil moisture depletion by the clover.

Table 1. Yield of no-till corn as affected by sidedress nitrogen and width of killed clover strips in the corn row at planting.

Sidedress Nitrogen	Killed strip widths, inches[1]			
	0	9	18	36
lb./acre	bu./acre			
0	18	34	32	50
60	65	75	76	91

[1]Row width was 36 inches and the 36-inch width was a complete kill.

EFFECTS OF LEGUME COVER CROPS ON YIELD OF NO-TILL CORN

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Legume cover crops can be used to provide the advantages associated with a mulch in no-till corn production, while also supplying a significant quantity of biologically fixed nitrogen (N). In Kentucky, it was estimated that a hairy vetch cover crop provided biologically fixed N equivalent to approximately 80 to 90 lb/acre of fertilizer N in addition to mineralized soil N (Ebelhar et al., 1984). Mitchell and Teel (1977) found grain yields of no-till corn that was planted into a cover crop mixture of hairy vetch and spring oats to be equivalent to yields obtained with 100 lb/acre of fertilizer N.

Nitrogen is usually the most limiting plant nutrient in corn production and applications of large quantities of inorganic N fertilizers are required to obtain economical yields. As the price of N fertilizers increases, it is reasonable to believe that increasing numbers of farmers will use legume cover crops In no-till corn production to supply a portion of the N requirement. The objectives of this study were to determine the effects on no-till corn of **1)** winter annual legume cover crops as compared to a rye cover crop and to a winter cover of corn stalk residue alone, 2) N fertilizer management for each cover treatment, and 3) method of seeding the cover crop.

MATERIALS AND METHODS

This experiment was established in the fall of 1979 at the West Kentucky Research and Education Center at Princeton, Kentucky and is still being conducted. Cover crops of hairy vetch (Vicia villosa), big flower vetch Vicia grandiflora), and rye (Secale cereale) were planted into no-till corn each fall. Two planting methods were used -- overseeding into no-till corn about mid-September and drilling into no-till corn residue about mid-October following harvest of the corn. Seeding rates were 35 lb/acre for the two vetches and 3 bu/acre for rye. The cover crop treatments were compared to a cover of corn residue from the previous year. Nitrogen fertilizer at rates of **0,** 45, and 90 lb/acre N as ammonium nitrate was applied as a split-plot treatment. The soil was a Zanesville silt loam, with slope ranging from about 1 to 3%.

In late May each year, corn was planted into the standing cover crops or corn residue using a no-till planter. The varlety of corn was Pioneer 3184 in 1980 and Pioneer 3535 in 1981-1983. When the corn was planted, the experimental area was sprayed with a mixture of 2 pt/acre of paraquat, 2.5 lb/acre of Bladex, 2.5 lb/acre of Lasso and X-77 surfactant in 45 gallons water/acre to kill the cover crops and provide weed control for the corn. N fertilizer treatments were surface-applied broadcast at corn planting.

Cover crop samples were harvested before the corn was planted to determine their dry matter yields and N content. Corn grain was harvested from 25 feet of each of the two center rows in each plot in early October.

RESULTS AND DISCUSSION

1980. Yields of cover crops were not affected by the method of planting, but hairy vetch produced approximately 4 and **5** times, respectively, more dry matter than big flower vetch and rye (Table **1).**

Table 1. Dry matter yield of cover crops at corn planting for 1980.

Cover crop	Yield, lb/acre
Hairy vetch	1956 a*
Big flower vetch	490 b
Rye	383 b

* Means followed by the same letter are not significantly different at the 5% level of probability based on LSD.

Corn grain yield (Fig. la) was significantly influenced by an interaction between cover treatment and applied N fertflizer. At 0 and 45 lb/acre applfed N, corn yields with hairy vetch were greater than wfth all other cover treatments. Since hairy vetch produced 4 to 5 times greater dry matter than big flower vetch or rye (Table **1),** this could be attributed to additional N supplied and soil water conserved by the mulch. Corn yields converged at 90 lb/acre fertilizer N for all cover treatments, apparently as a result of soil moisture deficiency limiting corn yields to a greater extent than available N. The 1980 growing season was a drought year.

1981. Hairy vetch significantly outyielded both big flower vetch and rye, and rye outyielded big flower vetch (Table 2). Planting the cover crops by overseeding was superior to drilling in terms of yfeld and N content.

Corn grain yields for 1981 are shown in Fig. lb, and as in 1980 the response to fertilizer N was dependent upon cover treatment. Water was not as limiting, and corn yield with big flower vetch and hairy vetch cover treatments were very similar. Based on corn yield with 0 N, both vetch cover treatments produced approximately 40 to 50 bu/acre more grain than corn residue or rye treatments. Yields at 0 fertilizer N with hairy vetch and big flower vetch treatments were estimated to be comparable to yields obtained with corn residue at rates of 70 and **52** lb/acre of fertilizer N, respectively.

Table 2. Dry matter yield and N content of cover crops at corn planting for 1981.

Cover crop	Yield	%N	N content	Planting method	Yield	N content
	lb/acre		lb/acre		---lb/acre---	
Hairy vetch	5304 a*	3.7	196 a	Overseeded	4691 a	133 a
Big flower vetch	3051 c	4.1	125 b	Drilled	3623 b	109 b
Rye	3981 b	1.0	40 c			

* Means within columns followed by the same letter are not significantly different at the 5% level of probability based on LSD.

1982. Overseeded hairy vetch produced greater yields of dry matter and produced 50 lb/acre more N in the above-ground portion when overseeded than when drilled. Planting method did not significantly influence nitrogen content of big flower vetch or rye (Table 3).

Table 3. Dry matter yield and N content of cover crops, 1982.

Cover crop	Planting method	Yield, lb/acre	%N	N content, lb/acre
Hairy vetch	Overseeded	2900 a*	3.9	112 a
	Drilled	1608 bc	3.8	61 b
Big flower vetch	Overseeded	1910 bc	3.5	66 b
	Drilled	1915 b	3.6	70 b
Rye	Overseeded	1363 cd	1.0	13 c
	Drilled	1028 d	1.0	11 c

* Means within columns followed by the same letter are not significantly different at the 5% level of probability based on LSD.

Corn grain yield in 1982 responded to applled N similarly for all cover treatments, although yield was dependent on cover treatment (Fig. lc). This suggests that soil moisture was not limiting, since the corn responded to the additional N avallable from hairy vetch and big flower vetch, even when 90 lb/acre of fertilizer N was applied.

1983. Dry matter production of hairy vetch was significantly greater than big flower vetch or rye, and big flower vetch yield was greater than that of rye. Nitrogen content of the cover crops coincided with their yields (Table 4).

Unfortunately, severe drought conditions persisted throughout the 1983 growing season, resulting in extremely low grain ylelds (Fig. Id). it is interesting to note that at the 0 N rate, corn yield responded to hairy vetch and big flower vetch treatments, whlle added N produced only a slight response with these two cover crops. There was a greater, but still small corn yield response to applied N with the corn residue and rye treatments. This trend suggested that both N and soil water were limiting, but soil water was the major limiting factor in those treatments.

Table 4. Dry matter yield and N content of cover crops,1983.

Cover crop	Yield, 1b/acre	%N	N content, lb/acre
Hairy vetch	2618 a*	3.4	89 a
Big flower vetch	1644 b	3.6	60 b
Rye	972 c	1.1	10 c

* Means within columns followed by the same letter are not significantly different at the 5% level of probability based on LSD.

SUMMARY

Legume cover crops are capable of supplying a portion of the N required by no-till corn in addition to providing the benefits usually associated with a mulch. In some years of this study, overseeding resulted in greater yields of certain cover crops, probably due to the earlier planting dates, allowing more growth to be made prior to the onset of winter. Years when soil moisture was less limiting, the additional N supplied by legume cover crops was more evident in terms of corn yield. The quantity of N potentially available to no-till corn from legume cover crops was dependent on dry matter yield and %N of the cover crop in question.

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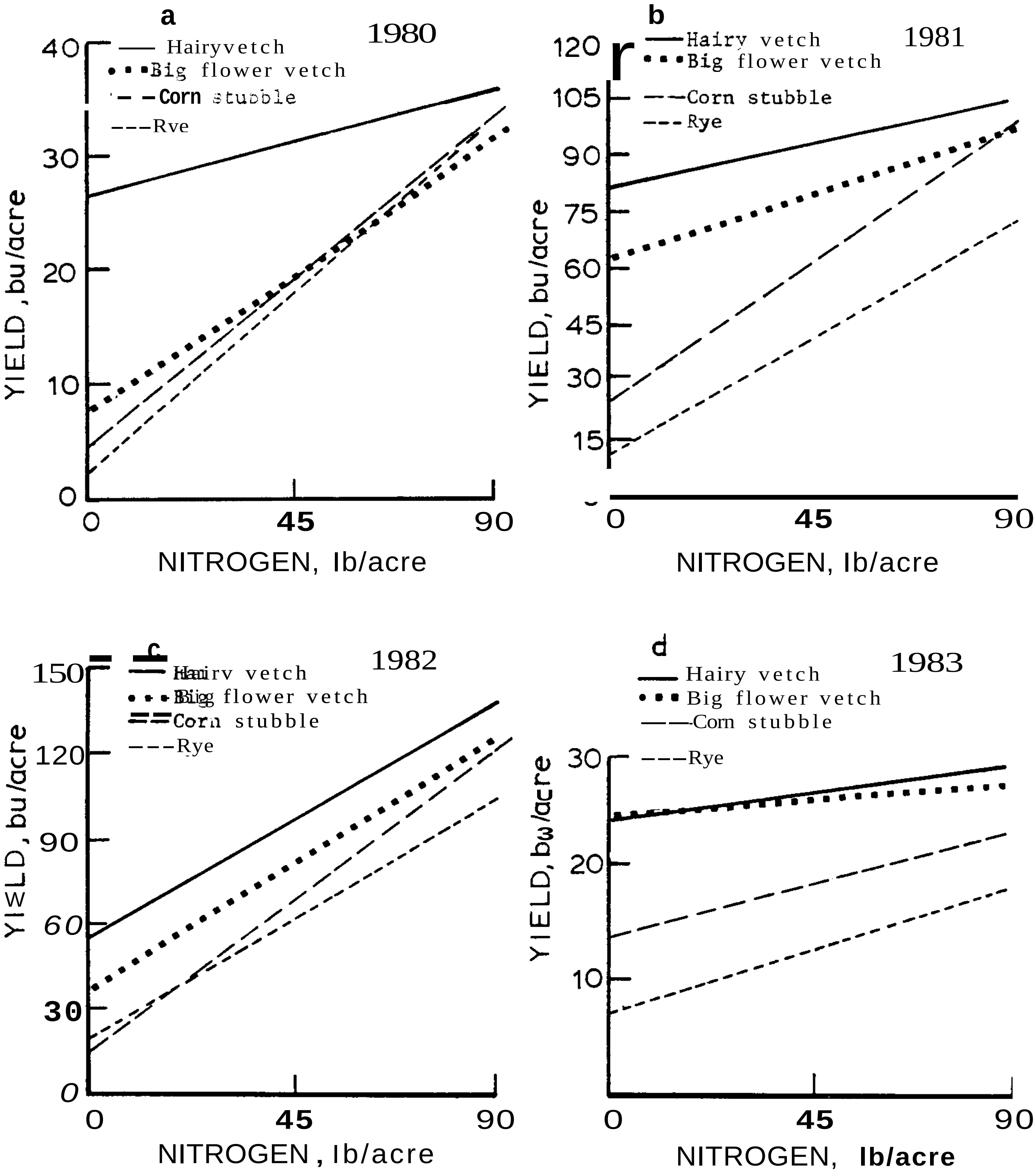

Fig. la-d. Effect of cover treatment and applied nitrogen fertilizer on corn grain yields: 1980 - 1953.

NITROGEN APPLICATIONS AND SUBSOILING FOR NO-TILL CORN

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Nitrogen loss from surface-applied urea fertilizers through ammonia volatilization can be substantial in no-till crops. The use of subsoilers to fracture root-restricting hardpans of Coastal Plain soils may provide an application method for improving the efficiency of urea-N in no-till systems.

In 1982, a study was initiated at the E. V. Smith Research Center to determine the effect of method and time of application, use of nitrification inhibitors, and planting tillage methods on the efficiency of N applied as urea or as ammonium nitrate to no-till corn. 'RA 1502' hybrid corn was planted no-till with or without in-row subsoiling (12-inch depth) into soybean residue on a Norfolk loamy sand. Nitrogen (140 lb./acre) as urea or ammonium nitrate, was applied either surface-banded or in the subsoil track at planting or 5 weeks after planting. Nitrification inhibitors, dicyandiamide (DCD) and ethylene dibromide (EDB), were also used with urea applied in the subsoil track. Nitrogen applied in the subsoil track at 5 weeks after planting was applied with between-the-row subsoiling. All plots were fertilized with 200 lb./acre 10-9-11-11 (N, P_2O_5, K_2O, S) starter fertilizer at planting.

The bulk of the applied N was utilized or lost within 6 weeks after application (Table 1). The rate of reduction of applied N was greater when N was applied 5 weeks after planting rather than at planting (Table 2). Larger plants with more extensive root systems were able to extract N from the soil at a greater rate. In-row subsoiling at planting did not affect the reduction rate of applied N (Table 2). Nitrification inhibitors did not increase N availability (data not shown).

Early season plant height was affected by time of N application and planting tillage methods (Table 3), but not by N source or method of application. Nitrogen applied 5 weeks after planting with in-row subsoiling produced the largest plants. Delaying N application to plants planted without in-row subsoiling was detrimental to early season plant growth although yields were not reduced at harvest.

Highest yields were obtained with in-row subsoiling at planting and applying N 5 weeks after planting (Table 3). Yields were lower when urea was applied surface-band without subsoiling, or when ammonium nitrate was applied with or without subsoiling (Table 4). Applications involving subsoiling and urea resulted in the best yields.

The first year's results indicate no benefit to subsoiling the middle if in-row subsoiling was done at planting; however, if corn were planted no-till without in-row subsoiling, subsoiling the middle 5 weeks after planting improved yields. Data also suggest that urea was as effective an N source as ammonium nitrate and that maximum effectiveness was obtained by applying nitrogen 5 weeks after planting with in-row subsoiling at planting time.

Table 1. Concentration over time of soil NH_4^+, NO_3^-, and total inorganic N (0 to 20-inch sample depth) in a Norfolk loamy sand fertilized with 140 lb./acre nitrogen 1/

Weeks after application	NH_4	NO_3	Total inorganic N
	----------------------------	ppm	----------------------------
3	80	36	116
6	30	37	68
9	26	25	52
check 2/	36	28	64

1/ Values are averaged over all N application times, methods, sources, and planting tillage treatments.

2/ Check values are from samples taken 3 weeks after application of 20 lb./acre starter nitrogen only.

Table 2. Change in concentration over time of soil N (0 to 20-inch sample depth) as influenced by time of application and planting tillage treatments 1/

Time of application and tillage treatments	Weeks after application	Total inorganic N
		(ppm)
N at planting	3	102
	6	98
	9	80
Sidedress N applied 5 weeks after planting no-till plus in-row subsoiling	3	126
	6	49
	9	38
Sidedress N applied 5 weeks after planting no-till without in-row subsoiling	3	121
	6	57
	9	31

1/ Values are averaged over all N source and application methods listed in Table 4.

Table 3. Influence of time of application and planting tillage treatments on plant height 7 weeks after planting, and on grain yield of no-till corn[1]/

Treatment	Plant height	Grain yield
	(inches)	(bu./acre)
N at planting	10.3	98
Sidedress N applied 5 weeks after planting no-till plus in-row subsoiling	13.4	128
Sidedress N applied 5 weeks after planting no-till without in-row subsoiling	6.5	99

1/ Values are averaged over all N source and application methods listed in Table 4.

Table 4. Influence of N source and method of application on corn grain yield 1/

N source, application method	Grain yield
	(bu./acre)
Subsoiled and surface-banded NH_4NO_3	94
Subsoiled and surface-banded urea	125
subsoiled, NH_4NO_3 applied in subsoil track	103
Subsoiled, urea applied in subsoil track	112
Subsoiled, urea + DCD in subsoil track	123
Not subsoiled, surface-banded NH_4NO_3	104
Not subsoiled, surface-banded urea	95

1/ Values are averaged over N applied at planting with and without in-row subsoiling, and N applied 5 weeks after planting with and without in-row subsoiling.

EFFECT OF N AND K FERTILLZATIOR ON THE YIELD OF A MAIZE-TOMATO SEQUENTIAL CROPPING SYSTEM IN NICARAGUA.

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Introduction

In Matagalpa, Nicaragua the most common cropping system practiced by farmers is maize (Zea mays L) followed by bean (Phaseolous vulgaris L) in sequence, this system generates little income. Previous research carried out by CATIE (1, 21, has demonstrated the feasibility of substituting tomato (Lycopersicum sculentum L.) for beans, which has resulted in a significant increase in farmer's income.

Research conducted in Matagalpa by CATIE in 1980, and 1981 (1, 2) determined that one of the most critical factors affecting tomato yields in the area was the amount of N available. The objective of this research was to develope a fertilizer program for a maize–tomato relay system under minimum tillage management.

Materials and Methods

Five N rates (0, 60, 120, 180, and 240 kg/ha) and two K rates (60 and 90 kg/ha) were compared, during the 1982 growing season. The experiment was conducted at three sites under a completely randomized block design with four replications at each site. The experimental plot consisted of four rows 5 m long and 0.8 m wide, all measurements were taken in the two central rows.

On June 1, 1982, maize (cultivar "NB-3") was planted under conventional tillage (three passes with an Egyptian wooden plow), leaving two plants every 0.5 m. At planting, all maize plots were fertilized with 132 kg/ha of the formula 17-45-2 (N-P-K, respectively) and 25 days after planting side dressed with 98 kg/ha of urea.

On September 13, tomato plants (cultivar "Tropic") were transplanted within the rows of corn, leaving one plant every 0.50 m (at the midpoint between maize hills). Corn plants were completely defoliated *15* days after tomatoes were transplanted. The N fertilization program for the tomato was as follows: one half of the amounts of N, and all the P and K were applied at the time of tranplant; except for the 60 kg N/ha where all the N was applied at transplant. Thirty days after transplant the N rates were completed by side dressing.

Make plots were kept free of weeds with post-directed applications of Paraquat (1 or 2 1/ha, depending on the site). Thirty days after the tomato plants were transplanted the field was covered with an application of 0.5 kg/ha of Sencor product (Metrabuzin). Diseases and insects were controlled with alternate applications of labeled rates of Metamidophos, Decamethrine, Chlorothalonil, and Propineb.

Results and Discussion

Maize

In all three sites there were no differences between maize treatments for number of plants per plot, number of ears, and number of damaged ears. Differences in sites 1 and 3 were found between treatments For yield, none were found in site 2 (table 1). The lowest (4940 kg/ha) and highest (7557 kg/ha) corn grain yield were observed at sites 2 and 1, respectively. Both of these yields are well above the area's average for farmer's (1900 kg/ha) that has been reported in the literature (2).

Tomato

In site 1, statistical differences (p=O.01) were found between N treatments for number of plants at harvest, number of fruits, number of healthy fruits, and yield (Table 2). The highest yields (21,688 kg/ha) were obtained with 180-60-90 kg/ha of N–P–K. Comparing K rates, no differences (p=0.0l) were found between 60 and 90 kg K/ha (Table 3).

Site 2 was severely affected by dry period 35 days after planting, causing a reduction in yield in comparison to site one (Table 3). The highest yields (13,405 kg/ha) were obtained with 240 kg N/ha, but there was no difference between this treatment and 180 kg N/ha. As in site 1, K did not affect yield (Table 3).

Site 3 was also severely affected by drought, this may have prevented any treatment effects. Nevertheless, the results follow a similar trend as those observed in sites 1 and 2 (Tables 2 and 3). The highest yields (16,531 kg/ha) were obtained with 240 kg N/ha. Again, as in the other two sites K did not affect yield (Table 3).

The results in all three sites indicate a tendency for increases in number of fruits and yield (Tables 2 and 3) as the rate of Y increased. It is also apparent that the point of diminishing returns is located somewhere between 180 and 240 kg N/ha.

A partial analysis of costs indicated that costs increased as €ertifizer sates increased. In sites 1 and 3 the highest net income per hectare was obtained with 180 kg N/ha, and in site 2 with 240 kg N/ha. A similar tendency was observed for the benefit/cost ratio, cash return per dollar invested in fertilizers and pesticides, and cash return per hour of labor input.

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TABLE 1. Corn Grain Yield in a Maize–Tomato Sequential Cropping System in Yatagalpa, Nicaragua, 1982.

PLOT NO	TKEATNENT N-P-K	CORN GRAIN SITE 1	SITE 2	SITE 3
		kg/ha		
1	60–60–0	6524 ah *	5069 a	6158 ah
2	60-60-0	6111 b	5914 a	5911 ab
3	60–60–0	7093 ab	4947 a	5325 a
4	60-60-0	6649 ab	6164 a	5847 ab
5	60-60-0	7156 ab	4940 a	5447 ba
6	60–60–0	6509 ab	6840 a	5436 ab
7	60-60-0	7557 a	6952 a	6533 a
3	60–60–0	6989 ab	5744 a	5515 ab
9	60–60–0	6992 ab	4976 a	5859 ab

* Values within a column followed by the same letter are not statistically different.

TABLE 2. Effect of N and K Rates on the Aeronomic Traits of Tomato in a Maize-Tomato Sequential Cropping System. Matagalpa, Nicaragua, 1982.

PLOT NO	TREATYENT N–P–K	POPULATION * Plants/ha	DAMAGED Fruits/ha	# FRUITS* Fruits/ha
1	0-0-0	16875 b **	5000 d	77625 e
2	60-60-60	20750 a	12250 ab	116000 abc
3	60-60-90	20500 a	10000 abc	196875 bcd
4	120–60–60	19750 ab	7625 bcd	92125 cde
5	120-60-90	19500 bc	5500 cd	85625 de
5	180-60-60	29875 a	10875 ah	123250 ah
7	130–65–60	21375 a	13625 a	134000 ab
8	240-60-60	20375 a	9125 abcd	133000 ab
9	240-60-90	20250 a	13875 a	137750 a

* Average of three sites
** Values within a column followed by the sane letter are not statistically different

TABLE 3. EFFECT OF N AND K RATES ON TOMATO YIELD IN THREE SITES IN MATAGALPA, NICARAGUA, 1982.

PLOT No	TREATMENT N-P-K	YIELD SITE 1	SITE 2	SITE 3
		kg/ha		
1	0-0-0	8219 c*	5188 c	10609 a
2	60-60-60	14250 bc	10313 ab	11313 a
3	60-60-90	12573 bc	7750 bc	12047 a
4	120-60-60	10484 c	3734 abc	10484 a
5	120-60-90	9453 c	7094 bc	11140 a
6	180-60-60	16563 ab	10953 ab	13500 a
7	180-60-90	21688 a	9609 abc	15031 a
8	240-60-60	17719 ab	11094 ab	16531 a
9	240-60-90	15656 ab	13406 a	14719 a

* Values within a column followed by the same letter are not statistically different.

YIELD OF IRRIGATED CORN DOUBLE CROPPED WITH SOYBEANS IN RELATION TO PHOSPHORUS FERTILIZATION

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Prior research on soil test interpretation has involved unirrigated crops, in most cases (2). Thus, more information is needed to determine the maximum level of phosphorus (PI required for high yields of corn under irrigation. When maximum P requirements are established, response models can be used to estimate the maximum economic levels of P fertilization for a given selling price of corn and cost of fertilizer P. Simplification of yield response models of corn to P can be accomplished by combining soil test P with fertilizer P added and defining the value as "P fertilization level".

There are three concepts of soil testing: a) cation saturation ratio, b) nutrient maintenance and c) nutrient sufficiency level (4). The nutrient sufficiency concept holds the greatest promise for providing maximum economic yields. Regular surveillance is required to keep the soil above the sufficiency level.

The nutrient sufficiency level varies with soil group, crop species, and perhaps even varieties of the same species. A fertility index is used by Alabama researchers to rate the nutrient level of each group of soils for each crop (2). The fertility index is defined as the per cent of sufficiency and is based on the relative yield of the crop. Thomas and Peaslee (5) present a generalized rating for soil test P with the double acid extractant in ppm-P: low 0-16, medium 17-37, and high >38 (ppm x 2.24 = kg/ha). These ratings correspond to fertility index ranges of 60-70, 80-100, and 110-200, respectively, from Cope and Rouse (2).

Ellington (3) summarized research data on crop response to P. A soil in Virginia, testing in the medium range of extractable P, produced 117 bu of corn/A (7338 kg/ha) with no fertilizer P and 142 bu/A (8906 kg/ha) with 120 lb-P_2O_5 /A (60 kg-P/ha). Another soil, testing 11 lb-P/A (12 kg-P/ha), produced 73 bu of corn/A (4579 kg/ha) with no fertilizer P and 149 bu/A (9345 kg/ha) with 82 lb-P/A (92 kg/ha) added as fertilizer. Irrigation was not mentioned in his report.

A statistical procedure is described by Cate and Nelson (1) for dividing soil test correlation data into two groups. One group has a high probability of response to the nutrient in question and the other a low probability of response. The dividing line between the two groups is referred to as the critical level of the nutrient being tested. A simple iterative process is used to obtain a series of R^2 values for divisions made at various 1 vels of soil test P. The critical level of soil test P is that where R^2 is maximum and this should be close to the 100% sufficiency level.

The objectives of this research were: a) to observe the relationship between grain yield of irrigated corn, double cropped with soybeans, and soil test P plus fertilizer P (P fertilization level), b) determine critical P fertilization levels (PFL) of two hybrids of irrigated corn in different years and c) calculate maximum economic PFL for irrigated corn.

METHODS

Four phosphorus (P) fertilization treatments were applied to irrigated corn during 1980-1983. Soybeans were planted in July following corn harvest each year, except 1983. Treatments were located on the same plots each year. Annual P application rates were 0, 30, 60 and 120 kg/ha. Potassium (K) was applied to all plots at the rate of 420 kg-K/ha each year. Method of application for P and K was broadcast and incorporated before planting. Magnesium sulfate was applied to supply 67-kg-Mg/ha and 90 kg-S/ha each year. Zinc sulfate supplied 9 kg-Zn/ha annually. Calcitic limestone was applied when needed to maintain soil pH above 6.0. All fertilizer was applied to the corn, whereas soybeans were produced with the residual.

Pioneer brand '3369A' was planted 17 March 1980 and 10 March 1981. Ring Around brand 'RA1604' was planted 17 February 1982 and 5 April 1983. Plant population was 86,450 plants/ha with row widths of 20 cm and 71 cm in an alternating pattern.

Total annual application of N was 336 kg/ha applied as follows: 84 kg-N/ha, per application, at emergence, 4, 6 and 8 weeks after emergence. Boron was applied at the rate of 2.25 kg-B/ha.

Soil type was Ruston loamy fine sand, thick surface, (fine loamy siliceous, thermic, Typic Paleudult). Conventional tillage methods were used for corn production in order to incorporate the broadcast P and K, while soybeans were grown with minimum tillage procedures. Soil samples were taken each February and analyzed for pH and double acid extractable P. Sprinkler irrigation was applied to recharge the plow layer when soil water suction reached 20 cb as measured at the 15 cm depth with tensiometers.

The experimental design was a randomized block with four replications. Regression analyses of yield versus PFL were run for individual years using the response model Y = A + B log PFL, where Y = yield in kg/ha. Values for PFL were divided into two groups according to relative yield to give one group with a low probability of response to additional fertilizer P and one with a high probability of response. The Cate-Nelson procedure was used to determine the group boundary which is referred to as the critical PFL (1).

Maximum economic PFL's were calculatd from individual years for corn prices of $2.00 and $3.00 per bushel (approx. $0.08 and $0.12 per kg) and a price of $0.57/lb of P ($1.25/kg). When the product of the first derivative of the regression equation referred to above and the ratio of corn price to P cost equals one, maximum economic PFL occurs. If the value is above one, maximum economic PFL has not been reached, if below one, it has been exceeded.

RESULTS AND DISCUSSION

Yield, expressed in terms of treatment means, had the largest difference between highest and lowest in 1982 (Table 1). The range was 8,028 kg/ha (130 bu/A) to 13,861 kg/ha (221 bu/A), these were also the highest and lowest yields for the duration of the experiment. Overall average yields were higher in 1982-83 than in 1980-81. The correlation between yield and PFL was significant in 1980 ($P = 0.05$), 1981 ($P = 0.01$) and 1983 ($P = 0.01$) but it was not significant ($P = 0.05$) in 1982.

Table-1. Yield of irrigated corn with four levels of applied P for two hybrids during 1980-83.

Applied P	Hybrid: Pioneer 3369A 1980	Pioneer 3369A 1981	RA 1604 1982	RA 1604 1983
	kg/ha[1/]			
0	9,722	8,530	8,028	9,345
30	10,913	10,600	12,293	9,220
60	10,851	11,039	13,861	12,293
120	11,478	11,666	13,736	12,858

1/Average of four replications.

The critical PFL's as determined by the Cate-Nelson (1) procedure were 21 kg-P/ha in 1980, 36 in 1981, 119 in 1982 and 85 in 1983. Since both hybrids were not grown the same year, I am not sure that the large differences between years were due to hybrids.

Maximum economic PFL's for the price of corn at $0.08/kg ($2.00/bu) were 50 kg-P/ha in 1980, 125 in 1981, 150 in 1982, and 100 in 1983. With the price of corn at $0.12/kg ($3.00/bu), maximum economic PFL's were 100 kg-P/ha in 1980, 200 in 1981, 225 in 1982 and 175 in 1983.

The range in critical PFL was much greater than the range in maximum economic PFL on a relative basis. There was almost a fivefold increase from lowest to highest critical PFL, while the maximum economic PFL increased twofold at $0.08/kg for corn and 1.25-fold at $0.12/kg.

Critical PFL's for 1980-81 were in the low range of the generalized rating system of Thomas and Peaslee (5). However, critical PFL's in 1982 and 1983 were in the high and medium ranges, respectively.

Soil test levels of P for the treatment that received the annual application of 120 kg-P/ha increased substantially after the first application and slight increases were observed each year thereafter (Table 2). Phosphorus soil test levels for the other three treatments showed increases in 1981 and 1982 with substantial decreases occurring in 1983. The 30 and 60 kg-P/ha application rates had about the same level of soil test P in

1983 as in 1981. Plots that received no P fertilizer had mean soil test levels that were identical in 1980 and 1983.

Table-2. Soil test levels of P sampled in February of each year before fertilizer was applied to irrigated corn.

Applied P	Year 1980	1981	1982	1983
		kg/ha[a]		
0	23	40	62	23
30	27	44	73	41
60	33	54	97	53
120	18	98	107	112

[a] Average of four replications.

Hydrogen ions in the double acid extractant greatly increase the solubility of all calcium phosphates and the sulfate ions seem to prevent readsorption of phosphate removed by other ions (5). Soil pH at sampling was between 5.0 and 5.5 in 1980 and 1983, while in 1981 and 1982 it was between 6.0 and 6.3 Soil P shifts from Ca-P to Al-P and Fe-P, which are less soluble than Ca-P, as pH decreases. This is a possible explanation for the higher soil test P levels in 1981 and 1982.

Acknowledgement

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WEED CONTROL IN NO-TILLAGE TROPICAL CORN

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Tropical field corn (Zea mays), because of its heat tolerance and disease resistance, is adapted to summer planting in Central and South Florida. It can be grown as a second crop following a spring planting of vegetables or field corn and brought to maturity during the fall for either forage or grain. Other early and full season types can only be grown in the spring to give a satisfactory crop.

In order to evaluate weed control programs for no-tillage tropical corn, the cultivar Pioneer 304C was planted on the Research Center farm on July 21, 1983. The soil, Imokalee fine sand, is a Arenic Haplaquod, with a shallow hardpan at approximately 24 inches. The experiment was designed as a factorial, with four contact post-emergent herbicide treatments to kill existing growth, four pre-emergent herbicide treatments to inhibit further weed development, and four replications. This comprised a total of 64 plots, each with six rows 35 feet in length. Of the four replications, two were on land with a heavy growth of annual weeds, primarily large crabgrass (Digitaria sanguinalis), narrowleaf signalgrass (Brachiaria piligera), and goosegrass (Elusine indica). The field had been used for vegetables during the winter of 1982-83 followed by spring fallow. The other two replications were planted on an adjacent field which had produced soybeans in 1981 followed by fallow in 1982 and the spring of 1983. By the summer of 1983, it was uniformly covered with a bermudagrass (Cynodon dactylon) sod with a few large weeds such as dogfennel (Eupatorium capillifolium).

The experiment was planted with a Buffalo Model 4570-H, 2-row All-Flex Till-Planter, supplied by Dr. R. N. Gallaher of the Agronomy Department, courtesy of the Fleischer Manufacturing Co., Inc. of Columbus, Nebraska. This planter has a front coulter, a slot-shoe opener, covering wheels, and a rear tine incorporator. Using 30 inch row spacing, a 24-cell plate, and sprockets to give a spacing in the row of 8.4 inches, 24,900 seed per acre were planted. Although herbicide spray and granule application equipment were attached, the weed control chemicals were applied with a separate small plot sprayer to permit uniform planting. The herbicides for each treatment were tank-mixed and applied in water at 60 gallons per acre, with full broadcast coverage.

To kill existing broadleaved weeds and grasses, the treatments were paraquat at two rates, 3/8 and 3/4 pound ai/acre, and glyphosate at two rates, 1 1/2 and 3 pounds. Ortho X-77 was added at 1/82 of the final volume to all paraquat treatments. The preemergence herbicides were alachlor and metolachlor, each used at both 2 pound and 3 pound rates, providing a total of 16 treatments. Additional broadleaf weed control was obtained with atrazine at 1 pound ai/acre, tank-mixed with the other treatment chemicals for all plots.

The crop was grown without any preparatory tillage or cultivation. One insecticide application was made for budworm control and the crop was irrigated twice, applying 1 inch of water each time by overhead sprinklers.

Weed control data were recorded on August 9. There was adequate control in all plots of broadleaf weeds. Grass control was rated on a scale of 0 to 10, with 10 indicating complete grass elimination. Individual grass species were not rated separately since there appeared to be little difference in the composition of the species in the various plots, except in those replications where bermudagrass predominated.

The ears were harvested on November 9. Yields are expressed as shelled grain at 15.5% moisture.

Summary data on weed control and corn grain yields are given in Tables 1 through 4. Although paraquat gave a rapid burn-down of the weeds, regrowth was evident within two weeks. Glyphosate was much more effective throughout the whole crop growing season. This was also reflected in corn yields. There was no significant effect of chemical rate with any of the herbicides. Alachlor and metolachlor, in combination with atrazine, were equally effective in controlling annual weed regrowth. A significant difference in weed control and crop yield was evident between the two field areas. Regrowth of the bermudagrass depressed corn yield to a lower level than was obtained where annual weeds were present at planting time.

Table 1. Effect of paraquat and glyphosate applied at planting on control of established grasses in no-till tropical corn.

Post-emergence herbicide	Chemical rate ai/acre	Weed control rating	Mean
	-----lb-----	----0-10----	
Paraquat	3/8	6.6	6.9
	3/4	7.1	
Glyphosate	1 1/2	8.7	9.0
	3	9.3	
LSD (0.05)		---	1.0
(0.01)		---	1.4

Table 2. Effect of alachlor and metolachlor applied at planting on subsequent growth of weeds in no-till tropical corn.

Pre-emergence herbicide	Herbicide mean	Rate effect 2 lb.	Rate effect 3 lb.	Interaction with post-E herbicides Paraquat	Interaction with post-E herbicides Glyphosate
	------------------------0-10			rating------------------------	
Alachlor	7.8	7.9	7.8	6.7	9.0
Metolachlor	8.0	7.9	8.0	7.0	9.0
Significance		N.S.	N.S.	N.S.	N.S.

Table 3. Comparison of weed control in annual weed field with that observed in bermudagrass sod planted to no-till tropical corn.

Post-emergence herbicide	Field: Annual weeds	Field: Bermudagrass sod	Mean
	-------------------0-10	rating-------------------	
Paraquat	6.5	7.2	6.9
Glyphosate	9.4	8.6	9.0
Mean	7.9	7.9	
LSD (0.05)	1.0		
(0.01)	1.4		

Table 4. Mean yields of tropical corn observed in no-till trial, comparing several experimental factors.

Comparison	kg/ha	bu/acre
Paraquat	5750	91.7
Glyphosate	6202	98.9
LSD (0.05)	N.S.	N.S.
(0.01)	455	7.3
Alachlor	5987	95.5
Metolachlor	5965	95.2
LSD (0.05)	N.S.	N.S.
Annual weed field	6278	100.1
Bermudagrass field	5674	90.5
LSD (0.05)	455	7.3
(0.01)	N.S.	N.S.

MINIMUM TILLAGE FOR CORN IN CENTRAL FLORIDA

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Interest in the minimum tillage concept in Florida has grown in recent years as a result of concern for energy saving economy and soil conservation. New techniques, materials, and equipment have given added impetus for further research and utilization of minimum tillage.

The objective of this study was to test the effects of minimum tillage planting and cultural practices versus conventional practices on field corn on old vegetable land in central Florida.

Materials and Methods

Corn (Zea mays, L.) was planted and grown under four different tillage treatments. The experiment was conducted at the University of Florida's Central Florida Research and Education Center at Sanford, Florida. on St. Johns fine sand (a Typic Haplaquod). The area used was in an old field adjacent to the center's farm on land which had lain idle for a number of years, but had been in soybeans in 1979. Soil test values were as follows:

pH	Extractable nutrients[1] Ca	Mg	P	K
	ppm			
5.7	580	59	24	21

[1]Mehlich I Extractant (0.05 N HC1 in 0.025 N H_2SO_4) average of 4 replicates.

By the April 1980 planting date, a partial cover of broadleaf weeds had developed in the soybean stubble. Predominant were ragweed (Ambrosia artemesifolia) and dogfennel (Eupatorium capillifolium).

Tillage and cultural details are given in Table 1. The conventional tillage plots were given a light cultivation after side-dressing. No irrigation was applied. Corn was harvested July 15, 1980, and yields calculated at 15.5% moisture.

Results and Discussion

Fuel requirements for tillage operations are given in Table 2 and time requirements in Table 3. In both fuel used and time, the no tillage treatments were the most economical, giving considerable savings over conventional tillage. Corn grew well in all four treatments. Weed growth was controlled sufficiently by the herbicide treatments and rainfall was enough to make the surface applied fertilizer available to the corn. Soil cover in the no-till treatments was maintained for protection against soil erosion.

Yield differences (see Table 4) did not prove statistically significant, but the overall average of 96.6 bu/A was considered creditable for the conditions of this trial. The subsoiling treatments appeared to be advantageous even on the sandy soil where this trial was conducted.

Summary and Conclusions

Results of this one season's trials are very encouraging. A considerable saving of tractor fuel and time in the field was gained by the no-till or minimum tillage treatments and yields were comparable to conventional cultural practices. The no-till or minimum tillage concept appears well adapted for this area and should come into wider usage.

Table 1. Minimum Tillage Corn, Treatment Description, and Cultural Details, Sanford, FL 1980.

Treatments

1. No-tillage, coulter-slot planting
2. No-tillage plus in-row subsoiling
3. Conventional tillage (harrow, plow, harrow)
4. Conventional tillage plus in-row subsoiling

Cultivar: Funk G 4507

Planting date: April 1, 1980 Harvest July 15, 1980

Plot size: 40 X 57.5' or .053 acre

Fertilization:	At planting	425 lb/A	10-4-10	April 1, 1980
	1st side dress	500 "	"	" 22, 1980
	2nd " "	1000 "	"	May 6, 1980

Nematicides: carbofuran (Furadan) 10 G 20 lb/A

Herbicides: paraquat 0.375 lb ai/A, atrazine 2 lb ai/A
Ortho X-77 1 pt/100 gal water, metolachlor (Dual) 2 lb ai/A

Table 2. Fuel Requirements, Minimum Tillage Trial at Sanford, FL 1980.

Treatment	Operation[1] Harrow	Plow	Harrow	Plant	Total
	gal/acre[2]				
No-tillage	--	--	--	0.70	0.70
No-tillage + in-row subsoil	--	--	--	1.39	1.39
Conventional tillage	0.70	1.54	0.68	0.80	3.72
Conventional tillage + in-row subsoil	0.70	1.54	0.68	1.34	4.26

[1]Ford 4600 tractor for all except plowing; plowed with Ford 5600.

[2]Average of 3 replicates.

Table 3. Time Required for Tillage and Planting, Sanford, FL 1980.

Treatment	Operation[1]				
	Harrow	Plow	Harrow	Plant	Total
	----------hours/acre[2]----------				
No-tillage	--	--	--	0.39	0.39
No-tillage, in-row subsoil	--	--	--	0.50	0.50
Conventional tillage	0.28	0.63	0.27	0.40	1.58
Conventional tillage + in-row subsoil	0.28	0.63	0.27	0.52	1.70

'Ford 4600 tractor **for** all except plowing; plowed with Ford 5600.
[2]Average of 3 reps.

Table 4. Corn Yields, Minimum Tillage Trial, Sanford, FL 1980.

Tillage treatment	Corn yields[1] bu/A @ 15.5% moisture	
No-till	82.9	
No-till + subsoil	103.4	No **till** average: 93.2
Conventional	92.0	
Conventional + subsoil	108.2	Conventional average: 100.1
LSD 0.05	NS	
Overall average	96.6	

'Average of 4 replicates.

EFFECT OF PLANTING DATES OF NO-TILL AND CONVENTIONAL CORN ON SOILS WITH RESTRICTED DRAINAGE

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No-tillage corn is best adapted to well-drained soils. It is on these soils that no-tillage has been most successful and the practice is most widely accepted. On soils that are moderately to somewhat poorly drained, no-tillage corn is successful but more management is required. Three areas which require more attention are weed control, nitrogen management and planting. A four to five day delay in planting date is presently recommended in Kentucky on well-drained soils to allow the cooler soils under no-till conditions to warm sufficiently. It has been recognized for years that development of young corn seedlings is retarded by low temperatures (Blacklow, 1972) and that soil temperatures are usually lower under no-tillage than conventional tillage (Blevins and Cook, 1970; Burrows and Larson, 1962). Willis and Amemiya (1973) showed that optimum average soil temperature for corn seedlings is 72^{0} F. Results of studies in Virginia (Moody et al., 1963) shows a faster rate of overall development of corn for no-tillage and they attributed this to increased mid-season soil moisture on the mulched plots. Additional research indicates that there are diseases that attack the corn seedling in the emergence stage that are more prevalent in no-till stands (Van Doren, et al., 1975). These diseases are most common when the soil is saturated and causes the most damage when the soil is cool resulting in a slow growing seedling and stress conditions.

It is well known that delaying planting past an optimum planting period often depresses corn yields (Hatfield, et al., 1965; Pendleton and Egli, 1969). After observing the problem in experiments and on farmer's fields in Kentucky with early no-till plantings on soils with restricted drainage, it was postulated that delayed plantings might improve no-till stands and yields. Another concern is whether delayed planting dates on no-till would result in depressed yield as it does in conventional tillage. The objectives of this study were to evaluate the effects of planting dates on no-till and conventionally tilled corn on soils with restricted drainage.

METHODS

A field experiment was established in the spring of 1979 at the Kentucky Agricultural Experiment Station, West Kentucky Research and Education Center, Princeton. The study site is a transitional area of moderately well-drained Tilsit silt loam (Typic Fragiudults) and somewhat poorly drained Johnsburg silt loam (Aquic Fragiudults). Both soils are underlain with a fragipan ranging from 18 inches to 28 inches below the soil surface. Corn (Zea mays L., 'Pioneer 3369A') was planted by no-till methods in early May, mid-May and early June (Table 1) at approximately 22,000 seeds per acre. The mulch on the no-till corn was corn residue and a wheat cover crop established each fall. The corn residue and wheat cover crop was turn-plowed before planting for the conventional tillage treatment followed by two to three disking operations to prepare a seedbed. All treatments received Furadan (carbofuran) at 20 lbs. of material/acre in the row. At planting time all treatments were sprayed with 2 lbs. of atrazine, 3 qts. of alachlor and 2 pints of paraquat per acre. The research plot design was a randomized complete block with four replications.

TABLE 1. PLANTING DATES BY YEAR (1979-82)

Planting Date	1979	1980	1981	1982
1	++	Apr 25	May 2	Apr 28
2	May 17	May 12	May 28	May 12
3	June 19	June 6	June 13	June 9

++ Not planted due to excessive wetness

RESULTS

Effect on Yield. Corn yields and stands are given in Table 2 and rainfall and air temperatures data is not included due to space limitations but are noted in the text. The summary at the bottom of Table 2 only includes the last 3 years of the experiment since the first planting date was not planted in 1979 due to excessive wetness. Over the 4 years, no-till yields were higher than conventional yields for the second and third planting dates and equal to them on the early May planting date. During the wetter years (1979 and 1981) conventionally tilled corn yields were comparable to or higher than those from no-till. However, no-till corn yields were considerably better during the dryer years (1980 and 1982). Conventional yields decreased consistently and dramatically with each delay in planting date. May 1 is usually about as early as conventionally tilled corn can be planted on these soils due to wetness. It is felt that the conventional yields decreased with time due to increasing moisture stress that develops in mid and late season. The no-till yields decreased only on the last planting date and the mid-May planting was a little better than the early May planting.

The increased soil moisture available in the no-till plantings was probably responsible for the higher yields at later planting dates. The delayed planting date of mid-May (about 2 weeks later than the optimum date for conventional tillage) appeared to be the optimum planting date of no-till. Evidentally, this date allowed the soil temperature to warm sufficiently to produce a vigorous growing seedling and reduced the chances of encountering excessively wet conditions. The second planting date was the best for 2 of the 3 years when all planting dates could be compared. The exception was 1981 when extremely high amounts of moisture fell during the germination and emergence period.

It is quite interesting to note how well the no-till yields held up with the later planting dates. The yield decreases between early May and early June were much greater for the conventional than the no-till plantings. The no-till yields from the early June plantings were just as good as the conventional mid–May plantings, and the no-till mid–May plantings are better than the conventional early May plantings. This indicates that the planting dates for no-till on these soils are not nearly as critical as conventional plantings and that no-till would be the preferred planting method during years of late planting.

Effect on Stand. Final plant populations were generally lower for no-till corn than conventional, but the differences were not great. Stands were always greater with conventional planting for the last planting date. The comparison varied for the first two planting dates. During the wetter years (1979 and 1981) the conventional stands were better. The no-till stands were better during the dryer years (1980 and 1982). Final stands were not closely related to final yields.

TABLE 2. EFFECT OF TILLAGE AND PLANTING DATE ON CORN YIELDS AND STANDS

Planting Date	Corn Yield (bu/a) Tillage CT	NT	Plants/acre (x1000) Tillage CT	NT
		1979		
1	-	-	-	-
2	134	104	18.4	16.0
3	133	127	21.8	20.1
		1980		
1	87	91	19.9	20.0
2	57	104	20.1	22.0
3	44	63	21.3	19.9
		1981		
1	150	134	17.4	16.0
2	100	112	13.9	13.8
3	112	128	19.5	17.6
		1982		
1	127	143	19.8	19.2
2	123	175	18.3	19.4
3	42	90	18.9	16.1
		SUMMARY (1980-82)		
1	121	121	19.0	18.3
2	91	130	17.4	18.4
3	68	94	20.0	17.9

CT - Conventional Tillage NT - No-tillage

SUMMARY AND CONCLUSIONS

1. Although it varies with the year, no-till planted corn will yield as well as or better than conventionally planted corn on moderately to somewhat poorly drained soils. No-till performed better during dryer years and conventional tillage performed better during wetter years.

2. Planting dates are not as critical on these soils for no-till as they are for conventional plantings. Yields from conventional plantings decreased rapidly with each planting date after early May. The yields for the no-till planting actually increased as the planting date progressed from early to mid-May and decreased more slowly after that time.

3. It appears that the optimum planting date on these soils for no-till is about 2 weeks later than that for conventional tillage. The optimum planting date was early May for conventional tillage and mid-May for no-till.

4. No-till planting is clearly superior to conventional methods for delayed planting dates. The no-till yields from the early June planting are as good as the conventional mid-May plantings and the no-till mid-May plantings are better than the conventional early May plantings.

5. It appears that the planting date for no-till corn on these soils can be delayed to improve the chances of better stands and yields.

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COTTON PRODUCTION PRACTICES

FULL SEASON AND DOUBLE CROPPED COTTON AS AFFECTED BY TILLAGE, STARTER FERTILIZER, IN-ROW SUBSOILING AND NEMATICIDE, 1-YEAR RESULTS

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This study is being conducted at the Monroeville Experiment Field on a Lucedale sandy loam soil. Wheat is used for a winter cover crop for both the full season and double cropped cotton, but the double cropped cotton is planted after wheat harvested for grain. Treatments consist of tillage (disk-plow-disk and no tillage), subsoiling (in-row 12 inches deep and no subsoiling), starter fertilizer (none and 100 lb./acre 22-20-3-3. N-P_2O_5-K_2O and nematicide (none and 1 lb./acre soilbrom, EDB). With the non-subsoil treatment, EDB is applied (9 inches deep) with anhydrous ammonia knives just prior to planting and starter fertilizer is applied 2 inches deep and 2 inches beside the seed (2 x 2) at planting. With the subsoil treatments, starter fertilizer and EDB are applied at planting; the EDB is applied at the bottom of the subsoil track and the starter fertilizer is dropped directly behind the subsoil shank and is probably mixed with the upper 10 inches of soil.

Initial soil pH was adequate and soil test P and K were high. Sidedress N was applied at a rate of 90 lb./acre. Recommended pesticides were used to control weeds and insects. The experimental area was not irrigated.

Results and Comments for 1983

Full Season Cotton

Early season growth was not affected by tillage or subsoiling, but was 77% greater when starter fertilizer was applied (Table 1). Applying EDB with the starter did not improve early season plant weights. Plant populations ranged from 22,000 to 46,000 plants per acre. The plant populations were not affected by tillage or starter fertilizers but were much lower for subsoiled than not subsoiled, and were also reduced by EDB in the non subsoiled plots. The primary effect of treatments on early season plant height was due to the starter fertilizer. The starter fertilizer increased the early season plant height 14% over the no starter treatments.

Table 1. Weight, population, and height of full season cotton 9 weeks after planting as affected by starter fertilizer, EDB, tillage and subsoiling.

Treatmept					Plant Height			
Starter[1]		Dry	Population[2]		Till		No Till	
fertilizer	EDB	weight	SS	NSS	SS	NSS	SS	NSS
	lb./acre	lb./acre	1000/acre		----------inches------------			
None	0	1130	22	46	29	26	28	28
Yes	0	1995	30	46	30	33	33	31
Yes	1	2030	30	33	29	32	31	31
LSD 10		470	9			4		

[1]Starter fertilizer was 100 lb./acre of 22-20-3-3.
[2]SS= subsoil and NSS= not subsoiled.

Seed cotton yields were affected by starter fertilizer, tillage, and subsoiling (Table 2). The starter fertilizer improved yields in each tillage and subsoiling system. Average yield increase due to the starter was 19% (300 lb./acre seed cotton). The 2 X 2 placed starter appeared to be as effective as the subsoil applied starter. No tillage resulted in 13% higher yields than conventional tillage, but in-row subsoiling did not improve yields within either tillage system.

Table 2. Seed cotton yield and percentage of cotton picked at first and second picking for full season cotton as affected by starter fertilizer, soil brome, tillage, and subsoiling.

starter[1]		Till		No-till		1st picking		2nd picking	
fertilizer	EDB	SS[2]	NSS	SS	NSS	Till	No-till	Till	No-till
	lb/A	--seed cotton, lb./acre				----------------%----------			
None	0	1530	1580	1480	1720	083	081	017	019
Yes	0	1710	1820	1990	2010	088	085	012	015
Yes	1	1580	1680	2040	2000	086	084	014	016
FLSD (0.12)				190		2.7		2.7	

[1]Starter fertilizer was 100 lb./acre of 22-20-3-3.
[2]SS= subsoiled and NSS= not subsoiled.

Double Cropped Cotton

Early season plant weights 6 weeks after planting were more than doubled by the starter fertilizer, and averaged 31% higher for the non subsoiled than subsoiled treatments (Table 3). Neither EDB nor tillage had an effect on plant weights. Plants were also 30% taller with than without the starter fertilizer. EDB plus starter resulted in taller plants than starter alone in the conventional till but not in the no-till system. No tillage resulted in taller plants only when EDB was not applied. Subsoiling did not affect plant height.

Table 3. Plant weight, population, and height of cotton planted after wheat harvest as affected by starter fertilizer, EDB, in-row subsoiling, and tillage.

Starter[1] fertilizer	EDB	Weight SS[2]	Weight NSS	Population Till SS	Population Till NSS	Population No-till SS	Population No-till NSS	Height Till	Height No-till
	lb./acre	lb./acre		--------1000/acre-----				----inches----	
None	0	140	107	56	58	77	44	12	14
Yes	0	230	320	62	59	53	60	15	20
Yes	1	230	360	51	58	60	65	19	19
FLSD (0.10)		70		16				3	

[1]Starter fertilizer was 100 lb./acre of 22-20-3-3.

[2]SS= subsoiled and NSS= not subsoiled.

Seed cotton yields (Table 4) in each tillage and subsoil system were increased by the starter fertilizer (26%, 468 lb./acre). The EDB increased yield above that obtain with the starter alone in both tillage systems (14%, 326 lb./acre) but only with the subsoil treatment. Nematode populations, however, were not high enough to be of practical importance. The only tillage effect on yields occurred within the subsoil system where no till plus starter alone and starter plus EDB resulted in higher yields than conventional tillage with starter and starter plus EDB. The highest yields occurred with no till subsoiled plus starter fertilizer (2700 lb./acre) and no till subsoiled plus starter and EDB (2920 lb./acre).

Table 4. Seed cotton yield, boll opening (15 October) 2 weeks prior to first picking, and percentage yield with first picking as affected by starter fertilizer, EDB, subsoiling, and tillage.

Starter fertilizer	EDB	Seed cotton yield Till SS	Seed cotton yield Till NS	Seed cotton yield No-till SS	Seed cotton yield No-till NS	Boll opening Till SS	Boll opening Till NS	Boll opening No-till SS	Boll opening No-till NS	1st picking SS	1st picking NS
	lb./acre	--------lb./acre------				------------%------------					
No	0	1700	1790	1780	1840	18	10	10	3	82	71
Yes	0	2070	1980	2700	2220	60	56	58	48	93	91
Yes	1	2500	2280	2920	2230	56	62	56	48	93	93
FLSD (0.10)		210								2	

Starter fertilizer had a tremendous effect on maturity (Table 4). Two weeks prior to the first picking, 58% of the bolls were opened when starter fertilizer was applied and only 10% when starter was not applied. This difference was reflected in percentage of cotton harvested at the first picking (77 and 92%) for the no starter and starter treatment, respectively. The EDB did not effect maturity. There was a tillage by subsoiling interacting effect on maturity. Two weeks prior to the first picking, the non-subsoiled, no-till cotton averaged 10% less boll openings than the other treatments.

EXPERIENCES FROM PLANTING COTTON IN VARIOUS COVER CROPS

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Introduction

Influence of three cover crops (wheat, vetch, and crimson clover) and no-cover conditions combined with three planting techniques and two cover kill schemes on cotton performance was investigated over a three-year period. Cotton population, plant height and spacing, yield, and soil temperature and moisture data are discussed. The influence of these factors is examined and some observations concerning cultural practices are made.

Experimental Procedure

Cotton was planted with three tillage-planter systems in four cover conditions: wheat, crimson clover, cahaba white vetch, and no cover (check plot). The first tillage-planter system consisted of a modified John Deere max-emerge planter which had a coulter and clearing disks preceding the planter units. The clearing disks were adjusted to operate about 1/2 inch deep to remove heavy cover residue from the row (approximately 6 inches wide). The second system included the first but was preceded by a subsoiler that passed about 14 to 15 inches deep through the soil under the row. The third was a Kelley subsoil-planter implement.

A field of Norfolk sandy loam soil near Marvyn, AL, was separated into four blocks of wheat, vetch, clover, and bare soil conditions. These blocks were approximately an acre in size. Four rows for each tillage-planter system were planted and the three systems were randomized into four replicate subplots. Then the field was divided, with one-half being planted within the first week of May (early) while the other section was planted within the first week of June (late). About 10 to 14 day days preceding the early planting, the cover was killed with paraquat in strips (about 14 inches wide) over the intended row location. This design outlay was used in 1981, 1982, and 1983 except for new randomization within subplots. In 1983 an additional section of only two replications was added to the early planted section to study the influence of the time of cover kill. In the additional section the cover was strip killed twice; once about 4 weeks and then 2 weeks prior to planting. The cotton was seeded in 40-inch rows with 3-way treated DPL-41 at a seed rate of 8 seeds/foot of row. Two hundred and fifty pounds per acre of 8-24-24 was banded beside the row for all plots. The no-cover and wheat plots received an additional 200 pounds per ammonia nitrate (34-0-0). All plots were mechanically rototilled and chemically cultivated as needed.

The stand count, plant height, plant spacing, and handpicked yields were observed from a single 20-foot-length row within the four-row subplots. Four 65-foot-long (1/50 acre) rows were mechanically harvested with a John Deere two-row cotton picker from each subplot to determine cotton yields. In addition to observing cotton performance, the following environmental factors were measured: daily maximum and minimum temperatures, moisture contents of the soil beneath the cover conditions, daily air temperatures, and rainfall.

Results and Discussion

Over the last three years the wheat cover has equaled or significantly exceeded cotton yields of the no-cover condition (Table 1). Usually, the vetch cover out-yielded the clover. However, it has been a problem with both legume covers to obtain and retain a cotton stand. As shown in Tables 2 and 3, the percent stand reduction in the legume covers may be the primary reason for poor yields. The cotton height performance data showed that the legume covers appear to retard growth of the cotton which may also decrease yields. The date of planting had no consistent influence on the yields of cotton but may indirectly affect yield from available moisture during critical stages of cotton growth.

The soil moisture data indicate that the average moisture content with the cover crops was usually lower than no-cover but only by less than 1/2 percent (dry basis); thus it was not considered influential. However, in a period of severe drought, especially soon after stand establishment, the moisture lost from uptake of the cover may depress cotton yields in the vegetative cover conditions. The average daily soil temperatures under the vegetative covers were usually lower than bare soil, but as the soil warmed during the spring the covers tended to act as an insulation barrier if a short cold period occurred. The bare soil had larger fluctuations of soil temperature.

If the tillage-planter systems gave uniform stands, little difference occurred between the systems; however, it appeared more difficult to obtain a uniform stand with the Kelley subsoil-planter. The difference in yield between the subsoil and no subsoil treatments was smaller than expected (Table 4). The no subsoil plots (which were kept at the same location over the three-year period) had higher plant stands than the subsoil plots. It is suspected that this may have been due to poorer seeding depth control in the subsoil plots resulting in poorer emergence.

The wheat yields were 3306, 1481, and 1240 pounds per acre for 1981, 1982, and 1983, respectively. This gives some indication of the benefit of a double-crop system. The reduction in wheat yields due to strip killing and traffic may be substantial if early planting is used unless specialized equipment and techniques are developed. The legume crops are not utilized as a double-crop but would add beneficial nitrogen to the soil for primary crop uptake. Thus lower rates of nitrogen fertilizer were assumed needed for cotton production. The crimson clover aggressively reseeded itself; after the third year the clover had started moving into the two adjacent cover plots. The vetch was not as successful in reseeding and would need to be replanted after the second or third year of use.

Conclusions

1. Stand reductions were severe in the clover and vetch cover crops resulting in poor yields of cotton.

2. The wheat cover plots produced cotton yields equal to or higher than bare soil conditiosn.

3. Wheat yields were acceptable when the wheat was harvested prior to planting cotton in the stubble.

Table 1. Three-year average yields from mechanically picked cotton.

	Early --lb/ac--			Late --lb/ac--		
	1982	1983		1981	1982	1983
No Cover	1621ba@	1251b*	1364ab†	1402a	1618b	1473b
Wheat	2228a	1726a	1550a	1044ab	2015a	1727a
Vetch	1724b	1217b	1134c	808b	1607b	1312b
Clover	1505c	873c	1291bc	793b	959c	1040c

@ Means followed by the same letter in a column do not differ significantly at the 0.05 level.

* The cover was strip killed about 2 weeks before planting for all means in this column.

t The cover was strip killed twice, at 4 and 2 weeks before planting for all means in this column.

	Emergence 1982	Emergence 1983 (plants/foot)		Final Stand 1982	Final Stand 1983 (plants/foot)		Percent Reduction 1982	Percent Reduction 1983 (%-Emergence Base)	
No Cover	2.96	4.66*	5.02t	2.81	3.99*	4.41t	5.0	14.3*	12.lt
Wheat	2.95	4.39	4.71	2.21	3.72	4.02	24.9	15.3	14.6
Vetch	2.17	4.10	3.77	1.47	3.12	3.05	32.4	24.0	19.1
Clover	2.28	3.55	3.71	1.23	1.77	2.03	46.1	50.1	45.3

of the late planted plots - 20 feet long

	Emergence 1981	1982	1983	Final Stand 1981	1982	1983	Percent Reduction 1981	1982	1983
	plants/foot			plants/foot			%-Emergence Base		
No Cover	5.07	3.14	4.07	2.97	3.03	3.67	41.4	3.7	9.8
Wheat	3.77	3.37	2.68	2.14	3.24	2.44	43.2	3.8	9.0
Vetch	3.80	2.42	3.73	1,08	2.01	3.30	71.6	16.6	11.5
Clover	3.86	3.32	3.45	1.16	2.63	2.53	70.0	20.8	26.7

Table 4. Three-year average yields from mechanically picked cotton.

	Early -- lb/ac-- 1982	1983		Late -- lb/ac-- 1981	1982	1983
JD Max-Emerge	1686b@	1223a*	1414a†	957	1487a	1224b
JD Max E + Sub	1991a	1316a	1441a	1045	1548a	1498a
Kelley + Sub	1632b	1273a	1149a	1034	1614a	1455a

@ Means followed by the same letter in a column do not differ significantly at the 0.05 level.

* The cover was strip killed about 2 weeks before planting for all means in this column.

† The cover was strip killed twice, at 4 and 2 weeks before planting for all means in this column.

COVER CROP MANAGEMENT FOR MINIMUM-TILL COTTON

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Experiments were conducted from 1980 to 1983 at the Tennessee Valley Substation, Belle Mina, Ala., to evaluate various aspects of cover crop management in minimum-till cotton. Cover crops included crimson clover, hairy vetch, rye, add "no cover." Cover establishment methods included (1) aerial seeding (interseeding) in late September at cotton defoliation, and (2) drill seeding in early November after cotton harvest and shallow disking. No-cover treatments (with and without shallow disking) were also established in the fall in cotton stalk residue. Spring management of covers consisted of (1) disking for conventional seedbed preparation and planting, and (2) no-till planting directly into covers. A conventional-till comparison (fall moldboard plow, spring disk/smooth) was also included.

Early establishment via aerial seeding resulted in acceptable clover stands each year, however drilled clover planted 6 weeks later was unsuccessful in 2 of 3 years due to dry or cold weather. Both seeding methods resulted in satisfactory rye stands, but drilled vetch had to be replanted in February of the initial year. Dry matter production, regardless of species, was greater following aerial than drill seeding, pointing to the benefits of early establishment (Table 1).

Nitrogen content of vetch (3.7 to 3.9%) was higher than clover (2.4 to 2.5%) and rye (1.1 to 1.2%). Nitrogen production on a per acre basis was similar for the two aerially seeded legumes and averaged 110 and 130 lb./acre in 1982 and 1983, respectively. In 1982, drilled vetch produced more N (77 lb./acre) than drilled clover (38 lb./acre) due to poor clover stands, but N production was similar for both crops in 1983.

Despite the fact that the field, which had been in conventional-tillage cotton for several decades, had no previous record of horseweed (*Conyza canadensis*), elimination of fall tillage with aerial seeding resulted in horseweed infestation. Horseweed seedlings were successfully eliminated even with light fall tillage. Primary tillage in the spring, i.e. disking cover crop under for conventional seedbed preparation, also eliminated horseweed. Horseweed present in no-till plots at cotton planting in 1981 was not controlled with Paraquat (2 applications at 1.0 qt./acre). In subsequent years, Roundup (1.2 qt./acre) proved effective.

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Both crop seeding methods and spring cover crop management affected cotton stands. In general, stands were lower following aerially seeded covers. Cotton stands in 1981 were reduced by no-till planting into legumes and rye compared to planting into disked under covers (Table 2). In 1982 and 1983, compared to the conventional till system, stands were reduced for cotton planted no till into legumes and following spring disking of some covers, Poor stands following spring disking were related to wet soil conditions which resulted in cloddy seedbeds.

Yield data indicated that although legume covers produced more than 90 lb./acre N, cotton benefited from additional commercial N. When cotton followed good stands of vetch, N fertilizer was not required for optimum yields in 1981 (1670 lb./acre seed cotton) and 1983 (940 lb./acre), but in 1982, 60 lb./acre N was required for no-till cotton (3060 lb./acre) and 30 lb./acre was required for conventional till (3390 lb./acre). When cotton followed clover, 30 lb./acre of N was required for optimum yield in 1981 (1650 lb./acre seed cotton) and 1982 (3040 lb./acre seed cotton), but in 1983 when yields were low (860 lb./acre), N fertilizer was not beneficial. Cotton following rye required 60, 90, and 60 lb./acre N for optimum yields in 1981 (1750 lb./acre), 1982 (3240 lb./acre), and 1983 (1100 lb./acre), respectively. Related research suggests that desiccation of covers a week or more prior to planting may facilitate planter operation, cotton stand establishment and seedling growth.

In summary, aerial seeding at the time of cotton defoliation resulted in successful cover establishment and was especially advantageous for legumes. Aerial seeding disadvantages for subsequent no-till planting of cotton included horseweed infestation due to elimination of fall tillage and cotton stand problems related to increased dry matter.

Table 1. Influence of cover and seeding method on cover production (averaged over years).

Cover	Seeding method	Dry matter	N content	N production
		(lb./acre)	(%)	(lb./acre)
Clover	Aerial	3910	2.4	119
	Drill	1190	2.5	39
Vetch	Aerial	2650	3.9	119
	Drill	1630	3.7	67
Rye	Aerial	2530	1.1	24
	Drill	1670	1.2	18

Table 2. Influence of covers and spring tillage on cotton stands.

Cover	1981 NT	1981 Conv.[1]	1982 NT	1982 Conv.[1]	1983 NT	1983 Conv.[1]
	(no./50 ft. row)					
Clover	140	169	113	129	101	98
Vetch	68	153	104	94	109	99
Rye	97	145	134	88	141	109
No cover	192	196	130	118	126	174
Conventional till[2]	--	213	--	142	--	138

[1]Consisted of spring disking of covers to prepare seedbed.

[2]System included fall moldboard plowing, spring disking/smoothing

HERBICIDE PROGRAMS IN MINIMUM-TILL COTTON

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Experiments were conducted from 1981 through 1983 at the Tennessee Valley Substation, Belle Mina, Ala., to evaluate 11 herbicide systems for cotton planted no till in crimson clover, hairy vetch, rye and "no cover," and for conventionally tilled cotton (fall moldboard plow, spring disk, smooth). Each treatment was applied to the same plot for three consecutive years.

Cover crop desiccation, cotton stands and annual weed control were among the factors affecting cotton yields. Clover, which winter killed completely in 1981 and partially in 1982, was effectively controlled by all treatments except Paraquat CL alone (1 qt./acre) in 1982 and Roundup (1 qt./acre) in 1983. Vetch, the most difficult of the covers to dessicate, was not effectively controlled by any treatments in 2 of 3 years. Vetch desiccation may have been related to maturity. Subsequent research has indicated that vetch nearing the bloom stage is easier to control. All treatments effectively dessicated rye each year.

Cotton stand reductions following some herbicide/cover systems limited cotton yields. Cotton stands were reduced in the vetch cover each year, which may have been due to lower soil temperatures, ammonia release and/or soil insects. In 1982, stands were reduced following preemergence Bladex (1.5 or 2.0 lb. ai/acre) for no-till plantings in clover, vetch and no cover. In 1983, stands were marginal for most treatments and were particularly poor in legumes.

Control of annual weeds declined over the 3-year period with most herbicide systems. In 1981, all residual treatments provided better than 80% control of large crabgrass, morningglories, prickly sida and redroot pigweed. In subsequent years as annual weed pressure increased, only Cotoran (2.0 lb. ai/acre) provided acceptable control, particularly in systems that included a postemergence directed application of Caparol + MSMA (1.5 + 2.0 lb. ai/acre). Counts of annual weeds were very low in 1981. However, weed counts in 1983 indicated extreme buildup of grasses in systems that had not provided effective season long control in previous years (Table 1).

Seed cotton yields from selected treatments are listed in Table 2. In 1981, highest cotton yields were obtained in the rye cover. Yields were lowest following vetch due to poor cover desiccation, reduced

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stands and slighter poorer weed control. In 1982, yields approaching 3,000 lb./acre seed cotton were obtained from most treatments. Yields were reduced in vetch/Bladex plots due to severely reduced stands and in plots where weed control was poor. In 1983, cotton yields were limited by drought. In no-till treatments where season long weed control had not been obtained in prior years, yields were essentially zero due to annual weed pressure.

Table 1. Annual grass counts 10 weeks after planting from selected herbicide systems in 1983.

Herbicide System PRE[1]/PDS	Cover				
	Clover	Vetch	Rye	No Cover	Conven.
	(no./67 ft.[2])				
Bladex	530	457	490	1070	50
Bladex + Prowl	245	400	195	55	2
Cotoran	197	150	255	62	2
Cotoran + Prowl	95	95	18	0	1
Cotoran/Caparol + MSMA	85	17	1	0	0
Cotoran + Surflan/Caparol + MSMA	0	1	0	0	0
Control	620	970	255	490	200

Grasses included large crabgrass, fall panicum, goosegrass.

'Preemergence applications for all herbicide systems included Paraquat CL or Roundup.

Table 2. Seed cotton yields from selected treatments in 1981 and 1982.

Herbicide System PRE[1]/PDS	1981			1982		
	Vetch	Rye	Conventional	Vetch	Rye	Conventional
	(lb./acre)					
Bladex	1800	2470	2120	10	460	2450
Bladex Prowl	2460	2890	2370	820	1900	3290
Cotoran	2120	2470	2580	3600	3120	3450
Cotoran+Prowl	2080	2470	2520	3700	3040	3490
Cotoran/ Caparol + MSMA	2260	3050	2360	3450	3460	3590
Cotoran+Surflan/ Caparol+MSMA	2450	2890	2510	3120	3250	3040
Control	690	1800	1930	0	0	0

'Preemergence applications included Paraquat CL or Roundup,

GRAIN SORGHUM
PRODUCTION PRACTICES

NITROGEN FERTILIZER REQUIREMENTS FOR GRAIN SORGHUM FOLLOWING WINTER LEGUMES IN CONVENTIONAL AND NO-TILLAGE SYSTEMS

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Introduction

Legumes have been utilized as a green manure or mulch and N source in cropping systems for tliousands of years. Frequent mention of winter-cropping legumes, particularly hairy vetch (Vicia villosa Roth) and Crimson clover (Trifolium incarnatum L.), started to appear in the literature in the U.S. in the 1890's and by 1920 almost every agricultural extension office in the southeastern U.S. was recom mending winter legumes for erosion control and soil building. The practice declined drasticallv in the post World-War II era with the advent of inexpensive N fertilizers; however, the change in economics of inorganic N useage and growing concern over soil erosion losses have sparked a comeback for green-mulching winter legumes in rotation with summer grains in the southeastern United States.

Materials and Methods

The experiment was conducted in 1982 and 1983 on an Arredondo fine sand, a member of the loamy silicious hyperthermic family of the Grossarenic Paleudults. The study examined a crimson clover/grain sorghun (Sorghum bicolor L. Moench) system. Four management systems were employed and included 1) no-tillage into clover for a mulch; 2) no-tillage into stubble of harvested clover; 3) conventional-tillage using the clover for green manure; and 4) conventional-tillage, after the clover was harvested. Subtreatments consisted of seven rates of N fertilizer; 0, 25, 50, 75, 100, 150, and 200 kg N/ha.

Results

Crimson clover dry matter yield averaged 5,000 kg/ha and had an average N content of 140 kg/ha for the two years. Using the clover as a mulch resulted in greater sorghum grain yield and higher N in leaf tissue (Figure 1). Critical leaf N levels were about 3.9 % when sampled at early bloom. Leaving clover as a mulch would require 25 kg inorganic N/ha and removing the clover would require 75 kg inorganic N/ha to maximize sorghum grain yield in these systems. At low rates of inorganic N, clover mulch under no-tillage conditions gave higher yields than removing the mulch (Figures 1 and 2). Data indicate that not only does the clover mineralize N from the mulch in equal quantities to green manure treatments but it also better utilizes the N at lower inorganic N rates, likely due to better moisture conservation.

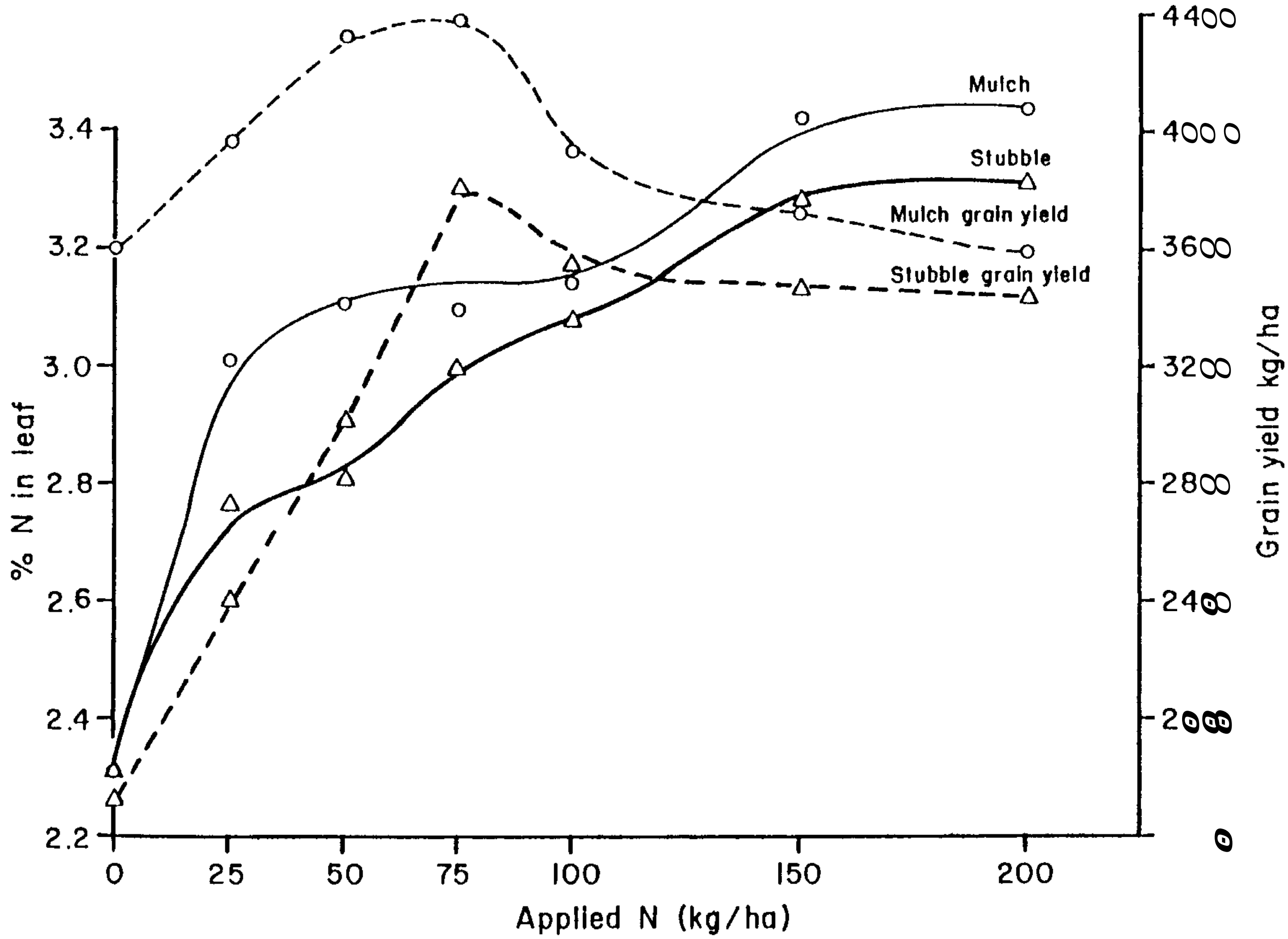

Fig. 1. Grain yield and leaf nitrogen of grain sorghum following crimson clover.

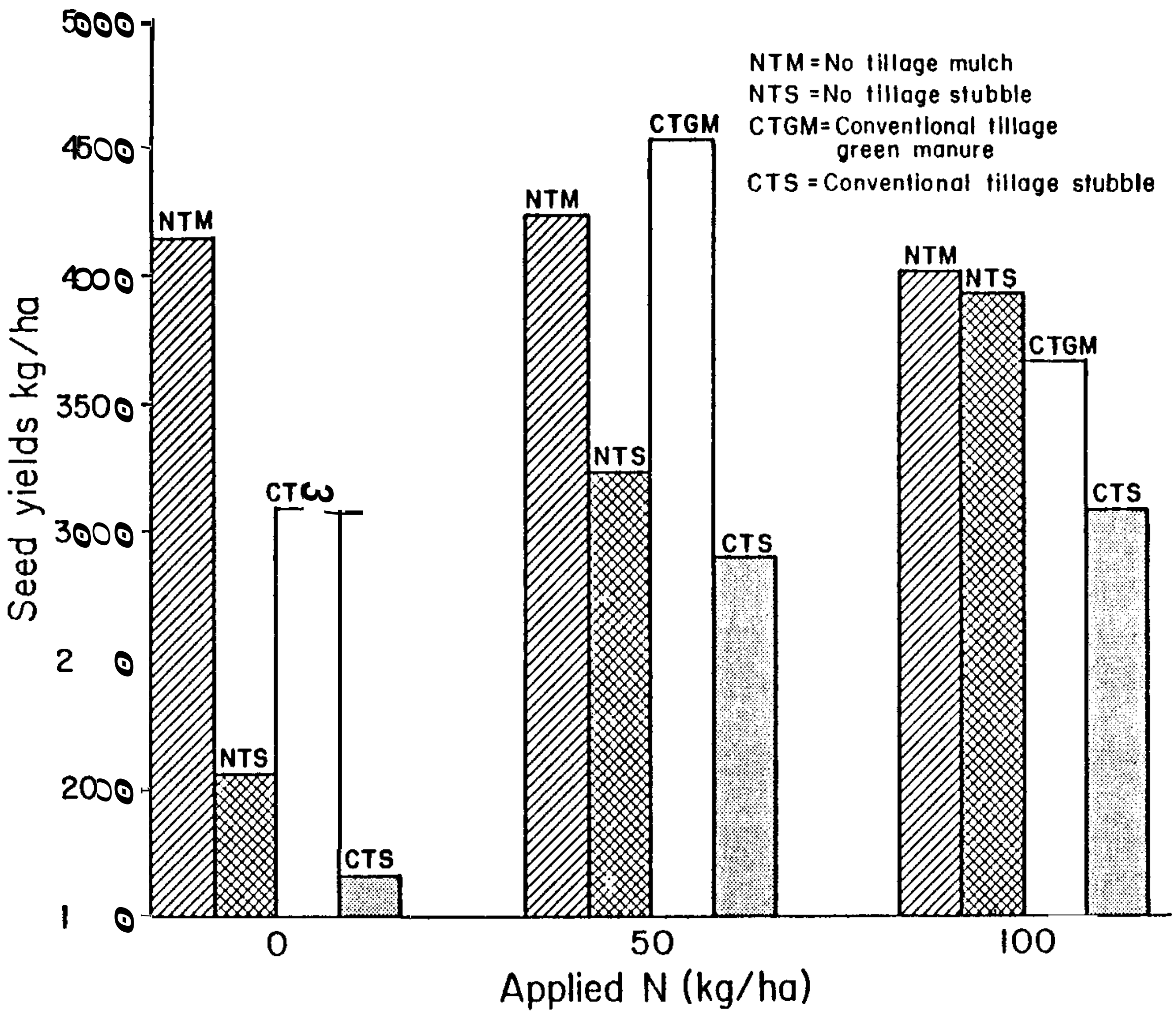

Fig 2 Grain sorghum seed yields as affected by tillage and N rate when following crimson clover.

PLANTED AND RATOONED GRAIN SORGHUM RESPONSE TO STARTER FERTILIZER AND FERTILIZER PLACEMENT

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This study was conducted for 2 years on a Dothan fine sandy loam soil at the Alabama Agricultural Experiment Station's Wiregrass Substation. Treatments consisted of tillage (none and disk-turn-disk), starter fertilizer (none and 100 lb./acre 23-26-0), and fertilizer placement (in-row subsoil track and soil surface). Regardless of tillage system, the sorghum (CNS 1334 BR in 1982 and Savannah 5 in 1983) was planted with an in-row subsoiler (12-inch subsoil depth). The in-row subsoil applied fertilizer was dropped into the subsoil track at planting; the surface application, also applied at planting, was applied 3 to 5 inches to one side of the row. The sorghum was planted on 13 March 1982 and 24 April 1983 at a seeding rate of 5 seeds per foot in 24-inch rows. The winter cover crop was rye which was killed with paraquat CL approximately 2 weeks prior to planting. Sidedress N rates were 120 lb./acre N for the planted crop and 100 lb./acre for the ratooned crop. Soil pH was 5.9 and soil P and K were high (85 lb./acre P and 120 Ib./acre K). Herbicides consisted of paraquat preplant, atrazine over the top 4 to 5 weeks after planting, and linuron post directed prior to boot stage for the planted crop. For the ratooned crop, paraquat was applied immediately after first crop harvest and post directed prior to boot stage. The planted crops were harvested 19 July 1982 and 9 August 1983. The ratooned crops were harvested 26 October 1982 and 1 December 1983.

Weights of whole plant samples (Table 1) taken on 20 April 1982 (approximately 6 weeks after planting) suggest that early season plant growth was exceptionally poor even when starter fertilizers were applied. The slow growth implies that early March may be too early to plant grain sorghum. There was no difference in plant weights among tillage systems, but the beside-row and in-row fertilizer increased plant weights by a factor of 4.4X and 11.4X, respectively. Since the beside-row starter was applied on the soil surface, increased growth from this treatment was probably due to N in the starter moving down into the rooting zone. It is doubtful that the surface applied P had any effect on early plant growth. Plant heights on 20 April 1982 (Table 1) were improved only by the in-row starter. Whole plant data were not taken in 1983.

The starter fertilizer application, especially the in-row application, had a tremendous effect on development rate, which could be seen at the early heading stage and at maturity (Table 1). In 1982, approximately 25% of the plants in plots receiving in-row starter had headed before any plants from the no-starter treatment had headed. By mid-June 1983, 99% of the plants receiving in-row starter had headed, but only 70% of those receiving no starter had headed. There was also a maturity advantage for in-row compared to beside row application, but differences between tillage systems were not found.

Table 1. Early season plant weight and height (20 April) and grain moisture at maturity in 1982, and heading on 27 May 1982 and 15 June 1983 as affected by tillage, starter fertilizer, and fertilizer placement.

Tillage	Fertilizer and placement	Plant weight	Plant height	Grain moisture	Heading 1982	Heading 1983
		lb./A	inches	%	-----%	-------
Conventional	none	31	23	25	0	70
	beside row	105	23	18	6	87
	in-row	280	26	17	23	99
None	none	14	18	32	0	70
	beside row	97	21	23	6	87
	in-row	243	25	19	23	99

When the first crop was harvested in 1982, grain moisture (Table 1) ranged between 25 and 32% for the no-starter treatment and 17 and 19% for the in-row starter. The planted crop could have been harvested 2 weeks earlier if all plots had received in-row starter fertilizers. Early maturity is exceptionally important in ratoon-cropping systems, and the use of starter fertilizers to hasten maturity of the planted crop may well be the key management practice in ratoon sorghum production.

Actually, the enhanced maturity effect of the starter fertilizer was a bonus because the yield increases obtained with the starter fertilizer exceeded the fertilizer cost. With the planted crop in 1982 (Table 2), there was an 11 and 31 bu./acre yield increase with the starter fertilizer placed in the subsoil track in the conventional- and no-tillage systems, respectively. With the ratooned crop there was a 12 to 14 bu./acre response to the starter fertilizer, but differences between tillage systems were not apparent. The total grain yield response to the starter fertilizer in the conventional- and no-tillage system was 25 and 43 bu./acre, respectively. For the planted crop, both the beside-row and in-row application increased

Table 2. Yield of planted and ratooned sorghum in 1982 as affected by starter fertilizer and tillage

Crop	Till No Starter	Till Beside row	Till In row	No-till No Starter	No-till Beside row	No-till In row
	-------------	-------------	------bu./A	-------------	-------------	-------------
Planted	52	62	63	28	53	59
Ratooned	22	22	36	19	15	31
Total	74	84	99	47	68	90

yields, but only the in-row application resulted in yield increases in the ratooned crop.

In 1983, there were no differences between tillage systems, but there was a grain yield response to the starter fertilizer (Table 3). The in-row fertilizer application resulted in higher grain yields than the beside-row application for both the planted and ratooned crop.

Table 3. Yield of planted and ratooned grain sorghum in 1983 as affected by starter fertilizer and fertilizer placement.

Crop	Fertilizer placement			
	None	Beside-row	In-row	FLSD
	-------------bu./acre---------			0.10
Planted	88	96	104	6
Ratooned	43	57	64	7
Total	131	153	168	

SOD SEEDED GRAIN SORGHUM AND CORN YIELD RESPONSE TO ANHYDROUS AMMONIA

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Introduction

Nitrogen is the largest and most expensive fertilizer component used in growing corn (Zea mays L.) and sorghum (Sorghum bicolor L. Moench) in the United States. Anhydrous ammonia is one of the least expensive sources of available N for agronomic crops.

Materials and Methods

Two separate experiments at two locations were planted during 1983. The experiments were in randomized complete block designs with six replications, one testing 'Pioneer brand X304C' a tropical corn hybrid and the other utilizing 'DeKalb DK59' grain sorghum planted into 15 vear old bahiagrass (Paspalum notatum L. Flugge cv. 'Pennsicola') sods. One location was planted on June 9, 1983 on a Kershaw fine sand (thermic, uncoated Typic Quartzipsamment) an excessively drained sand and the other on June 23, 1983 on a Chiefland fine sand (Loamy, siliceous, thermic, Arenic Hapludalf).

'The plats were 8 rows, 30 inches wide, and 40 feet in length. The plots were planted with an in-row subsoil planter with anhydrous tube attached to the subsoil shank. The corn was planted at a population of 22,500 plants/acre and the sorghun at 65,000 plants/acre. No irrigation was provided at either location. An application of 1.5 lb. active ingredient (a.i.) Carbofuran 15G (Furadan) was applied in front of the press wheel at planting. Ten days prior to planting, an application of 0.75 lb a.i glyphosate (Roundup) plus 2.0 quarts of X-77 surfactant/100 gallons of water was applied in a spray volume of 17 gallons/A. at 40 p.s.i. This was done to suppress the bahiagrass sod prior to planting.

All plots were fertilized with a broadcast application of 120 lb K_2O/A, 16.5 lb S/A, and 8.25 lb Mg/A just prior to planting. Sources of K, S, and Mg were K_2SO_4, $MgSO_4$ (K-Mag), and KCL (Muriate of Potash). Nitrogen was applied at planting under the row and injected from the subsoil shank at a 10 inch depth. Nitrogen rates were randomized and applied at 0, 50, 100, 150 and 200 lb N/A.

On July 26 and 27 at the two locations, .25 lb a.i. paraquat plus 1 pint X-77/100 gallons was direct sprayed to further suppress the sod. Plots at location one were hand harvested on September 12, 1983 and those at location two on September 26, 1983.

Results and Discussion

The corn showed a grain arid stover yield response to the 100 Ib N/A rate averaged over the two locations. One location responded to 50 lb N/A for grain residue, and whole plant dry matter yields due to insufficient rainfall during the silking to ear fill period. Grain yield significantly decreased with increasing rate of N at one location where rainfall was limiting. This physiological response of corn to drought stress has been reported previously.

Differences occurred at the 150 1b N/A rate averaged over the two locations for corn stalk dry matter, whole plant dry matter, and corn residue dry matter yields. The corn grain to residue ratio averaged over the two locations was significant at the 50 lb N/A rate.

Grain sorghum yields differed at each location and responded similarly to increasing rate of N from 0 to 200 lb N/A. Percentage of grain was significant only in the plots receiving no supplemental N. A significant interaction occurred due to location for number of plants in the final stand and tne grain to residue ratio.

In summary, the rate of anhydrous ammonia as applied in this experiment, had an effect on most components measured. Insufficient rainfall at one location and distribution of rainfall had a greater effect on corn yields than on sorghum yields.

Acknowledgements

The authors acknowledee the following individuals for their resources and technical support of this research project. Peggy and Spencer Miller, Bronson, Florida; Danny Stevens and Don Bennink of North Florida Holsteins, Bell, Florida; Sonnv Tomkins, Bill Carter, Betty Hurst, and Evelyn Bluckhorn, Technical Assistants, IFAS, Gainesville, and Bronson, Florida.

Table 1. Corn response to no-tillage in-row subsoil planting into bahiagrass sod as influenced by rates of anhydrous ammonia and location.

N Treatment	Location: Miller farm	Stevens farm	Average
lb. N/acre	Grain yield bu./A		
0	4 c	7 c	6 c
50	22 a	28 b	25 b
100	20 ab	51 a	35 a
150	21 ab	61 a	41 a
200	13 b	67 a	40 a
	Stalks Ton DM/A		
0	0.69 b	0.60 c	0.64 c
50	1.17 a	1.59 b	1.38 b
100	1.21 a	1.76 b	1.48 b
150	1.39 a	2.30 a	1.84 a
200	1.17 a	2.31 a	1.74 a
	Corn residue Ton DM/A		
0	0.70 b	0.61 c	0.65 c
50	1.31 a	1.62 b	1.46 b
100	1.33 a	1.90 b	1.61 b
150	1.52 a	2.39 a	1.95 a
200	1.28 a	2.46 a	1.87 a
	Whole plant Ton DM/A		
0	0.81 b	0.68 d	0.74 d
50	1.84 a	2.29 c	2.06 c
100	1.82 a	3.12 b	2.47 b
150	2.02 a	3.84 ab	2.93 a
200	1.59 a	4.07 a	2.83 a
	Grain/Residue		
0	0.14 c	0.16 c	0.15 b
50	0.41 a	0.42 b	0.42 a
100	0.35 ab	0.63 a	0.49 a
150	0.33 ab	0.62 a	0.48 a
200	0.25 bc	0.65 a	0.45 a

Values in columns within a variable not followed by the same letter are significantly different at the 0.05 level of probability according to Duncan's new multiple range test.

Table 2. Grain sorghum response to no-tillage in-row subsoil planting into bahiagrass sod as influenced by rates of anhydrous ammonia and location.

N Treatment	Location: Miller farm	Location: Stevens farm	Average
lb. N/acre	Grain yield bu./A		
0	9 c	4 c	7 c
50	35 b	14 b	25 b
100	34 b	16 b	25 b
150	40 ab	27 a	38 a
200	46 a	25 a	34 a
	Whole plant Ton DM/A		
0	0.93 c	1.02 c	0.98 a
50	2.17 b	2.42 b	2.29 c
100	2.45 ab	3.12 a	2.79 b
150	2.69 ab	3.23 a	2.96 b
200	3.02 a	3.48 a	3.25 a
	Residue Ton DM/A		
0	0.70 d	0.93 c	0.84 d
50	1.31 c	2.07 b	1.65 c
100	1.62 b	2.72 a	1.97 b
150	1.71 ab	2.57 ab	2.07 b
200	1.91 a	2.86 a	2.40 a
	Grain/Residue		
0	0.31 b	0.11 b	0.20 c
50	0.64 a	0.17 ab	0.44 a
100	0.51 a	0.16 ab	0.32 b
150	0.58 a	0.25 a	0.40 a
200	0.60 a	0.21 a	0.40 a

Values in columns within a variable not followed by the same letter are significantly different at the 0.05 level of probability according to Duncan's new multiple range test.

PEANUT PRODUCTION PRACTICES

NO-TILL PEANUT RESEARCH IN FLORIDA

D. L. Wright and L. C. Cobb[1]

No-till peanuts have been produced in Florida on a limited basis for the last three years. Interest in planting peanuts no-till followed successes in other crops such as corn, grain sorghum, and soybeans. The primary concern of peanut farmers has been for disease problems, primarily "White Mold". With increased planting of small grain crops, like wheat or temporary grazing crops, there is greater interest in planting peanuts no-till following these crops. Following is a summary of research conducted in Florida on no-till peanuts planted in late May following harvest.

Information on the research data presented in tables 1 thru 5 regarding production procedures are as follows: total rainfall (June-September) was 14.97" in 1981, 23.78" in 1982 and 20.65" in 1983. Planting dates were June 5, 1981, May 18, 1982 and June 3, 1983. Seeding rate was 90 lbs. per acre of Florunner peanuts. Herbicide used was Paraquat 1½ pints + Prowl 2 pints at planting; Paraquat 1 pint as a directed spray twice + ½ pint of Butoxone over the top per acre. For soil insect control Furadan 156 was banded at 15 lbs./acre. Equipment used to plant the peanuts was: 1981 - Cole no-till planter and 1982-83 Brown Hardin no-till planter. Harvest dates were October 12, 1981, October 1, 1982 and October 12, 1983.

[1] Associate Professor of Agronomy, Agricultural Research and Education Center, Quincy and County Extension Director, Jackson County, Florida.

Table 1. Influence of irrigating peanuts on yields using different moisture levels (Quincy 1981).

Water schedule cb	Yield (lbs./acre)		
	No-Till	Conventional	Average
20	2882	3257	3070[b]
60	2868	3359	3114[b]
100	3648	3832	3824[a]
None	3624	3960	3792[a]

Means in a column followed by different letters are significantly different at the 10% level of probability.

Table 2. Influence of row width on peanut yields under no-till and conventional till (Quincy 1981).

Row width	Yield (lbs./acre)		
	No-Till	Conventional	Average
15"	3462	3940	3701[a]
30"	3049	3348	3199[b]
Average	3256	3644	

Means in a column followed by different letters are significantly different at the 10% level of probability.

Table 3. Influence of irrigating peanuts on yields using different moisture levels (Quincy 1982).

Water schedule cb	Yield (lbs./acre)		
	No-Till	Conventional	Average
20	4233	4123	4178[a]
60	3738	3361	3550[b]
100	3633	3201	3417[b]
None	3675	3284	3480[b]
Average	3820[a]	3492[b]	

Means in a column followed by different letters are significantly different at the 10% level of probability.

Table 4. Influence of irrigating peanuts on yields using different moisture levels (Quincy 1983).

Water level	Yield (1bs./acre) No-Ti 11	Conventional	Average
20	2893	2468	2681
60	2563	3105	2834
100	3356	3384	3370
None	3289	3340	3315
Average	3025	3074	

Table 5, Three year average yield of peanuts planted no-till and conventional at different irrigation levels (Quincy 1981-83).

Water schedule cb	Yield (1bs./acre) No-Ti 11	Conventional	Average
20	3336	3283	3310
60	3056	3275	3166
100	3546	3473	3510
None	3530	3528	3529
Average	3367	3390	

Table 6. Results of an on-farm demonstration conducted on John King farm, Jackson County, Florida (L. C. Cobb, County Extension Director).

	Yield (lbs./acre) No-Ti 11	Conventional	Average
36" single rows	4214	4649	4432
36" twin rows	5133	5310	5222
Average	4674	4980	

Twin rows = 2 rows, 10" apart on 36" centers.

SUMMARY

There was no significant reduction in yield in planting no-till compared with conventional although most of the actual research tests were not planted where known history of "White Mold" existed. Also the trend is for no-till yields to be slightly less than conventional till. This indicates that peanuts may be planted no-till behind harvested wheat provided a good crop rotation is maintained.

There was a significant increase in yield in closer row pattern planting no-till. This was observed in row spacing studies and on the farm demonstration. No-till planting of peanuts in the future will increase as better no-ti11 herbicides and planting techniques come into practice.

WEED CONTROL PROGRAMS FOR NO-TILL PEANUTS

B. J. Brecke, University of Florida, Agricultural Research and Education Center, Jay, Florida 32565-9524.

Soil erosion is becoming an increasingly serious problem in the southeastern U. S. Wind erosion in fields planted to peanuts (Arachis hypogaea L.) results in the loss of valuable top soil along with any nutrients and/or pesticides which may have been applied. In addition, the wind driven soil often causes serious injury to the seedling peanut plants. No-till planting of the peanuts into some type of cover crop could greatly reduce this wind erosion and subsequent crop damage.

Peanuts is one crop, however, where extensive tillage is an important part of recommended production practices. Deep turning of the soil with a moldboard plow to bury any surface trash has been shown to reduce the incidence of disease. In addition, a power drive tiller is often used to incorporate herbicides and prepare the seedbed. For these reasons only a limited amount of research has been conducted to evaluate the feasibility of no-till peanuts.

In order for no-till peanut production to be successful, weeds will need to be controlled. This study was conducted to compare weed control obtained witn several herbicide programs in both no-till and conventionally planted peanuts.

MATERIALS AND METHODS

Studies were conducted during 1981-83 at the University of Florida Agricultural Research Center, Jay, FL to evaluate several herbicide programs for weed control in peanuts grown under three different tillage systems. Peanuts were planted during early May into - a) a conventionally prepared seedbed (moldboard plowed and disked), b) small grain stubble after harvest of the forage, and c) standing small grain covercrop. In all instances the peanuts were planted with an in-row subsoil no-till planter at a rate of 15 seeds per meter in rows spaced 76 cm apart.

Herbicide treatments were applied with a tractor mounted air propellant sprayer in 190 L/ha total spray volume. Weed control by species was visually rated periodically throughout the growing season. A standard fungicide program was used for control of foliar disease. The peanuts were harvested at maturity using commercially available equipment.

RESULTS AND DISCUSSION

Peanuts no-till planted into small grain stubble following forage harvest produced yields comparable to those produced under the conventional tillage system over the three year period of this study (Tables 1, 2, 3). Yields of no-till peanuts in stubble were somewhat higher than for those grown under conventional tillage in 1981 and 1982 and were somewhat lower than for the plow-disk system in 1983 (Tables 1 and 2 VS 3). No-till peanuts in standing cover-crop produced consistently lower yields than either of the other two tillage systems.

The herbicide programs of alachlor preemergence (PRE) plus alachlor + alanap + dinoseb "at cracking" (AC) plus dinoseb postemergence (POST) and pendimethalin (PRE) plus alachlor + alanap + dinoseb AC plus dinoseb POST provided good to excellent control of both annual grass and broadleaf weed species in both conventionally and no-till planted peanuts in at least two of the three year test period. Alachlor + paraquat AC plus alachlor + paraquat POST provided excellent crabgrass and sicklepod control but less than adequate tall morningglory control in 1983.

The results from the three year study indicate that no-till peanut production is feasible and that with the proper choice of herbicides weeds can be controlled under no-till peanut culture.

Table 1. Weed control and peanut yield resulting from various herbicide programs under three tillage systems, Jay, FL 1981.

				Weed Control[2]						
				Rated 6-23-81			Rated 8-7-81			
Treatment	Rate	Applied[1]	Tillage	GG	TM	SP	SP	TM	FB	Yield
	(kg/ha)			-----(%)-----			-----(%)----			(kg/ha)
Alachlor +	3.4	PRE	Conv.	95	100	100	80	100	98	5214
alachlor +	3.4	AC	NT stu[3]	83	100	98	76	100	86	6016
alanap +	3.4	AC	NT sta[4]	100	98	95	73	100	96	4084
dinoseb +	1.7	AC								
dinoseb	0.8	POST								
Alachlor +	3.3	PRE	Conv.	100	88	100	58	76	100	4485
alachlor +	3.3	AC	NT stu	98	85	100	73	94	98	4558
metribuzin	0.6	AC	NT sta	100	95	100	78	68	100	3245
Ethalfluralin +	1.7	PRE	Conv.	100	100	53	15	100	76	3683
ethalfluralin +	1.7	AC	NT stu	95	98	98	56	100	71	4557
alanap +	3.4	AC	NT sta	100	98	75	5	95	78	3245
dinoseb +	1.7	AC								
dinoseb	0.8	POST								
CHECK	---	----	Conv.	0	0	0	0		0	2990
			NT stu	0	0	0	0		0	3718
			NT sta	0	0	0	0		0	2406

[1]PRE = preemergence; AC = at cracking; POST = postemergence.
[2]GG = goosegrass; TM = tall morningglory; SP = sicklepod; FB = Florida beggarweed.
[3]NT stu = No-Till stubble.
[4]NT sta = No-Till standing cover crop.

Table 2. Weed control and peanut yield resulting from various herbicide programs under three tillage systems, Jay, FL 1982.

Treatment	Rate	Applied[1]	Tillage	Weed Control[2]: Rated 6-23-82 CG	SP	TM	Rated 8-30-82 CG	SP	TM	Yield
	(kg/ha)			-----(%)-----			-----(%)-----			(kg/ha)
Alachlor +	3.4	PRE	Conv.	100	90	98	100	78	90	3160
alachlor +	3.4	AC	NT stu[3]	100	95	95	98	75	83	3569
alanap +	3.4	AC	NT sta[4]	100	90	93	93	70	83	2997
dinoseb +	1.7	AC								
dinoseb	0.8	POST								
Pendimethalin +	1.1	PRE	Conv.	100	88	93	100	70	78	2607
alachlor +	3.4	AC	NT stu	98	89	100	100	80	88	3222
alanap +	3.4	AC	NT sta	100	93	88	90	78	73	2950
dinoseb	1.7	AC								
CHECK	---	--	Conv.							1481
			NT stu							1331
			NT sta							1625

[1]PRE = preemergence; AC = at cracking; POST = postemergence.
[2]CG = crabgrass; SP = sicklepod; TM = tall morningglory.
[3]NT stu = No-Till stubble
[4]NT sta = No-Till standing cover crop.

Table 3. Weed control and peanut yield resulting from various herbicide programs under three tillage system, Jay, FL 1983.

Treatment	Rate	Applied[1]	Tillage	Weed Control[2]: Rated 6-3-83 CG	TM	SP	Rated 7-9-83 CG	TM	SP	Yield
	(kg/ha)			-----(%)----			-----(%)----			(kg/ha)
Alachlor +	3.4	PRE	Conv.	100	95	88	100	100	94	5265
alachlor +	3.4	AC	NT stu[3]	100	78	100	85	95	90	3841
alanap +	3.4	AC	NT sta[4]	100	93	100	60	88	88	2932
dinoseb +	1.7	AC								
dinoseb	0.8	POST								
Pendimethalin +	1.1	PRE	Conv.	100	90	98	90	100	95	4666
alachlor +	3.4	AC	NT stu	100	90	100	88	95	90	4199
alanap +	3.4	AC	NT sta	100	88	98	73	93	100	3662
dinoseb +	1.7	AC								
dinoseb	0.8	POST								
Alachlor +	3.4	AC	Conv.	100	58	100	93	68	100	4715
paraquat +	0.14	AC	NT stu	100	70	98	93	98	100	4023
alachlor +	3.4	POST	NT sta	100	63	95	95	95	100	3910
paraquat	0.14	POST								
CHECK	----	----	Conv.	0	0	0	0	0	0	1000
			NT stu	0	0	0	0	0	0	1900
			NT sta	0	0	0	0	0	0	1486

[1]PRE = preemergence; AC = at cracking; POST = postemergence.
[2]CG = crabgrass; SP = sicklepod; TM = tall morningglory.
[3]NT stu = No-Till stubble.
[4]NT sta = No-Till standing cover crop.

WEED CONTROL IN MINIMUM TILLAGE PEANUTS (Arachis hypogaea) AS INFLUENCED BY VARIETY, ROW SPACING, AND HERBICIDES

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Field experiments were conducted in 1982 and 1983 on a Dothan sandy loam (Plinthic Paleudult) at Headland, AL to investigate the effectiveness of minimum-till production of peanuts (Arachis hypogaea L.). Experimental variables included, two peanut varieties: 1) 'Pronto'- (an earlier maturing Spanish type) and 2) 'F1orunner'- (a later maturing runner tyep), and two row spacing patterns 1) conventional 91-cm rows and 2) a modified twin 18-cm row pattern on 91 cm centers. A constant seeding rate (140 kg/ha) was used regardless of row spacing. Six different herbicide systems were evaluated within each combination of variety and row spacing (Table 1). Experimental area was heavily infested with Texas panicum (Panicum texanum Buckl.), Florida beggarweed [Desmodium tortuosum (Sw.) DC.] and sicklepod (Cassia obtusifolia L.).

Experimental area was seeded with rye (Secale cereale L.) in the fall prior to the initiation of this test. Paraquat (0.05 lb/A) was applied 2 weeks prior to planting to kill the rye and any weeds. Experimental design was a split-plot with four replications. Whole plots consisted of all combinations of the two peanut varieties and two row spacings. Tilled planting strips (40 cm wide) were prepared using a Brown-Harden Ro-till planter, with the planter unit removed. Planting which was a separate operation due to equipment limitations, utilized conventional equipment.

During both years 'Florunner' yielded significantly more than 'Pronto' which was in part attributable to greater tolerance to herbicide treatments. Across both years and varieties the twin row pattern resulted in higher yields than the conventional single row pattern. This yield increase was greater with 'Pronto' than with 'Florunner'. Within the six herbicide systems tested, at least two (systems 2 and 6) provided comparatively superior weed control (Table 3). Yields of 'Florunner' with the two best herbicide programs were comparable to yields commonly obtained with conventional practices (Table 3). Achieving satisfactory weed control was not a limitation to no-till peanut production.

Table 1. Herbicide programs - minimum tillage peanuts.

Treatment	Time of application			
	Cover	PRE	CR	EPOT
1	oryzalin (1.50)	paraquat (0.25)	sethoxydim (0.25)	chloramben (2.00) 2,4-DB (0.20) dinoseb (1.00)
2	--	paraquat (0.25) oryzalin (1.50)	paraquat (0.25)	naptalam (3.00) + dinoseb
3	--	paraquat (0.25) pendimethalin (1.50)	paraquat (0.25)	naptalam (3.00) + dinoseb
4	pendimethalin (1.50)	paraquat (.25)	sethoxydim (0.25)	chloramben (2.00) 2,4-DB (0.20) dinoseb (1.00)
5	--	acetochlor (3.00)	pendimethalin (0.75) dinoseb (1.50)	dinoseb (1.00)
6	--	paraquat (0.50) pendimethalin (1.50)	acetochlor (1.50) dinoseb (1.50)	cyanazine (1.50) (EPDS)
7	weed free check			
8	weedy check			

[1]Rates in lb/A

Table 2. End of season weed control as affected by herbicide system (averaged across varieties and row spacings).

Treatments[a]	Weed Control: Texas panicum	Florida beggarweed	Sicklepod
	------------	%	------------
1	75c	76c	70de
2	90b	06b	75cde
3	71c	76c	68e
4	65d	75cd	78cd
5	59d	70d	80bc
6	77c	91b	85b
7	100a	100a	100a
8	0e	0e	0e

[a]For treatment description refer to Table 1.

Table 3. Peanut yield as affected by variety, row spacing and herbicide systems (averaged across years).

Treatment #[b]	Peanut Yield[a]			
	Florunner		Pronto	
	Conv.	Twin	Conv.	Twin
	lb/A			
1	3100bc	3360ab	1930a	2070abc
2	3540ab	3750a	1860a	2400abc
3	2970bc	3000b	1660a	1920bc
4	2680c	3290ab	1740a	2620a
5	2630c	2760b	1420a	2360abc
6	3040bc	3400ab	1980a	2330abc
7	3730a	3290ab	1990a	2470ab
8	1750d	1940c	1620a	1810c
mean	2930	3100	1780	2250
	3020		2010	

[a]Means not followed by the same letter within a column are significantly different at the 5% level according to DMRT.

[b]For treatment description refer to Table 1.

WEED POPULATIONS IN CONVENTIONAL AND NO-TILLAGE PEANUTS

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INTRODUCTION

The Florida peanut (Arachis hypogaea L.) crop is often subjected to intensive wind and water erosion. In an effort to conserve the soil along with expensive chemical fertilizers and herbicides, no-tillage practices for peanut production in Florida are under investigation. Weed control under no-tillage systems, which do not allow for the frequent, intensive cultivation often practiced in peanut production, might be difficult or ineffective, resulting in crop losses. However, no-tillage does allow the use of an organic surface mulch which can have several beneficial effects on crop production, including weed control (Gallaher, 1978, Reeves, 1971). The objective of this study is to evaluate the influence of small grain (rye, Secale cereale L.) residue on weed populations in no-tillage and conventional tillage peanuts.

MATERIALS AND METHODS

The experiment was conducted on an Arredondo fine sand (loamy, silicious, hypertherrmic Grossarenic Paleudult) on the Green Acres Agronomy Research Farm located West of Gainesville, Florida in 1981, 1982 and 1983. In the late fall (November)120 1bs/A of "Wrens Abruzzi" rye was drilled into a conventionally tilled seedbed. The winter rye crop recieved a split application of 100 lbs N/A and 2 lbs a.i./A of 2.4-D ((2,4-dichlorophenoxy) acetic acid) broadcast for winter broadleaf control.

The rye crop was harvested with a combine in late May. Over all three years yields of rye averaged 23 bu/A grain and approximately 3000 lbs/A straw. Straw was removed off some plots with a forage chopper and redistributed by hand an the plots to recieve a mulch treatment. Four tillage-mulch treatments were set up in a randomized complete block design over 4 replications in 1981 and 1982, and 6 replications in 1983. The 4 treatments were 1) no-tillage into rye straw mulch, 2) no-tillage into rye stubble where the straw was removed, 3) conventional tillage with the rye straw incorporated, and 4) conventional tillage following rye straw removal. Plots were 15 ft wide, allowing for six, 2 and one-half foot rows. For all three years Florunner peanuts were planted in late June to insure good moisture for germination as the peanuts were unirrigated.

In all three years the herbicide program over all plots was similar. Pre-emergence herbicides were broadcast following planting and included 2 lbs a.i./A glyphosate (N-(phosphonomethyl) glycine), 2 lbs a.i./A alachlor (2-chloro-2' ,6'-diethyl-N-(methoxymethyl) acetanilide), and 1 and one-half lbs a.i./A dinoseb (2-sec-butyl-4,6-dinitraphenol) Approximately 3 weeks after emergence weeds were identified and populations counted for a representative 10 ft inter-row sample area in each plot. Plots were then sprayed with 2 lbs a.i./A toxaphene (Chlorinated camphene) and 0.75 lbs a.i./A dinoseb. About 4 weeks after emergence a post-directed over the row application of 0.125 lbs/A paraquat with X-77 as a surfactant was made. along with a second broadcast application of 2 lbs a.i./A toxaphene. In 1983 a post-emergence grass herbicide was applied in an effort to control the grass buildup in all plots. A second weed count was made half-way through the growing season in 1982 and 1983, and a late season weed count was taken at about 100 days after emergence in 1981 and 1982. Grassy weed populations were visually estimated as number of individual plants per unit area as closely as possible. In 1983 a wick application of glyphosate was used to clean up remaining weeds prior to harvest.

Peanuts were dug by hand. and yields calculated from a 17, 8.5, and 50 square foot area in 1981, 1982, and 1983 respectively. Plants were dried in an oven at 70°c for at least 48 hours and then separated into kernel (nut), hull (shell). and plant residue, and weighed. Peanut yields were adjusted to 15% moisture. A randomized complete block Statistical analysis was performed according to Steel and Torrie (1960) using the Radio Shack TRS Model III microcomputer and a program written in BASIC. Duncan's New Multiple Range Test was performed on means that were significantly different.

RESULTS AND DISCUSSION

Broadleaf weed populations were reduced in the no-tillage plots as compared to conventional for all three years. There were no grasses in any of the plots following an application of a post-emergence grass herbicide in 1983, therefore population levels of the major broadleaf weed present (hairy indigo, Indigofera hirsuta) are shown for both an early and late sampling date (Fig. 1). Broadleaf weed populations increased by approximately 20% over all plots from 1981 to 1983.

For all 3 years there were significantly fewer broadleaf weeds present in the no-tillage plots, especially early in the season. In 1981 conventional tillage had almost 300% more total weeds than no-tillage when measured soon after emergence. By 1983, the no-tillage plus rye straw mulch treatment had significantly fewer broadleaf weeds than all other treatments. This reduction can probably be attributed to the combined effects of the lack of soil disturbance under no-tillage practices and the weed supressing characteristics of the mulch (Gallaher, 1978, Reeves, 1971).

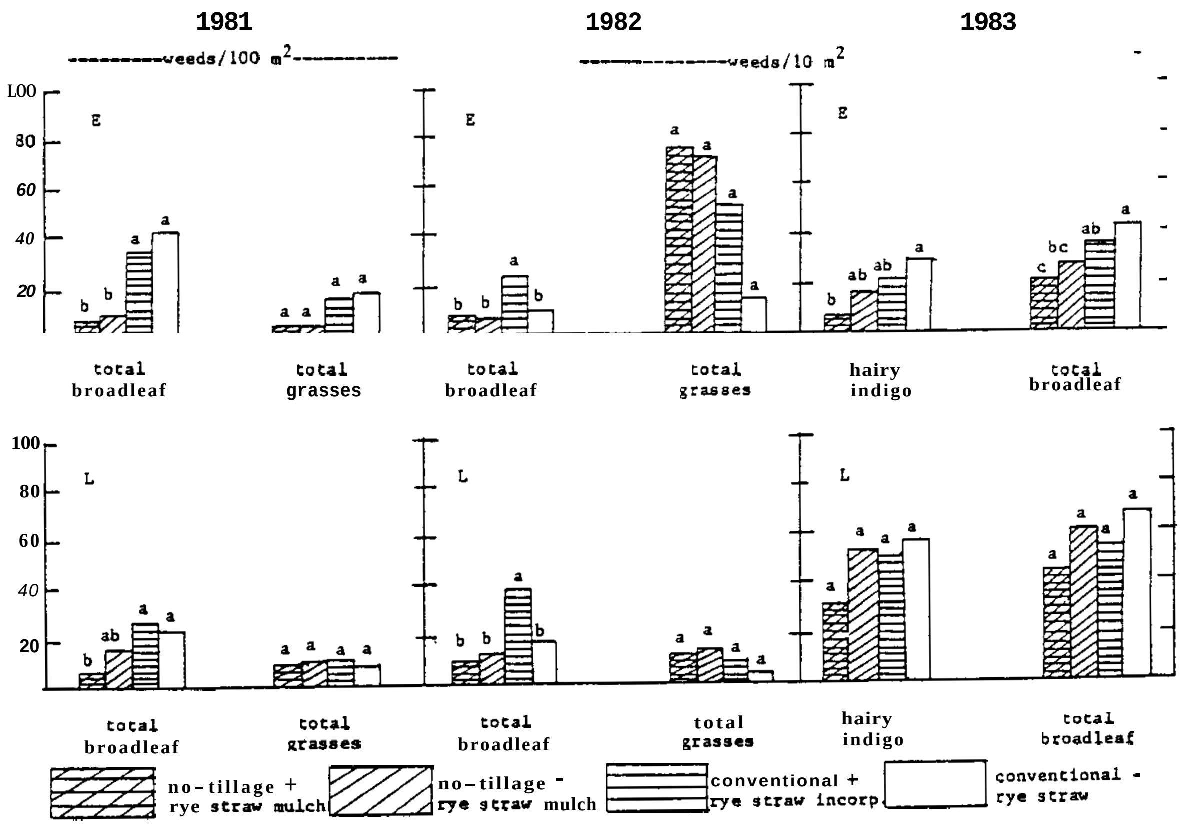

Fig. 1. Weed populations in Florunner peanuts under different tillage and mulching treatments sampled early (E) and late (L) in the growing season over three consecutive years. Bars topped by the same letter within weed groups are not significantly different at the 0.05 level of probability.

Table 1. Yields of Florunner peanuts planted under 4 tillage-mulch management systems for three consecutive years. Yields have been corrected to 15% moisture.

Treatment	Year 1981	1982	1983	$\bar{X}$
	kg/ha			
No-tillage + rye straw mulch	3350ns*	2080ns	1740ns	2390ns
No-tillage - rye straw mulch	3860	1760	1240	2290
Conventional with rye straw incorp.	3970	2240	1390	2540
Conventional - rye straw	3970	2260	1130	2450
$\bar{X}$	3790	2090	1370	

*ns = no significant differences among tillage-mulch treatments within each year.

The major broadleaf weed species found in all plots were sicklepod (Cassia obtusifolia), Florida beggerweed (Desmodium tortuosum), and hairy indigo (Indigofera hirsuta). Grassy weeds in peanut were effectively controlled using a post-emergence grass herbicide in 1983.

Due to high variability in the data, no significant differences were found between peanut yields under the four tillage-mulch treatments for each of the 3 years. Average peanut yields declined over the 3 years of continuous cropping in the same plots. In 1983 a severe outbreak of Cercospera leaf spot prevented peanuts from reaching full maturity. No-tillage peanut yields were comparable to conventional. The presence of a mulch did not seem to affect yields.

SUMMARY

An additional benefit from no-tillage management of peanuts in Florida besides soil and water conservation considerations may be suppression of broadleaf weed pests such as sicklepod. Yields of no-tillage peanuts were comparable to conventional, and the presence of a rye straw mulch did not affect pegging or yields.

ACKNOWLEDGEMENTS

The authors express their appreciation to Mr. Sonny R. Tompkins for his assistance in the field.

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SOYBEAN PRODUCTION PRACTICES

COMPETITION BETWEEN SOYBEAN AND SICKLEPOD AS AFFECTED BY METRIBUZIN RATE AND TILLAGE

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Sicklepod (Cassia obtusifolia) is one of the major pests to soybean (Glycine max L. Merr.) in the southern United States. Metribuzin (4-amino-6-tert-butyl-3-(methylthio)-as-triazin-5(4H)-one) is a herbicide that deals with rates of metribuzin and the use of a previous rye (Secale cereale L.) crop residue to control siklepod populations. A comparison of dry matter and energy yields of both the soybean and sicklepod is focused on over their life cycle.

Objectives

1. Evaluate the sicklepod-soybean dry matter accumulation over their life cycle.
2. Determine the competition between soybean and sicklepod for dry matter and total caloric energy.
3. Compare sicklepod-soybean competition as affected by rye straw residue incorporation.

Materials and Methods

Soybean followed rye grain in succession. Rye straw (4000 kg/ha) was incorporated in one treatment, and removed prior to tillage in another. 'Bragg' soybean were planted into a conventional seedbed. Five rates of metribuzin were split plots (0, 0.28, 0.56, 0.84, 1.12 kg active ingredient (a.i.)/ha). Soybean and weed samples were taken five times during the growing season. The data are presented for 0.56 kg a.i./ha metribuzin rate. Whole plant samples of soybean and sicklepod were collected from one-half square meter of each treatment. Dry matter was determined after drying at 70 C. Samples were ground with a Wiley mill to pass a 1 mm screen and stored in air tight containers. Combustible caloric energy was determined using a computerized Adiabatic calorimeter. Regression analysis was performed on data with the following equation: DM or $E=a+bx+bx^2+bx^3$ where DM = dry matter and E = caloric energy. Calories per unit weight was multiplied times plot weight to get total energy per plot.

Results

Dry matter and energy data are presented in Figures 1 through 8. Fitted curves were plotted based on regression analysis.

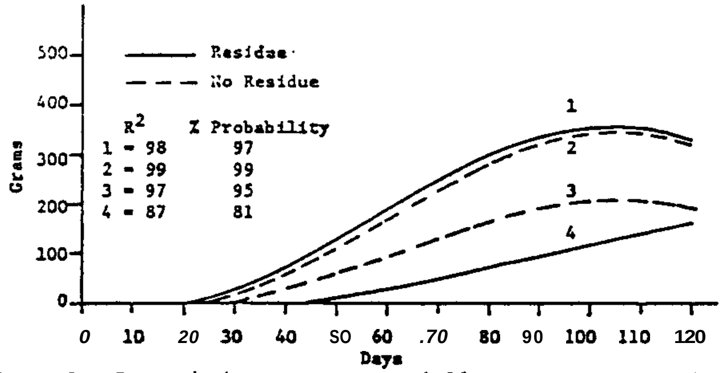
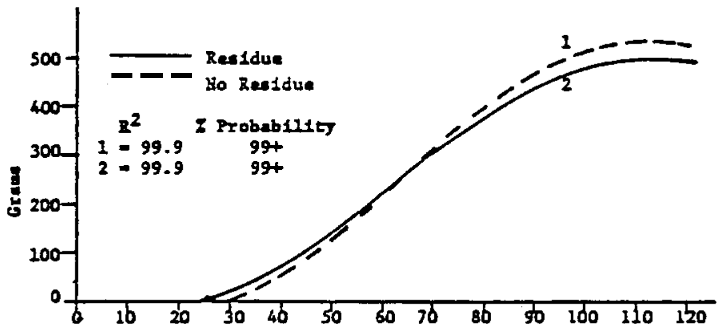
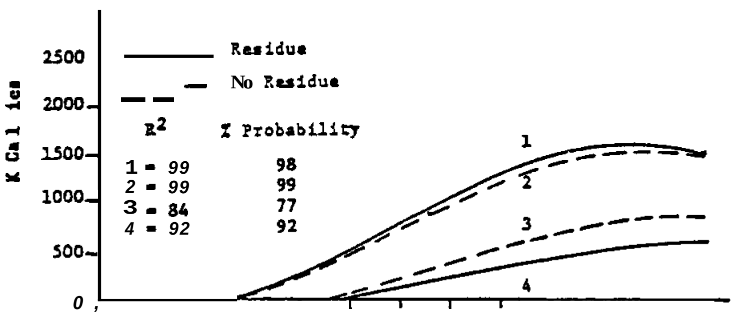


Figure 1. Change in dry matter per one-half square meter for soybean and weeds during the soybean growing season. 1 and 2 = soybean; 3 and 4 = weeds.





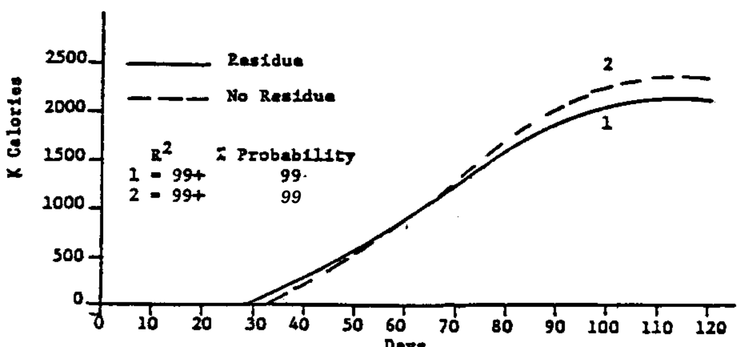


Figure 4. Change in energy per one-half square meter for soybean plus weeds during the soybean growing season.

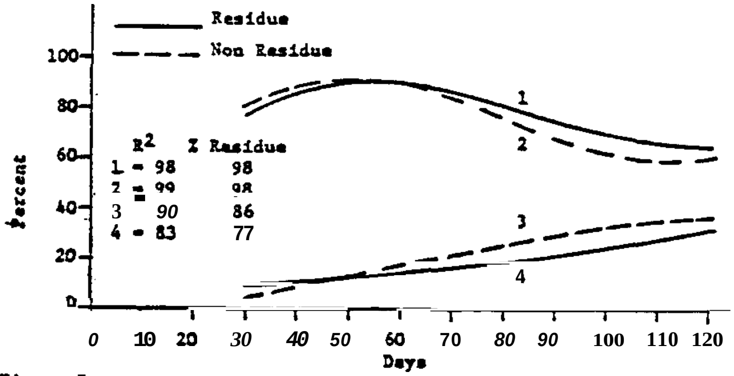


Figure 5. Change in percent dry matter for soybean and weeds during the soybean growing season. 1 and 2 = soybean; 3 and 4 = weeds.

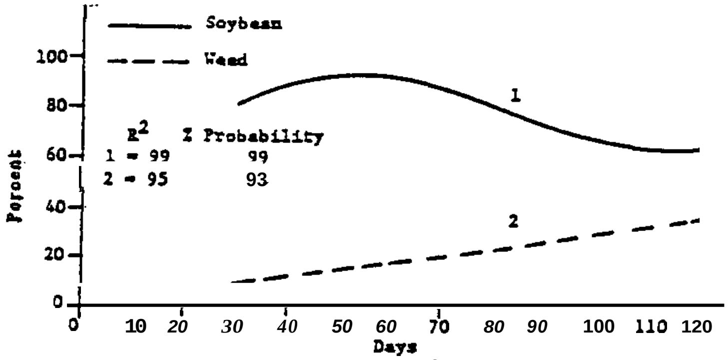


Figure 6. Change in percent dry matter for soybean and weeds during the soybean growing season. 1 = soybean averaged over residue treatments; 2 = weeds averaged over residue treatments.

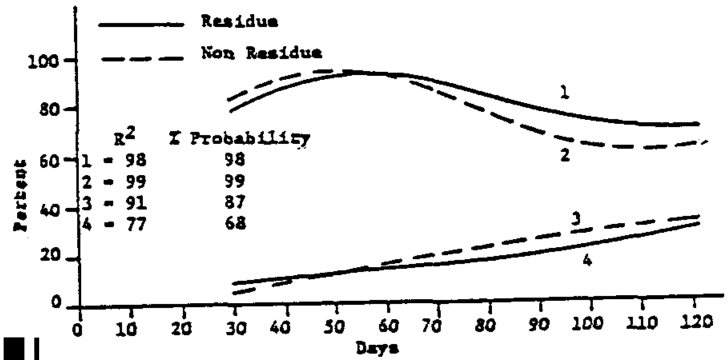


Figure 7. Change in percent energy for soybean and weeds during the soybean growing season. 1 and 2 = soybean; 3 and 4 = weeds.

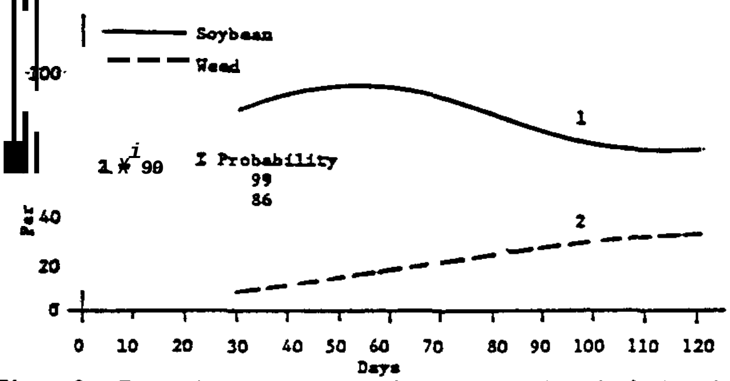


Figure 8. Change in percent energy for soybean and weeds during the soybean growing season. 1 = soybean averaged over residue treatments 2 = weeds averaged over residue treatments.

Conclusions

Residue incorporation had a greater influence on sicklepod than soybean. Residue reduced sicklepod dry matter. Total soybean plus sicklepod dry matter was greater for residue plots for the first 30 days of soybean growth but this relationship reversed for the last 50 days. The higher dry matter in non-residue plots is likely due to moisture stress causing deeper soil penetration of roots. Total caloric energy followed the same trends as for dry matter but had slightly different slopes of change over time. Sicklepod competed very little with soybean during the first 50 days of growth. After 50 days, competition for space steadily increased for sicklepod and caused major competition for soybean. Residue incorporation gave less competition by sicklepod as compared to non-residue. We estimate that soybean energy accumulation was reduced by one-third due to competition of sicklepod.

SOYBEAN ROOT RESISTANCE AS AFFECTED BY TILLAGE IN OLD TILLAGE STUDIES

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Introduction

Many scientists have observed that yields of soybean (Glycine max L. Merr.) tend to decrease beginning the second or third year of continuous no-tillage. The exact reason for this decrease has never been thoroughly defined. Some have proposed that conventional tillage is needed every second or third year to eliminate the problem. Another approach is to conventionally till the soil every year in the fall when establishing the small grain and to utilize no-tillage planting only for the summer crop when timing, incorporation of fertilizers, moisture conservation, and/or soil conservation are more important. While these and other manaqement practices help reduce or eliminate decreased yields over time with continuous no-tillage, the problem still needs to be defined so that other possible solutions may be found. The purpose of this research was to measure root resistance of soybeans as an indication of rooting patterns in relation to no-tillage and conventional tillage. Root resistance was measured by determining the maximum g/cm^2 required to pull soybean plants free from their attachment to the soil.

Materials and Methods

A single root resistant measurement consisted of selecting a 2324 cm^2 section at random in soybean plots. In this measurement area the number of soybean plants were counted for calculating the area per plant. Three side-by-side plants were then selected from the area at random, tied together near the base with a string which was attached to a killogram scale. A smooth and continuous force was then applied to the scale until the soybean plants were released from the *soil*. The maximum reading on the scale was recorded. Five selection sites and readings were taken in each individual treatment of a replication and averaged for the treatment-replication value. These readings were adjusted for population so that plant size would not be a confounding factor. An example of a root resistant calculation is as follows: 1) assume the number of plants in a 2324 cm^2 area was 8.2; 2) assume the field resistance for three plants was 15.2 kg; 3) the area per plant would be 2324 cm^2/8.2 plants = 283.4 cm^2 /plant; 4) the original g resistance per plant would be 15.2 kg X 1000 g/kg/3 plants = 5067 g/plant; 5) the corrected root resistance would be 5067 g/plant/283.4 cm^2/plant = 17.88 g/cm^2,

One experiment where measurements were made was an oat (Avena sativa)/soybean succession begun in 1974. Tillage treatments included 1) no-tillage plus subsoil, 2) no-tillage, 3) conventional tillage plus subsoil, and 4) conventional tillage. No-tillage treatments were imposed with an in-row subsoil no-tillage planter. Conventional plots were tilled to a depth of 25 cm with a rototiller and planted with the same planter. Root resistance measurements were begun in 1981 and will continue through 1984 at which tine the tillage treatments will have been maintained for eight years. Measurements were taken just prior to senescence except in 1983 when one measurement was taken 11 days prior to senescence and a second measurement was taken at senescence.

Measurements were made in a rye (Secale cereale L.)/soybean succession which began in 1975 and ended in 1983. This experiment had only two tillage variables until 1981 and included 1) no-tillage plus subsoil, and 2) no-tillage. In 1981 these treatments were split to include 1) continuous no-tillage plus subsoil, 2) imposed conventional tillage plus subsoil, 3) continuous no-tillage, and 4) imposed conventional tillage. Root resistance measurements were begun in this study in 1981 and continued through 1983. Heasurements were taken just prior to senescence of the soybeans except in 1983 when the measurement was taken about one week after senescence.

Root resistance measurements were also made in two other experiments with identical tillage variables in 1981 to observe first year mulching effects for soybean and peanut (Arachis hypopaea L.). Treatments in these studies included 1) no-tillage into rye straw residue, 1) no-tillage after rye straw removal, 3) conventional tillage incorporation of rye straw, and 4) conventional tillage after rye straw removal.

All experiments were conducted on an Arredondo fine sand (loamy, silicious, hyperthermic grossarenic Paleudults) and were in randomized complete block designs. Experiments were replicated four times. Analysis of variance was run using standard procedures and means tested using Duncans new multiple range test.

Results and Discussion

Subsoiling in either no-tillage or conventional tillage resulted in greater root resistance than nonsubsoiling treatments (Tables 1 and 2). The traditional no-tillage treatment had the least root resistance in almost all cases, followed closely by conventional tillage.

Visual observation of soybean roots in no-tillage without subsoiling showed that roots were confined to the upper few centimeters of soil in close association with the previous oat or rye residues. Observations support the idea that, since small grain residue mulch conserves moisture and degrades rapidly under Florida conditions, more water and nutrients are available near the soil surface for the no-tillage soybeans. This favorable environment near the soil surface would favor root growth in the upper few centimeters. The mulching study (Table 3) supoorts this idea because root resistance for both soybeans and peanuts were lowest in mulch treatments.

In 1976, when the experiments in Tables 1 and 2 were begun, one of the objectives was to determine if the recently invented no-tillage in-row subsoil planter would alleviate the yield decline problem for no-tillage soybeans. Root resistance data and visual observations indicate that roots are stimulated to grow to deeper depths as well as proliferate near the surface under the small grain mulch in the no-tillage plus subsoil plots. Root resistance for no-tillage in-row subsoil were equal in almost all cases to root resistance measuredin conventional tillage in-row subsoiling.

These data show that crop residues play a Major role in distribution and location of roots. No-tillage in-row subsoiling can allow direct seeding without tillage over a longer period than traditional no-tillage planting of soybeans based on root resistance data in this report. It is proposed that crop residues acting as a mulch in no-tillage soybeans causes roots to grow nearer the soil surface because of additional water, lower soil temperatures, and slower release of plant nutrients. Root resistance data from this researcl; supports this idea. Because of this soil surface root gowing habit under mulching conditions, few roots would be deep in the soil profile and plants could he adversely affected during periods of drought stress. This rooting habit under no-tillage is Likely part of the reason that soybean yields decrease after the second or third year of continuous no-tillage. Since research studies have shown yield responses to no-tillage in-row subsoil planting under these conditions, the use of this type of no-tillage equipment would result in roots utilizing the surface benefits of the mulch as well as encouraging deeper rooting habits in order to better maintain the plants during drought stress.

Acknowledgement

The author acknowledges and appreciates the technical assistance of Mr. Sonny R. Tompkins, Agricultural Technican III, in obtaining the root resistance data.

Table 1. Soybean Root Resistance in an oat-soybean double cropping system.

Tillage	Year 1981	1982	1983-1	1983-2	Average
	g/cm2				
No-Tillage Sub.	10.00a	17.53a	13.96 b	9.52b	12.75a
No-Tillage	5.21b	11.28b	10.91c	6.99c	8.60c
Conv-Tillage Sub.	9.26a	17.85a	16.35a	10.47ab	13.48a
Conv-Tillage	9.95a	12.57b	12.61 b	11.36a	11.62b

Conv is conventional. Sub is subsoil. Values in columns not followed by the same letter are significantly different at the 0.05 level of probability according to Duncans new multiple range test.

Table 2. Soybean root resistance in a rye-soybean double cropping system.

Tillage	Year 1981	1982	1983	Average
	g/cm2			
No-tillage Sub.	9.26 a	9.75 a	6.28 ab	8.43 a
No-tillaee	6.15 b	6.92 b	5.32b	6.13 b
Conv-tillage Sub.	7.95 a	10.68 a	8.43 a	9.33 a
Conv-tillage	7.89 a	5.53 b	6.58 a	7.00 b

Conv is conventional. Sub is subsoil. Values in columns not followed by the same letter are significantly different at the 0.05 level of probability according to Duncans new multiple range test.

Table 3. Soybean and peanut root resistance in double cropping systems with rye for grain in 1381.

Tillage	crop Soybean	Peanut
	g/cm 2	
No-tillage plus rye straw	5.85 b	7.44 b
No-tillage minus rye straw	4.89 b	10.9 7a
Conv-tillage plus rye straw	6.21a	9.73ab
Conv-tillage minus rye straw	6.88a	12.81a

Conv is conventional. Values in columns not followed by the same letter are significantly different at the 0.05 level of probability according to Duncans new multiple range test.

EFFECTS OF TILLAGE SYSTEMS ON YIELD OF SOYBEAN VARIETIES

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Alabama had 1.5 million acres in soybeans in 1983 and 18 percent was in conservation tillage. Much research has been done with tillage systems with one or two soybean varieties. However additional research, using a large number of soybean varieties is needed to determine if varieties respond differently among various tillage systems. In 1983, a study was conducted at the E.V. Smith Research Center to see if an interaction exists between tillage systems and varieties.

Tillage systems were conventional tillage, no-till, and no-till with in-row subsoiling. Varieties used are listed in Table 1. All plots were planted June 10 with a John Deere Flex 71[1] planter. No-till plots were planted in wheat stubble with a fluted coulter and no-till with in-row subsoiling were planted with a Brown-Harden[1] ro-till(9-inch subsoil depth). Conventional tillage plots were moldboard plowed and disked 6 weeks prior to planting, then rototilled before planting.

One year's data indicated some soybean varieties responded differently among tillage systems. Some soybean varieties had higher yields when grown with conventional tillage than either of the no-till systems, except for Ransom and Wright which yielded the same on the no-till subsoil as the conventional tillage. These varieties are listed in Table 2. With these varieties, conventionally grown soybeans had a yield range from 22.7 to 36.7 bu./acre; no-till, in-row subsoiling was next with yields from 19.2 to 35.9 bu./acre; and no-tillage was lowest with yields from 15.2 to 31.5 bu./acre. The highest yielding variety with conventional tillage was Coker 156; with no-till, in-row subsoiling was Ransom; and with no-tillage was Wright.

Some soybean varieties (Table 3) had their highest yields with no-tillage and lowest with conventional tillage. Soybean yields with no-tillage ranged from 27.2 to 36.4 bu./acre; yields with no-till plus in-row subsoiling ranged from 26.6 to 34.6 bu./acre; and yields with conventional tillage ranged from 21.4 to 30.1 bu./acre. Cobb was the highest yielding variety regardless of tillage system.

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[1]Mention of trademark name or proprietary product does not constitute a guarantee or warranty of the product by Auburn University and does not imply its approval to the exclusion of other products that may also be suitable.

Yields of some soybean varieties were the same for all tillage systems (Table 4). Varieties unaffected by the three tillage systems studied included Braxton, Coker 237, and Coker 488. These varieties averaged 35.6 bu./acre across tillage practices.

The data reported are only for one year, thus more testing is needed before any conclusions about variety reaction can be made. This is due to the reaction of varieties with the environment and the tillage system. However, the data do indicate varieties respond differently under various tillage practices. This test will be repeated in future years, primarily because it appears that with some varieties no-tillage without the use of expensive in-row subsoiling may be possible.

Table 1. Soybean Varieties and Maturity Groups

Maturity group	Variety
V	Bay, Bedford, Coker 355, Forrest
VI	Centennial, Coker 156, Davis, Tracy M
VII	Braxton, Coker 237, Ransom, Wright
VIII	Cobb, Coker 338, Coker 488, Hutton

Table 2. Soybean Varieties Which Yielded Higher on Conventional Tillage

Variety	Yield per acre		
	Conventional	No-till, subsoil	No-till
	Bu.	Bu.	Bu.
Bay	22.7	19.2	19.7
Bedford	26.8	23.3	21.6
Centennial	35.1	32.9	28.9
Coker 156	36.7	32.7	29.3
Coker 355	27.7	25.9	21.1
Davis	35.0	33.4	26.5
Forrest	31.9	25.5	15.2
Ransom	34.8	35.9	31.4
Tracy M	35.0	23.0	19.6
Wright	33.0	34.6	31.5

Table 3. Soybean Varieties Which Yielded Higher on No-till

Variety	Yield per acre		
	Conventional	No-till, subsoil	No-till
	Bu.	Bu.	Bu.
Cobb	30.1	34.6	36.4
Coker 388	26.9	30.5	29.4
Hutton	21.4	26.6	27.2

Table 4. Soybean Varieties For Which Yields Were Not Affected by Tillage Systems

Variety	Yield per acre		
	Conventional	No-till, subsoil	No-till
	Bu.	Bu.	Bu.
Braxton	35.4	35.7	36.8
Coker 237	35.5	36.4	34.4
Coker 488	34.5	36.0	35.3

NO-TILLAGE PLANTING OF SOYBEANS AFTER WINTERGRAZED RYEGRASS PASTURE

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INTRODUCTION

Approximately 300,000 acres of ryegrass-legume or small grain combinations are planted annually for winter grazing beef cattle in Mississippi. These pastures are planted from mid-September to the end of November and grazed until the forage matures about mid-May. Areas used for winter pasture are sometimes fertilized to produce native grasses for grazing or hay but generally are untended until planted again for winter grazing.

These unused acres have a potential for soybeans production because termination of the wintergrazing season coincides with the optimum planting date for full season soybeans. The date of soybean harvest coincides favorably with the planting date of forage species used for wintergrazed pasture. In spite of the potential for planting soybeans after wintergrazed pasture, and the fact that many innovative producers are double-cropping, research on this subject has been very limited.

Due to the high cost of land, many farmers are planting soybeans after wintergrazed pasture to increase cash flow. When conventional tillage practices are used, acceptable grain yields are obtained: however, severe erosion problems can be encountered on the sandy soils and rolling terrain. Using no-tillage practices reduces the erosion problem, moisture loss and machinery trips across the field, but yields have been low because the soil is compacted by cattle grazing which makes proper seed placement and coverage difficult. Land preparation, soil compaction, and erratic moisture distribution delay planting and make it important to investigate the feasibility of no-tillage cultural practices in the production of soyeans after wintergrazing.

Experiments with no-tillage soybeans planted after wintergrazed ryegrass pasture were conducted for four years (1978-81) at the White Sand Unit of the South Mississippi Branch Experiment Station. Five tillage treatments (table 1) were evaluated on a Basin soil using a split plot statistical design with tillage treatments as main plot and row width as sub plot.

PROCEDURES

Cattle grazing winter pasture were removed in mid-May and soybeans planted the last week in May. The tillage treatments imposed were: chisel and disc, disc only, no-tillage with in-row subsoiling, no-tillage with colter only, and no-tillage with an alfalfa tyne in row. In all instances a rippled colter was used. Two row widths (20 and 40 in) were imposed upon each tillage treatment. Disc and chisel/disc operations were done a week prior to planting with cultipacking and leveling done the day of planting. In-row subsoiling was accomplished by marking the rows, running a 1 row subsoiler 12 in deep and planting over the subsoiled area. No-tillage treatments were imposed at planting in a once-over operation.

Weed control was accomplished using a tank mix of 1.5 pt paraquat plus .25% VV surfactant for non-selective weed control (burn down). Preemergence weed control was 2 quarts of Lasso and 0.5 lbs Metribuzin 50 W applied in 35 gallons of water per acre. Post emergence weed control was accomplished by post directing 0.5 pt of paraquat plus .25% VV surfactant.

Seed yield was determined by harvesting four 40-inch rows or seven 20-inch rows 50 feet long. Plant height was determined by measuring from the soil surface to the terminal leader of four plants per sub plot at harvest. Plant stand was determined by counting two40 inch lengths of row per sub plot.

RESULTS

The major problems encountered in soybean seeding were colter penetration and seed placement in the no-till with colter and colter with alfalfa tyne treatments because of dry soil conditions and soil compaction by grazing animals. Seed placement in the other treatments was not a problem because of the amount of soil disturbed.

There were differences in plant stand attributable to tillage treatment ranging from 16.4 plants/40 inch of row for no-till with colter only to 21.7 for chisel and disc. Current research shows that these differences are not enough to affect yield.

Soybeans planted using conventional methods were taller at maiuiity than those planted using no-tillage without an in-row subsoiler. Soybeans planted using and in-row subsoiler were not significantly different in height from the other treatments.

There was no difference in yield between the conventionally planted and no-tillage in-row subsoiler planted soybeans but the other two treatments did produce lower yields.

There was no interaction between row width and tillage treatment. Soybeans planted in 20 inch rows produced higher plant stands, taller plants and yielded more than those planted in 40 inch cows.

No-tillage practices in this case do not appear to be superior in yield to conventional land preparation and planting procedures. However, factors that should be considered in addition to bushels per acre are monetary returns per acre and conservation of resources such as soil, fossil fuels and labor. Cost and return budgets indicate that the cost of no-tillage soybean production is $17 to $20 per acre less than conventional tillage. A quart of paraquat is substituted for numerous trips across the field with tillage machinery requiring both labor and high cost fuel. The savings in time and labor may also enable a farmer to put more acreage into production.

Table 1. Four year average of soybean plant stand, final plant height, and seed yield averaged over two row widths as affected by tillage treatment, MAFES South Mississippi Branch Station, Poplarville, Mississippi 1978-81.

Treatment	Plant stand	Final plant height	Seed yield
	plants/40"	in.	bu/ac
Tillage method			
No-tillage with in-row subsoiler	20.5[ab]*	21.0[ab]	21.0[a]
Chisel and disc	21.7[a]	27.9[a]	21.1[a]
Disc	18.2[bc]	22.6[a]	21.3[a]
No-tillage with alfalfa tyne in row	18.2[bc]	18.7[b]	16.5[b]
No-till colter only	16.4[c]	17.8[b]	15.7[b]
Row width			
20"	19.6[a]	21.9[a]	20.2[a]
40"	18.4[b]	19.2[b]	18.0[b]

* Means followed by the same letter are not different at the 5% level of significance according to Duncan's multiple range test.

A REVIEW OF SOYBEAN TILLAGE STUDIES CONDUCTED ON BROWN LOAM SOILS OF NORTH MISSISSIPPI

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Research on tillage practices has been conducted at Mississippi Agricultural and Forestry Experiment Station, North Branch, for more than two decades. Unfortunately, yield data have been inconsistent and quite frustrating to scientists. In many studies the first years' yield data showed a substantial yield reduction for the no-till system. Yet, when experimental plots were maintained on the same site for consecutive years this yield difference tended to disappear when using the same mechanical, chemical and cultural practices. This paper reviews the data from our tillage studies and summarizes our findings in no-till soybean research.

In 17 field experiments where conventional and no-tilled systems were compared on monocrop soybeans, an average of 22% reduction resulted in grain yield the first test year (Table 1). It was considered that grasses, poor crop stands and plant injury from herbicides caused some of this reduction. These experiments were conducted on sites that were conventional tilled in the year prior to the study and had virtually a clean soil surface.

In the second and succeeding experimental years when no-till plot sites were maintained in the same location, the no-till yields were reduced by an average of 13% in a monocrop system. Crop residue was not burned, baled or destroyed by plowing on these sites.

It appears that a definite relationship exists between the accumulation of crop residue and improved no-till monocrop soybean yields. Even though not measured at this location, there should be a reduction in evaporation when a mulch is allowed to build.

In a three-year double cropping study there was a reduction in the average yields for no-tilled double cropped soybeans. There was no difference, however, in the average yields of the no-tilled monocrop soybeans in the same study (Table 2).

Although there was adequate crop residue from the wheat straw in the double crop no-till soybeans It may not necessarily serve as a mulch. Beneficially, wheat straw residue can serve a dual role in no-till double crop wheat-soybean regime. First, it can serve as a thatch to help break the force of the raindrops. This helps prevent erosion. Second, it can form a mulch to retain moisture from runoff and evaporation. How good a mulch the thatch would form could depend on stubble height, coarseness or fineness of chopped straw and how even it is spread.

Soil moisture is an important factor in determining soybean grain yield. It would be impractical to use either ground or surface water for irrigation on the Brown Loam Hills of Mississippi for soybean production. Since the hill lands of North Mississippi have a moderate production capability, an additional increase in production cost through irrigation may not necessarily result in additional returns. A thatch of crop residue may help in reducing runoff, reducing evaporation, and conserving soil moisture to be available at the appropriate growth stage. Future research at this station will deal with how to form better mulches for moisture conservation using no-till planting practices.

Table 1. A summary of monocrop soybean tilage experiments conducted at MAFES, North Branch between 1978-1983 where the experimental site was conventional tilled in years prior to the experimental study.

Tillage System	Average grain yield and percent yield reduction for no-till			
	Soybean grain yield		Yield reduction	
	First year of experiment	Average of succeeding years of experiment	First Year of experiment	Average of succeeding years of experiment
	----bu/A----		----%----	
C.T.1/	31.4	27.9	0	0
N.T.2/	24.4	24.3	22	13

Table 2. Comparison of tillage regimes and row spacing on soybean yields when grown as a monocrop and as soybean-wheat double crop at MAFES, North Branch during 1981-1983.

Preplant tillage	Row spacing	Soybean Cropping Regime							
		Monocrop				Double Crop			
		1981	1982	1983	Avg.	1981	1982	1983	Avg.
		---- bushels per acre ----							
C.T.1/	36"	38	33	38	36.3	43	33	34	36.7
C.T.	10"	32	35	40	35.7	36	35	36	35.7
N.T.2/	36"	35	35	41	37.0	36	31	21	29.3
N.T.	10"	31	37	39	35.7	31	29	36	32.0

1/ Conventional tilled seedbed (disked, chiseled, disked, field condition, plant).
2/ No-tilled seedbed (planted in old seedbed with a no-tillplanter).

FERTILIZER MANAGEMENT OF MONOCROPPED SOYBEANS IN REDUCED TILLAGE SYSTEMS

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Introduction

Placement of P and K fertilizers in reduced tillage systems for soybeans has recently received much attention in the farm and agricultural research press. The resource-conserving advantages associated with reduced tillage systems are accompanied by a number of management difficulties, one of which is poor vertical fertilizer distribution. Because P and K fertilizers are relatively immobile in most soils, broadcast applications of these nutrients under no-till management leads to accumulation of P and K in the top few inches of soil (Whitney, 1982; Bakermans and Wit, 1970). Surface accumulation of P and K may result in "positional unavailability" because uptake by roots in the surface can be inhibited by soil drying and herbicides. This problem, and the need to evaluate fertilizer rates and placement in conservation tillage systems, has recently received national recognition (Quinn et al., 1984).

Suggested methods for overcoming this problem include placing starter fertilizer in the bottom of an in-row subsoil track (Martin and Touchton, 1983), deep injection of liquid P and K, banding and dribbling strip applications of P and K on the soil surface, and tillage rotations. In general, it has been shown that deep placement of fertilizer results in more efficient use of applied nutrients (Batchelor, 1983), but relatively little data exists for methods of P and K placement in no-till soybeans. Thus the objective of this work was to evaluate P and K applied by liquid injection or surface broadcast in conventionally tilled and no-till soybeans.

Materials and Methods

'Centennial' soybeans were planted on a Memphis silt loam at Raymond, MS, an Okolona silty clay at Brooksville, MS, and a Leeper silty clay loam at Mississippi State University (MSU) in 1983. Each experiment was a split-split plot design. The treatments at the Raymond and Brooksville locations were tillage (conventional chisel plow vs. no-till), method of fertilizer placement (injected vs. broadcast), and fertilizer rates (0-0-0, 0-30-45, 0-90-135 lbs/a). Each treatment was replicated five times. At MSU, treatments included tillage (conventional vs. no-till), row placement (in or between the previous year's rows), and fertilizer placement (injected vs. broadcast 0-90-135). Each treatment was replicated four times.

The liquid fertilizer used was a mixture of K_2HPO_4 and KC1 and was injected 8" deep and 4" to the side of the row. Initial soil test values were low to medium for P and K at Brooksville and Raymond, while both P and K tested high at MSU.

Results and Discussion

Soybean yields for the MSU location are seen in Table 1. There was no significant yield difference between broadcast and injected fertilizer treatments in either no-till or conventionally tilled plots when soybeans were planted in the old rows. When beans were planted between the old rows, broadcast P and K resulted in significant yield increases in the conventionally tilled plots while injected P and K increased yields in the no-till treatments.

On the Blackbelt soil at Brooksville, there was no significant response to injection in either tillage system (Table 2). On the Brown Loam soil at Raymond, injection resulted in a significant yield increase over broadcast P and K in no-till plots, but no difference was observed in conventionally tilled beans. At both locations, increasing rates of broadcasted P and K in no-till treatments caused a slight yield decrease that was not observed in injected plots. The first year of the tillage rotation (3 times the annual fertilizer rate with deep incorporation) resulted in significantly higher yields relative to broadcast no-till plots.

Results at these three locations indicates that liquid injection of P and K can overcome positional availability problems in no-till soybeans, and are similar to those results of Martin and Touchton (1983), who noted positive responses to deep placement of P and K in double cropped soybeans. Because yields of no-till soybeans in heavy textured soils are usually lower than conventional-tilled beans (Sanford et al., 1983) this management practice may hold promise for the future.

Row Placement	Method of fertilizer application	Tillage Conventional	Tillage No-till
Planted in old rows	Broadcast	32.3 (A)	32.4 (A)
	Injected	31.3 (A)	34.8 (A)
Planted between old rows	Broadcast	36.9 (B)	32.4 (A)
	Injected	32.2 (A)	36.2 (B)

Table 1. Soybean yields (bu/a) as a function of tillage, method of fertilizer application, and row placement on a Leeper silty clay loam at MSU, 1983. Yields followed by the same letter do not differ at the 0.05 level of significance (DMRT valid for comparison of broadcast and injected pairs only.)

	Annual rate of P_2O_5 (lbs/a)	Method of Fertilizer Application: Broadcast	Inject	3 x Annual rate:deep incorporation
No-Till	0	19.2	19.5	20.1
Okolona silty clay	30	18.2	18.0	23.9
Brooksville, MS	90	16.4	20.2	22.4
	Means	18.0(B)	19.2 (AB)	22.1 (A)
Conventional tillage	0	19.9	16.4	23.4
Okolona silty clay	30	20.9	19.1	22.9
Brooksville, MS	90	21.7	20.0	22.6
	Means	20.9(AB)	18.5(B)	23.0(A)
No-Till	0	12.0	16.7	23.8
Memphis silt loam	30	10.2	14.1	23.8
Raymond, MS	90	8.6	16.2	22.1
	Means	10.3(C)	15.7(B)	23.2 (A)
Conventional tillage	0	20.4	20.7	21.3
Memphis silt loam	30	19.6	18.8	20.3
Raymond, MS	90	19.9	20.9	20.7
	Means	19.9(A)	20.1 (A)	20.8(A)

Table 2: Sovbean Yields (bu/a) as a function of tillane, method of fertilizer application, and rate of fertilizer application on Blackbelt and Brown Loam loess soils in Mississippi, 1983. Yields and means in each row followed by the same letter do not differ at the 0.05 level of significance (DMRT).

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EFFECTS OF TILLAGE ON SOYBEAN YIELDS, NET RETURNS AND INCIDENCE OF STEM CANKER ON BLACKLAND PRAIRIE SOIL IN MISSISSIPPI

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The Blackland Prairie Land Resource Area (Black Belt) of Mississippi and Alabama (4.52 million acres total, over 2 million in Mississippi) is comprised of soils with a high content of expanding clay. These soils developed from soft chalky limestone. The topography is gently sloping and, while erosion rates for these soils are much less than for loess soils, erosion is a serious concern among farmers and conservationists in the Black Belt. Extensive erosion occurred in the past due to the practice of preparing the soil in the fall so that cotton and corn could be planted early. Because of past natural and accelerated erosion, chalk outcrops and thin soil occupy a significant acreage in the Black Belt.

A high percentage of the Black Belt in Mississippi is presently in row crops, primarily soybeans which produce relatively little crop residue. This, along with poor conservation practices such as plowing up and down the slope and some fall plowing, have caused erosion to again become rampant. Reduced tillage and no tillage have been shown to be effective in reducing erosion in numerous studies. Double cropping wheat and soybeans can also be an excellent conservation practice. However, some soils are not well suited to double cropping and the acreage of double cropped soybeans that can be managed effectively is limited.

We established a study on Okolona silty clay at the Mississippi Black Belt Branch Station, Brooksville, MS to evaluate five soybean production systems. The systems are (1) conventional land preparation (beginning in the spring) and cultivated, (2) fall chiseling plus conventional, (3) stubble planted and cultivated, (4) stubble planted and not cultivated (no-till), and (5) double cropped with wheat. In the double crop treatment, the wheat and soybeans are no-till planted with soybeans being cultivated. In addition to yields, several other parameters are measured such as (1) net return, (2) runoff and erosion, (3) nutrients in runoff, (4) herbicides in runoff, (5) penetrometer resistance, (6) residue and canopy cover, etc. Data collection began January 1, 1981. This is a report of a small amount of 3-year period 1981-1983, net returns, and the relationship between production systems and an infection of stem canker which occurred during the 1983 growing season.

The yields for treatments where the soil received primary tillage (seedbed prepared) have been better than those for the stubble planted treatments. This same study is also replicated on Leeper silty clay at Mississippi State University (MSU). Yields at MSU for the 3 years show identical trends those at Brooksville. The main difference in yields between locations is one of magnitude. Yields at MSU are somewhat higher on the Leeper soil (a bottom-land soil).

Production system	Yield 1981	Yield 1982	Yield 1983[1/]	Yield 2 yr. avg.	Avg.net returns	Plants infected by stem canker in 1983
	bu/a	bu/a	bu/a	bu/a	$/a/yr.	%
Monocrops:						
Conventional	25.0	27.9	12.6	26.4 a[2/]	53	19.2 c[2/]
Fall chisel + conv.	25.1	28.9	8.3	27.0 a	43	34.2 b
No-till plant, cultivated	18.6	21.2	4.2	19.9 b	21	86.0 a
No-till plant, not cultivated	18.4	18.9	5.0	18.6 b	24	80.0 a
Double crop:						
Soybeans	12.8	18.3	9.4	15.6 c	128[3/]	4.2 d
Wheat	(47.6)	(40.9)	(26.7)			

1/ 1983 soybean yields were severely reduced by an infection of stem canker and drought and were not included in the average.

2/ Means followed by the same letter are not significantly different at the 5% level of probability.

3/ Double crop average net returns are based on the combined net returns from both soybeans and wheat for 1981 and 1982.

Stem canker was much worse on plots with high residue cover; i.e., the no-till planted plots. Stem canker was also a problem at MSU in 1983; however, the disease was less severe at MSU and yields were not reduced as much as at Brooksville. Disease ratings were made at both locations during the pod filling stage (mid-September). Disease ratings for MSU were similar to those at Brooksville but at an overall lower rate of infection. The cultivar used at both locations each year of the study was 'Centennial', a soybean cultivar with some resistance to stem canker.

This study is being continued at both locations in 1984 and the plots will be closely monitored for stem canker.

INFLUENCE OF CROP ROTATION AND TILLAGE SYSTEMS ON CORN AND SOYBEAN YIELDS

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Conservation tillage is a system of managing crop residue on the soil surface with minimum or no tillage. With the development of effective chemical weed control and suitable planting equipment, use of conservation tillage systems has increased considerably in Alabama. Several minimum and no-tillage systems have been developed that produce corn yields equal to or higher than those obtained with conventional tillage. However, additional information is needed on conservation tillage systems for soybeans or soybeans in rotation with corn.

A recent study by the Alabama Agricultural Experiment Station showed that soybean yields were increased by conservation tillage practices and crop rotation. Conventional tillage systems were compared to minimum and no-tillage systems on soybeans, corn, and wheat on a Hartsells fine sandy loam soil on the Sand Mountain Substation at Crossville, from 1981 to 1983.

The minimum tillage treatment consisted of planting corn and soybeans over 8- to 9-in. deep chisel slots; the no-tillage treatments were planted with a double-disk opener planter directly into the untilled soil surface. Row spacing was 36 in. Cropping sequences were continuous soybeans; continuous corn; corn-soybeans; and corn-wheat for grain-soybeans. Wheat was on all plots as a winter cover, including those plots not used for grain crop. The wheat was killed on the winter cover plots 10 days before planting corn or soybeans.

Continuous soybean yields were increased 16% with the no-till and in-row chiseling tillage systems over conventional tillage in 1981 and 1982, and 52 and 34% by the no-tillage and in-row chiseling tillage, respectively in 1983. The 3-year average yield of soybeans in 2-year rotation with corn, across all the tillage systems, was 23% higher than under continuous soybeans (Table 1).

This reduction of soybean yield under continuous soybeans may be caused by a soybean cyst nematode (SCN) population found in September, 1983 (Table 2). SCN counts were lower in plots where soybeans were rotated with corn than in continuous soybeans, except with conventional tillage. The nematode numbers were further reduced in a double-cropped system with wheat for grain. It is speculated that the reduced time the land was cropped to soybeans is the reason for this reduction in nematode count.

Corn yields in 1983 were 14% higher when rotated with soybeans than when corn was grown continuously, and 8% higher for the 3-year average across all tillage (Table 1). Yields in 1983 were 10% lower on conventional tillage than other tillage systems when averaged

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[1]Cooperator, USDA - in part Summer Highlights article.

across all cropping systems, and 7% lower for a 3-year average. SCN were not found in plots where continuous corn was grown. The conventional tillage had higher SCN counts than other tillage treatments. The stunt nematode count under corn was not affected by rotation with soybeans.

The results of this study show that soybean yields were increased by conservation tillage practices and crop rotation. Further, the results suggest that cultivating soybeans exclusively will result in the buildup of soybean cyst nematodes, and cultivating corn exclusively will result in the buildup of stunt nematodes in corn. This may be a factor contributing to lower yields of these crops.

Table 1. Effect of tillage systems and cropping sequence on yields of corn and soybeans, 1981-1983.

Cropping sequence[1]	Per acre yield by treatment			
	Conventional	Chisel under row	No-tillage	Avg.
	Bu.	Bu.	Bu.	Bu.
3-year average soybean yield				
Soybean continuous	20.8	27.3	31.8	26.6
Soybean-corn	31.0	32.9	33.8	32.6
Corn-wheat for grain-soybean	33.9	31.2	27.5	30.9
Av.	28.6	30.5	31.0	
3-year average corn yield				
Corn continuous	117	110	108	111
Corn-soybean	111	127	118	118
Corn-wheat for grain-soybean	114	127	122	121
Av.	114	121	116	
2-year average wheat yield				
Wheat	32.6	31.1	28.7	30.8

1 Wheat was on all plots as a winter cover, including those plots not used for grain crop.

Table 2. Effect of tillage systems and cropping sequence on soybean cyst nematode counts found in September, 1983 after 3 years of cropping.

Cropping sequence[1]	Count per 50 cc soil: Conven- tional	Chisel under row	No- till- age	Av.
	Soybean cyst larvae and cyst counts under soybeans			
soybean continuous	460	806	498	598
Soybean–corn	1090	143	21	418
Corn–wheat for grain–soybean	246	13	2	95
Av.	598	321	189	--
	Soybean cyst larvae and cyst counts under corn			
Corn continuous	1	1	1	1
Corn–soybean	100	23	4	42
Corn–wheat for grain–soybean	54	39	3	31
Av.	51	21	2	--

[1] Wheat was on all plots as a winter cover including those plots not used for grain crop.

Effect of In-row Chisel at Planting on Yield and Growth of Full Season Soybeans

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Sandy surface soils, such as those in the Coastal Plains of Alabama, are highly susceptible to traffic and tillage compactions. Wheel traffic of tractors and combines often compacts the plow layers, and disks and plows can create severe compaction at the bottom of the tillage zone, which is referred to as a disk, plow, or tillage pan. These compacted layers often prevent proper root development and prevent roots from reaching available moisture in the subsoil horizons. Tillage pans are present in almost all soils, but they do not restrict root development in all soils.

During 1974 and 1975, the Alabama Agricultural Experiment Station conducted a study at the Wiregrass Substation to determine the effects of in-row subsoiling, conventional tilled soil, and planting date on growth and yields of Forrest, McNair 600, and Bragg soybean varieties. The conventional treatment seedbed was prepared by turning soil 9 inches, disking, and rotary tilling (prior to planting). The chisel treatment was prepared with a 2-inch subsoil shank run to a depth of 14 inches and the soil bedded over the chisel opening (Table 1).

Table 1. Effect of planting date and in-row chiseling on soybean yield and plant height when grown at Wiregrass Substation, 1974-75

Planting date	Soil preparation	Variety	Yield 1974	Yield 1975	Yield 2-yr. Av.	Plant height 1974	Plant height 1975	Plant height 2-yr. Av.
			(bu./acre)			(inches)		
Early	Chisel	Forrest	45	27	36	28	24	26
Early	Chisel	McNair 600	47	34	41	30	25	28
Early	Chisel	Bragg	45	29	37	33	29	31
				Av.	38			28
Early	Conventional	Forrest	30	25	28	23	21	22
Early	Conventional	McNair 600	36	36	36	21	24	23
Early	Conventional	Bragg	33	27	30	27	28	28
				Av.	31			24
Late	Chisel	McNair 600	44	31	38	30	37	34
Late	Chisel	Bragg	54	27	41	35	31	33
				Av.	40			34
Late	Conventional	McNair 600	33	30	32	25	23	24
Late	Conventional	Bragg	39	25	32	31	26	29
				Av.	32			27

[1]Planting dates were May 10 and May 30 for 1974 and May 22 and June 3 for 1975.

There was a yield increase to chiseling under the row with all varieties at both planting dates in 1974. However, yields were not different due to chiseling in 1975. There was a planting date interaction on yield of McNair 600 and Bragg in 1974 in that McNair 600 produced a higher yield for May 11 planting but was lower in yield than Bragg for the May 30 planting (Table 1). All varieties responded with increased plant height at both planting dates and in both years where the subsoil chisel was used.

From 1977 through 1981 the Alabama Agricultural Experiment Station conducted studies at nine locations in Alabama to determine if disrupting the tillage pans with an in-row subsoiler at planting, in both conventional and no-tillage cropping systems, would improve soybean plant growth and yields.

The conventional tillage treatment consisted of either chiseling or turning soils 8-10 inches deep and then disking, rotary tilling, or using a combination seedbed conditioner to prepare a seedbed. The no-tillage treatment was planted into a killed stand of small grain or old crop residue with only a double disk opener planter. The in-row subsoil treatments were planted with a Brown Harden Super Seeder[R]. Subsoil depth was 12–14 inches.

Essex soybeans were planted in the three northern Alabama locations and Ransom soybeans were planted in the six southern locations. All plantings were made for full season production using a 36-inch row width. The yield and growth of soybeans are reported as relative yield and plant height in relation to the conventional tillage treatment, tables 2 and 3.

When compared to the conventional tillage treatment, no-tillage without subsoiling resulted in reduced soybean yields and plant growth on all Coastal Plain and River Terrace soils. The use of the in-row subsoiler with the conventional tillage system at planting increased yields over the conventional tillage system at Tallassee and Headland. The Tallassee soil had a strong plow pan and the soil at Headland developed a very compact layer in the lower plow layer during the herbicide incorporation with rotary tiller and disk.

Yields of soybeans under the no-tillage system with the in-row subsoiler were equal to those grown on the conventional system with and without the in-row subsoiler except for the Crossville location. At Crossville, the highest yields were from conventional tillage. The most noticeable effect of tillage treatments on vegetative growth was reduced plant height in the no-tillage treatment at Tallassee, Prattville, Monroeville, Headland, and Fairhope. At Belle Mina, all plots produced good growth and yield with all tillage systems.

The results of these studies suggest that for full season soybeans, yields from no-tillage systems may be comparable to or higher than yields from conventional tillage systems provided an in-row subsoiler is used on Coastal Plain and River Terrace soils.

Table 2. Relative Plant Height of Soybeans as Affected by Preplant Soil Preparation and In-Row Subsoiling on Eight Soils in Alabama[1]

Tillage treatment	Relative plant height by location						
	Belle Mina 2 yr. (1978-79)	Cross-ville 2 yr. (1977-78)	Tallassee 5 yr. (1977-81)	Pratt-ville 5 yr. (1977-81)	Monroe-ville 2 yr. (1977&79)	Headland 1 yr. (1978)	Fairhope 1 yr. (1978)
Conventional tillage	100	100	100	100	100	100	100
Conventional tillage plus in-row subsoiling	100	101	107	100	102	125	103
No-tillage	97	101	82	71	87	71	76
No-tillage plus in-row subsoiling	102	109	107	94	100	118	94
Av. plant height (in.) for conventional tillage	26	25	31	31	33	23	37

[1]Soil types: Belle Mina, Decatur clay; Crossville, Hartsells fine sandy loam; Winfield, Savannah fine sandy loam; Prattville, Lucedale fine sandy loam; Monroeville, Lucedale fine sandy loam; Fairhope, Malbis fine sandy loam; Headland, Dothan fine sandy loam; Tallassee, Cahaba fine sandy loam.

Table 3. Relative Yield of Soybeans as Affected by Preplant Soil Preparation and In-row subsoiling on Eight Soils in Alabama

Tillage treatment	Relative yield by location							
	Belle Mina 2 yr. (1978-79)	Cross-ville 3 yr. (1977-79)	Win-field 2 yr. (1978-79)	Tallassee 4 yr. (1977-78) (1980-81)	Pratt-ville 4 yr. (1978-81)	Monroe-ville 3 yr. (1977-79)	Head-land 3 yr. (1978-80)	Fairhope 2 yr. (1978-79)
Conventional tillage	100	100	100	100	100	100	100	100
Conventional tillage + in-row subsoiling	113	92	106	115	105	99	156	98
No-tillage	114	71	87	84	66	85	85	79
No-tillage plus in-row subsoiling	116	87	91	100	104	105	152	100
Av. yield (bu./acre) for conventional tillage	37.4	33.9	28.8	28.4	19.5	37.1	15.6	33.9

POPULATION DYNAMICS OF PLANT-PATHOGENIC AND NONPATHOGENIC FUNGI IN A REDUCED-TILLAGE EXPERIMENT MULTICROPPED TO RYE AND SOYBEANS IN FLORIDA.

R.C. PLOETZ, D.J. MITCHELL, AND R.N. GALLAHER

When compared to conventional-tillage, reduced-tillage may result in decreased soil erosion and an increased soil retention of plant nutrients, organic matter, and water. Multicropping may be used in conjunction with reduced-tillage as an effective way to use land, labor, and equipment. Crop management utilizing both reduced-tillage and multicropping is increaseing in popularity in the Southeastern United States(3). Because many of these crop management systems have been proposed only recently, much research remains to be done on the feasibility of using these systems in a given region. One of the factors determining the feasibility of any cropping system is its performance with regard to plant pests. Plant pathologists have demonstrated that certain plant pathogens survive in crop residues. Due to the increased crop debris found in soil managed under reduced-tillage, it might then be expected that these cropping systems will foster and possibly succumb to certain pathogens. This scenario has been suggested, and documented for certain pathosystems but not for others. If experience with pathosystems in different environments has demonstrated anything, however, it is that it is difficult to predict which pathogens may become a problem in a given cropping situation on the basis of one's intuition or past experience in related situations. Certainly, additional research on plant pathogens found in these nonconventional cropping systems is warranted.

The purpose of the present research was to identify and quantify populations of pathogenic and nonpathogenic fungi recovered from soil in a reduced-tillaae experiment multicropped to rye (Secale cereale) and soybean (Glycine max) in Florida.

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METHODS AND MATERIALS

The experimental field assayed in this study wae maintained on the Green Acres research facility of the Agronomy Farm of the University of Florida at Gainesville. For 4 years. prior to the start of this. study, plots in the field were not tilled and were either subsoiled at a depth of 45 cm to break compacted subsurface layers or not subsoiled. 'Bragg' soybean was planted in May and harvested in October and 'Wrens Arbuzzi' rye was planted in November and harvested as grain in April. At the beginning of this study, plots subsoiled and not subsoiled in the field were either tilled to a depth of 15 cm or not tilled; in the resultant split-plot design, subsoiled plots became main plots and tillage plots were subplots. Tillage and subsoiling treatments were imposed before the rye crop was planted each year and both crops were drill-planted. Treatments were replicated four times.

On 22 sample dates soil samples were taken from the surface 5 cm of treatment plots in the field; the sample dates spanned 820 days at intervals of approximately 5 weeks. Forty subsamples were taken with a 2.5-cm-diameter soil core sampler from within plant rows in each treatment plot. Soil subsamples were pooled for each treatment plot and the pooled samples were used in assays for fungi. KO's (5) medium amended with 0.5% benomyl (2) was used for the isolation of Rhizoctonia spp. for the first six sample dates and Flowers' (8) medium was used for isolating Rhizoctonia spp. for the last 16 sample dates. Difco cornmeal agar amended with 10 ppm pimaricin, 250 ppm ampicillin, 10 ppm rifamycin, and 100 ppm PCNB was used to assay soil for Pythium spp. (4). Difco potato dextrose agar amended with 1000 ppm Tergitol NPX and 50 ppm chlortetracycline was used for estimated the population densities of common spore-forming fungi found in field soil (7). Data were analyzed with a SAS (Statistical Analysis Systems) GLM (General Linear Models) program.

RESULTS AND DISCUSSION

Fungi in the genera Penicillium, Asperaillus, Trichoderma, Fusarium, and Rhizopus accounted for 38 to 71% of all fungi recovered from a given treatment plot on a given sample date. Less frequently isolated fungi included species of the genera: Laetisaria, Mortierella, Mrrothecium, Mucor, Neocosmospora, Neurospora, Paecilomyces, Phoma, Pyrenochaeta, and several others that were not identified. The following fungal species are listed in descending order of frequency of recovery for a given genus. Species of Penicillium recovered from the field included P. citrinum, P. purpurogenum, and two other species that were not identified. Asperaillus orhraceus, A. clavatum, A. flavus, and A. niqer constituted the total detectable Aspergillus population in field soil. Only two species of Trichoderma were routinely isolated during these studies: T. harzianum, and T. hamatum. Isolates of Fusarium and Rhizopus were not idenfified to species.

Nine anastomosis groups or species of Rhizoctonia were isolated from field soil; isolates of R. solani AG 4 and the binucleate Rhizoctonia spp. anastomosis group CAG 3 were the most commonly isolated of these. Prthium irregulare, P. acanthicum, and several other unidentified species of Pythium were isolated from th'e field.

In general, fungal population densities were influenced significantly by tillage and sample date; subsoiling effects were not significant (p=O.O5) for any of the fungi tested. The effects of tillage and sample date on population densities of total fungi were highly significant, as was the tillage X sample date interaction; Rhizoctonia spp., Pythium spp., Penicillium spp., and Rhizopus spp. responded to these influences on variability in a similar manner. Tillage and sample date influenced significantly the population densities of P. irregulare, Aspergillus spp., and Fusraium spp.; tillage X sample date interactions were not significant for these fungi. Population densities of R. solani AG 4 and Trichoderma spp. were affected significantly by sample date but not by tillage.

Others have described the influence of reduced-tillage on soilborne microbes. In soils planted to winter wheat, Lynch and Panting *(6)* reported an increase in soil biomass in no-till soils versus tilled soil; they attributed this difference to an increase in fungal biomass. Doran (1) studied surface soils from several different cropping systems, and found consistently higher populations of three groups of microorganisms in no-till soils than in conuentionally-tilled soils. In a multicropping study, Sumner et a1. (9) reported higher population densities of R. solani (mainly AG 4) and Pythium spp. in surface soil from reduced-tillage systems than from conventionally-tilled soils shortly after planting. Wacha and Tiffany (10) studied a 4-year rotation of corn and soybean. They found no significant quantitative differences between total fungal populations from no-till and conventionally-tilled soils; however, their soil samples were taken at the end of the soybean growing season and after plant debris had been removed from the soil surface. These factors likely obscured any quantitative differences that may have existed after plowing and during the growth of the soybean crop.

Our results with fungal population densities agree with those of Lynch and Panting (6), Doran (1), and Sumner et a1. (9). When population densities of total fungi were broken into their component genera and species, however, these were not always positively influenced by no-tillage. Although Sumner et al. (9) found higher population densities of R. solani AG 4 in no-till soils versus conventionally-tilled soils they did not quantitate the population densities of the various anastomosis groups of this species from the different tillage treatments in their study. In our work, population densities of Rhizoctonia spp. were higher in no-till plots, but when populations of R. solani AG 4 were quantitated no difference was found between populations in no-till and 15-cm till plots; no-tillage was not associated with increased populations of R. solani AG 4 pathogens in this experiment.

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SUPPRESSION OF BROADLEAF WEEDS BY RYE AND WHEAT STRAW AND ISOLATION AND IDENTIFICATION OF PHYTOTOXIC COMPOUNDS

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ABSTRACT

No-tillage crop production is a very effective means of reducing soil erosion from wind and water, conserving soil moisture, and reducing energy require- ments when compared to conventional-tillage crop production. This practice is increasing in many crops throughout the U.S. and is expected to continue to increase. It is predicted that by the year 2000, about 65% of the feed grain crops in the U.S. will be grown this way.

Control of weeds has been the biggest obstacle to successful no-till crop production. There is heavy reliance on herbicides for the whole weed control job, since preplanting tillage is not done or is very limited and postplanting mechanical cultivation for weeds is rarely possible. Most researchers and farmers report temporary increases in broadleaf weeds and increased problems with annual grasses and especially perennial weeds in no-till crops.

In our work in weed control in no-tillage crops over the years, we have noted significant suppression of several broadleaf weeds in no-till crops where small grain cover crops or straw residues are left on the fields. Weeds reduced have been cocklebur, morningglory, prickly sida, sicklepod, pigweed and lambsquarters. We therefore initiated studies in no-till corn, soybeans, sunflower, and tobacco to evaluate and separate the effects of small grain mulches and tillage on suppressing some of these broadleaf weeds.

Planting corn no-till into a desiccated green wheat cover crop reduced morningglory growth 79% compared to a non-mulched, tilled treatment. Elimination of tillage at planting was as effective in reducing weed growth as replacing the mulch after tilling the soil. In double-crop soybeans, there was little mulch effect on morningglory, but tilling the soil greatly increased weed growth.

In no-till tobacco, elimination of tillage and presence of a rye mulch reduced growth of pigweed. lambsquarters and ragweed by 51, 41, and 73%, respectively. A rye mulch reduced lambsquarter growth in both the tilled and non-tilled systems by 60%. In full-season soybeans and sunflowers planted into desiccated green rye, the elimination of tillage and the

mulch reduced Iambsquarter, ragweed, and pigweed growth 99, 92, and 96%, respectively. Rye mulch was as effective as elimination of tillage in reducing lambsquarter and pigweed growth. Ragweed seemed to be iess affected by the mulch and more responsive to soil disturbance.

Aside from weed control benefits of not disturbing the soil, shading, etc., we suspected that allelopathy (chemical warfare among plants) was involved. In studying alkali extracts of wheat straw, the compound having the greatest inhibitory effects on morningglory and prickly sida seed germination and root growth was ferulic acid (4-hydroxy-3-methoxy cinnamic acid). In very small amounts, this compound inhibited weed seed germination and root growth up to **82%.** We further found that feruiic acid was changed by a bacterium living on the seed coats of prickly sida seeds to a compound more phytotoxic to the weed. The new compound was identified as a styrene derivative, 2-methoxy-4-ethenylphenol. This phenomenon could be termed as a natural "biomagnification" to the detriment of the weed.

Two phytotoxic compounds were identified from water extracts of field-grown rye. These were β-phenyllactic acid (βPLA) and 3-hydroxybutyric acid (βHBA). Neither of these chemicals had been implicated in allelopathy before. Both compounds inhibited root and shoot growth of lambsquarters and pigweed. The IJPLA and βHBA inhibited lambsquarters shoot growth **68** and 30%. respectively, at **8** mM in laboratory bioassays. Both acids inhibited root growth **29%** at **2** mM. Redroot pigweed shoot growth was inhibited **17%** by βPLA **at 0.8** mM with **100%** inhibition at **8** mM. IJHBA gave 27% inhibition at 8 mM. Pigweed root Growth was inhibited 59 and 39% at 2 mM by IJPLA and IJHBA, respectively. These compounds plus other yet unidentified phytotoxic natural chemicals could help explain suppression of certain weeds by rye and wheat mulches in no-till crops.

Thus, we believe that many no-till farmers are unconsciously receiving benefits of allelopathy when they plant crops no-till into certain cover crops or straw residues. Utilizing this naturally-occurring chemical warfare among plants may play an important role in controlling weeds in crops in the future. In some cases, herbicide use may be reduced by partial substitution of the naturally-occurring phytotoxic chemicals in mulches. In 1983, we grew crops that provided shade quickly, such as soybeans, tobacco, and sunflowers, in no-till situations without residual or postemergence herbicides for control of the broadleaf weeds present. More research is needed to help farmers take advantage of this natural aid in controlling many broadleaf weeds available in no-till cropping systems.

ECONOMIC VARIABLES OF CONVENTIONAL VS. IN ROW SUBSOIL AND DRILLED NO TILLAGE SOYBEANS IN GILCHRIST COUNTY

Marvin Weaver, County Extension Director, IFAS – Gilchrist County

Gilchrist County is located in North Florida and the soil type is a deep sand. Small grains, corn and soybeans are the chief crops grown. Wind erosion and lack of soil moisture at the critical times are our greatest production problems, along with weed control.

Rye and wheat are the main winter crops and they are followed by soybeans.

For the past three years Extension has demonstrated minimum tillage and farmers have adapted some of their fields to minimum tillage.

The no tillage system has allowed farmers to plant earlier and when there is moisture. Minimum tillage has also allowed double cropping and in some cases three crops per year on the same field. This requires proper management, but with minimum tillage it can be done.

Of great importance to our area also is the top soil that is saved with minimum tillage. The Soil Conservation Service estimated that 2 tons of soil per acre was saved in our demonstration fields.

The following is summary data collected from the fields and the following tables are cost of production for each practice.

Cultivar	Tillage yes	Tillage no	Yield bu/a	$ Returns: Gross	- Variable Cost	- Total Cost
Bragston	x 1		46.8	245.70	136.51	$95.13
Bragston	x 1		34.0	178.50	69.31	27.93
Coker 337	x 2		20.3	106.58	- 8.61	- 49.99
Coker 237	x 2		16.0	84.00	- 25.19	- 66.57
Coker 237	x 2		14.3	75.08	- 34.11	- 75.49
Cobb		x 3	47.0	246.75	128.66	85.95
Coker 488		x 3	44.8	235.20	117.11	74.40
Bragg		x 3	37.0	194.25	76.16	33.45
Bragg Drill		x 4	30.5	160.13	89.89	54.35

1 Bragston soybeans planted June 7.
2 Coker 237 and 337 soybeans planted July 1.
2 Coker 337 cost $6.00 per bushel more than all other soybean seed.
3 Cobb, Coker 488, and Bragg in-row subsoil no-tillage soybeans planted June 9.
4 Bragg Drill soybeans planted June 6.

Table 1. Cost of production for conventional tillage soybeans in Gilchrist County, Florida, in 1982.

Variable	Unit	Cost/Acre
Moldboard	six 16-inch plow 120 hp tractor	$12.00
Fertilizer	250 lbs/acre 6-13-39	24.50
Disk	incorporate fertilizer, 10 ft. disk, 120 hp tractor	7.00
Plant	six row planter, 120 hp tractor	5.00
Soybean seed	one bu/acre	12.00
Sencor preemergence	0.38 lb. active ingredient per acre (50% wettable powder)	8.59
Ground spray	broadcast Sencor	3.00
Paraquat for harvest aid	0.25 lb. active ingredient per acre (one pint)	5.31
X77 Surfactant	Mix of one pint/100 gallons water with paraquat	0.14
Aerial spray	broadcast paraquat and X77	3.00
Toxaphene	two quarts/acre	4.45
Methyl parathion	one pint/acre mixed with toxaphene	2.70
Aerial spray	broadcast toxaphene and methyl parathion	3.00
Harvest soybeans	Combine with 12 foot head	18.00
Total variable cost		109.19
Interest	calculated at 15.00% interest	16.38
Land rent	estimated	15.00
Taxes	estimated	10.00
Total fixed cost		41.38
Total cost	variable plus fixed	150.57

Table 2. Cost of production for in-row subsoil no-tillage soybeans in Gilchrist County, Florida, in 1982.

Variable	Unit	Cost/Acre
Fertilizer	250 lbs./acre 6-13-39	$24.50
Roundup preemergence	one quart/acre	18.50
Ground spray	broadcast	3.00
Plant	two row planter, 70 hp tractor	8.00
Soybean seed	one bu./acre	12.50
Lexone preemergence	0.38 lb. active ingredient per acre (50% wettable powder)	8.59
Paraquat preemergence	0.25 lb. active ingredient per acre (one pint)	5.31
XJJ Surfactant preemergence	Mix of one pint/100 gallons water with paraquat & lexone	0.44
Ground spray	broadcast paraquat and XJJ and lexone	3.00
Paraquat postdirect	0.12 lb. active ingredient per acre (one-half pint)	2.66
XJJ Surfactant postdirect	Mix of one pint/100 gallons water with paraquat & lexone	0.44
Ground spray	post direct paraquat and XJJ	3.00
Toxaphene	two quarts/acre	4.45
Methyl parathion postemergence	one pint/acre mixed with toxaphene	2.70
Aerial spray	broadcast toxaphene and methyl parathion	3.00
Harvest soybeans	Combine with 12 foot head	18.00
Total variable cost		118.09
Interest	calculated at 15.00% interest	17.71
Land rent	estimated	15.00
Taxes	estimated	10.00
Total fixed cost		42.71
Total cost	variable plus fixed	160.80

Table 3. Cost of production for drilled no-tillage soybeans in Gilchrist County, Florida, in 1982.

Variable	Unit	Cost/Acre
Lexone preemergence	0.38 lb. active ingredient per acre (50% wettable powder)	$8.59
Paraquat preemergence	0.25 lb. active ingredient per acre (one pint)	5.31
X77 Surfactant pre-emergence	Mix of one pint/100 gallons water with paraquat & lexone	0.44
Ground spray	broadcast paraquat and X77 and lexone	3.00
Plant	Tye drill, 70 hp tractor	6.00
Soybean seed	one and one-half bu./acre	18.75
Toxaphene	two quarts/acre	4.45
Methyl parathion post emergence	one pint/acre mixed with toxaphene	2.70
Aerial spray	broadcast toxaphene and methyl parathion	3.00
Harvest soybeans	Combine with 12 foot head	18.00
Total variable cost		70.24
Interest	calculated at 15.00% interest	10.54
Land rent	estimated	15.00
Taxes	estimated	10.00
Total fixed cost		35.54
Total cost	variable plus fixed	105.78

SURFLAN AND PROWL APPLICATIONS IN WHEAT FOR WEED CONTROL IN NO-TILL SOYBEANS

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Weeds that often cause the most problems in no-till soybeans are those that become established in wheat prior to soybean planting. In some situations, weed control may be improved by applying wheat-tolerant herbicides into the wheat prior to weed seed germination.

Experiments were conducted from 1981 through 1983 at the Tennessee Valley (TVA) and Sand Mountain (SMS) Substations to evaluate herbicide applications in wheat for weed control in no-till soybeans. Treatments consisted of 2 rates of Surflan and Prowl applied in March when the wheat was fully tillered or in June after soybeans were planted. 2,4-D was also evaluated when applied alone and in combination with Surflan. Paraquat was applied alone and in combination with Surflan or Prowl after the soybeans were planted. Wheat injury ratings and yields, and soybean weed control ratings and yields were taken.

Visual ratings of wheat in May indicated only minor herbicide injury at TVS, but at SMS injury was observed with the highest rate of Surflan in 1981, and with both rates in 1983. Wheat yields, however, were not affected by either herbicide. 2,4-D alone (1 qt./acre) and 2,4-D (1 qt./acre) plus Surflan (2½ qts./acre) reduced yields in 1983 at TVS. The Surflan rate was twice the labeled rate for this soil.

Soybeans were not injured by any herbicides treatment to wheat in any year at either location. Surflan caused minor early injury when applied after soybean planting. Combinations of Surflan with 2,4-D applied after soybean planting caused moderate injury in 2 of the 3 years at SMS.

In two of the **3** years at TVS, Surflan application into the wheat improved annual grass control when compared to applications made after soybean planting (table 1) and prowl applications in the wheat improved grass control in 1 of the 2 years. At SMS, the only benefit from applying herbicides in wheat was improved grass control by Prowl in 1983.

Soybean yields ranged from 2 to 51 bu./acre depending on year and weed control. When compared to the no herbicide control, Surflan applied to the wheat improved yields in 1981 at the Tennessee Valley location. In 1983, soybean yields were improved with all herbicide applied to the wheat at the Sand Mountain location.

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[1]Former Weed Scientist and Research Associate, respectively.

In summary, wheat was not adversely affected with Prowl and Surflan applications made at the fully tillered stage at either location. Annual grass and smartweed control were generally improved with Surflan and Prowl applications made into fully tillered wheat when compared to those made after soybean planting. Soybean yields were improved in 1981 with Surflan applications in wheat at the Tennessee Valley location and in 1983 with both Prowl and Surflan applications at the Sand Mountain location.

Table 1. Annual Grass (fall panicum and large crabgrass) and Smartweed Control As Affected by Herbicide, Rate and Time of Application, Tennessee Valley Substation.

Herbicide/Time	Rate	Annual grass control			Smartweed control	
		1981	1982	1983	1983	1983
	qts./acre	%				
Wheat[1]						
1. Surflan[5]	1.25	99	97	78	99	84
2. Surflan	2.5	100	100	76	100	84
3. Surflan + 2,4-D[3]	1.25 + 0.5	100	98	72	98	88
4. Surflan + 2, 4-D	2.5 + 1.0	100	99	16	100	90
5. 2,4-D Ester[4]	1.0	90	89	52	85	74
6. Prowl	1.0	---	88	60	100	89
7. Prowl	2.0	---	100	72	100	84
8. Untreated	---	0	0	0	0	0
Soybeans[2]						
9. Surflan	1.25	5%	77	72	40	54
10. Surflan	2.5	66	76	72	46	53
11. Prowl	1.0	--	61	69	46	64
12. Prowl	2.0	--	75	80	41	71
LSD (5%)		20	16	20	14	11

[1]Applied to fully tillered wheat
[2]Applied after soybean planting
[3]Amine form of 2,4-D - 4 lb./gal
[4]Ester form (Esteron 99) of 2,4-D - 4 lb./gal
[5]All treatments received Paraquat + Surfactant soybean planting

Table 2. Annual Grass (fall panicum and large crabgrass) and Smartweed Control As Affected by Herbicide rate and Time of Application, Sand Mountain Substation.

Herbicide/Time	Rate	Annual grass control 1982	Annual grass control 1983	Smartweed control 1983	Smartweed control 1983
	qts./acre	---------------	%	---------------	
%eat[1]					
1. Surflan[5]	1.25	85	86	100	91
2. Surflan	2.5	90	92	100	92
3. Surflan + 2,4-D[3]	1.25 + 0.5	87	83	100	86
4. Surflan + 2,4-D	2.5 + 1.0	89	94	96	96
5. 2,4-D Ester[4]	1.12	91	91	95	68
6. Prowl	1	71	80	98	86
7. Prowl	2	79	80	100	95
8. Untreated	---	82	0	55	0
Soybeans[2]					
9. Surflan	1.25	87	81	83	33
10. Surflan	2.5	93	83	95	23
11. Surflan + 2,4-D	1.25 + 0.5	94	82	100	53
12. Surflan + 2,4-D	2.5 + 1.0	89	76	58	60
13. Prowl	1.0	81	68	73	18
14. Prowl	2.0	--	78	--	33
LSD (5%)		8	10	28	19

[1]Applied to fully tillered wheat
[2]Applied after soybean planting
[3]Amine form of 2,4-D - 4 lb./gal
[4]Ester form (Esteron 99) of 2,4-D - 4 lb./gal
[5]All treatments received Paraquat + Surfactant soybean planting

TOBACCO PRODUCTION PRACTICES

REDUCING SOIL EROSION IN TOBACCO THROUGH NO-TILLAGE

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ABSTRACT

Production of flue-cured and burley tobacco occupies about 726,800 acres of land in the Southeastern U.S. It is an important source of income in several states; and in North Carolina, gross value of flue-cured tobacco alone was $1.2 billion for 1983. However the traditional clean-cultivation production methods, along with morphological characteristics of the plant make tobacco a very soil erosion prone crop. Average soil losses from tobacco cropland in North Carolina total 15-18 T/A), exceeding the average annual loss of 5 T/A from U.S. cropland. Even with large scale adoption of herbicides for chemical weed control, several cultivations are still recommended for additional weed control, to loosen the soil and to build row ridges.

In the Upper Tar River area in North Carolina, a Soil Conservation Service study showed soil erosion from tobacco cropland averaged 11.4 T/A and in the Piedmont Bright Leaf district, soil losses averaged as much as 18 T/A. Sheet and rill erosion in tobacco results in 47%. 26%, and 27% of the cropland losing soil at rates of < 5.0, 5.0-10.0, > 10.0 T/A/year, respectively. Based on the 1977 National Resource Inventory report, 51% of the nation's cultivated cropland is faced with soil erosion as a major conservation problem. These substantial losses of topsoil from tobacco and other cultivated cropland could threaten long term soil productivity.

Another problem in tobacco related to clean cultivation is the accumulation of sand and soil on the lower leaves caused by splashing raindrops. This problem is so severe in fact that, in one year, one tobacco company removed 8.6 million pounds of sand at a cost of $9 million before the leaf could be processed for tobacco products.

In view of these severe losses of topsoil in tobacco and the fact that the potential for no-till tobacco seems promising in research done in North Carolina, a preliminary soil erosion research project was initiated in 1982 with more detailed studies in 1983. The purpose of this study was to measure the differences in soil loss from conventionally-tilled tobacco and no-till tobacco. The idea of no-tillage or conservation tillage production of tobacco has been around since 1965 with sporadic research efforts in

Kentucky, North Carolina, and Virginia. Advantages of no-till tobacco could be realized in fuel and labor savings, increased soil moisture conservation, reduced soil erosion, and elimination of tillage for planting and weed control.

The primary objectives of this research project were (1) to measure soil loss differences between the two tillage methods and (2) to determine the potential for implementing no-till production in flue-cured tobacco as another means to control soil erosion.

Methods: Eight 30 gallon metal barrels were prepared for collecting runoff and sediment by cutting the tops in half and then hinging them in place. The hinged tops prevented rainfall from falling into the barrels and were propped open 4 inches to allow the runoff to flow into the barrel. Each barrel was **30** inches deep and 18 inches wide with a volume of 7861 $inches^3$. Collected runoff water flowed from one half of two adjacent rows and was channeled into the barrel by galvanized metal skirts attached to the lip of the barrel and extending to the crest of the ridged row. Sand and cement was spread around the skirting and the immediate entrance to the barrel. V-shaped galvanized metal sheets were secured into the ground 47 feet from the barrels to function as sample plot borders and surface water barriers. Row ridges were approximately 12 inches tall and served as borders along the plot length.

Each collection plot measured 4 ft. x 47 ft. The four foot plot width is a standard tobacco row width. Total area for the four replications in conventional and no-till treatments was 1/58 of an acre (16' x 47'). Average slope for the test in 1982 was 1.3% and 3.1% in 1983. Soil types in the collection area were a Goldsboro loamy sand on the upper range and a Bibb series on the lower end of the field.

For no-till production, a rye cover crop was sown on rows bedded in the fall. The rye cover was treated with paraquat (.5 lb ai/A) two weeks prior to transplanting the tobacco. The barrels were placed in the ground the same day as transplanting. Diphenamid was broadcast at 6.0 lb/A for weed control immediately after transplanting.

Sample collections were made after each significant rainfall, >.5 in. Depth of water in each barrel was measured and recorded before drawing the samples. Two-liter samples were taken from each barrel after the contents were thoroughly stirred to suspend the sediment.

Samples were filtered through a Buchner funnel and a glass microfibre filter paper. Samples were dried 24 hours at 100^oC, then cleaned of plant material and stones. if present, before determining dry weight.

Results: Data for 1982 and 1983 show a dramatic difference in soil loss between the two methods (Table 1) of tobacco production. An unusually heavy rain, 5.2 inches, fell within less than a 24-hour period in 1983, accounting for substantial differences in the first collection. When a normal rainfall occurred after cultivations, there was an increase in sediment collected from the conventional plots. Runoff was generally greater in the no-till plots than in the conventional. Tobacco yield and quality differences have been recognized in herbicide evaluation tests and these differences were examined in 1983 between the no-till and conventional plots of this study. The yield reduction in no-till averages about 20% less than the conventional; whereas quality in no-till is higher on lower leaves and about the same for the upper leaves. This difference is important in determining the potential tor the no-till culture in flue-cured tobacco.

_Summary: Loss of soil between the two treatments in 1982 and 1983 was 22 and 80 times greater in the conventionally tilled tobacco compared with the no-tillage tobacco, respectively. Soil loss in the no-till plots in 1983 averaged 0.05 T/A while soil loss in the conventional plots was 4.03 T/A. Yield of the no-till tobacco was 1707 lb/A compared to 1962 lb/A for the conventional. Thus the no-till tobacco produced 255 lb/A less (13%) than the conventional tobacco in these tests. No-till tobacco definitely reduces soil erosion and with further work to improve weed control and yield it should be to the point where it could be adopted hy growers in the near future.

Table 1. Soil Loss, No-Till vs. Conventional Tobacco, NC, 1982 and 1983.

Treatment	Soil loss* 1982	Soil loss* 1983	Yield* 1983
	(T/A)		(Ib/A)
No-ti11	**0.05**	**0.05**	**1707**
Conventional	**1.10**	**4.03**	**1962**
(Difference)	**(22X)**	**(81X)**	**(87%)**

*Ave. 2 replications. Sandy loam soil, 1.3% slope in 1982, 3.1% slope in 1983. Rainfall + irrigation May-September, 1982 -- 22.9 in., 1983 -- 15.3 in.

WHEAT PRODUCTION PRACTICES

TILLAGE SYSTEMS FOR DOUBLE-CROPPED WHEAT AND SOYBEANS

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A significant quantity of soybeans grown in the Southeast are double cropped with wheat harvested for grain. This continuous cropping, which should not be confused with crop rotations, requires timely harvesting and planting for optimum yields. The elimination of tillage or the time required for tillage after wheat harvest can help ensure timely planting for soybeans. From 1981 through 1983, two separate studies were conducted by the Alabama Agricultural Experiment Station at six locations (Table 1) to compare the effects of various tillage systems on yields of double-cropped wheat and soybeans. One study consisted of tillage prior to planting wheat (wheat tillage), and the other study consisted of tillage prior to planting soybeans (soybean tillage).

Wheat Tillage

In the wheat tillage test, tillage systems consisted of no-till, disk, chisel plow-disk, chisel plow-drag, turn-disk, and turn-drag. At Brewton, Monroeville, and Prattville, a drag bar was used for the drag treatment, but at the other locations, a roterra was used instead of a drag bar. After wheat harvest, tillage plots were split and soybeans were planted no till without a subsoiler on one side of the plot and no till with an in-row subsoiler on the other side of the plot. Soil types and wheat varieties are listed in Table 1. The soybean variety was either Bragg or Braxton.

For both wheat and soybeans, yield differences were generally not found within the deep tillage treatments (chisel-disk, chisel-drag, turn-disk, and turn-drag). Because of fairly equal yields among these treatments, they will be collectively referred to as deep tillage.

Wheat yields (Table 1) were highly dependent on tillage. No-tillage planted wheat resulted in 11 to 43% yield reductions when compared to deep tillage at all locations. Disk tillage resulted in lower yields than the deep tillage at Headland, Brewton, and Prattville.

During the first two years of the wheat tillage test, subsoiling for soybeans did not affect wheat grain yields. In the third year, wheat following subsoiled soybeans yielded higher than wheat following non-subsoiled soybeans at Headland, Fairhope, and Monroeville. This yield difference (7 bu./acre), which occurred regardless of tillage prior to planting wheat, further illustrates the importance of deep tillage for wheat on some soils.

Table 1. Locations of Wheat Tillage Test, Soils, Wheat Varieties, and 3-year average wheat grain yields.

Location	Soil	Wheat variety 1980	Wheat variety 1981 and 1982	Tillage No-till	Tillage Disk	Tillage Deep
				wheat yield, bu. (acre		
Headland	Dothan fsl	Coker 747	Coker 747	34	41	50
Brewton	Benndale sl	Coker 747	Coker 747	20	25	35
Monroeville	Lucedale scl	Coker 747	Coker 747	44	52	54
Prattville	Bama sl	McNair 1817	Coker 747	29	40	48
Marion Junction	Sumter c	McNair 1003	McNair 1003	32	40	39
Fairhope	Malbis fsl	-------	Coker 762	49	55	55

Soybean yields in Table 2 are averaged over years. At some locations, treatment effects varied among years, but yields averaged over years probably give a more realistic relationship between tillage for wheat and yield of no-tillage soybeans.

On the Lucedale soil at Monroeville, the Sumter soil at Marion Junction, and the Malbis soil at Fairhope, soybean yields were not affected by tillage for wheat or subsoiling for soybeans. (There was not a subsoil treatment at Marion Junction). When considering both wheat and soybean yields, the most economical tillage system on these soils probably would be to disk prior to planting wheat and no-till soybeans without an in-row subsoiler. Row widths, however, must be considered. The subsoiled soybeans were planted in 24 to 36-inch row widths, and the non-subsoiled soybeans were planted in 18 to 24-inch row widths. With wide-row planting (30 to 36-inch row widths), it is highly possible that the subsoiled beans would have yielded higher than the non-subsoiled beans primarily because subsoiling generally results in the largest plants. Large plants are required to close the canopy in wide rows but not in narrow rows.

On the Dothan soil at Headland and the Benndale soil at Brewton, especially on the Benndale soil, in-row subsoiling resulted in higher soybean yields than planting without a subsoiler unless the soil was deep tilled prior to planting wheat. The data from both locations suggest that if wheat is no-till planted or if the soil is disked prior to planting wheat, soybeans should be planted with an in-row subsoiler even if the soybeans are planted in narrow rows, but if the soil is deep tilled prior to planting wheat, there is no need for in-row subsoiling. Since wheat yields at both locations were highest with deep tillage, it appears that the most economical tillage system would be deep tillage for wheat followed by no-till soybeans. The soybeans, however, should be planted in narrow rows.

Table 2. Yield of No-tillage Soybeans as Affected by Tillage Prior to Planting Wheat and In-row Subsoiling for Soybeans.

Location[1]	Subsoiling for soybeans	Tillage prior to wheat planting		
		No-till	Disk	Deep
		---------bu./acre--------------		
Headland	No	40	41	44
	Yes	43	45	44
Brewton	No	30	36	44
	Yes	46	49	49
Monroeville	No	35	36	36
	Yes	37	37	37
Prattville	No	28	25	28
	Yes	31	29	31
Marion Junction	No	35	30	32
Fairhope	No	49	47	51
	Yes	52	49	50

[1]Data represent 1 year at Marion Junction, 2 years at Fairhope, and 3 years at all other locations.

On the Bama soil at Prattville, soybean yields were not affected by tillage prior to planting wheat, and regardless of wheat tillage system, there was a consistent yield increase (3 to 4 bu./acre) with in-row subsoiling. Since deep tillage for wheat resulted in a consistently higher wheat yield than no tillage or disk tillage, the most economical tillage system for the Bama soil would be deep tillage for wheat and in-row subsoiling for soybeans.

Tillage Prior to Planting Soybeans

This study was conducted at the same locations as the wheat tillage study. Soil types and varieties are the same as reported in Table 1, except the soil type at Prattville was a Lucedale fsl instead of a Bama sl. Tillage treatments prior to planting soybeans were no till, no till plus in-row subsoiling, disk, chisel plow-disk, chisel plow-drag, turn-disk, and turn-drag. The soil was disked each year prior to planting wheat.

Soybean yields did not differ within deep tillage systems so yields for deep tillage are averaged over the four systems. Except for the Lucedale soil at Prattville, yield differences were found among the four tillage systems shown in Table 3. Wheat yields were not affected by tillage prior to planting soybeans, so the most economical spring tillage should be based on soybean production.

On the Lucedale soil at Prattville and Malbis soil at Fairhope, no-till without subsoiling would be the most economical. On the Dothan soil at Headland and Benndale soil at Brewton, no-till with in-row subsoiling would be the most economical. Disk tillage would be best for the Black Belt soil and either disk tillage or no-till with in-row subsoiling would be best on the Lucedale soil at Monroeville.

Table 3. Yield of Double-cropped Soybeans as Affected by Tillage Prior to Planting Soybeans.

Tillage	Location: Headland	Brewton	Monroe-ville	Pratt-ville	Marion Junction	Fairhope
	------------------soybean yield, bu./acre ----------------					
No-till	39[1]	24	18	29	16	48
No-till+[2]	43	39	22	29	22	44
Disk	40	22	23	29	28	46
Deep	42	32	24	29	21	51
FLSD(O.lO)	2	4	3	NS	4	5

[1]Yields are averaged over 2 years at Marion Junction and Fairhope and 3 years at all other locations.

[2]No till+ is in row subsoiling.

Summary

The two tests, tillage before wheat and tillage before soybeans, were separate but were located adjacent to each other at all locations except Prattville. When comparing those tests, it is difficult to draw firm conclusions about optimum tillage systems. It appears, however, that tillage prior to planting wheat followed by no-till soybeans is the most economical approach to an optimum tillage system. The degree of tillage prior to planting wheat will vary with soil types, climatic conditions, and many other factors. Based on average yields obtained for both crops in these studies, it appears that optimum tillage prior to planting wheat would be disk tillage on the Malbis, Sumter, and Lucedale soils and deep tillage for the Dothan, Benndale, and Bama soils. The data strongly suggest that if the above tillage systems are used, soybeans can be planted without an in-row subsoiler except for the Bama soil. If in-row subsoilers are not used, row widths probably should be narrow (24 inches or less).

NO-TILL WHEAT IN RESIDUE

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Introduction

The growing season for warm season crops in North Florida is in excess of 235 days. This allows for the use of many multicropping systems. One of the most widely used double cropping systems is wheat or other small grain followed by soybeans. This system is used without rotation by some growers which may lead to serious nematode problems in the soybean crop. However, where large acreages are grown, timely planting and management are important factors for economical yields of both wheat and soybeans. The research reported in this paper was conducted to determine the effect of tillage treatments on yield and physiological factors of wheat when planted into soybean stubble or dormant summer perennial grasses.

Results and Discussion

Florida 301 wheat was planted into residue of soybean stubble and dormant sods of bermudagrass and bahiagrass in the fall of 1981 and 1982. Tillage treatments (moldboard plow, chisel plow, disk harrow, and no-till) were accomplished after harvest or dormancy in each of the systems which usually occurred around November 15. Fertilizer was broadcast over all systems before any tillage was accomplished. A Tye no-till drill was used to plant the experiments. Average wheat yields were higher in 1983 than in 1982 (Table 1). After soybeans, Table 1 shows that no-till wheat yielded least of all tillage treatment in 1982 and most in 1983. Different fields were used for soybeans in each of the years. In 1982, wheat was no-till planted after soybeans that had not been subsoiled and a traffic pan was noted at the 6 inch depth using a recording penetrometer (Table 2). In 1983, wheat was no-till planted after soybeans that had been no-till planted and subsoiled for a number of years. This system had decayed roots down to the 8 inch depth which left channels through the traffic pan that were not destroyed by tillage and this soil was less compacted than the soil in any of the tillage treatments (Table 2). The loose nature of the soil where soybeans were grown gave a better environment for root exploration of both water and nutrients which resulted in highest yields.

Wheat grown in bahiagrass yielded more across all tillage treatments in 1983 as compared to 1982 (Table 1). No-till wheat was significantly less in both years than with any tillage treatment. Obtaining stands of wheat in bahiagrass with the no-till method was much more difficult than in either of the other 2 systems. Wheat no-tilled into bahiagrass develops more slowly than with tillage and is often yellow as it grows. No difference was noted between the tillage treatments in 1982 but the harrow treatment yielded highest in 1983 (Table 3). However, 4 harrow passes were made in the bahiagrass to prepare a seedbed. The higher yields in bahiagrass from tillage may be explained by soil compaction in 1982 (Table 4) but cannot be as readily explained in 1983 except that stands were less under no-till plantings but test weights were not different.

In bermudagrass, yields of wheat were similar for both years (Table 5). Tillage treatments did not significantly influence yields or test weight. There was some difference in soil compaction in each year but did not seem to have any influence on the wheat. Stands of wheat were as good when planted no-till bermudagrass as with any tillage treatment in both years.

Soil compaction can be a major yield limiting factor in a shallow rooted crop such as wheat. Rain is often adequate for high wheat yields in the Southeast but can suffer yield losses by droughts of 2 weeks or more during the head filling period where root systems are limited by compaction.

Planting Method Suggestions for Wheat Following Soybeans, Bahia and Bahiagrass

Soybeans

1. If wheat is to be no-till planted after soybean harvest, select only those fields which have no traffic pans.

2. Use a moldboard plow after soybean harvest for soils with compacted layers. An increased yield of 10 or more bushels wheat may be made over no-till plantings or using a harrow.

3. A chisel plowing will result in higher yields than shallow or no-tillage where compaction layers exist in the plow layer.

Bahiagrass

1. Do not plant wheat into bahiagrass unless the soil is wet enough to allow good penetration for adequate seed placement with a no-till planter.

2. When planting conventionally following bahiagrass, allow several weeks for plants to decay before planting.

Bermudagrass

1. No-till planting of wheat into bermudagrass should be accomplished in a dormant sod and yields as good as with any type of tillage may be expected.

2. Bermudagrass residue should be no higher than 2"-4" to prevent shading on young seedlings.

3. An early maturing wheat should be used so as not to have competition from the bermuda during the grain fill period in the spring.

4. Plant as soon after November 15 as possible, since bermudagrass is entering dormancy and early planting results in earlier maturity of the grain so that the bermuda hay crop is not interfered with.

5. Residual fertilization from the wheat can be used by the bermudagrass during summer months.

Table 1. Wheat yield as influenced by tillage treatments on 3 previous crops (Quincy, 1982).

Previous crop	Tillage treatment: Moldboard plow			Chisel plow			Harrow			No-till		
	wheat yield bu/A											
	1982		1983	1982		1983	1982		1983	1982		1983
Soybeans	60.8	a	62.8	53.4	a	57.2	48.5	a	56.4	36.3	a	68.4
Bahia	42.5	b	61.5	36.8	a	59.0	41.4	b	75.3	20.6	b	42.4
Bermuda	47.8	b	52.5	50.1	a	54.2	52.0	a	54.7	47.1	a	47.7

Table 2. Influence of tillage on soil resistance 6 weeks after planting wheat into soybeans (Quincy, 1982).

Soil depth (in.)	Tillage method at planting: Moldboard plow		Harrow		Chisel plow		No-till	
	soil resistance (lbs/sq in)							
	1982	1983	1982	1983	1982	1983	1982	1983
2	0	46	0	42	0	25	54	8
4	0	54	8	75	0	46	104	8
6	21	83	171	133	75	133	242	8
8	63	79	329	271	183	221	404	63

Table 3. Wheat yield and test weight as influenced by tillage in bahiagrass (Quincy, 1982).

Seedbed treatment	Grain yield bu/A			Test wt. lbs/bu		
	1982		1983	1982		1983
moldboard plow	42.5	a	61.5	55.3	a	62.0
chisel plow	36.8	a	59.0	57.5	a	62.0
harrow	41.4	a	75.3	59.1	a	62.9
no-till	20.6	b	42.4	57.5	a	59.8

Table 4. Influence of tillage on soil resistance 6 weeks after planting wheat into bahiagrass (Quincy, 1982).

Soil depth	Tillage method at planting: Moldboard plow		Harrow		Chisel plow		No-till	
	----------soil resistance (lbs/sq in)---------							
	1982	1983	1982	1983	1982	1983	1982	1983
2	4	33	42	42	67	17	192	71
4	104	67	133	121	154	71	246	79
6	204	150	325	196	238	183	354	192
8	250	238	483	254	350	200	479	304

Table 5. Wheat yield and test weight, as influenced by tillage in bermudagrass (Quincy, 1982).

Seed treatment	Grain yield bu/A		Test wt. lbs/bu	
Moldboard plow	47.8 a	52.5	54.5 a	61.3
Chisel plow	50.1 a	54.2	54.9 a	61.3
Harrow	52.0 a	54.7	52.5 a	62.0
No-till	47.1 a	47.7	56.5 a	62.5

Table 6. Influence of tillage on soil resistance 6 weeks after planting wheat into bermudagrass (Quincy, 1982).

Soil depth (in.)	Tillage method at planting: Moldboard plow		Harrow		Chisel plow		No-till	
	-------------soil resistance (lbs/sq in)------------							
2	0	79	0	50	0	33	71	65
4	4	100	0	164	8	81	183	124
6	121	142	167	299	171	185	308	208
8	183	206	346	451	292	228	429	293

THE INFLUENCE OF TILLAGE ON NITROGEN MANAGEMENT FOR SOFT RED WINTER WHEAT PRODUCTION SYSTEMS

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Approximately 260,000 acres of soft red winter wheat were sown in Kentucky in the fall of 1977. By the fall of 1983. preliminary reports indicted that this acreage had risen to nearly 720.000. A large portion of these acres are being sown using conventional (plow, disc (1-3 times), plant) tillage management on soils with a significant erosion hazard **if** surface residues are not maintained.

Interest In winter cereals in Kentucky has evolved from the winter cover and green manure crops of past years to wheat and barley as important components of grain crop rotations. Winter cereals are now being looked upon as a means of generating early feed and/or cash flow. Because of this. interest in better management practices has also arisen, and use of higher nitrogen (N) rates to Increase wheat yields has coincided with increased emphasis on tillage reduction. Tillage methods have been important determinants of yield response to fertilizer N in summer annuals such as corn (1, 2), and are expected to be of no less importance to the yield response of the winter annuals.

Two experiments have been initiated to evaluate the influence of tillage on yield and other important agronomic responses related to nitrogen applications on soft red winter wheat. In the first of these, located on a Maury silt loam (Typic Paleudalf). wheat follows corn in a corn-wheat-doublecrop soybean rotation. Two tillage systems, no-till and conventional (plow. disc 2x, plant) are represented. The Caldwell wheat was planted and fertilized in such a way as to give three levels of N on the wheat (0. 40. 80 lb N/A) at each of three levels of N applied to the prior corn crop (0, 100, 200 lb N/A).

Soil nitrate nitrogen levels strongly reflected corn fertilization patterns when samples were taken in the fall prior to wheat seeding. but not the next spring. when the plots were soil sampled prior to wheat N

The investigations reported in this paper (No. 84-3-87) are publlshed with approval of the director. Kentucky Agricultural Experiment Station.

fertilization (Table 1). Corn yields averaged 120 bu/A across all treatments, but crop utilization depleted soil nitrate levels much more in no-till corn than in conventionally tilled corn plots. The wheat did respond to the "residual" N fertilization pattern (Table 1) in terms of leaf tissue N concentrations and lodging patterns, regardless of wheat spring N fertilization rate. No-till wheat production resulted in less N recovery and lodging.

Table 1. Influence of corn N fertilization rate on residual soil nitrate levels, wheat leaf N concentration and wheat lodging.

Tillage System	N Rate Corn	Soil Nitrate N 10/82	Soil Nitrate N 4/83	Flag-Leaf N	Lodging* Rating
	------ -lb	N/A ---+--	---	%	
No-Till	0	16 e	12	3.6 b	0.2 c
	100	40 d	13	3.7 b	0.2 c
	200	128 b	14	3.9 a	0.3 c
Conventional	0	26 d	11	3.5 b	0.2 c
	100	96 c	11	3.9 a	3.3 b
	200	198 a	11	4.0 a	5.2 a

*0..2 = no lodging, 9.0 = plot lodged totally flat.
+Values within a column followed by the same letter not significantly different (P>O.05).

Wheat yield patterns were strongly influenced by both applied spring N and residual N from the previous corn crop (Table 2). No-tillage production practices resulted in a different yield pattern than conventional tillage. On plots where corn received no N fertilizer there was a strongly positive yield response to both application rates of spring N on no-till wheat. However, the response "peaked" at 40 lb N/A under conventional tillage management. Following use of 200 lbs N/A on the prior corn crop the wheat yield response pattern was generally negative with respect to applied spring N, especially in conventional tillage wheat. Wheat following corn fertilized at 100 lbs N/A required some additional N to maximize yields under no-till management. With conventional tillage, no additional N was required. Yield losses with excessive N were associated with increased lodging on conventionally planted wheat and head and foliar diseases on wheat grown under both residue management systems.

At this location the Maury soil has a large reserve of organic N that becomes available under conventional tillage. When combined with residual fertilizer N from the prior corn crop, an excessive N supply resulted.

The second field experiment was sited on a Loradale silt loam (Typic Argiudoll) in a killed ryegrass sod. The plot area had been used for several years to evaluate inbred corn lines and had received large quantities of N fertilizer during that period of time. Thus, the potential soil N availabil ty to the wheat was also considered to be very high at this location. In this experiment, no-till and conventional tillage were evaluated at two nitrogen application rates (70, 140 lb N/A) as a part of an intensive wheat management experiment that also involved two different varieties (Caldwell, Wheeler) and the presence or absence

Table 2. Wheat yield response to tillage, applied and residual nitrogen - 1982/83 production year.

Tillage System	N Applied to Wheat	N Rate on Corn (lb N/A) 0	100	200
	lb/A	Wheat yield (bu/A)		
Conventional	0	*52 fg	66 bcde	43 ghi
	40	76 ab	61 cdef	42 ghi
	80	79 a	56 ef	41 hi
No-Till	0	36 i	51 fgh	68 abcd
	40	55 f	73 ab	69 abc
	80	71 abc	70 abc	57 def

Yield values followed by the same letter are not significantly different ($P>0.05$).

of programs of disease control (with fungicides) and plant growth regulation (with ethephon).

It was apparent that both tillage and applied N significantly affected wheat yields (Table 3). The no-till wheat outyielded the conventionally managed wheat by 9 bu/A, averaging 91 bu/A. The yield difference between the two systems appeared to be related to N availability. All fertilizer N was managed in split applications, with three-fourth's applied at spring greenup and one-fourth at late boot. Additional N resulted in yield declines in both tillage systems when no fungicide was used, and the generally poorer performance of the conventionally planted wheat was related to greater N recovery, lush early vegetative growth, and earlier lodging (Table 3).

The earliest lodging commenced with the onset of grain filling and was related to weakening of basal stems by powdery mildew (*Erysiphe graminis* f. sp. *tritici*). The fungicide program was generally effective, and the largest yield increases (15 to 16 bu/A) occurred at higher N fertilization levels. Where 140 lb N/A was used on conventional tillage wheat, the fungicide program did not raise wheat yields to near maximum levels in the experiment. This seemed indicative of the greater disease stress in these plots.

As these experiments continue the depletion of soil N reserves and the inefficient recovery of N in no-till environments should shift the response pattern. However, where wheat follows N fertilized corn, as in large areas of Kentucky, the no-till wheat appears less likely to be adversely affected by high levels of residual/available soil N and will indeed require more fertilizer N when soil N reservoirs are low or unavailable.

Table 3. Yield and lodging response of soft red winter wheat* to tillage management, applied nitrogen, and disease control.

Tillage System	N Rate	Lodging Rating† 8 June		Lodging Rating† 22 June		Wheat Grain Yield -fungicide		Wheat Grain Yield +fungicide	
	lb/A					bu/A			
No-Till	70	0.4	a‡‡	1.1	a‡‡	**91	bc	100	a
	140	0.7	ab	2.4	b	79	d	94	ab
Conventional	70	0.9	bc	1.3	a	81	d	93	ab
	140	1.1	c	2.1	b	69	e	85	cd

*Average of 2 varieties, Caldwell and Wheeler.
†0.2 = no lodging, 9 = whole crop lodged flat.
‡‡Ratings within a column followed by same letter are not significantly different (P>0.05).
**Yield values followed by the same letter are not significantly different (P>0.05).

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INTERSEEDING CLOVER WITH WHEAT FOR ESTABLISHMENT OF CLOVER RESEEDING SYSTEMS

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Using winter legumes as a N source for summer grain crops helps reduce the dependency on N fertilizers. Unless reseeding legume systems are used, however, seed and seeding cost of the legume can be as costly as the N fertilizer they replace. Advantages for reseeding legumes include substantial savings in production cost, and early establishment (mid August) which results in greater growth and N production than legumes seeded after summer crop harvest in October and November. Disadvantages for reseeding legumes include the elimination of winter grain crops, and late planting of summer grain crops (winter legumes such as crimson clover generally don't set seed until late April or early May). The purpose of this study was to evaluate the possibility of establishing intensive cropping systems which would permit reseeding legume systems without losing the potential for winter grain crops, and also allow early plantings for summer grain crops. The cropping system used was wheat-clover combinations followed by no-till grain sorghum the first summer, reseeded clover the second winter, and early planted corn the second summer.

In mid November of 1982, two tests were established on a Lucedale fine sandy loam (Rhodic Paleudult). Wheat 'Coker 762' was seeded into prepared soil (disk-chisel-disk) at the recommended seeding rate (90 1b./acre). Crimson clover (Trifolium incarnatum L. var. Tibbee) was seeded simultaneously with wheat at rates of 0, 5, 10, and 15 1b./acre and alone at 20 lb./acre.

Nitrogen rates were applied to wheat at 0, 30, 60 and 90 lb./acre in one test. In the other test, N was applied to sorghum at 0, 30, 60, and 90 lb/acre (1983) and corn at 0, 40, 80, and 120 1b.facre (1984). The grain sorghum 'Savannah 5' was no-till planted into wheat/clover mulches after wheat grain harvest. Sorghum row width was 24 inches and seeding rate was 6 seed/foot. In 1984, corn 'PA 1502' was no-till planted into reseeded clover stands. Corn row width was 36 inches and seeding rate was 24,000 seed/acre. The experimental design was a randomized complete block, replicated 4 times, with clover seeding rates in whole plots and N rates in split plots. These treatments were designed to determine (1) how much clover could be interseeded with wheat without reducing wheat grain yield, (2) how much, if any, N would the clover provide for wheat, (3) how much N would the various clover rates release to grain sorghum, and (4) how much clover would have to be interseeded with wheat to initiate a clover reseeding system.

Wheat forage yields (Table 1), measured when the clover was at full bloom, were significantly reduced only where clover seeding rates reached 15 lb./acre (26 and 36% reduction for 0 and 60 lb./acre applied N, respectively). Applied N increased forage wheat yields and there was little evidence of N being provided by the clover for wheat growth. Applied N decreased clover forage yields an average of 45%.

Wheat grain yield reductions increased with increasing clover seeding rates. Averaged across N rates, wheat yield reductions were 5, 10, and 31% for 5, 10, and 15 lb./acre clover seeding rates, respectively. The maximum wheat grain yield (65 bu./acre) was achieved with 30 lb./acre N applied to the wheat with no clover treatment.

Although wheat grain yields declined at the high clover seeding rate, grain sorghum yields increased with each clover seeding rate increment. Sorghum yields from the 0 N rate were improved 17, 32, and 48% for clover seeding rates of 5, 10, and 15 lb./acre, respectively (Table 2). Regardless of clover seeding rate, N application generally increased grain sorghum yields. Total clover N production exceeded 100 lb./acre, however, the 1983 growing season was extremely dry and may have limited N release from clover tissue.

In August 1983, reseeding clover had already germinated and by December ground cover ranged from 70 to 90%. The differences in ground cover reflected clover production trends from 1982 rather than initial establishment rates. Dense reseeded clover stands eliminated wheat planting and severe weather limited total clover N production to 45 lb./acre. Clover stands initially established in the fall of 1983 were completely winter killed. Advantages of reseeded rather than planted clover include more fall growth, increased, winter hardiness, and elimination of annual seeding expenses. The results suggest that interseeding clover and wheat is a successful method for establishing a reseeding system. Corn no-till planted this spring will determine if the extra fall growth of reseeded clover will result in sufficient N production to support optimum yields, without the use of N fertilizer.

Table 1. Oven-dry wheat and clover forage yields as affected by rates of interseeded clover and applied N.

	Clover seeding rate (lb./acre) and applied N (kg/ha)							
	0		5		10		15	
Material	0	60	0	60	0	60	0	60
	forage yields, lb/acre							
Wheat	4340	6790	4250	6230	4840	6200	3310	4070
Clover	----	----	540	370	960	530	1960	1010
Total	4340	6790	4790	6600	5790	6320	5280	5080

Table 2. Grain sorghum yields as affected by clover seeded into wheat and sidedress N applied to the sorghum 4 weeks after planting.

Clover seeding[1/] rate	Applied N, lb./acre			
	0	30	60	90
lb./acre	--------sorghum yield, bu./acre-----------------			
0	37	58	56	60
5	43	55	67	70
10	49	62	61	60
15	55	64	59	70
20	59	55	61	63

* * *FLSD (0.10) for any two values is 430

[1/]Except for the 20 lb./acre clover seeding rate, the clover was interseeded with 90 lb./acre wheat. The sorghum was planted after harvesting wheat for grain.

RELATIONSHIPS BETWEEN TILLAGE SYSTEMS AND SOIL EROSION

RESOURCE MANAGEMENT SYSTEM FOR CROPLAND EROSION IN KENTUCKY

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The Soil Conservation Service assists land users in planning and applying resource management systems.

A resource management system is a combination of conservation practices identified by the primary use of land or water that, if installed, will at a minimum protect the resource base by meeting tolerable soil losses, maintaining acceptable water quality, and maintaining acceptable ecological and management levels for the selected resource use. Resource management systems, in addition, may include conservation practices that provide for quality in the environment and quality in the standard of living.

The resource management system will address the following:

1. Quality in the resource base

   A. Soil loss will be kept to t or below
   B. Improve drainage for the crops produced
   C. Organic matter, tilth and fertility will be improved or maintained

2. Quality in the standard of living

   A. Produce optimum crop yield
   B. Produce high quality crop
   C. Improve management efficiency

3. Quality in the environment

   A. Minimize onsite and offsite pollution
   B. Improve visual quality
   C. Improve wildlife habitat
   D. Provide for diversity of plants, animals, and vegetative patterns
   E. Improve recreation opportunities
   F. Resource use will be compatible

Resource management systems are made up of a combination of conservation practices identified by the primary use of the land, such as cropland.

Examples are -

1. Conservation cropping system

2. Contouring
3. Conservation tillage (no-till)
4 Contour stripcropping
5. Grassed waterways
6. Terraces with pipe outlets
7. Diversions
8. Grass and legumes in rotations
9. Cover crop
10. Crop residue management

Resource management and no-tillage systems commonly used in Kentucky are -

(1) <u>Small grain/soybeans (double cropping) or grain sorghum (milo)</u>

(a) Small grain harvested for grain and soybeans no-till planted in the small grain residue; soybeans harvested and small grain planted with no-till planter 1/ in soybean residue. All residues left on the surface. Two grain crops harvested in one year.

(b) Waterways, diversions, terraces, and stripcropping practices used as applicable.

(c) Predicted average annual soil losses of 0.68 tons as compared to 16 tons per acre per year from conventional tilled soybeans. 2/

(2) Corn-small grain/soybean (single and double croppping)

(a) First year, corn no-till planted in small grain, and soybean residue; corn harvested for grain and small grain no-till planted 1/ in corn residue. Second year, small grain harvested for grain and soybeans no-till planted in the small grain residue, soybeans harvested and small grain cover crop no-till planted 1/ in soybean residue. All residues left on the surface. Three grain crops harvested in two years.

(b) Waterways, diversions, terraces, and stripcropping practices used as applicable.

(c) Predicted average annual soil losses of 0.68 tons as compared to 16 tons per acre per year from conventional tilled corn and soybeans. 2/

(3) <u>Corn, continuous</u>

(a) Corn no-till planted in killed small grain cover crop. Corn harvested for grain or silage and small grain cover crop no **till** planted. 1/ All residue left on surface when corn harvested for grain.

(b) Waterways, diversions, terraces, and stripcropping practices used as applicable.

(c) Predicted average annual soil losses of 0.68 tons as compared to 16 tons per acre per year from conventional tilled corn for grain. 2/

(4) Corn, followed by one or more years of meadow (pasture)

(a) First year, corn no-till planted in killed sod. Corn harvested for grain or silage and small grain cover crop no-till planted. 1/ Meadow fall or spring seeded in small grain. Second year, small grain harvested for grain, hay, or silage. All meadow harvested for hay. Corn residue left on surface when harvested as grain.

(b) Waterways, diversions, terraces, and stripcropping practices used as applicable.

(c) Predicted average annual soil losses of 0.68 tons as compared to 16 tons per acre per year from conventional tilled corn for grain. 2/

The above resource management and no-tillage systems affect the quality in the (1) resource base (soil) for sustained use by reducing the annual soil loss from 16 tons to less than one ton per acre; (2) environment by minimizing onsite and offsite pollution by pesticides, nutrients, and sediments and the additional crop residues increase the amount of wildlife food and cover during the winter months; and (3) standard of living by increasing crop yields, reducing production cost and sustaining resource productivity.

1/ May also be broadcast or airplane seeded.

2/ Soil loss predicted by the USLE for a Loring silt loam soil with a slope of 4 percent and a length of 200 feet.

EROSION AND SOIL PRODUCTIVITY IN THE BLACKBELT

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The Blackbelt, a natural prairie, occupies approximately 4.5 million acres in Mississippi and Alabama. Blackbelt soils have T values ranging from one to five tons per acre per year, with depth to Selma chalk (the parent material) being a primary consideration in determining tolerable soil loss. These soils are adapted to grasses and clovers and have been used to support livestock and produce Johnsongrass hay in the past. Cotton was the major row crop until the mid-1950's. Cotton yields had already declined significantly by the mid-1930's in the Blackbelt even with the use of mechanized tillage equipment (Jones et al., 1941). There is little doubt that excessive fall and winter tillage used in cotton production on these soils severely damaged major portions of the Blackbelt. Sheet and rill erosion went unrecognized for years. Many of the same areas are now in soybean production and are being degraded even further.

Increasingly, soil scientists and researchers are being asked to provide information on land productivity. Many soil conditions have been correlated to yield (Sakar et al., 1966). Some of these characteristics are moisture-holding capacity, organic matter, pH and cation exchange capacity. Munn et al. (1978) found that thickness of the A1 horizon (mollic epipedon) was the soil characteristic that correlated most closely with rangeland productivity of 23 soils in western Montana. Sopher and McCracken (1973) found that corn yields of both Udultic and Aquultic soils in North Carolina were highly correlated with moisture holding capacities, certain combinations of clay and sand, extractible phosphorus, percent base saturation, and other properties related to soil acidity and amount of charge on the cation exchange complex. Most of these type studies did not consider how soil characteristics may have been influenced by previous erosion.

Our primary objective was to determine how depth to chalk, a parameter directly related to accelerated surface erosion in the Blackbelt, relates to yield. A secondary objective was to determine long term productivity under various tillage systems and measured or calculated erosion rates.

Materials and Methods

The study was initiated in 1982, using three farmers' fields in the Blackbelt near Brooksville, MS. The study makes use of sequential testing which is essentially a reversal of the idea of locating experiments or data collection points on uniform soils. Sequential testing consists of deliberately locating experiments and data collection points on contrasting soils across the landscape to evaluate selectively the effects of soil differences.

Mini-plots (19.2 ft.^{2}) were used for data collecting points in this particular study but did not follow a true grid due to the wide variability in chalk depth. Twenty to 28 plots were selected in each field where chalk depth ranged from 4 to 60 inches. The test crop was soybeans and data were collected on mature height and grain yield. Soil samples were collected from the 0 to 6 and 6 to 12-inch depths (where appropriate), and analyzed for pH, organic matter and available nutrients. Depth to firm chalk was determined by use of an auger or probe.

Two of the three fields used in 1982 were studied again in 1983. Four additional fields were selected for study in 1984. Fields have slopes that range from 2 to 8% and the type of catena that could have resulted from surface erosion. Upland soils were generally of the Okolona series and graded downslope through Binnsville to chalk outcrops on the side slopes and into Griffith or Leeper series on the footslopes and bottoms.

Rainfall data was computed from recording rain gauges. Regression analyses were used to make statistical comparisons.

Results and Discussion

Soybean yield was more highly correlated with depth to chalk than any other soil parameter measured in 1983 (see table below).

Variable correlated with Soybean Yield	(r)	
	Field 1	Field 2
Depth to chalk (inches)	.825	.922
pH	-.254	-.501
P (available-lb/a)	.541	.563
K (available-lb/a)	.638	.762
Organic matter (%)	.546	.790
Mature plant height (inches)	.933	,802
Significant coefficient at .05 level	i.388	i.451
Significant coefficient at .01 level	i.496	±.575

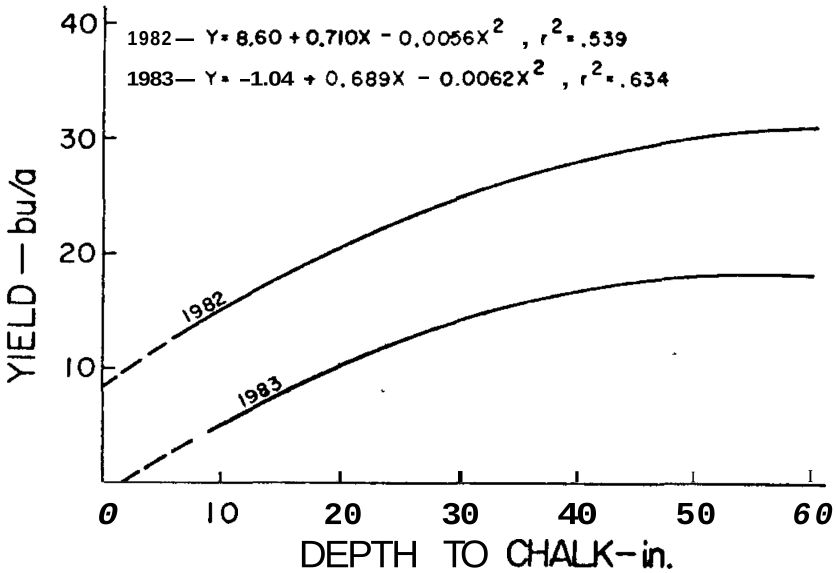
However, soybean yield was significantly correlated with all the other soil parameters with the exception of pH in Field 1. The negative correlation with pH is reflected in the fact that pH becomes more alkaline (approaching 8.3) with decreasing depth to the calcareous chalk. Apparently, higher pH has a depressing affect on yield. As expected; soybean yield was highly correlated with mature plant height.

Multiple linear regression analysis was used to see how much the relationship between soybean yield and depth to chalk could be improved by including the other soil parameters (see table below).

Soybean yield regressed with:	r^2 or R^2 Field 1	Field 2
Depth to chalk	.680	.849
Depth to chalk + pH	.730	.854
Depth to chalk + available P	.739	.880
Depth to chalk + available K	.811	.904
Depth to chalk + organic matter	.726	.850

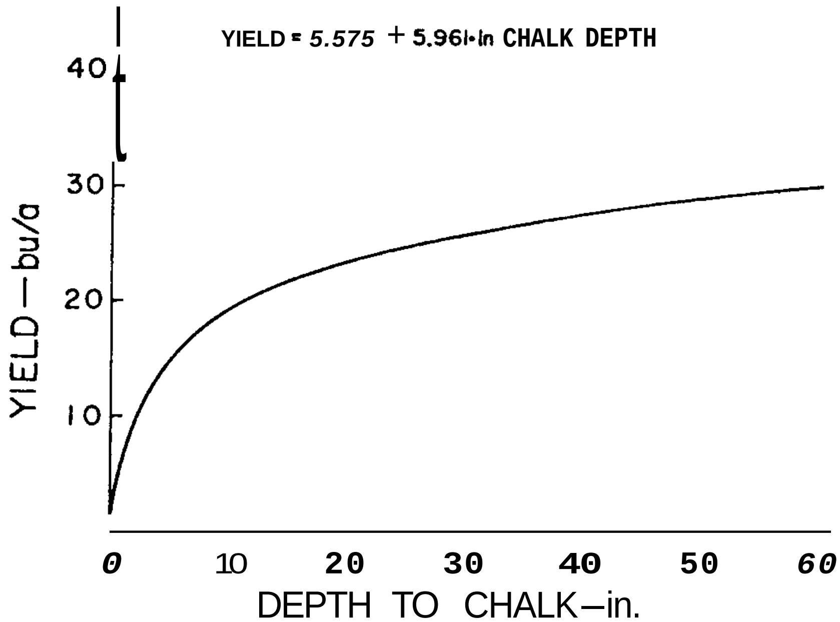
Depth to chalk alone accounted for 68 and 85% of the yield variability in Fields 1 and 2, respectively. Although organic matter decreased as depth to chalk decreased and was significantly correlated with depth at the .05 level, it improved yield predictability very little in Field 1 and none at all in Field 2. The most significant improvement was seen with available soil K where predictability was improved 13 and 5.5% respectively for Fields 1 and 2.

All 1982 and 1983 data were combined for a general graphical interpretation of the relationship between soybean yield and depth to chalk (see illustration below).



The best relationship was non-linear and represents three fields and two soybean varieties in 1982 and two fields and two varieties in 1983. Depth to chalk alone accounted for 54 and 63% of the yield variability in 1982 and 1983, respectively, when combining the data in this fashion. The trend was very similar both years. The lower yields in 1983 were due to later planting and below normal rainfall during July and August.

Blackbelt soils generally have low infiltration rates that range from <.06 to .22 inches per hour and water supplying capacities that range from 0.12 to .22 inches per inch of soil. Therefore, without supplemental water, soil depth can become critical as far as moisture supply is concerned. Since 1982 was a more normal rainfall year, data from Field 1 in 1982 was used to determine the best logarithmic relationship between yield (Centennial variety) and depth to chalk (see figure below).



Soybean yields increased an average of 1 bu/a per inch of depth increase between 5 and 10 inches above chalk. Between 10 and 20 inches depth, yield increased about 5 bu/a and .with greater than 20 inches yield increased approximately .2 bu/a for each inch of soil to a 60-inch depth.

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EROSION EVALUATION OF CONSERVATION TILLAGE

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Conservation tillage systems have been evaluated for effectiveness of erosion control on the North Mississippi Branch Experiment Station at Holly Springs, MS since 1956. The first erosion plots were used to evaluate "good" and "poor" management for pastures and corn. Since 1970, we have evaluated no-till and reduced-till for corn, soybeans, and soybean-wheat double-crop. Presently, we are evaluating conservation tillage for cotton on the erosion plots. This paper will discuss the results of these tests and will also mention other research on soil conservation that we have done on the station. A list of publications that fully explain our completed research is attached at the end of this paper.

Most of the research reviewed here was done on erosion plots 13.3 feet wide by 72.6 feet long located on 5% sloping land. The soils on the plots are predominately Providence (Typic Fragiudalfs).

In the no-till system, corn or soybeans were planted in a slot made by a small chisel following a fluted coulter which cut through surface residues. Fertilizer, placed in the bottom of the slot, was covered and separated from the seeds by a 2- to 3-inch layer of soil. A press wheel closed the slot opening. Broadcast pre-emerge and spot treatment post-emerge applications of herbicides controlled weeds during the growing season.

In the reduced-till system, corn or soybeans were planted no-till, but cultivated twice during the growing season. No-till wheat was broadcast in standing soybeans when soybean leaves started to drop. Conservation tillage was evaluated for both corn for grain and corn for silage. Recommended crop varieties, plant populations, planting dates, and fertilization rates were used for all treatments. Rows were spaced 40 inches apart, up and down the slope.

Runoff and soil loss estimates from 1970 to 1981 for soybeans, corn and wheat are given in Table 1. Values in the table are measured soil losses, adjusted to a common base of slope, soil and rainfall; Providence soil has a tolerable soil loss of 3 t/a·y. The conventional till treatment was used as a check, to compare with the conservation tillage treatments. Residue management on the conventional treatments was good. All the crop residue was shredded and spread after harvest; weeds were allowed to grow except during the crop growing season. Crop yields for the conservation tillage systems were about the same or higher than those on the conventional till plots.

No-till and reduced-till greatly reduced soil loss. Disturbance of cover by the corn cultivation in the reduced-till system only slightly increased soil loss. However, the cultivation in soybeans increased annual soil loss to 3.5 t/a, compared to 0.8 t/a for no-till which did not have the cultivation during the growing season. The same increased soil loss with greater tillage is seen for all crops.

The destruction of cover is a major factor contributing to increased soil loss following tillage. The reduced-till system has cultivation only during the corn and soybean growing season. However, the disturbance of surface cover by that tillage affects erosion during cultivation, and also during the remainder of the year. This effect is particularly evident for soybeans, where the reduced-till treatment soil loss of 3.5 t/a exceeded the tolerable amount for Providence soil.

Cover is also gained by weed management. The soil loss values given in Table 1 indicate a significant reduction of soil loss due to weed cover. This type cover is particularly important in the Southeast, where rainfall erosion occurs the year around and soil erosivity is highest during the cool, wet season of the year.

As expected, weeds are more evident in the treatments without tillage. The double crop treatments had few weeds due to year-around cover and chemical weed control. Weeds play an important part in soil conservation with corn grown for silage, since the crop provides good canopy cover only from June to August. Without weed cover, erosion from no-till corn silage is excessive; if the weeds that flourish from harvest until being chemically killed before planting are left undisturbed, soil loss from silage corn is relatively insignificant.

In general, conservation tillage conserves water by reducing runoff. This is particularily important with high summer temperatures of the Southeast and thin soils that have a shallow root zone and low water holding capacity.

Other erosion experiments have been completed in the last 10 years: Erosion from 7-inch rows for soybeans was about two-thirds that from 40-inch rows, but soybean yields were about the same for both spacings. The greater soil loss for the wide rows was attributed to cultivation for weed control and slower canopy cover development that left the soil more susceptible to erosion. Soybeans with 7-inch rows received no cultivation. Also, a system of alternating 16 and 24 inch rows for soybeans was evaluated. Erosion control effectiveness was good and crop yields were comparable to those from conventional tillage soybeans in 40-inch rows.

Several projects are underway on the erosion plots at the station. Preliminary results indicate reduced soil loss from cotton by the use of no till and reduced tillage. However, neither conservation system reduced soil loss below tolerable amounts. Therefore, we are adding a vetch cover crop to all treatments. One conclusion is that land used for cotton production is much more erodible than when used for corn or soybeans.

A project initiated in 1983 seeks to compare nutrient loss from fertilizer applied on the surface with that from fertilizer banded along corn rows. Erosion plots have been established to determine the long term effect of erosion on soil productivity. This project may take 10 to 12 years to complete.

In conclusion, we have learned that tillage must be reduced for erosion control. A large part of the tillage effect is because of disturbance or destruction of cover by the tillage. Keeping crop residue on the soil surface and removing weed cover only when essential for crop production are important requirements for an effective soil conservation system.

Table 1. Expected soil loss from corn, soybeans, and wheat using no-till, reduced-till and conventional tillage. Values computed for a 72.6-ft slope length, 5% slope, Providence soil, and rainfall R = 360.

Crop and Tillage System	With Weeds Soil Loss+	With Weeds Runoff	Without Weeds Soil Loss*
	tonsfacre	% of rainfall	tonsfacre
Corn grain, conventional till	7.2	31	8.1
Corn grain, no-till	0.4	28	0.8
Corn grain, reduced-till	0.6	18	1.2
Corn silage, conventional till	11.2	33	15.1
Corn silage, no-till	0.2	17	4.2
Soybeans, conventional till	8.3	42	9.3
Soybeans, no-till	0.6	30	0.8
Soybeans, reduced till	3.5	26	3.5
Soybeans-wheat, double crop:			
Soybeans-wheat, no-till	0.2	23	--
Soybeans-wheat, reduced till	1.0	30	1.0

+ Soil loss was computed from measured C factors.

* Soil loss was adjusted by analytically removing the effect of weeds.

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THE EFFECTS OF CONSERVATION TILLAGE ON EROSION IN NORTH WEST FLORIDA

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Because of topography, soils, climate and poorly managed intensive cultivation, a significant percentage of cropland is eroding faster than the topsoil can be replenished through natural processes. The soils are dominantly well and moderately well drained with sandy surface layers over loamy and clayey subsoils. They occur on nearly level to moderately steep slopes that extend 20 to 600 feet. The surface layers have weak granular or single grain structure with very friable or loose consistency which are highly susceptible to erosion under intensive cultivation. The subsoils are strongly acid and low in fertility. In many fields, the subsoil is exposed and mixed with the remaining topsoil resulting in excessive crusting, cloddiness, reduced rainfall infiltration, and a poor medium for root growth.

Northwest Florida includes 17 counties extending from the Alabama and Georgia line on the north and the Gulf of Mexico on the south. Annual rainfall varies within the area but averages about 58 inches. About 60 percent of the total rainfall as well as highest intensity rains occur from December through April when most cultivated soils are bare and vulnerable to erosion. The rainfall factor for the USLE is the highest in the nation. The range of temperatures are such that allow for a long growing season which is suitable for multi-cropping coupled with conservation tillage.

There are 784,168 acres of cropland making up 30,446 fields in the area according to a recent study made by the Soil Conservation Service. Using the factors in the Universal Soil Loss Equation (USLE), the following data indicates the acres and the annual soil loss by water and wind.

Table 1.

Sheet and Rill Erosion*			Wind Erosion*			
< 5	5-10	> 10	< 2	2-5	5-10	> 10
168,361	316,063	271,276	147,202	174,202	213,814	58,140

* Shown in tons per acre per year

The USLE calls for factors such as rainfall, soil type, cropping system, slope length, steepness and existing conservation practices on the field to predict annual tons of soil eroded from each acre.

The purpose for the study was to group as well as locate those fields losing less than 5 tons of soil per acre per year, those losing between 5 and 10 tons and those losing more than 10 tons per acre per year. Special effort then is first directed toward erosion control treatment on those fields with more than 10 tons soil loss per acre per year.

Placing an economic value on conservation tillage is a difficult task. Table 2 reflects soil loss after treatment and cost of different treatments as they are applied to a field that is eroding at 16.6 tons/acre annually.

Presently, the erosion rates on 35% of NW Florida's cropland is high enough to threaten long term productivity. To help reduce this soil loss, research and all disciplines in agriculture are constantly seeking new ways to help producers develop and apply affordable conservation practices. Conservation tillage is once such practice that is now growing rapidly.

Table 2 – Corn on Dothan Sandy Loam with 4 percent slopes.

Conservation Treatment					Erosion Tons/Ac	Treatment Cost $	Cost Per Ton $	Net Return $
Conven. Tillage	Conser. Tillage	Contour	Terrace & Cover	Winter Cover				
**					16.6	00	00	131.07
**		**			8.32	4.26	0.51	126.81
**			**		4.71	22.26	1.87	108.81
**				**	12.47	8.70	2.09	122.37
**				**	3.53	32.65	2.49	98.43
	**				4.44	-19.81	-1.63	150.88
	**	**			2.22	-16.33	-1.13	147.40
	**		**		1.26	1.67	0.11	129.40
	**			**	3.33	-11.11	-0.84	142.18
	**		**	**	0.94	11.81	0.75	119.26

** Indicates practice performed.

The negative figures reflect a savings as compared to a cost in Table 2. It is evident that conservation tillage is one of the most cost-effective treatments that can be applied to reduce erosion on those critically eroding fields.

Conventional tillage shows a net return of $131.07 per acre with no conservation practices and a soil loss of 16.6 tons per acre per year. Soil losses can be brought down to 3.5 tons per acre per year with conventional tillage, terraces, contouring and winter cover crops but the profit turns out to be only $98.43 per acre. The same soil and crop, however, treated by the lone practice of conservation tillage would yield a profit of $150.88 with a tolerable erosion rate of 4.4 tons per acre per year.

The report revealed that there were 194,683 acres of conservation tillage during the 1983 cropping season, which is a good indicator that the producers in the area can see the beneficial effects. One such effect is increased production per unit of land. By selecting crop varieties that are best suited to an early or late growing season, two or more crops may be grown in sequence on the same land in the same year. For example, early, short season corn varieties and late season soybean varieties may be selected to be grown the same year on the same land. Multicropping can be accomplished successfully with a conservation tillage system. The conservation tillage system provides for timing the harvest of one crop and planting the second crop more efficiently than with a conventional tillage system. The producer will also better utilize his fertilizer and chemicals with multicropping than with one crop per year conventional tillage system.

Conservation tillage may not be pretty, but it is one of the most cost effective solutions to the erosion problem on cropland. For example, a conventional tilled corn field, clean and bare at planting, on 3% slopes, 200 feet long and on Dothan soil results in 11 tons of soil loss per acre per year. By growing another crop such as small grain after the corn harvest, the soil loss will reduce to 7 tons per acre per year. Using the same crops on the same land, but by using a conservation tillage method and utilizing the previous crop residue, the soil loss by sheet and rill erosion is 3 tons per acre per year. The erosion rate can be reduced as much as 5.5 tons per acre per year by contour farming the field. With a conservation tillage method and contouring, the erosion on this field will be less than 2 tons per acre per year.

Some other beneficial effects of conservation tillage not readily recognized by producers is the prevention of pollution of nearby water with soil particles carried by runoff water. Those soil particles carry attached atoms of fertilizer and chemicals that are included in water pollutants.

It is estimated that about two dollars worth of fertilizer is lost per ton of soil loss. Conservation practices and good management can almost totally eliminate this problem.

Conserving soil moisture for crop use with conservation tillage is accomplished in two ways. First, the crop residue promotes cooler temperatures at the soil surface and less evaporation occurs. Second, conservation tillage allows for a reduced number of tillage operations that reduces moisture in the plow layer. For example, irrigated peanuts and corn in small grain residues grown by two separate producers in the 1983 growing season required only one half as much irrigation water as their conventionally tilled irrigated fields with the same treatments. Both no-till and conventional tilled fields yielded about the same, but the no-till fields required less labor and time.

Soil compaction has a direct impact on yields. Most producers to not *see* these losses. Soil compaction problems are often misdiagnosed as some other crop problem. Conservation tillage equipment with subsoilers or straight shank chisels will break up or shatter the compacted layer that restricts water and air penetration, root development, and reduces the water holding capacity of the soil. Conservation tillage reduces the number of tillage operations, thus reduces the traffic pressure which causes compaction. There is no permanent cure for soil compaction, but when the soil is not too wet, conservation tillage is a good start toward reducing the problem. Using in-row subsoilers in conjunction with conservation tillage, multicropping, contouring and good management, over 500,000 acres of cropland in northwest Florida can have sheet and rill erosion reduced to tolerance levels. However, many fields have large and/or shallow gullies (ephemeral erosion) occurring which conservation tillage alone cannot solve. These areas usually have extremely high amounts of soil loss and require mechanical practices such as terraces and grassed waterways to control the erosion.

In summary, the crop residues left on the surface with conservation tillage reduce wind velocity thereby protecting young crops from the effects of the wind and abrasion from blown soil particles. Wind erosion can be reduced to tolerance levels with conservation tillage. In combination with multicropping, conservation tillage is an excellent tool for erosion control on intensively cultivated land.

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RELATIONSHIPS BETWEEN SOIL PHYSICAL AND CHEMICAL PROPERTIES

SLIT-TILLAGE FOR COMPACTED SOILS

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The plowpan is generally recognized throughout the world as a problem in compactible soils that are intensively tilled (2, 8, 10). This form of soil compaction, most severe on coarse-textured soils containing nonswelling clays, impedes root growth into the subsoil. The compacted soil in plowpans has reduced pore size and total porosity, and develops high strength as it dries (3). When a plowpan is wet, a large percentage of its pores is filled with water, so soil oxygen supply is inadequate for good root growth. Low soil oxygen when wet, and high soil strength when dry, are the primary factors limiting root growth in compacted soil (3,9).

It was hypothesized that a narrow, vertical slit cut through a plowpan, from which water would rapidly drain, would eliminate both low soil oxygen and soil strength as barriers to root growth (4). The slit substitutes for the macropores that are missing in the compacted soil. In 1979, 'Hutton' soybeans were grown on a plowpan soil with the following treatments: (1) no-till; (2) no-till with a narrow slit cut beneath the row to a depth of 15 inches; and (3) complete tillage of the plow layer. Yields for treatments 1, 2, and 3 were 18 bu./acre, 29 bu./acre, and 25 bu./acre, respectively. During a 6-week drought, the no-till beans wilted severely and the beans with complete tillage showed water stress each afternoon. The slit-tilled beans showed no drought stress. Roots of no-till and completely tilled beans were restricted to soil above the plowpan. Roots of the slit-tilled beans grew down the slit, extending to a depth of 39 inches and spreading 20 inches to each side of the row beneath the plowpan. Experiments with glass-fronted boxes and in the field have shown that the slit must be narrow enough to provide good root-to-soil contact (6). Roots do not grow well in a void.

An experiment with soybeans double-cropped with wheat is in its fourth year of comparing slit-till to no-till, to complete tillage, and to chiseling under the row (7). Yield averages for the first 3 years for soybeans following wheat for grain were slit-till - 29 bu./acre, chisel under the row - 27 bu./acre, no-till - 24 bu./acre, and complete tillage - 26 bu./acre. Slit-till was superior to other tillage treatments in promoting rapid growth of soybean roots through the plowpan and into the subsoil.

Two different subsoiler-planters have been modified for application of slit-tillage in conservation cropping systems (7). The modification consisted of shortening the subsoiler shanks so the subsoiler point runs just above the plowpan, and attaching 5/32 inch-thick blades beneath the subsoiler feet. The blades extend about 7 inches below the subsoiler feet and cut a narrow slit through the plowpan. For research purposes we made blades from rolling coulters. Indications are that this material may wear out rapidly.

Measurements made at the USDA National Tillage Machinery Laboratory showed a 12 to 43% reduction in force required for operating the slit-cutting implement compared with operating a chisel at the same depth (6). Energy savings depend on soil type, depth to the plowpan, and speed of operation. The most interesting aspect of slit-tillage is its residual effect. Once the narrow slits are cut and filled with plant roots, they remain effective for future crops. We have observed 4-year-old slits functioning as well as newly cut slits. The slits appear to be maintained by organic matter that accumulates from decaying roots of each crop.

Slit-tillage should be considered as a possible management system for plowpan soils. This will require implement development and, perhaps, use of blade material that will not wear out so rapidly. The primary requirement of slit-tillage is that the slit through the plowpan be narrow enough to provide good root-to-soil contact.

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NO-TILLAGE ON SWELLING HEAVY CLAY SOILS: A PROGRESS REPORT

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Introduction

Reported increases in soil bulk density, soil strength, and lower root densities under no-tillage demonstrate the need for tillage under some conditions (1,5,6). However, long-term cropping systems using no-tillage management have potential for reducing erosion, fuel and labor costs, and enhancing water use efficiency. Previous studies from locations on heavy clay soils with poor drainage have not favored no-tillage (4). The Blackland Prairie of Texas is comprised of self-mulching, montmorillonitic clay and silty-clay soils that have good surface drainage, but poor internal drainage when wet. The soils are very sticky and highly erodible when wet. Because yield of crops grown with no-tillage have varied with respect to location, environment, and soil type, our objectives were to determine the long-term effects of no-tillage on soil properties, crop development, and yield for the heavy clay soils of the Texas Blacklands.

Methods

A long-term study (four years) was established in October, 1980 to determine the effects of conventional tillage and no-tillage on soil physical properties, crop development and yield of wheat, grain sorghum, and cotton. The experimental site was on an Austin silty clay soil with a 1 to 3% slope. The conventional tillage treatment was comprised of repeated disk and chisel operations (to depths of 10-12 cm) following harvest to control weeds and completely incorporate the existing crop residue. A rotary-tine harrow was used to provide a uniformly flat surface and weed free seedbed prior to conventional planting. No-tillage treatments were maintained free of weeds using combinations of pre-emergence, post-emergence directed spray, and post-harvest herbicide applications. Both conventional and no-tillage systems received identical quantities of nitrogen and phosphorous to maximize crop yields. Fertilizer was applied in solution fomulation at 10 cm depth prior to planting of cotton and grain sorghum. Urea-ammonium nitrate was dribbled on the surface during the tillering stage for wheat. Crops were planted with commercially available equipment fitted with double-disk furrow openers and smooth rolling coulters. Soil bulk density, cone penetration resistance, available water, and crop yield and yield components were measured.

Results

No-tillage management did not alter the physical properties of our expanding silty-clay soil after three crop years. Both soil strength (as measured by cone penetration resistance) and wet soil bulk densities were similar between conventional tillage and no-tillage (Tables 1 and 2). Plant available soil water increased by 25 mm/year for crops growing under no-tillage (2). Root densities (cm/cm^3) in the top 30 cm of soil profile were significantly higher for no-tillage grain sorghum and cotton, but were not affected by tillage at depths greater than 30 cm (Table 3). However, rooting density of wheat was not altered by tillage treatments. Each crop produced thicker (larger diameter) roots in the upper 30 cm of the no-tillage treatment (Table 4).

Grain yields of wheat and sorghum and lint yields of cotton were equivalent under no-tillage and conventional tillage during the 1981-1983 crop years. One exception was the low grain yield of 1982 no-tillage wheat. In this instance, a severe drought, coupled with high levels of leaf rust at the tillering and jointing development stages reduced the no-tillage wheat capacity to produce tillers.

Discussion

The results of our study, thus far, suggest that no-tillage is a viable management alternative to conventional tillage of expansive clay soils. Crop yields are equivalent under no-tillage with no adverse effects on soil properties. No-tillage increases rooting of the crop in the upper 30 cm of the soil profile permitting better crop utilization of water and nutrients. Residue and soil movement occurred during the study as evidenced by rill formation, demonstrating that no-tillage alone will not eliminate erosion. Modification of the system by the use of permanent raised beds with discrete furrow to control the flow of excess water may solve this problem and provide other benefits (3) to extend no-tillage technology to high clay soils in more humid regions. In addition, no-tillage may reduce the risk associated with alternative management practices such as double cropping of grain sorghum, soybeans, and cotton following small grains and ratoon cropping grain sorghum, thereby increasing crop productivity by more efficiently utilizing available growing season and water resources.

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Table 1. Cone penetration resistance comparisons of conventional tillage (CT) and no-tillage (NT) on a swelling clay soil near the upper limit of plant available soil water after three crop years.

Depth	Penetration Resistance CT	NT
(cm)	-kg/cm²	
0-15	3.04	3.26
15-30	16.51	18.59
30-60	35.0	38.0
60-90	40.0	50.0
LSD 0.05 (tillage x depth)	NS	

Table 2. Wet bulk densities of conventional tillage (CT) and no-tillage (NT) on a swelling clay soil near the upper limit of plant available soil water after three crop years.

Depth	Bulk Density CT	NT
(cm)	g/cm³	
0-2	0.99	0.99
2-4	1.23	1.18
4-6	1.32	1.29
8-15	1.51	1.57
30-38	1.61	1.62
50-58	1.64	1.64
LSD 0.05 (tillage x depth)	NS	

Table 3. Root length density (RLD) and specific root weights (SRW) at flowering of wheat, sorghum and cotton as affected by conventional tillage (CT) and no-tillage (NT) in 1983.

Crop	Depth	RLD CT	RLD NT	SRW (1×10^{-5}) CT	SRW (1×10^{-5}) NT
	- cm -	--- cm/cm^3 ---		---- g/cm ----	
Wheat	0-15	16.11	13.38	4.0	4.8
	15-30	2.93	3.01	4.8	5.7
	30-60	1.38	1.40	5.5	6.0
	60-90	1.32	1.13	6.1	7.7
LSD 0.05 (tillage x depth)		NS		0.4	
Sorghum	0-15	2.01	2.42	12.5	16.3
	15-30	1.32	1.86	7.4	9.2
	30-60	0.89	1.04	5.9	9.5
	60-90	0.89	0.81	5.8	9.4
LSD 0.05 (tillage x depth)		0.15		2.1	
Cotton	0-15	1.28	2.01	14.8	19.9
	15-30	1.69	1.82	10.2	9.4
	30-60	1.10	1.01	12.1	9.8
	60-90	0.88	0.84	11.3	11.1
LSD 0.05 (tillage x depth)		0.11		2.9	

Table 4. Grain yields of wheat and sorghum and lint yield of cotton growth under conventional tillage (CT) and no-tillage (NT) for 1981-1983 crop years.

Year	Wheat CT	Wheat NT	Sorghum CT	Sorghum NT	Cotton CT	Cotton NT
	------------ kg grain/ha			------------	- kg lint/ha -	
1981	3170	2630	6320	6200	*	*
1982	1940	1250	4960	4530	254	216
1983	3410	3270	3665	3637	568	565
LSD 0.05 (tillage x year)	610		560		39	

* Data not available.

INFLUENCE OF PRIMARY TILLAGE ON COMPACTNESS OF BLACK BELT SOILS

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No-till and reduced tillage systems that leave more surface residue are generally useful in reducing erosion, but are not universal in their impact on crop yields. No-till yields have been reported that range from better than conventional tillage to total crop failure. The nearly level, dark, poorly drained soils of Ohio, Indiana, and Illinois, for example, are similar to soils in the Black Belt and frequently produce lower yields when residues are left on the surface rather than turned under by conventional tillage (SCSA, 1974).

Jones et al. (1941) and Leonard (1945) studied tillage in the Black Belt during the 1930's and 1940's and concluded that looseness was necessary in the surface soil to promote abundant root growth. Many soils, including those of the Black Belt, have been overworked in the past. The general belief today is that soil needs to be tilled just enough to assure optimum crop production and weed control. Many fine textured soils, such as those of the Black Belt, may require a finite amount of tillage to provide adequate aeration and reduce compaction caused by equipment or raindrop impact.

Our objective was to determine how soil strength and surface soil compaction is influenced by tillage intensity on two Black Belt soils.

Materials and Methods

A base crop of soybeans was established on Okolona silty clay and Leeper silty clay loam soils in the Black Belt in 1980. During the following three years, soybeans were grown under four monocrop tillage systems and one soybean-wheat doublecrop system. The monocrop systems were defined as: conventional spring chisel plus fall chisel plowing (CT+), conventional spring chisel only (CT), zero-till planting plus cultivation (MIN), and zero-till planting with no cultivation (NO-TILL). Both conventional systems received secondary tillage in the form of disking and/or harrowing to prepare the seedbed. In the doublecrop treatment both wheat and soybeans were zero-till planted. Wheat straw was burned prior to planting soybeans and the soybeans were cultivated twice. Monocrop soybeans were usually planted the third week in May and doublecrop soybeans were usually planted by mid-June.

Penetrometer readings were taken in conjunction with soil moisture readings during the second week of July in 1981. No readings were taken during 1982. In mid-April of 1983 penetrometer readings were taken on the

Okolona soil in conjunction with soil moisture and bulk density measurements. Penetrometer readings were taken in the Leeper soil in mid-April of 1984. The 1983 and 1984 readings were taken prior to any spring tillage operations and while soil moisture was relatively uniform among the tillage treatments. All penetrometer and bulk density measurements were taken in row middles where wheel traffic had little affect.

Analysis of variance and regression analyses were used to make statistical comparisons.

Results and Discussion

The response of both soils was similar. Primary tillage provided only a temporary (one season or less) modification of such soil conditions as soil strength (penetrometer resistance) and compaction (bulk density). Soil strength in mid-July of 1981 was sensitive to water content as well as bulk density, and was negatively correlated to plant height and yield on the Leeper soil (see table below).

Regression Analyses - 1981

Penetrometer resistance (P.R.) regressed with:	Regression equation	r^2
Bulk density (D_B)	Y = 1.14 + .002X	.670[1/]
Water content (P_v)	Y = 37.62 - .1245X	.780
Plant height (Leeper soil)	Y = 54.3 - .053X	.433
Yield (Leeper soil)	Y = 42.3 - .062X	.373
Yield (Okolona soil)	Y = 24.5 - .0094X	.062

1/Values >.332 or >.501 are significant at the .05 and .01 level of probability, respectively.

Penetrometer readings taken in mid-July of 1981 (data not shown) indicated that soil strength was significantly greater in minimum and no-till plots than in conventional tillage plots, especially at the 3-inch depth. The Okolona soil was harder to penetrate in 1981, even at a higher volumetric water content. Penetrometer readings taken in mid-April of 1983 on the Okolona soil and mid-April of 1984 on the Leeper soil reflect the inability of these soils to ameliorate soil strength through natural forces associated with the shrinking and swelling characteristics of the soils (see table below).

Means for Penetrometer Resistance (P.R.), Bulk Density (D_B) and Volumetric Water Content (P_v) by Tillage Treatment

Tillage Treatment	Soil[1] Okolona[2] P.R. kg/cm²	D_B g/cm³	P_v cm³/cm³	Leeper[3] P.R. kg/cm²	D_B g/cm³	P_v cm³/cm³
CT+	4.50 a[4]	1.29 a	.46	4.92 a	1.39	.30
CT	6.89 b	1.38 b	.44	7.52 b	1.40	.30
MIN	7.03 b	1.36 b	.42	7.73 b	1.44	.30
NO-TILL	8.09 c	1.30 b	.42	0.06 c	.44	.30
DUO	8.09 c	1.36 b	.41	9.98 d	1.38	.26

1/ Values reported for 3-inch depth.
2/ Measurements made mid-April, 1983.
3/ Measurements made mid-April, 1984.
4/ Means within a column followed by same letter are not significantly different at the 5% level of probability (DMRT).

The no-till system therefore results in greater compactness in the surface soil as reflected in resistance to penetration. Potential consequences include lower hydraulic conductivity, poor aeration, uneven germination, and undesirable environment for early root growth. Penetrometer resistance more accurately reflected differences in soil strength and gave greater differences among the tillage systems than did bulk density, especially in the Leeper soil. However, bulk densities taken six months or longer after primary tillage were in the 1.36 to 1.44 g/cm³ range. According to Jones (1983) bulk density should be about 1.2 g/cm³ for ideal root growth on soils of this texture. His data also indicate that with a bulk density of 1.45 g/cm³ root growth is only two-tenths of normal. If this is the case, most Black Belt soils need tillage every spring for optimum crop yields.

Data presented elsewhere in these proceedings (Sanford et al.) showed no-till doublecrop soybeans-wheat was the most productive of five tillage systems in the Black Belt over a three year period. However, no-till monocrop soybeans in the same study yielded significantly below conventional chisel plowed soybeans.

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SOIL NITROGEN AND ORGANIC MATTER CHANGES AS AFFECTED BY TILLAGE AFTER SIX YEARS OF CORN

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Abstract

Changes in soil chemical properties are expected from different tillage systems. Nitrogen and Organic Matter (OM) were measured to a depth of 60 cm in tillage treatments on an Alfisol (Hernando loamy fine sand, a member of the fine mixed thermic family typic Hapludalfs) in a six year old corn (Zea mays L.) experiment. The experiment was a split plot with conventional and no tillage treatments as whole plots, and position of sampling either over the row or between the row as split plots. No tillage treatments had 45% more N in the top 15 cm of the soil as compared to conventional plots (3.065% N in no–tillage versus 0.045% in conventional). This same relationship was similar for OM with no–tillage plots having 35% more OM than conventional. There was a close positive correlation between N and OM and they decreased linearly with depth. The decrease from the surface to 60 cm was from 2.00 to 0.50% for OM and 9.05 to 0.013% for N.

Introduction

The organic matter OM) content present in the soils is highly variable, and is considered to be a very important factor in plant growth and soil fertility. Stevenson (1982) by considering several important facts about OM, concluded: 1) Addition of fresh organic residues may result in a small priming action on the native OM of the soil; 2) Plant residues decay rapidly in soil and are more or less completely transformed, even the lignin fraction.

In multicropping farming, land productivity is maximized per unit area per season. This practice is very important in Florida where rainfall is high and the year round warm climate is conducive to multiple cropping. Several studies conducted with no–tillage and minimum tillage have shown that OM content on the soil surface is higher as compared to conventional tillage systems (Blevins et al., 1977 ; Dick, 1983 ; and Lal, 1974). Moschler et al (1972) suggested that the no-tillage increases the total OM in the soil.

The purpose of this study was to determine the relationship between N and OM after six years of conventional tillage and no–tillage practices used on corn (*Zea mays* L.).

Materials and Methods

The experimental field is located in Williston, Florida. The soil is a Hernando loamy fine sand (Member of the fine mixed thermic family of typic Hapludalfs) with a slope of 2 to 5%. Corn had been grown for Six years. Four tillage treatments (no-tillage plus subsoiling, no-tillage, conventional tillage plus subsoiling, and conventional tillage.) were replicated four times. The experiment was a split plot with conventional and no-tillage systems as whole plots and position of sampling either over the row or between the row as split plots. Analysis of variance for a split plot was conducted according to Steel and Torrie (1960) using a TRS 80 Model III microcomputer.

The soil samples were taken in early spring of 1983, between the row and over the row to a depth of 60 cm in 5 cm increments to a depth of 30 cm and 15 cm increments from the 30 crn to the 60 cm depth. The samples were air dried and ground to pass a 2 mm sieve. Organic matter was determined by Walkley-Black method (Allison, 1965). Soil N was by Kjeldahl digestion (Gallaher et al., 1975) followed by colorimetric determination on an autoanalyzer.

Results and Discussion

Soil N was different in the 0-5 crn soil layer among tillage treatments, however there were few differences at deeper layers (Table 1). Percent N was not affected by row sampfing position at any depth and there were no interactions between tillage treatments and the position of sampling. More soil N was associated with no-tillage by 45% (no-tillage 0.065% N and conventional 0.045% N) as compared to conventional tillage treatments (Table 1). Soil N content was higher over the row position at the soil surface in no-tillage treatments as compared to no-tillage plus subsoiling, however these differences were lower between the row. This fact may be accounted for by N leaching and denitrification losses as a result of subsoiling.

By combining sampled soil layers in 15 cms increments with depth (Table 1) differences in N were only found at the 0-15 cm depth where no-tillage treatments were higher than conventional tillage by a difference 0.01% N. No differences were found at greater depths in the soil profile.

Percent OM was significantly affected by tillage at at the 90% probability level in the 0-5 cm depth and at the 95% probability level in the 45-60 crn depth. Between the row, OM was higher than over the row, at the 0-5 cm depth. At the same depth, the interaction between sampling position and tillage treatment was significant. In the no-tillage plus subsoiling treatment, OM decreased by 20% over the row as compared to the other sampling position. Migration of OM, leaching of N, and increased OM decomposition as a result of increased aeration could be responsible for this decrease. In the 0-5 cm depth significant differences were found between the row, in no-tillage plus subsoiling and conventional tillage plus subsoiling. On the average, OM was 35% higher in no-tillage treatments than in conventional tillage treatments (Table 2).

When combining layers in 15 cm increments with depth, interactions were found between sampling position and subsoiling treatments (no-tillare and conventional). Between the row, the subsoiling treatments were different, and over the row no-tillage and conventional tillase plus subsoilins were different. At the 45 to 60 cm depth, no-tillage plus subsoiling had more 0.M. than conventional tillage treatments (Table 2).

Summary

1. No-tillage treatment increased the soil N in the 0-5 cm depth.
2. Increases up to 35% and 45% in OM and N respectively occurred in no-tillage treatments as compared to conventional tillage treatments.
3. Subsoiling over the row decreased OM by 20X as compared to other non subsoiling treatments. This was likely due to leaching of N and decomposition of OM and its migration to the lower profiles.
4. Soil OM and N decreased with depth but the change in OM was geater than in N.
5. A highly positive correlation was obvious between OM and N especially in the 0-5 cm depth. This may be because most of the N is likely associated with the OM in the soil surface and to mineral colloids in lower depth.
6. The use of crop residues in no-tillage and multicroppinq systems can alleviate the losses of N by leaching and denitrification in this type of soils. The values reported, support the fact that OM can be increased in soils with high rainfall and temperature regimes.

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Table 1. Percent nitrogen in the 0-5 and 0-15 cm depth of an Alfisol as affected by conventional versus no-tillage treatments and corn management after six years.

Tillage	Soil Surface Position: Between Row	Soil Surface Position: Over Row	Average
	% N, 0-5 cm Depth		
No with Subsoil	0.060	0.060	0.060 ab
No	0.063	0.068	0.065 a
Conv with Subsoil	0.046	0.043	0.045 b
Conv	0.047	0.048	3.047 b
Average	0.054	0.055 NS	
	% N, 0-15 cm Depth		
No with Subsoil	0.051	0.053	0.052 a
NO	0.053	0.055	0.054 a
Conv with Subsoil	0.044	3.042	0.043 b
Conv	0.045	0.046	0.046 b
Average	0.048	0.049 NS	

NS means no significant difference. Values in columns not followed by the same letter are significantly different at the 0.05 level of probability. No means no-tillage. Conv means conventional tillage.

Table 2. Percent organic matter in the 0-5, 0-15 cm depth of an Alfisol as affected by conventional versus no-tillage treatments after six years of corn cropping.

Tillage	Sig	Soil Surface Position: Between Row	Soil Surface Position: Over Row	Average
		% OM, 0-5 cm depth		
No with subsoil	*	2.16 a	1.72 ab	1.94
NO	NS	2.01 ab	2.14 a	2.08
Conv with subsoil	NS	1.43 b	1.35 b	1.39
Conv	NS	1.56 ab	1.51 ab	1.54
Average		1.79	1.68	
		% OM, 0-15 cm depth		
No with subsoil	*	1.79 a	1.59 ab	1.69
No	NS	1.70 ab	1.75 a	1.73
Conv with subsoil	*	1.41 b	1.34 b	1.38
Conv	NS	1.52 ab	1.53 ab	1.52
Average		1.61	1.55	
		% OM, 45-60 cm depth		
No with subsoil		0.68	0.57	0.63 a
NO		0.42	0.57	0.50 ab
Conv with subsoil		0.41	0.32	0.37 b
Conv		0.40	0.40	0.40 b
Average		0.48	0.47 NS	

NS means no significat differences. The * means there are significant differences in OM between soil surface positions of sampling within the tillage treatment at the 0.05 level of probability. Values in columns not followed by the same letter are significantly different at the 0.05 level of probability. No means no-tillage. Conv means conventional tillage.

ORGANIC MATTER AND NITROGEN IN AN ULTISOL AS AFFECTED BY CROPPING AND TILLAGE SYSTEM AFTER SEVEN YEARS.

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Organic matter (O. M.) contents in the soil surface is usually higher under no-tillage or minimum tillage than under conventional tillage (Gallaher, 1983, Dick, 1983). Blevins, et al., (1977) showed that organic soil N was significantly higher under no-tillage and increased with increasing rates of N fertilizer applied.

The objective of this study was to determine the O. M. and N content in an Ultisol as affected by cropping and tillage systems.

Materials and Methods

The experiments were conducted at Green Acres Agronomy farm near Gainesville, Florida, on an Arredondo loamy sand, a member of the loamy, silicious, hyperthermic family of grossarenic Paleudults. The field study started in 1976 included cropping systems of oat (Avena sativa)/soybean (Glycine max L. Merr.) versus oat/grain sorghum (Sorghum bicolor L.) that were split plots of four tillage treatments: No-tillage subsoil, no-tillage, conventional tillage subsoil, and conventional tillage. Tillage treatments were whole plots in a randomized complete block with four replications.

In November 1983 soil samples were taken in 12 increments of depths (0-5, 5-10, 10-15, 15-20, 20-25, 25-30, 30-35, 35-40, 40-50, 50-60, 60-70, 70-80 cm) for laboratory analysis of N and O M The soil was air dried and sieved to pass a 2 mm stainless steel screen. Organic matter (organic carbon) was determined by the Walkley-Black method and soil N was by Kjeldahl digestion followed by colorimetric determination. Statistical analysis of each soil depth was for a split plot and was conducted with a TRS 80 Model III microcomputer.

Results and Discussion

Nitrogen

Cropping systems did not differ in soil N at any depth (table 1). There were differences in percent N among tillage plots only at the 0-5 cm depth (table 1). No interaction occurred and N was highest in no-tillage plots compared to conventional tillage. No-tillage had more soil N than other treatments and was 12, 15, and 2% more than no-tillage subsoil, conventional tillage subsoil, and conventional tillage, respectively (table 1).

Organic Matter

No differences in O M were found between tillage systems at the 0-5 cm depth. Similar results in O C levels were reported by Hargrove, et al., (1982). There were differences in percent O M among tillage treatments at the 5-10 and 10-15 cm depths at the 99% probability level and at 25-30 and 60-70 cm depths at the 90% probability level (table 2). No interactions occurred at the 5-10 and 10-15 cm depths and O M was generally highest in conventional tillage and lowest in no-tillage.

Conventional tillage was 16, 22.6, and 5% higher in O M than no-tillage subsoil, no-tillage, and conventional tillage subsoil at the 5-10 cm depth (table 2). Soil O M at the 5-10 cm depth was not affected by subsoiling but was higher in the "conventional tillage without subsoil" treatment that either of the no-tillage treatments (table 2). No differences were found between cropping systems at this depth. Conventional tillage had 23.6, 13, and 26% higher O M than no-tillage subsoil, no-tillage, and conventional tillage subsoil at the 10-15 cm depth (table 2). Soil O M at the 5-10 cm depth was not affected by subsoiling but was higher in conventional tillage, than the no-tillage treatment (table 2). No differences were found between cropping systems at this depth.

Differences in O M were found at the 25-30 and 60-70 cm depths at the 90% probability level (table 2). Conventional tillage subsoil showed 2, 16.6, and 3% more O M than no-tillage and conventional tillage, respectively at the 20-25 cm depth (table 2). Conventional tillage subsoil had 23.6, 13, and 26% more O M than no-tillage subsoil, no-tillage, and conventional tillage at the 60-70 cm depth (table 2). No differences between cropping systems were found at this depth.

Variations in percent O M (percent O C) and percent N in the first 0-30 cm soil depth has been reported by several investigators in minimum and conventional tillage experiments (Gallaher (1983), Dick (1982), and Hargrove et al., (1982). Some important points affecting no-tillage O C and N in the 0-30 cm soil depth, were outlined by Hargrove et al., (1982). In this Florida experiment, several factors are suggested that can affect the distribution of O M through the soil profile (especially in the 0-15 cm depth).

1. High temperature and moisture in Florida would limit the accumulation of O M from plant residues deposited on the soil surface (O M oxidation and C loss).
2. Incorporation of residues by plowing may explain the higher contents of O M at the 5 to 15 cm depth. Incorporation would place residue in a more moist and cooler environment than leaving on the soil surface in the hot humid climate of Florida.
3. The sandy texture of this Florida soil would not retain O M as well as a soil having a clayey texture.

O C-N relationships (C/N)

The O C/N ratio in the 0-5 cm soil depth was lower for no-tillage compared to conventional tillage (table 3). Cropping systems did not differ in O C/N at any depth of the soil profile.

No-tillage had the lowest O C/N ratio followed by no-tillage subsoil, conventional tillage and conventional tillage subsoil. This lower O C/N ratio in the no-tillage systems at the 0-5 cm depth could be explained by:
1. There would be more residues on the soil surface of no-tillage plots to accumulate as compared to incorporation in conventional tillage. 2. The higher temperature on the soil surface causes plant residues to break down rapidly through oxidation and CO_2 evolution. 3. The conditions that cause rapid breakdown of O M under no-tillage also would favor a more rapid N mineralization.

Conclusions

Tillage affected N and O M in the top 15 cm. Nitrogen was higher in no-tillage than in conventional tillage systems at the 0-5 cm soil depth. Organic matter was higher in conventional tillage than in no-tillage at the 5-15 cm depth. Cropping systems of oat/grain sorghum versus oat/soybean had little effect on these variables.

Soil N and O M were highly positively correlated throughout the soil profile. Both N and O M decreased almost linearly from the surface (N = 0.06% and O M = 1.57%) to a depth of 35 cm, (N=0.015% and O M = 0.45%), then increased to a depth of 70 cm (N = 0.011% and O M = 0.32%) and decreased again at 80 cm.

The analysis of variance of the O C/N ratio only detected differences (95% probability) between treatments at the 0-5 cm depth. Otherwise, the O C/N ratio followed the same trend as that observed in O M and N except at the 30 cm depth.

Various factors such as climate, residue accumulation and incorporation, soil temperature, moisture, tillage, cropping systems, and soil particle size influence O M and N. More soil chemical and physical variables need to be studied to better understand N and O M in this tillage and cropping systems experiment.

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Table 1. Percent nitrogen in the 0 to 5 cm depth of an Arredondo fine sand as affected by tillage and cropping system after seven years.

Tillage	System Oat/Soybean	Oat/Sorghum	Average
		%N	
No-tillage subsoil	.063	.056	.60 ab
No-tillage	.068	.069	.068 a
Co-tillage subsoil	.044	.058	.051 b
Co-tillage	.053	.058	.056 b
Average	.057	.060 NS	

Values in average column not followed by the same letter are significantly different at the 0.05 level of probability according to Duncans new multiple range test.
NS= No significant differences at the 0.05 level of probability according to F test.
No-Sub= No-Tillage Subsoil
No= No-Tillage
Conv-Sub= Conventional-Tillage Subsoil
Conv= Conventional-Tillage

Table 3. Organic Carbon/Nitrogen relationships in an Arredondo fine sand at the 0-5 cm depth as affected by tillage and cropping system after seven years.

Tillage	System Oat/Soybean	Oat/Sorghum	Average
		OC/N	
No-tillage subsoil	15.01	14.17	14.59 ab
No-tillage	12.10	14.11	13.41 b
Co-tillage subsoil	17.73	16.86	11.10 ab
Co-tillage	17.27	16.65	16.96 a
Average	15.53	15.60 NS	

Values in columns not followed by the same letter are significantly different at the 0.05 level of probability according to Duncans new multiple range test. The NS between average values for comparing croppinu systems means no significant differences at the 0.05 according to F test.
OC/N = Organic Carbon/Nitrogen.
Co = Conventional-Tillage.
No = No-Tillage.

Table 2. Percent organic matter in the 5 to 10, 10 to 15, 25 to 30 and 60 to 70 cm depth of an Arredondo fine sand as affected by tillage and cropping system after seven years.

Tillage	system Oat/Soybean	Oat/Sorghum	Average
		%OM (5-10 en)	
No-Tillage Subsoil	1.45	1.21	1.33 be
No-Tillage	1.17	1.29	1.23 c
Co-Tillage Subsoil	I.42	1.61	1.51 ab
Co-Tillage	1.41	1.12	1.59 a
Average	1.31	1.46 NS	
		%OM (10-15 cm)	
No-Tillage Subsoil	1.24	1.20	1.22 b
No-Tillags	1.10	1.11	1.13 b
Co-Tillage Subsoil	1.29	1.54	1.42 a
Co-Tillage	I.40	I.58	1.49 a
Average	1.26	1.37 NS	
		%OM (25-30 cm)	
No-Tillage Subsoil	0.98	0.90	0.94 at
No-Tillage	0.12	0.88	0.80 b+
Co-Tillage Subsoil	0.81	1.10	0.96 a+
Co-Tillage	0.84	1.02	0.91 a+
Average	0.84	0.98 NS	
		%OM (60-70 cm)	
No-Tillage Subsoil	0.36	0.21	0.29 a+
No-Tillage	0.21	0.40	0.33 b+
Co-Tillage Subsoil	0.29	0.41	0.18 ab+
Co-Tillage	0.23	0.32	0.28 b+
Average	0.28	0.35 NS	

Valuer in average column not followed by the same letter are significantly different at the 0.05 level of probability according to Duncans new multiple range test. The NS between average values for comparing cropping systems means no significant differences at the 0.05 level of probability according to F test.
+ = Means that the level of provability is at the 0.10 level according to Duncans new multiple range test.
Co = Conventional-Tillage
No = No-Tillage