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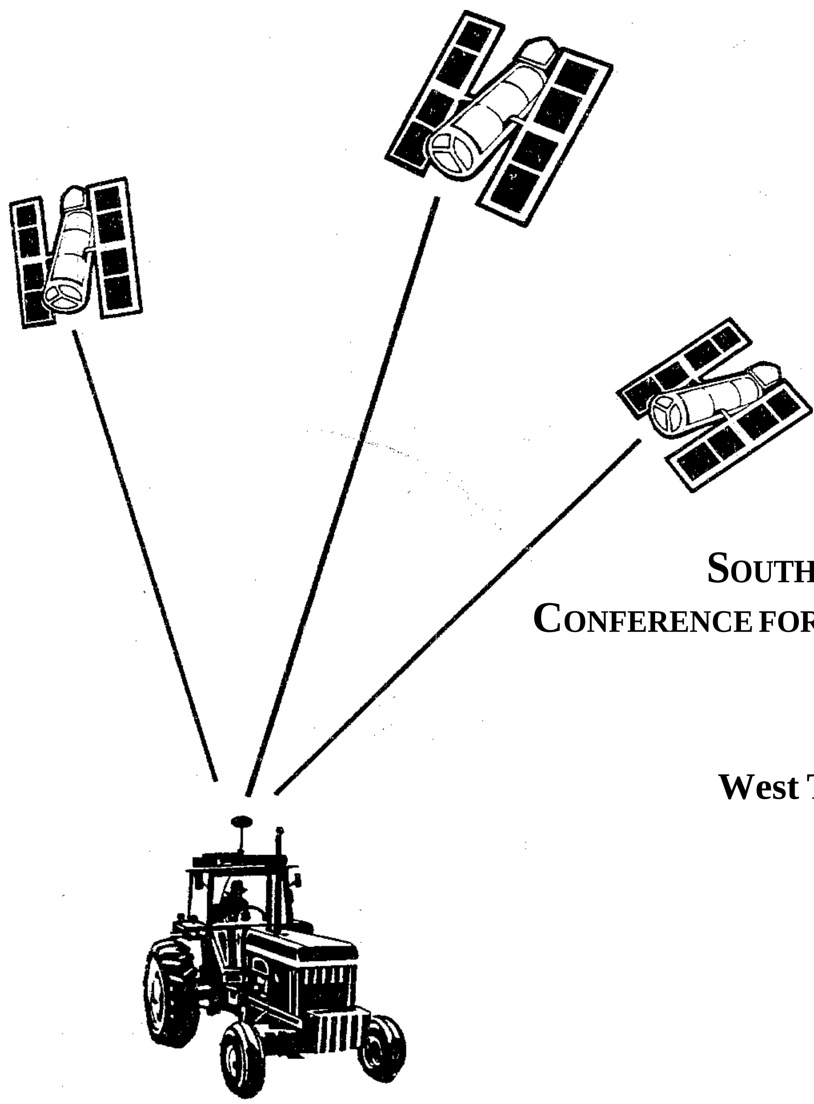
PROCEEDINGS

"New Technology and Conservation Tillage"



19TH ANNUAL
SOUTHERN CONSERVATION TILLAGE
CONFERENCE FOR SUSTAINABLE AGRICULTURE

The University of Tennessee
West Tennessee Experiment Station
Jackson, Tennessee
Milan Experiment Station
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Foreword

Conservation tillage systems offer great benefits for southern U.S. agriculture. These systems effectively address some of the major production limitations faced by fanners in the region, including soil erosion, drought and poor soil structure. They also provide savings in labor, machinery and fuel. Conservation tillage is an integral part of minimizing the negative environmental impacts of crop production.

The purpose of the Southern Conservation Tillage Conference for Sustainable Agriculture is to encourage investigation and improvement of conservation tillage systems and to expand their use in southern agriculture. Since the first conference in Georgia in 1978, the conference has served as a forum for exchange of information and ideas. The widespread adoption of conservation tillage systems is due in no small part to the efforts of conference participants in the various states.

The theme for this year is *"New Technology for Conservation Tillage"*. It was chosen to emphasize the new opportunities that biotechnology, precision farming and other emerging technologies offer for conservation systems. The conference will also address more traditional areas which continue to be of interest in refining and adopting conservation tillage systems.

The conference is being held in conjunction with the 16th Annual Milan No-Till Field Day. This is one of the premier events in the South for presenting conservation tillage research and new technology to farmers.

We at the University of Tennessee welcome the opportunity to host the conference. We welcome you to Tennessee, the West Tennessee Experiment Station and the Milan No-Till Field Day.

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Effects of Conservation Tillage and Cover Crops on Vegetable Crop Yields in Southwestern Mississippi on a Memphis Silt Loam Soil

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(Alcorn State University) and **Tom Collins** (USDA-NRCS, Jackson, MS)

Abstract: This field research was initiated in year 1989 on highly erodible Memphis Silt Loam Soil. To determine the effect of minimum tillage on the yields of sweet corn (Zea mays L.), snap beans (Phaseolus vulgaris L.). and cowpeas (Vigna unguiculata L.), and the physical penetrability of the topsoil due to wheat, clover, and vetch treatments followed by the main crops as affected with time. arandomized complete block design with four replications was used. The control treatment received conventional tillage and the rest of the treatments with wheat, clover and vetch received minimum tillage. merely to seed the crops. The entire area received herbicides uniformly and the recommended dose of fertilizers along with the side dressings were used before planting the main crops like sweet corn, snap beans, or cowpeas. The average ground residue cover percent determined by camline on March 1992, showed that clover and vetch were significantly superior to wheat, and wheat was found significantly superior to the control ($P<0.05$). The subsequent statistical analyses were also performed at *0.05* level of probabilities. Sweet corn in 1992 had non-significant yield differences due to treatments: which also was found to be true in case of cowpeas in years 1992 and 1993. However, the multiple harvested total yields of snap beans showed significantly higher yield (1863 lbs/acre) due to vetch treatment as compared to the control (411 lbs/acre). Therefore, snap beans responded better than sweet corn and cowpeas with minimum tillage when planted after vetch. Also, the penetrometer readings taken in December 1994 did indicate significant lowest resistance due to control treatment as compared to the other treatments (wheat, clover and vetch).

lntroduction

Memphis Silt Loam Soil (Typic Hapludalf, fine-silty, mixed, thermic) is fertile but highly erodible (Vanderford, 1962) which is extended in the western part of Mississippi from north to south (Soil map of Mississippi). This soil contains on the average 65% silt, 28% clay, 6% sand, and has close to 1% organic matter. (Panicker and Tiwari, 1991).

Organic matter residues such as green manures that decompose rapidly, improve soil structure more quickly than the materials such as barley, rice, and wheat. However, the slowly decomposing materials also have the immediate effect of protecting soil surfaces from the impact of rain drops before they decompose. Organic matter when decomposing produces polysaccharides and polyuronides which stabilize soil for better infiltration of soil moisture (Boyle et al., 1989). Crop residues contain appreciable plant nutrients, which contribute to the maintenance of soil productivity when not removed (Holland and Coleman, 1987).

The objectives of this field trial were: (I) To determine the effect of minimum tillage on the subsequent yields of horticultural crops (sweet corn, cowpeas, and snap beans) planted after the yearly treatments of wheat, clover, vetch and control as well as (2) The physical penetrability of the top soil due to these treatments followed by the main crops as affected with time. Continuous minimum as well as no tillage for 28 years had no deleterious effects on soil physical properties (Mahboubi et al., 1993). However, the use of no-till in Iowa, Central Illinois, and Minnesota; as well as on poorly drained soil in Indiana and Ohio, has led to some soil compaction problems (Karlen, 1990).

Hoyt (1983) indicated that providing winter cover by legume crops have two advantages. Firstly, they increase nitrogen and secondly, they provide coverage. Whereas grasses only provide the winter cover. In case oftomatoes and broccoli, Hoyt, 1984, explained that the yield have shown to increase with vetch and crimson clover. Also, the timing of planting as well as herbicide application with intervals before planting the main crop, may be the key factors in sustaining higher crop yields (Hoyt , 1989).

Conservation tillage may reduce crop yields, which may arise from intensive management, based on varying equipment, and long spectrum of weeds, insects, and disease problems combined with allopathic effects and decreased nutrients' availabilities (Unger and McCalla, 1980). On the other hand conservation tillage systems enable seed to be planted earlier and faster, the benefits of which help offset the disadvantages of colder soil in the spring (Carter and Kunelius, 1990).

Thus, no-till and minimum tillage systems are more energy efficient than conventional tillage systems. Conservation tillage systems require less total energy to achieve approximately the same crop production levels as conventional tillage systems. No-till and minimum tillage reduce organic C losses from soil and reduce emission by using less fossil fuel (Frye, 1984).

Materials and Methods

A long term randomized complete block esperiment was set in year 1989 with four blocks. Each block (25'x36') received four treatments: crimson clover (Trifolium incamatum L. var. Dixie), vetch (Vicia Villosa L. var. Hairy), wheat (Triticum aestivum L. var. Mixed) and control. The experimental unit for each randomized treatment consisted of three rows (25'x9'). These treatments were initiated in fall of every year; however the control treatment received conventional tillage by using a rotary tiller to till the land 7 times and a middle buster one time. The other treatments received minimum tillage by using a mantis tiller cultivator. It cuts 10" down into the soils, churning up sod and weeds, incorporating compost and soil amendments. Sweet corn (variety Merit), was planted in April 1992 and 1993, in rows 3' apart with plant to plant distance of one foot. Cowpeas (variety Mississippi Silver) were planted in September 1992 and 1993, by using the planter with 6" spacing from plant to plant. The yield was harvested in the end of October. Snap beans (variety Provider) were hand seeded in the end of April 1994. The row to row and plant to plant distances were 3' and 6" respectively for cowpeas and snap beans.

Herbicides (Gramoxone and Bladex, 1.1 8 L/HA of each) were mixed with water and used uniformly to kill the cover crops and the weeds before planting the main crops. All the main crops (sweet corn, cowpeas, and snap beans) were sprayed twice with spectracide and captan by mixing them with water at the rate of I.573 L/HA against diseases and insect attack. Fertilizer (13:13:13) was used uniformly for each crop at the rate of 145.2 Ibs/A.

The soil area of the four treatments were then tested for resistance against penetration to reveal the intensity of soil compaction by penetrometer. Also, residue meters (camline) were used to determined the ground residue cover. The matured crops were then harvested and the yields were recorded for statistical analysis based on analysis of variance followed by Duncan Multiple Range Test.

Results and Discussions

Ground residue cover with clover and vetch were found to be significantly superior to wheat and to the conventional tillage at 0.05 probability level; which has been indicated by the previous researchers (Hoyt 1983, 1984, and 1989; Boyle et al., 1989). Conventional tillage had significantly the least residue coverage as compared to the other treatments (Table I). The common weed infestations were found to be higher in the clover and vetch treatments than the wheat and control treatments as measured on scale of 0 to 10 (Table 2). The final sweet corn yields as affected by control treatment was minimum as compared to other treatments and found to be non-significant (Table 3). However, this result needs to be ignored due to the invasion of raccoons at the harvest time. With no such invasion, the yield of cowpeas as affected by control, clover, vetch, and wheat were found to be non-significant in both the years (1992 and 1993). However, there is a remarkable trend of comparative higher yield due to wheat, vetch, and clover as compared to control in year 1993 when compared to year 1992 (Table 4). This trend of the increase over the control seemed to be very clear in case of snapbeans in year 1994. The vetch treatment was found to be superior to all the treatments; and the control and wheat treatments were found to be inferior to clover treatment at 0.05 probability level (Table 5). These yield results seem to be somewhat consistent with the findings of Hoyt in year 1989 where he experimented on tomatoes and broccoli. The soil resistance to penetration after five years did indicate lowest resistance value in the control treatment as compared to other treatments including vetch, clover, and wheat (Table 6). Such compaction has been found in no till plot in the poorly drained soil (Karlen 1990); which is just the reverse in case of this moderately well drained soil where the moisture permeates freely and in due coarse causes compaction if not cultivated.

Conclusion

There is clear indication to show that the response of well drained soil to minimum tillage is different than the poorly drained soils. In addition, the analyzed data from this research shows that snap beans responded better than sweet corn and cowpeas with minimum tillage when planted after vetch as a legume crop compared to conventional tillage with no vegetation raised before planting the main crop. However, the ground residue cover percent as well as the resistance to penetration in top soil seem to be directly related (Tables 1 & 6. Soil compaction measured by penetrometer within 6" depth in the conventional tilled treatment indicated significantly easy penetration with lesser resistance as compared to all other minimum tilled treatments with clover, vetch, and wheat covers. Additional ongoing research data on a continuing basis may seem to be essential for exploring the long term effects of minimum tillage on this moderately well drained Memphis Silt Loam Soil.

Table 1. Ground residue cover percent measured by the camline as affected by the treatments recorded on March 1992.

Treatments	Average Ground Residue Cover
	%
Control	60 c*
Clover	98 a
Vetch	95 a
Wheat	80 b

*Means followed by the same letter are not significantly different at 0.05 probability level using the New Duncan Multiple Range Test.

Table 2. Average infestation of common weeds as quantified on the scale of (0-lo)** recorded on March 1993.

Treatment	Common Weeds Infestation on Scale (0-10)
Control	3 a*
Clover	6 a
Vetch	6 a
Wheat	3 a

**(0) Value indicates less than 10% of weeds and (10) indicates more than 90% infestation of weeds.

*Means followed by the same letter are not significantly different at 0.05 probability level using the New Duncan Multiple Range Test.

Table 3. Average total yield of sweet corn in year 1992 as affected by treatments.

Treatment	Yield
	(I bs/Acre)
Control	1452 a*
Clover	2166 a
Vetch	1538 a
Wheat	1568 a

*Means followed by the same letter are not significantly different at 0.05 probability level using the New Duncan Multiple Range Test.

Table 4. Average total yield of cowpeas in 1992 and 1993 as affected by the treatments.

Treatment	Yearly Yields	
	I992	1993
	lbs/acre	
Control	3399 **a***	3242 a*
Clover	2431 a	4598 a
Vetch	3339 **a**	4065 a
Wheat	3695 a	4344 a

'Means followed by the same letter are not significantly different at 0.05 probability level using the New Duncan Multiple Range Test.

Table 5. Average total yields of snap beans in year 1994 as affected by the treatments.

Treatment	Yields
	(Ibs/Acre)
Control	411 b*
Clover	968 ab
Vetch	1863 a
Wheat	949 ab

*Means followed by the same letter are not significantly different at 0.05 probability level using the New Duncan Multiple Range Test.

Table 6. Average resistance up to 15 cm depth measured by penetrometer in December 1994 as affected by treatments.

Treatment	Average Resistance Based on Five Readings with Four Replications
	Pounds Pressure 10.75 inch
Control	63 b*
Clover	162 a
Vetch	181a
Wheat	192 a

*Means followed by the same letter are not significantly different at the 0.05 probability level using the New Duncan Multiple Range Test.

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Ultra-Narrow Row No-Till Cotton Production Systems for the Mid-South

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Abstract: Ultra narrow row cotton (UNRC) production (1 0 or less) is now a possible management option for growers across the cotton belt. Decreasing the distance between plants will reduce lateral branch length while Pix plant regulator will reduce vertical growth making broadcast stripper harvest feasible. Our objective was to build an economical system to grow higher yielding, high quality, short season cotton across a wide variation of soils, topography. and tillage conditions. Plants were grown in row spacings from 10 to 40 inches. As row spacing decreased, cotton plants changed from a conical to a columnar structure. When Pix plant regulator was applied, plant height was significantly reduced. When UNRC was treated with Pix, there was a dramatic increase in the number of first fruiting positions per acre, and adecrease in second and other positions. This resulted in a yield increase of high quality cotton.

Introduction

Determining the optimum row width and spacing of cotton has been of interest to producers and agronomist since it was introduced to this country. Brown (I 938) reported that the length of the stem is determined mainly by soil and water conditions, but variety does play a part. Cook and Meade (1911) reported that rainy weather and rich land may cause a higher percentage of vegetative branches to develop and thus produce extra vegetative growth at the expense of fruit branches. Close spacing is conducive to earlier maturity because there is a higher percentage ofprimary bolls (Brown, 1927). Heitholt (et al., 1995) reported that an increased flower production rather than increased boll retention was responsible for the small narrow row yield increase. Anderson (1973) and Sappingfield (et al., 1969) reported that narrow rows produced more yield, were earlier, and resulted in shorter plants than wide rows.

Materials and Methods

In 1992 a four year study was initiated on a Waverly silt loam soil at Shelby Farms Agri Center Int. at Memphis, TN. Stoneville 132 was planted with a Kinze planter in 10, 15, 20, 30, and 40 inch rows as main plots. lntra row plant spacing was held fairly constant with 3 to 4 plants/ft for the wide rows and 2 to 3/ft for the UNRC or 40,000 plantsiac. and 120,000 plants/ac. respectively.

Two Pix applications (totaling 0 and 24 oz./ac.) were subplot treatments.

Ten plants per rep (30 total) were mapped for height, number ofmain stem nodes, first fruiting branch node, number of vegetative branches, length and diameter, and the percent fruit retention at positions 1,2 and other. The wide rows were harvested with a Case Spindle Picker and the UNRC were harvested with an Allis-Chalmers Finger Stripper. Yields were measured from each treatment while percent gin turnout was recorded for the picker vs. the stripper.

Results and Discussion

Pix and row spacing had little effect on number of mainstem nodes (21), and first fruiting branch node (6).

Height

Pix reduced plant height by 30 percent across all row spacings, while 10 inch rows showed only a slight trend for shorter plants. The optimum height for UNRC is 32”.

Branches

The number (3 to 0), length (30 inches to 2 inches), and diameter (6/16 inch to 1/16 inch) of vegetative branches decreased as row spacing decreased. While Pix had no effect on the number of vegetative branches, it reduced the length and diameter size. Pix and UNR reduced all branch length and size to form a very columnar plant structure. This caused a delay in canopy closure with the wide row spacings.

Fruit Set

As the row spacing decreased from 40 inches to 10 inches, the percent first position fruit increased from 69 to 89 for the Pix treated and 61 to 87 for the untreated. As the row spacing decreased from 40 inches to 10 inches the percent second and other fruit decreased from 24 to 1I and 9 to 0 for Pix and 27 to 13 and 12 to 0 for the untreated.

Yields

Pix increased lint yields across all row spacings from 13 percent on 40 inch rows to 41 percent on 10 inch rows. Without Pix the plants became rank and the yields decreased for the 15 and 10 inch rows. The treatment with the greatest yield was Pix and 10 inch rows. The lowest yield occurred with the untreated 10 inch rows.

Conclusions

UNRC - Keeps cotton plants from branching out. (Columnar)

Pix - Keeps cotton plants from growing too tall. (32" optimum)

Pix and UNRC - Both contribute to a greater fruit set at the money positions.

Pix and UNRC - Combine to structure the plants for high quality, high yield and a short season.

Pix and UNRC - Combine to shape the plants for fast efficient broadcast stripper harvest.

Pix and UNRC - Result in quality cotton that gins & grades favorably to WRC.

Pix and UNRC - Provides the grower with a profitable alternate cropping system.

Pix and UNRC -Allows the grower the flexibility to tailor his farming system to fit a wide variation of soils, topography and tillage conditions.

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Essential Steps to Successful Ultra-Narrow Row Cotton Production

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Abstract: Ultra narrow row cotton (UNRC - 10" or less) production is now a viable management option for growers across the cotton belt. New technologies include selective over top herbicides. growth regulators, earlier varieties, precision planters, HVI classing and No-Till production systems.

Introduction

Scientists and growers have searched for the optimum row width and plant density spacing for many years. Research conducted all across the cotton belt in the late 60's and early 70's showed that the structure of the cotton plant is favorably influenced by very narrow row spacing and plant density. Yields were higher for the UNRC and the plant structure indicated the possibility of a broadcast harvester. For practical purposes the system failed because of the growers inability to effectively control grass and broadleaf weeds, rank growth, and precision plant in order to obtain the necessary columnar plants.

One by one new technologies that are very effective have resolved those problems, making UNRC aviable production system. Grasses are now routinely controlled with over the top selective herbicides such as Poast Plus. Staple herbicide along with Roundup and Buctril tolerant cotton varieties will take care of the broadleaf weed problem. Pix plant regulator is well known for controlling rank cotton growth and setting fruit. Precision drill type plantersare now available that will strategically place the seed for consistent, predictable stands across various soils and conditions. Although finger stripper harvesters are being used, much improvement is needed.

Using the new technology the UNRC system was evaluated in 1995 in Texas, Louisiana, Mississippi, Arkansas, and Tennessee. Seventeen on farm demonstrations ranged from 2 to 40 acres. Our objective was to build an economical system to grow higher yielding, high quality, short season cotton across a wide variation of soils, topography, and tillage conditions. Excellent stands were obtained at every location using a Great Plains 2,000 series UNRC drill planter with depth bands. Seven were No-Till, four were stale seed bed, and six were conventional tilled. Soils ranged from clays to deep sandy loams and from flat to 12% slope. At eleven of the locations there was a direct comparison to wide rows. Ten of the demonstrations were harvested with a 7450 John Deere stripper with a modified AC finger header. Two demonstrations were harvested with John Deere 7445; two others were harvested with John Deere 484, and the remaining demonstrations were harvested with an Allis-Chalmers Finger Stripper.

Lint Yields for UNRC ranged from 645 Ibs./ac. to 1118 lbs./ac., with a 748 average. Wide row yields were from 445 to 900 Ibs./ac. with a 678 Ibs./ac. average. Cost and profit figures showed a 52% advantage for UNRC. UNRC resulted in an average profit of $280.80/ac. compared to $147.50/ac. for wide rows. Gin turnout ranged from 27% to 34% for UNRC stripper harvest to 32% to 36% for wide rows with an average of 28% for UNRC and 32% for wide rows. Thirty percent of the UNRC bales graded light bark. More tests need to be done in this area.

UNRC System

- Burndown (no-till) or conventional tillage
- Pre-emerge herbicide
- Plant with UNRC planter
- Control grass and broadleaf weeds over the top
- Monitor and control insects
- Monitor and regulate cotton growth and development with Pix
- Apply defoliant and boll opener
- Apply desiccant
- Harvest with broadcast stripper
- Sow cover crop and cut stalks

Conclusions

The UNRC system works very well and is easy to do, but it is very different. These demonstrations along with other recent tests suggest that UNRC is a viable, economical alternate cotton production system that will allow producers to grow high yielding, quality, short season cotton across a wide variation of soils, topography, and tillage conditions.

UNRC Advantages

- Fits across all tillage systems
- Fits across most soils, topography, and conditions
- Less erosion
- Less machinery cost
- Less labor

Table 1. 1995 BASF UNRC Demo field trials yield and profit results

Rep/Ave. of all Locations	UNRC Y_0Gin Turnout	UNRC Lint Yield/ac.	WRC Y_0Gin Turnout	WRC Lint Yield/ac.
Brad Guice, Winnsboro, LA	27	929	32	900
Wade Stewart, Scott, MS		1052		799
John Harden, Keiser, AR	28	824	32	807
Sam Atwell, Memphis, TN	28	897	32	813
Russ Perkins, Lubback, TX		765		556
Average	28	894	32	775
Example				
Ave. price $.70 Gross		$625.80		$542.50
Ave. Cost UNRC $345.00/ac.				
Ave. Cost WRC $395.00/ac.				
Net		$280.80		$147.50

* Less input cost
* Less weed pressure
* Potential for higher yield
* Potential for higher quality cotton
* Moreprofit

UNRC Disadvantages

* All applications must be broadcast
* No post-directed applications
* No cultivation
* Must plant flat
* Difficult to furrow irrigate
* Once-over harvest
* Potential for lower gradesitrash

Precautions

* Do not plant UNRC on poorly drained, cold natured soils.
* Do not plant UNRC on land with weed problems that cannot be controlled easily with the current herbicide arsenal.
* Do not plant UNRC without a precision drill planter on 10" or less row spacings.
* Do not plant UNRC without a good over top broadcast sprayer.
* Do not plant UNRC without a good finger stripper harvester.
* Do not plant UNRC before consulting with your Ginner.
* UNRC works very well and is easy to manage, but it is very different. Management is generally more difficult on good fertile soils.

UNRC Problems Or Needs

* Improve harvesters
* Improve planters
* Ginner acceptance
* Improve leaf grade

Surface and Deep Tillage Effect on Double-Cropped Soybean

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Abstract: Information is needed on optimum conservation tillage soybean production management when the soybean is planted following a wheat grain crop. Our objective was to determine the effect of surface tillage, deep tillage. and row width on double-cropped soybean growth and yield. Surface tillage treatments were disked or not disked. Row width treatments were 7.5 in or 30 in. Deep tillage treatments consisted of fall paratilling before seeding wheat or not paratilling. In the spring, half of the 30-in plots were in-row subsoiled and half of the 7.5-in plots were paratilled, and these were compared to no spring deep tillage. Soybeans were planted in early June in 1994 and 1995. Surface tillage and spring deep tillage impacted plant height at some measurement times through each season, but row width and fall deep tillage did not. Averaged over all treatment combinations, soybeans grown in 7.5-in rows yielded 30.1 buiac (1994) and 21.2 bu/ac (1995) more than soybeans grown in 30-in rows. Surface tillage and deep tillage had no effect on yield when the 30-in-row width was used. When the 7.5-in-row width was used, both fall and spring deep tillage increased yield. Disking before planting the 7.5-in-row-width soybeans resulted in yield reductions of 14.2 bu/ac in 1994 and 9.8 buiac in 1995, compared to the no surface tillage treatment. Conservation tillage, combined with narrow-row culture and deep tillage. should improve double-crop soybean production in the Coastal Plain.

Introduction

Soybean planted after wheat harvest is a common practice in the southeastern USA. In 1995, approximately 50% of the total soybean acres were seeded after wheat in South Carolina. Conservation tillage systems that left wheat residues on the soil surface were used on about 40% of those double-cropped acres (Gene Hardee, USDA-NRCS, personal communication). Most conservation tillage soybean production was planted in wide-row spacing (30-38 in). Limited data is available on narrow-row (≤ 10 inches) production of soybean on the Coastal Plain, especially for conservation tillage production. Compared to soybean grown in wide rows, narrow-row soybeans compete better with weeds, have higher pod placement, lose less soil water through evaporation, have greater root dispersion throughout the soil, and reduce soil erosion (Palmer and Privette, 1992).

There is a need for deep tillage to break root restricting layers or hardpans in some Coastal Plain soils (Busscher et al., 1986). Currently, straight-shanked in-row subsoilers are used to disrupt these layers for soybeans grown in wide rows. Touchton et al. (1989) reported that deep tillage before wheat in the fall eliminated the need for in-row subsoiling before planting soybean the following spring. Similarly, Khalilian et al. (1991) found that when using controlled traffic, fall deep tillage with a paratill (bent-leg shank) before planting wheat was adequate for the following interseeded soybean crop.

A better understanding of the influence of surface residues and deep tillage on double-cropped soybean in narrow- and wide-row culture will lead to improved management practices for conservation tillage production. In this report. we present results on the effects of surface and deep tillage on the growth and yield of soybeans produced with narrow- and wide-row widths.

Materials and Methods

The experiment was conducted at Clemson University's Pee Dee Research and Education Center near Florence, SC. A randomized complete block experimental design with four replicates was used in 1994 and 1995. Surface tillage treatments were disk and not disked. Within each surface tillage treatment, all combinations of row spacing (30 in vs 7.5 in), spring deep tillage (deep-tilled vs not deep-tilled), and fall deep tillage (deep-tilled vs not deep-tilled) were evaluated. Deep tillage for the 30-inch-row-spacing treatments was with straight-shanked in-row subsoilers. A paratill with four bent-leg shanks spaced 26 in apart was used for performing deep tillage in the 7.5-in-row-spacing treatments and for all fall deep tillage. Plot size was 10 ft wide and 50 ft long. Plots were established by planting wheat in the fall of 1993, and treatment combinations for each plot were maintained each year.

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Wheat was harvested each spring with a 13-ft-wide combine header equipped with a sicklebar cutter. To maintain uniformity of the wheat residues, the height of the sicklebar was set to leave wheat stubble standing approximately 9 in tall in all plots. All surface tillage plots were disked twice with a 10-ft-wide tandem disk harrow after wheat harvest. We used a John Deerel model 7200 four-row planter attached to a KMC subsoiler to plant the wide-row soybeans with deep tillage. The four subsoil shanks were removed from the unit to plant the non-deep-tilled wide-row soybeans. Separate from the planting operation, a four-legged Tye paratill was used for all deep tillage in the narrow-row treatments. The narrow-row treatments were planted with a John Deere model 750 drill. The seeders were set to plant nine seeds/ft in the wide-row treatment and 3 seeds/ft in the narrow-row treatment. 'Hagood' was the soybean cultivar each year.

Fertility and weed control used in the experiment were as described by Busscher et al. (1995). Plant height was determined during each growing season by randomly selecting an area in the middle of each plot and measuring the height of five adjacent plants. Measurements were made in late July of 1995 and throughout August of both years. Yield was determined by hand-harvesting 20 ft of row (randomly selected in 39-in sections) from the middle of each plot. After sampling for yield, the remainder of each plot was combine harvested to uniformly distribute the soybean residues.

Data were analyzed with analysis ofvariance. Treatment means from significant effects were separated by calculating a protected least significant difference with P=0.05.

Results

Row width and fall deep tillage did not influence plant height at any measurement time in either year of the study. On August I, 1994, soybeans in the disked treatments were I.4 in shorter than the soybeans growing in wheat stubble ($P\leq0.01$) (data not shown). At later measurement dates, no differences between disked and nondisked plots were found. In 1995, soybeans in the diskedtreatment were 1.3 in shorter on 21 July ($P\leq0.01$) and 1.1 in shorter on 28 July (P0.05) than the soybeans grown with wheat surface residues; but as in 1994, there were no differences at later sampling dates (data not shown). No interactions between spring deep tillage and surface tillage occurred on any sampling date.

In August of both years, soybean plants grown with spring deep tillage were one to two in taller than those grown without spring deep tillage at most sampling times (Figure I). Since deep tillage allows for greater root penetration of the soil, the greater plant height for the deep-tilled treatment was probably due to better plant water relations for those plants during August of both years.

For soybean yield, significant row width x surface tillage, row width x spring deep tillage, and row width x fall deep tillage interactions occurred both years. No three-way or four-way interactions occurred in either year. Averaged

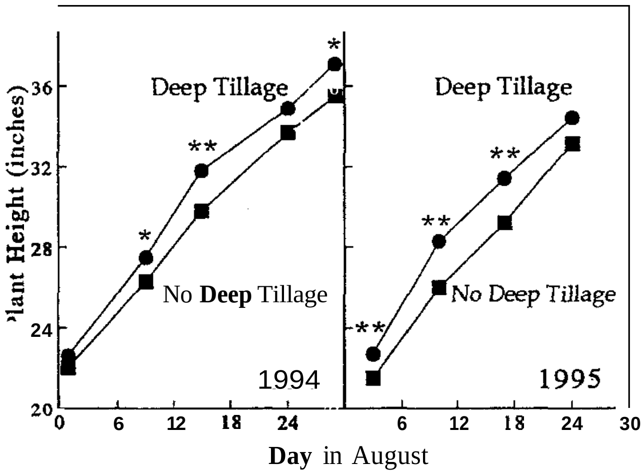

Figure 1. Effect of spring deep tillage on soybean plant height during August of 1994 and 1995. *,** indicate treatment means were significantly different at **P=0.05** and **P=0.01**, respectively.

over all treatment combinations, the soybean grown in narrow rows yielded 30.1 bu/ac (1994) and 21.2 bu/ac (1995) more than soybean grown in wide rows. At the higher yield level, narrow-row soybean yields were affected by the soil management treatments in our experiment, while the lower yielding wide-row soybeans were not (Table I). There were no yield differences between surface tillage treatments or either fall or spring deep tillage treatments for the wide-row soybeans in either year of the study. In narrow-row culture, soybean yield for the non-disked treatment was 14.2 bu/ac higher than the disked treatment in 1994 and 9.8 bu/ac higher than the disked treatment in 1995. Spring deep tillage increased yield by 17 bu/ac in 1994 and 15 bu/ac in 1995. Both years. the residual effects of fall deep tillage resulted in a 7.4-bu/ac increase over no fall deep tillage in the narrow-row soybeans.

Summary

Surface and deep tillage influenced plant height to the same degree for soybeans in both row widths, but yield differences due to tillage occurred only for narrow-row culture. Yield limiting factors in wide-row culture need to be identified. These results indicate there is a potential to improve conservation tillage soybean production in the Coastal Plain by using narrow-row culture and deep tillage. Other management factors, such as variety selection, optimum soil fertility, and insect pest thresholds need to be defmed for this production system.

[1] Mention of a trade name is for information only and does not imply an endorsement to the exclusion of oiher products that may also be suitable by the USDA or Clemson University.

Table 1. Effect of row width, surface tillage, and deep tillage on soybean yield in 1994 and 1995. Values followed by the same letter within a tillage comparison and year are not significantly different ($P \leq 0.05$).

Tillage Variable	1994		1995	
	Row Width			
	30	7.5	30	7.5
Surface	bu/ac			
Disked	42.1a	66.8b	29.8a	46.7b
Not Disked	46.0a	81.6c	32.0a	57.5c
Spring Deep				
Yes	45.6a	82.7c	31.9a	59.6c
No	42.5a	65.7b	29.9a	44.6b
Fall Deep				
Yes	43.8a	77.9c	31.4a	55.8c
No	43.8a	70.5b	30.4a	48.4b

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Stand Establishment in Water-Seeded, Minimum-Till Rice as Influenced by Water Management and Preplant Vegetation Control

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Abstract: Water seeding is the predominant cultural practice for establishing rice in Louisiana. While the majority of water-seeded rice is cultured in conventional tillage systems, minimum-till is gaining in popularity. Inadequate stand establishment in water-seeded, minimum-till systems can result in delayed maturity and reduced yields and is one factor that limits continued expansion of this new cultural practice. A study was conducted in 1994-1995 to evaluate the effects of water management and preplant vegetation on stand establishment of six rice varieties in a minimum-till system. Water management strategies included 1) pinpoint flooding with a 4-day postplant drainage interval, 2) delayed pinpoint flooding with a 10-day postplant drainage interval, and 3) delayed flooding with a 20-day postplant drainage interval. Preplant vegetation was manipulated by 1) no herbicide termination, 2) herbicide termination, and 3) herbicide termination plus rolling of preplant residue. Seedbeds were prepared in November prior to planting each year and allowed to revegetate with native weeds. Stand density of rice was influenced by water management in 1995 and increased with a 20-day postplant drainage period. Maturity was delayed for some varieties each year with a 4-day postplant drainage period. Water management influenced grain yield of all varieties in 1994.

Yields of Bengal and Jodon increased as the postplant drainage period increased to 20 days. Cypress. Lacassine, and Jackson yields were highest with a 10-day postplant drainage. Kaybonnet yield was decreased with a 10-day drainage. Preplant vegetation management influenced stand densities and grain yields in 1994. Densities and yields were both reduced when no herbicide was used to terminate preplant vegetation. Neither water management nor preplant vegetation management affected grain yields in 1995. Cypress, Jodon. and Kaybonnet significantly outyielded Lacassine and Jackson. Yield of Bengal was significantly higher than that of Jackson, lower than Jodon and Cypress, and similar to Lacassine and Kaybonnet. Water management and preplant vegetation management can influence the growth and yield of rice in water-seeded, minimum-till systems. Differential varietal response also needs to be considered.

Introduction

Approximately 85% of the rice produced in southwest Louisiana is water seeded. A considerable portion of this total is grown in systems where most of the tillage is performed under flooded conditions and is referred to as "mudding in." A result of this cultural practice is the release of floodwater after planting that contains significant amounts of solids and nutrients that negatively impact the water quality of receiving streams (Cormier, et al.. 1990). Alternative planting practices have been evaluated in an attempt to identify management practices that mitigate the problems associated with mudding in (Feagley et al., 1992: Bollich and Feagley, 1994). No-till and minimum-till rice planting practices have been shown to significantly improve the quality of rice field effluent being released into receiving streams. From a commercial production aspect, these practices have also been found to be feasible alternatives to mudding in.

Adequate stand establishment is critical in water-seeded rice and has been a particular concern in the no-till systems. Poor stand establishment can result in delayed maturity and decreased grain yields. These problems have been observed in commercial fields and were documented in earlier studies (Bollich, 1992; Bollich and Feagley, 1994).

The main objective of this study was to determine which management practices might influence stand establishment in a water-seeded, minimum-till system. Specific objectives included 1) a comparison of three water management strategies, 2) a comparison of three methods to manage preplant vegetation, and 3) an evaluation of six rice varieties.

Materials and Methods

A factorial experiment was conducted at the South Unit of the Rice Research Station, Crowley, LA, in 1994-95. Variables included rice variety, water management, and preplant vegetation management. Fertilizer (0-40-40) was incorporated in November preceding each year of the experiment. All land preparation required to establish a finished seedbed was also performed at this time. Three methods of preplant vegetation management included (1) no herbicide termination, (2) herbicide termination, and (3) herbicide termination plus rolling of preplant vegetation. Glyphosate (1.0 lb ai/A + 0.25% surfactant 13 days preplant) and paraquat (0.66 lb ai/A + 0.25% surfactant 5 days preplant) were used to terminate vegetation in 1994 and 1995, respectively, in those treatments receiving a herbicide. Preplant vegetation was rolled down 1 day after herbicide application in Treatment 3.

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A shallow flood was established 1 day prior to seeding pregerminated Cypress, Bengal, Jodon, Lacassine, Kaybonnet, and Jackson rice varieties at a rate of 150 Ib/A. Three methods of water management included (I) pinpoint flooding with a 4-day postplant drainage, (2) delayed pinpoint flooding with a 10-day postplant drainage, and (3) delayed flooding with a 20-day postplant drainage. The 10- and 20-day delayed flooding treatments were flush irrigated as needed unless rainfall provided enough moisture to encourage seedling development and stand establishment. The pinpoint flood and 10-day delayed flooding treatments were drained for 2 days on Day 18 postplant. A nitrogen application of 90 lb/A was applied to the soil surface of all water management treatments. A permanent flood was established 20 days postplant.

Agronomic input practices (midseason N application and weed, insect, and disease control) were applied as required according to current recommendations (LSU Agricultural Center, 1987). Stand densities were recorded approximately 3 weeks after seeding. Maturity (days to 50% heading), plant height, and grain yield were determined.

The experiment was analyzed as a randomized complete block with a split-split plot arrangement of treatments and three replications. Water management was assigned to main plots, vegetation management to subplots, and varieties to sub-subplots. Results will be discussed by year.

Results

Plant height was not affected by water management or preplant vegetation management either year. Differences were due only to varieties (data not shown). Water management had little effect on stand density in 1994 (Table I). There was a tendency to increase the number of plants with postplant drainage periods of 10 and 20 days, but due to variability in stand counts, the increase in stand density was not significant ($P<0.08$). Preplant vegetation management had a significant effect on stand density. Density was increased when vegetation was terminated with a herbicide. Rolling the preplant vegetation after herbicide termination had no influence on stand density. Stand densities were significantly different among the six varieties, with Kaybonnet establishing the highest plant population. Cypress, Jodon, and Jackson were similar in stand densities. Bengal and Lacassine stand densities were significantly lower than those of the other varieties.

An interaction occurred between water management and varieties (Table I) for days to *50%* heading. Figure I shows a graphic representation of relative varietal differences. Maturity was significantly delayed by 3.7, and 4 days when the postplant drainage period was only 4 days for Cypress, Lacassine, and Jackson, respectively. Maturity was delayed by 2 days for Bengal, Jodon, and Kaybonnet. There appeared to be little difference in maturity between the 10-and 20-day drainage period for any of the varieties. Preplant vegetation management significantly affected maturity by delaying days to 50% heading by 3 days when no herbicide was used for termination, but by only 1 day when vegetation was rolled after herbicide application.

Grain yield was significantly reduced when no herbicide was used to terminate preplant vegetation (Table I). Yields were similar between the herbicide termination and termination plus rolling treatments. A significant water management by variety interaction occurred for grain yield (Table 1). A graphic representation is shown in Figure 2. Grain yields of Bengal and Jodon increased as the postplant drainage period increased. Yields of Cypress, Lacassine, and Jackson were highest with a 10-day postplant drainage period. Kaybonnet yield was decreased with a 10-day drainage period.

Water management significantly influenced stand densities in 1995 (Table 2). Stand densities were highest with a 20-day postplant drainage period. There was no difference between the 4- and 10-day drainage periods. Stands were lowest for Jodon and Jackson and highest for Lacassine and Cypress. Preplant vegetation management had no effect on stand densities.

A variety by water management interaction occurred for days to 50% heading (Table 2). A graphic representation of relative varietal differences is shown in Figure 3. Maturity was delayed for Cypress, Jackson, and Lacassine as the postplant drainage period decreased. Water management appeared to have little influence on the maturity of Bengal, Jodon, and Kaybonnet.

Grain yields were not affected by water management or preplant vegetation management in 1995 Yield differences were due only to variety. Cypress, Jodon, and Kaybonnet yields were above 7500 Ib/A. Yields of Lacassine and Jackson were significantly lower than those of the other varieties. Yield of Bengal was significantly higher than that of Jackson, but lower than yields of Cypress and Jodon.

Discussion

Poor stand establishment is often a serious liability in water-seeded, minimum-till rice production. Stand reductions usually delay maturity and can lead to reduced grain yields. Water management significantly affected stand densities in this study only in 1995. There was a tendency for stand densities to be reduced with a 4-day postplant drainage period in 1994. Maturity of some varieties was delayed each year, indicating that even when stand densities are not reduced, early flooding still negatively impacts plant growth. Earliness in maturity is extremely important in southwest Louisiana because ratoon cropping is very common. Delays in main crop maturity further increase the risks associated with this practice.

Varieties responded differentially to water management treatments in 1994. Yields of Bengal and Jodon increased as the postplant drainage period increased to 20 days. Yields of Cypress, Lacassine, and Jackson were highest with a 10-day drainage period. A longer drainage had no effect on these varieties. Yield of Kaybonnet was slightly reduced with a 10-day drainage and were higher with a 4- and 20-day drainage.

Table 1. Effect of preplant vegetation management, water management, and varieties on stand establishment in wator-seeded rice. Rice Research Station, South Unit, Crowley. LA. 1994.

		Water management[1]											
		Stand density				Days to 50% heading				Grain yield at 12% moisture			
Variety	Preplant vegetation management	PP	DP	DP	Mean	PP	DP	DF	Mean	PP	DP	DF	Mean
		----(plants/ft[2])---								----------(lb/A)-----------			
Cypress	No burndown	15	16	15	15	91	85	85	87	6484	7685	6929	7033
Cypress	Burndown	16	22	29	22	85	86	85	85	7217	7613	7616	7482
Cypress	Burndown + Grooving	17	25	31	24	90	84	84	86	7261	7597	7608	7489
Bengal	No burndown	11	13	11	11	86	84	83	84	6012	6081	6870	6321
Bengal	Burndown	15	14	20	16	84	82	81	82	6675	7161	7517	7118
Bengal	Burndown + Grooving	11	22	18	17	86	83	82	83	6157	6521	7136	6605
Jodon	No burndown	12	11	13	12	84	83	81	83	6143	6311	6996	6483
Jodon	Burndown	13	19	32	22	83	79	80	81	6579	8017	8172	7589
Jodon	Burndown + Grooving	17	28	32	26	82	80	78	80	6872	7668	8152	7564
Lacassine	No burndown	6	11	7	8	97	91	88	92	4692	5662	5807	5387
Lacassine	Burndown	11	23	17	17	92	85	86	88	5462	6740	6361	6188
Lacassine	Burndown + Grooving	9	20	25	18	93	86	87	88	6014	6339	6943	6432
Kaybonnat	No burndown	33	21	17	24	86	83	85	85	8094	7148	7913	7718
Kaybonnet	Burndown	21	36	39	32	85	82	81	83	8092	8287	8794	8391
Kaybonnat	Burndown + Grooving	30	36	42	36	84	83	81	82	7882	7757	8256	7965
Jackson	No burndown	11	19	18	16	88	81	81	83	5181	7248	6788	6406
Jackson	Burndown	12	21	25	19	83	81	80	81	6636	7235	6973	6948
Jackson	Burndown + Grooving	17	22	28	22	84	81	80	82	5893	7132	6955	6660
Water management (WM) mean		15	21	23		87	83	83		6519	7122	7321	
C.V., %			27.54				2.11				8.66		
LSD (0.05):[2]													
Water management			ns				3				ns		
Preplant vegetation management (PVM) mean													
No burndown			14				86				6558		
Burndown			21				83				7286		
Burndown + grooving			24				84				7119		
LSD (0.05):[2]			5				1				276		
Variety (V) mean													
Cypress			21				86				7334		
Bengal			15				83				6681		
Jodon			20				81				7212		
Lacassine			14				89				6002		
Kaybonnet			31				83				8025		
Jackson			19				82				6671		
LSD (0.05):			3				1				327		
Main effect interactions[2]													
WM x PVM			ns				ns				ns		
WM x V			ns				*				*		
PVM x V			ns				ns				ns		
WM x PVM x V			ns				ns				ns		

[1] PP = pinpoint flood; DP = delayed pinpoint flood; DF = delayed flood.
[2] * denotes significance at P = 0.05; ns =nonsignificant.

Table 2. Effect preplant vegetation management, water management, and varieties *on* stand establishment in water-seeded rice. Rice Research Station, South Unit, Crowley, LA. 1995.

		Water management[1]											
		Stand density				Days to 50% heading				Grain yield at 12% moisture			
Variety	Preplant vegetation management	PP	DP	DF	Mean	PP	DP	DF	Mean	PP	DP	DF	Mean
		----(plants/ft^2)---								----------(lb/A)-----------			
Cypress	No burndown	15	16	15	15	91	a5	a5	a7	6484	7685	6929	7033
Cypress	No burndown	13	13	17	14	90	a7	87	88	7556	7958	8345	7953
Cypress	Burndown	18	17	20	18	89	87	87	87	7489	7857	8128	7825
Cypress	Burndm + Grooving	13	11	18	14	a9	89	86	88	7077	7686	8322	7695
Bengal	No burndown	10	11	14	12	86	a5	a4	85	6529	7105	7917	7184
Bengal	Burndown	14	9	15	13	a4	85	a4	85	7326	6550	7625	7167
Bengal	Burndm + Grooving	12	11	15	13	a4	a4	a4	a4	7484	7132	8064	7560
Jodon	No burndown	9	10	14	11	a5	84	a2	84	6949	6978	8390	7439
Jodon	Burndown	a	10	14	11	a5	a4	82	84	7769	7019	a593	7794
Jodon	Burndm + Grooving	11	9	9	10	a4	a4	82	83	7632	7413	8076	7707
Lacassine	No burndown	15	17	19	17	a7	86	84	86	7058	6781	7333	7057
Lacassine	Burndown	12	15	18	15	88	86	84	86	7185	6647	7492	7108
Lacassine	Burndown + Grooving	12	15	17	15	89	85	84	86	6845	6806	7712	7121
Kaybonnet	No burndown	12	11	17	13	88	88	a4	a7	7332	7048	7801	7394
Kaybonnet	Burndown	16	13	20	17	87	88	a5	a7	7560	7230	7913	7568
Kaybonnet	Burndm + Grooving	10	9	17	12	a7	88	a5	87	7009	7528	8483	7673
Jackson	No burndown	8	9	16	11	88	86	83	85	6020	6684	7520	6741
Jackson	Burndown	7	8	13	9	87	a5	a3	a5	6931	6911	7733	7192
Jackson	Burndown + Grooving	6	13	12	10	a7	85	a3	85	6755	6839	7634	7076
Water management (WM) mean		11	12	16		a7	86	a4		7139	7121	7949	
C.V., %			25.78				1.57				6.11		
LSD (0.05):[2]													
Water management				1				1				ns	
Preplant vegetation management (PVM) mean													
No burndown				13				86				7295	
Burndown				14				86				7442	
Burndown + grooving				12				86				7472	
LSD (0.05):				ns				ns				ns	
Variety (V) mean													
Cypress				16				aa				7824	
Bengal				12				a4				7303	
Jodon				10				83				7647	
Lacassine				16				86				7095	
Kaybonnet				14				a7				7545	
Jackson				10				85				7003	
LSD *(0.05):*				2				1				245	
Main effect interactions													
WM x PVM				ns				ns				ns	
m x v				ns				•				ns	
PVM x V				ns				ns				ns	
WM x PVM x V				ns				ns				ns	

[1] PP = pinpoint flood; DP = delayed pinpoint flood (10 day); DF = delayed flood (20 day).
[2] • denotes significance at P = 0.05; ns =nonsignificant.

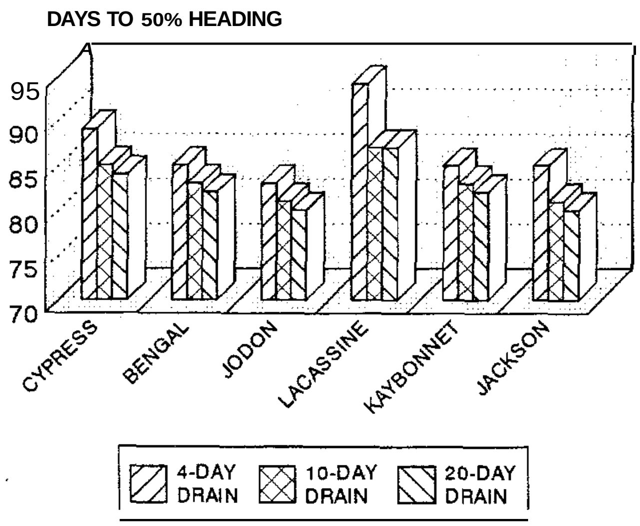

Figure 1. Maturity response of six varieties to postplant drainage time in minimum-till, water-seeded rice. 1994.

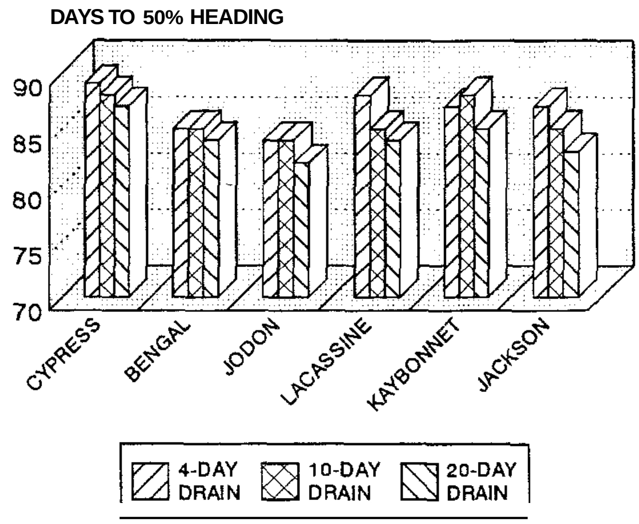

Figure 3. Maturity response of six varieties to postplant drainage time in minimum-till, water-seeded rice. 1995.

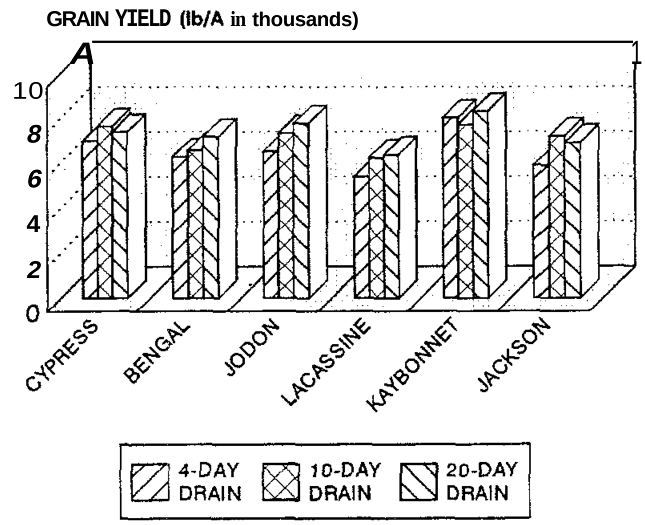

Figure 2. Yield response of six varieties to postplant drainage time in minimum-till, water-seeded rice. 1994.

Vegetation management influenced yields only in 1994. Preplant vegetation was excessive and yields were decreased when no preplant herbicide was applied. Vegetation was less dense in 1995, stand densities were not affected, and yields were similar.

Lacassine and Jackson were the lowest yielding varieties each year, while Cypress, Jodon, and Kaybonnet yielded significantly higher. Varietal responses such as these are very common in conventional seedbeds, indicating differences in genetic potential (Bollich, et al., 1993; Bollich, et al., 1994). These differences seem to be exacerbated in minimum-till seedbeds.

Results of this experiment indicate that management decisions concerning variety selection, water management, and preplant vegetation management may all play a role in rice performance in minimum-till seedbeds. Depending on year and environmental conditions, these factors could affect performance singly or in combination with each other.

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Minimum Tillage Cultivation in a Hardpan Soil

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Abstract: To reduce strength in a hardpan soil. a high-residue cultivator with 8-in deep mid-row disruption was compared to chemical weed control with in-row subsoiling. Treatments included no ,tillage, subsoiling, cultivation, and both subsoiling and cultivation. Cotton *(Gossypium hirsutum* was planted into standing winter ryegrass *(Lolium multiflorum* Lam.) or winter fallow. Cultivation significantly lowered soil strength over not tilling. When performed with subsoiling, it lowered strength over subsoiling only. Yield was increased by subsoiling. Yields in cultivated plots were similar to those in non-cultivated plots. Yields for the fallow plots were higher than for the rye cover. Though the cultivator decreased soil strength. it did not improve plant characteristics or yield.

Introduction

The top two soil horizons, the Ap and E, in many productive southeastern Coastal Plains soils are structureless, sandy in texture, and low in organic matter. These horizons, especially the E, can have soil strengths that reduce or prevent root growth (Box and Langdale, 1984). The E horizon can become dense enough to prevent root growth even when soil water content is at field capacity (Campbell et al., 1974). Most conventional and reduced tillage management systems include deep profile disruption (subsoiling). Increased yield has been attributed to these tillage practices (Sojka et al., 1991). Once the roots get through the E horizon, they can grow into the B horizon which has good structure. Even when the B horizon gets hard, roots can grow along its ped faces.

Weed control by either mechanical cultivation or chemical application is necessary to prevent excessive plant competition. The Brown Chiselvator' is a conservation tillage (high residue) cultivator. It tills the soil just below the surface leaving the residue on the surface. Depth of cultivation is controlled with a shallow (eight in deep) shank and gauge wheels that run in the mid rows. Beyond its activity as a cultivator, the Chiselvator's mid-row soil disruption has the potential to increase growth and yield.

The objective of this experiment was to evaluate the Chiselvator as a tillage tool: measure mid-row disruption of the Chiselvator and compared it with subsoiling.

Methods

In 1993 and 8994, we grew cotton on Norfolk loamy sand soil at the Pee Dee Research and Education Center of Clemson University in Florence, SC. Winter cover treatments included fallow (winter weeds) and rye. Tillage treatments were subsoiled and non subsoiled each of which was cultivated with a Chiselvator or not tilled. Non-subsoiled treatments were planted after killing the winter cover with Gramoxone. Subsoiled treatments were in-row subsoiled to adepth of 16 to 18 in (to the top of the B horizon) before planting. Cover and tillage treatments were arranged in a randomized complete block design within each of four replicates.

In mid November, rye was seeded with a grain drill at a rate of 110 lbs/a. In mid-to-late April, plots were sprayed to kill winter vegetation. We deep-tilled half the plots with a KMC subsoiler. Cotton was planted within 15 days of killing winter vegetation at five seeds/ft in four 35-ft long, 30-in wide rows. Because of problems with stand establishment, we replanted all plots in mid May 1994.

Plots received 70 lbs N/a. Lime, P, K, S, B, and Mn were applied to meet Clemson University Extension recommendations (Parks, 1989). Herbicides (fluometuron, monosodium or disodium methanearsonate, sethoxydim, cyanazine) and pesticides (aldicarb, pyrethriod and organophosphate insecticides) were applied at labeled amounts, as needed.

Six weeks after germination, half the plots were cultivated with the Brown Chiselvator. Soil strength and soil water content were measured within four days of cultivation. Soil strength (cone index) was measured with depth as the pressure needed to push a 0.5-in diameter cone-tipped metal rod into the soil. These measurements were taken to a depth of 22 in at five uniformly spaced positions across the row from non-wheel-track mid row to wheel-track mid row. Cone index data were log transformed as recommended by Cassel and Nelson (I 979). Soil water content samples were taken in the non-wheel-track mid row and in row with a I-in diameter sampling tube at 8-in depth increments to 24 in.

Plant samples were taken from 3 feet of each of the two mid-plot rows in mid September. Sampling included plant height, weight, and number of plants. In early to mid

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November, seed cotton yields were taken from the *two* mid-plot rows.

Plant sample and yield data were analyzed as a randomized complete block design using SAS (SAS Inst., 1990). Cone index and water content data were analyzed as a randomized complete block design with position across the row and depth as splits.

Results

Yield

Average lint yield was greater in 1995 than in 1994 at 723 vs. 537 lbs/a (Table 1). Problems in 1994 included poor seed quality and erratic germination. leading to a replanting after two weeks of growth. Lint yield for fallow cover was higher than rye cover (690 vs 570 lbs/a). This difference was mainly due to a 2.75 tons/a rye cover in 1994 that made planting difficult. Subsoiled plots outyielded non-subsoiled plots by 697 to 564 lbs/a. Non-cultivated plots had non significantly higher yields than cultivated plots (667 to 592 lbs/a). This is somewhat in agreement with Reeves and Touchton (1989). They found no advantage to mid-row deep disruption five weeks after planting.

Soil Water Content

Water contents taken along with the cone indices showed no differences among cover crop, subsoiling, or cultivation treatments. Water contents in 1995 were higher than they were in 1994. Significant increases were seen with depth in both years (Table 2).

Soil Strength

Because of mechanical loosening, lower cone indices were measured for subsoiled vs. non-subsoiled and cultivated vs. non-cultivated plots (Table 3). Soil strength patterns for selected treatments can be seen in Figure 1. The cone index of the subsoiled treatment was lower under the row. Cultivated plots showed shallow zones of disruption in the mid rows. Data analysis showed a significant cone index difference with position across the row because of the loosening effect of the implements.

Although both subsoiling and cultivating lowered soil strength below the non-tilled treatment, cultivated treatments (with subsoiling) had lower cone indices than subsoiled-only treatments, especially near the surface (Figure l). The ranks of cone indices for the treatments shown in Figure 1 are cultivating and subsoiling < cultivating only < subsoiling only < no tillage (12.2 atm < 14.8 atm < 17.8 atm < 20.3 atm with an LSD = 4.5 atm at 5%). Soil strength for cultivating-only teratment was not significantly lower than subsoiling-only treatment. The overall higher strength of the subsoiled plots, when compared to the cultivated plots, may be at least partially due to settling since plots were subsoiled six to eight weeks before cone index measurements were taken. Cultivated treatments had significantly lower soil strength than not-tilled treatments. Cultivated-and-subsoiled treatments also had lower strengths than treatments that were subsoiled only.

Table 1. Cotton lint yield (lbs/a)*.

Cover	Tillage		1994	1995
Rye	Subsoiled	Cultivated	407	800
		Non cultivated	628	790
	Non subsoiled	Cultivated	395	579
		Non cultivated	254	707
Fallow	Subsoiled	Cultivated	717	749
		Non cultivated	740	742
	Non subsoiled	Cultivated	355	740
		Non cultivated	801	680

* LSD = 94 lbs/a at the 5% level.

Table 2. Water contents taken with cone indices.

	1994	1995
Depth (in)	Water content (lb/lb)	
0-8	7.6b*	10.7c
8-16	7.7b	13.9b
16-24	10.8a	18.3a

* Water content is on a dry weight basis. LSD at 0.05 is 2.5.

Table 3. Cone indices for cover, subsoil, and cultivated treatments.

	1994	1995
Treatment	Cone index (atm)*	
Subsoiled	16.2	11.7
Non subsoiled	18.0	14.8
Cultivated	14.6	10.6
Non cultivated	19.9	16.2
Rye	16.2	13.0
Fallow	18.0	13.4

* LSD = 2.4 atm at the 5% level

Plant Characteristics

Even after replanting, stands were still spotty in 1994. At the time of measurement, plants in subsoiled treatments were taller than in non-subsoiled treatments (40 vs. 37 in), plants in fallow treatments were taller than in rye treatments (41 vs. 35 in), and plant heights in Cultivated treatments were

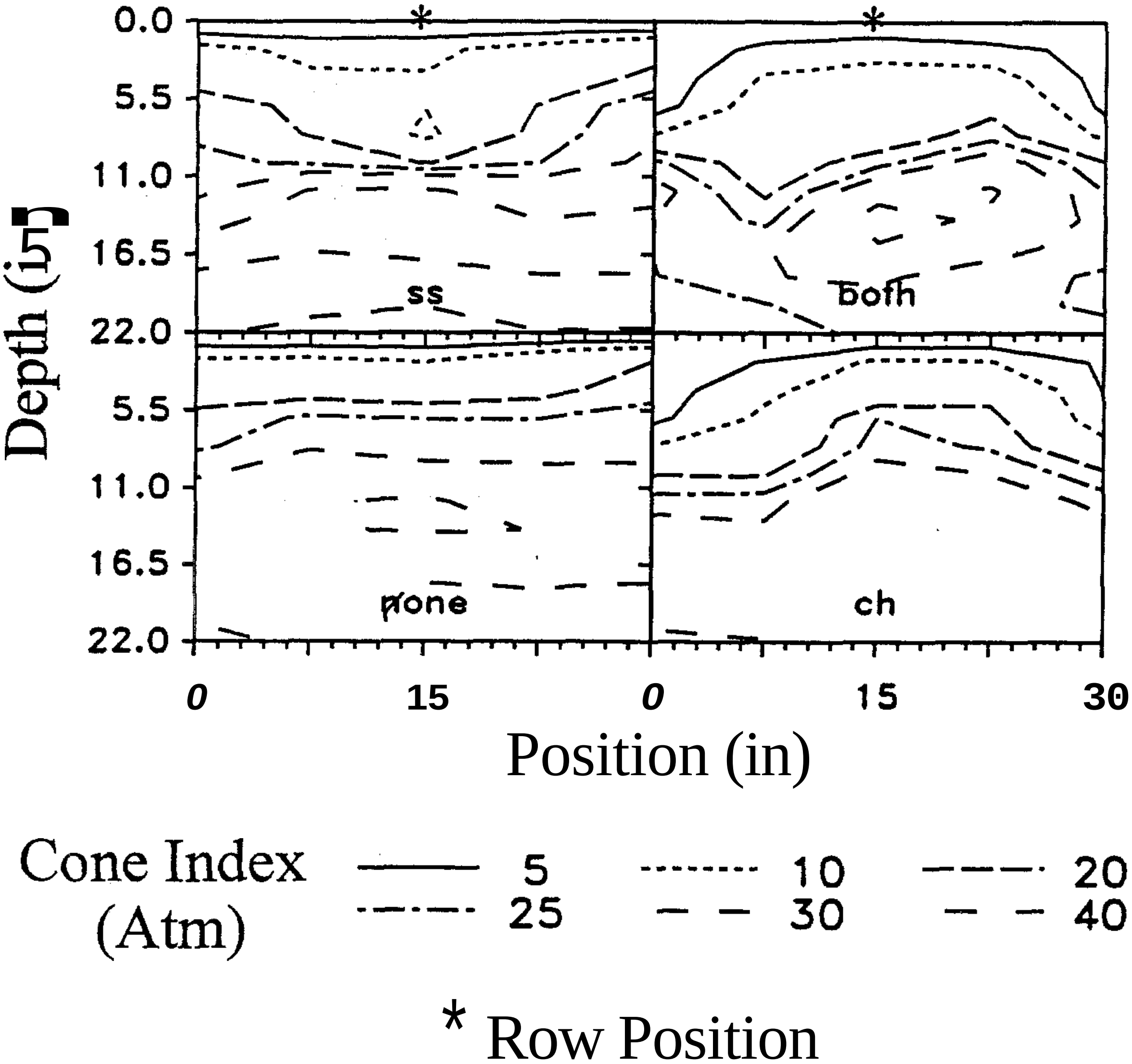

Figure 1. Cone index contours of the soil profile for treatments that were subsoiled (ss); cultivated with the Chiselvator (ch), subsoiled and cultivated (both), and not tilled (none).

Table 4. Plant height (in)*.

Cover	Tillage		1994	1995
Rye	Subsoiled	Cultivated	34.9	41.6
		Non cultivated	40.6	35.2
	Non subsoiled	Cultivated	33.0	30.0
		Non cultivated	30.5	36.2
Fallow	Subsoiled	Cultivated	41.1	43.4
		Non cultivated	40.8	43.7
	Non subsoiled	Cultivated	41.8	42.1
		Non cultivated	43.3	37.9

* LSD = 6.5 in at the 5% level.

mixed (Table 4).

For plant weights taken from the 3-ft sample sections of row, the fallow, non-subsoiled, cultivated treatment had the heaviest weights while the rye, non-subsoiled, cultivated treatment had the lightest weights. Both were among the poorer yielding treatments. Plant weights for the 3-ft section samples of the non-subsoiled rye were significantly lower than for the non-subsoiled fallow treatment (1. I vs. 1.9 lbs with an LSD = 0.75 lbs at ***5%).*** The subsoiled rye and fallow treatments were similar at 1.6 lbs each. Subsoiling could have helped eliminate the effect of the rye cover by a limited amount of in-row tillage. However, this was not substantiated by stand counts of the 3 ft section which was not significantly different.

Conclusions

Cultivating only did not reduce soil strength more than subsoiling only. Cultivation did significantly lower strength over no tillage. Cultivating and subsoiling had lower soil strengths than subsoiling only. Yield was increased by subsoiling but not by cultivation. Yields for fallow plots were higher than for rye cover. This could be a result of thick rye cover and difficulty with stand establishment, though this was not verified by stand count of the sampled section. Though the cultivator decreasedsoil strength, it did not increase plant characteristics or yield.

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Changes in Some Chemical Properties of an Oxisol and Summer Crops Yields as Affected by Tillage and Cover Crops in Southwestern Parana, Brazil. *

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In Brazil, since colonization started, the lack of adequate global planning in natural resources in all different regions as well as the use of land without taking into consideration its 'agricultural aptitude have led to misuse and exploitation of land. The State of Parana, located in the Southern part of the country (22° 29' 30" and 26° 42' 59" of south latitude and between 48° 02' 24" and 54'37' 38" of longitude west of Greenwich), is one of the most important agricultural regions, representing only 2.4% of total agricultural exports. In this State approximately 6.5 million hectares are cultivated with summer crops such as soybeans, maize, beans, cotton, upland rice, wheat, sugar-cane, cassava, etc. Approximately half of this area remains in fallow during the season. This situation associated with heavy rainfall increases soil losses. Soil erosion has become one of the most serious problems in agriculture production. In Parana, average soil losses of 10 to 40 t of fertile soil ha^{-1} were observed when traditional soil tillage systems were used. The severity of erosion in many areas means land had been irreversibly lost. There is evidence which shows when nutrients removed by harvesting are not replaced by mineral weathering and organic inputs, such systems became unsustainable.

A field experiment was established in 1986 on clayey Oxisols, to evaluate the effects of winter cover crops on summer crops (maize and soybean). Treatments combined winter cover crops, including blue lupins *(Lupinus augustifolius* L.), hairy vetch *(Vicia villosa* Roth), black oat *(Avena strigosa* Schreb), corn spurrey *(Spergula arvensis* L.), oilseed radish *(Raphanus sativus* L.), winter wheat *(Triticum aestivum* L.), and fallow, two nitrogen levels (0 and 90 kg N ha") in maize plots, and two tillage systems, conventional (one disc plough and 2 disc harrowings) and no-tillage, every year before crop planting. The treatments were laid out using a split-plot design in three blocks with three replications. Cover crops were grown during the winter time and controlled at the flowering stage by the application of weed-killerherbicide (spergula and fallow) or by cutting with a knife roller (lupins, hairy vetch, black oats and oilseed radish), and wheat grain was harvested. The vegetal mass of dead materials was left on top of the soil as mulch under the no-tillage system or incorporated under conventional tillage. Summer crops, maize and soybean, were sown at the beginning of the summer season. The shoot plant tissues of different cover crops and fallow were collected during the flowering period in 1994; after harvest, the wheat straw was collected. All samples were dried at 60°C, ground and sieved (0.2 mm) for chemical analysis. The soil samples were collected in November 1994 (0-5, 5-15 cm) in each sub-sub plot. The soil samples were sieved (2mm) and then ground by mortar & pestle to pass a 0.2mm sieve for chemical analysis (N,P,K^+,Ca^+-, Mg^{++},C,$AL^{3+}$$H^+$). The summer crops grain yields were evaluated each year. Dry matter accumulated for different cover crops presented significant and strong differences among species in tissue element concentration. The different cover crops used showed a significant increase in the organic carbon level in the soil for both depths (0-5 and 5-15 cm) and also increased levels of some soil nutrients. There is a trend to improve organic carbon levels in no-tillage when cultivated with winter cover crops. The crop residues and also tillage regime caused significant alteration and redistribution of nutrients within the soil profile. The better no-tillage system promoted higher maize and soybean yield. The use of some legumes (blue lupin and hairy vetch) in no-tillage. allowed an economy of 90 Kg N ha-1 fertilizer when compared with fallow in the conventional system.

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Densities and Herbicide Rates for No-Till Drilled Soybeans

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A field study was conducted at six locations in Illinois to evaluate the following objectives: 1) Compare adapted soybean varieties at three planting rates for days to canopy closure and evaluate weed control when no-till drilled into corn stubble; and 2) Evaluate the effects of 0.5x, *0.75x* and 1x of recommended herbicide rates for a total Pre-emergence (PRE) and a total Postemergence (POST) program, and a weedy check, on weed control and soybean yields. The locations included DeKalb and Monmouth in northern Illinois, Urbana and Perry in central Illinois, and Brownstown and Dixon Springs in southern Illinois. Urbana data is not included in this report.

At each location 3 adapted soybean varieties were combined with 3 planting densities designed to provide final plant stands of 140,000, 180,000 and 220,000 plants/acre. Varieties used at the northern and central locations included Pioneer brands 9273 (early) and 9342 (late) along with Asgrow 3237 (mid-season). Varieties at the two southern locations included Pioneer brands 9394 (early) and 9451 (mid) along with Asgrow 4715 (late).

Variety by planting rate combinations were randomized in strips and replicated 4 times. Across these 9 strips, 7 herbicide treatments were applied (in a strip-plot design or checkerboard pattern). The herbicide treatments included a check, 0.5 PRE, 0.75 PRE, 1.0 PRE, 0.5 Post, 0.75 Post and 1.0 Post. The 1.0 PRE consisted of 2 pints Dual II (2.5 pints were used in northern IL and Urbana) +7 oz Canopy. The entire plot area had been treated with 1 qt Roundup + 2,4-D + NIS and Ammonium Sulfate approximately 10 days before planting. The 1.0 POST treatment consisted of 0.25 oz Classic + 0.25 oz Pinnacle + 8 oz Assure I1 + 0.25% v/v NIS + 2.5% v/v UAN.

Weed seeds were sown just prior to planting at 4 out of the 5 locations in 1995 only (Perry was excluded). Weeds sown included common lambsquarters (Colq), redroot pigweed (Rrpw), giant foxtail (Gift) and velvetleaf (Vele). Data collected in 1995 include final soybean plant stands, grain yields, and days to canopy closure as well as weed counts and ratings (for each of the weeds above plus any significant residual weeds). In 1994, grain yields, plant stands, plant heights and weed control ratings were taken.

Plant Stands

Final plant stands varied by location and years, but in most cases were within a reasonable percentage of intended stands (Tables 1 and 2). Locations where stands were much lower than anticipated were usually affected by heavy rainfall in May and June especially immediately after planting. Because of the lateness of planting in both years, replanting seemed undesirable. There were occasionally location/years which showed varietal differences but they were small and tended to not affect final yields. Three out of five locations had stand losses associated with check treatments in 1995 but none in 1994, and only one out of five locations in 1995 only showed losses in stand with PRE treatments compared to POST treatments. These effects are probably due to increased competition from weeds in 1995. Overall, however, planting rates had much larger effects on final stand than did variety or herbicide treatments.

Canopy Closure

In 1994, there were observations of differences in canopy closure for the various treatments. In 1995, canopy closure was measured as the number of days from planting until a canopy was formed over the middles of the rows. Four out of five locations showed planting rate effects on days to canopy closure (Table 3). Planting rate differences varied due to differences in final stand but in general those locations with greater than 200,000 plants/acre canopied 3-7 days sooner than the lowest stands at the same location. Growing conditions and varieties also factored into canopy development. Check treatments canopied sooner at each location. In general, PRE herbicide treatments canopied 2-4 days earlier than POST and the 1.0 PRE rates delayed canopy closure by 1-2 days in southern Illinois. High rates of POST delayed canopy closure only at locations with poor stands due to weather problems.

Grain Yields

In 1994, the northern locations failed to produce significant increases in grain yield as planting rates increased (Tables 4 and 5). This may have been due to the higher stands than intended with the low rate or could be because of the growing conditions in 1994 (favorable weather and low weed competition). Four out of five locations increased yields with increasing seeding rates in 1995. Planting was delayed by wet weather in 1995 and late season development was reduced by high temperatures and low rainfall in August and September.

Table 1. Soybean plant stands (1000 pts/acre) at each location, 1994.

Variable	DeKalb	Monmouth	Perry	Brownstown	Dixon Springs
Planting Rate					
140,000	159	179	135	--	84
180,000	181	175	190	--	104
220,000	202	208	239	--	125
Dense lin	**	**	**	--	**
Dense quad	*NS*	*	*NS*	--	*NS*
Variety					
Early	179	156	162 b	--	101
Mid-season	174	187	193 a	--	111
Late	191	190	205 a	--	101
LSD	NS	*NS*	***17.1***	--	*NS*
Herbicide					
Check	176	194	200	--	111
0.50 PRE	180	184	184	--	102
0.75 PRE	182	184	195	--	95
1.00 PRE	178	190	187	--	101
0.50 POST	181	185	192	--	99
0.75 POST	189	187	184	--	108
1.00 POST	183	187	177	--	114
Contrasts					
Ck vs others	*NS*	*NS*	*NS*	--	*NS*
PRE vs POST	*NS*	*NS*	*NS*	--	*NS*
PRE lin	*NS*	*NS*	*NS*	--	*NS*
POST lin	*NS*	*NS*	*10%*	--	*NS*
Var X Dense	*NS*	--	*NS*	--	*NS*

10%, * and ** refer to 10%, 5% and 1% levels of significance. NS = not significant.

Earlier canopy development under the high planting rate may have conserved soil moisture which led to higher yields. Variety differences were not significant at any location in 1995 but were in 1994. Lateness of planting may have contributed to poorer variety performance in 1995. The check treatments had the lowest yields at four out of five locations in 1995 and three out of five in 1994. When average across all five locations in 1995, the checks yielded about 10 bu/acre less than the herbicide treated plots. Differences were less in 1994 because of lower weed pressure. The POST treatment yielded lower than the PRE at two locations, but higher at two other locations in 1995 and higher at one location only in 1994. Averaged acrossall locations, PRE and POST yielded about the same. At Dixon Springs there was a lower yield associated with cutting PRE herbicide rates in both years. This may be related to the tougher weed problems at Dixon Springs, as will be discussed below. At DeKalb, there was a significant yield reduction with the high rates of POST in 1995.

Weed Control

a) Gift. There was a dense stand of Gift at each of the five locations in both years. Soybean planting rate increased Gift control at three out of the five locations in 1995 but only one in 1994, however differences were very slight (Tables 6

Table 2. Soybean plant stands (1000 pts/acre) at each location, 1995.

Variable	DeKalb	Monmouth	Perry	Brownstown	Dixon Springs
Planting Rate					
140,000	101	143	125	141	156
180,000	114	182	157	143	177
220,000	120	203	166	148	223
Dense lin	**	**	**	*NS*	**
Dense quad	*NS*	*NS*	*NS*	*NS*	*NS*
Variety					
Early	111	164 b	150	145	182 b
Mid-season	111	198 a	151	145	167 b
Late	113	163 b	146	142	207 a
LSD	NS	13.7	NS	NS	21.4
Herbicide					
Check	105	169	145	125	136
0.50 PRE	114	178	149	153	200
0.75 PRE	110	161	157	158	178
1.00 PRE	115	172	149	141	191
0.50 POST	109	182	143	140	199
0.75 POST	118	183	159	144	208
1.00 POST	109	183	142	148	186
Contrasts					
Ck vs others	*10%*	*NS*	*NS*	*	**
PRE vs POST	*NS*	*	*NS*	*NS*	*NS*
PRE lin	*NS*	*NS*	*NS*	*NS*	*NS*
POST lin	*NS*	*NS*	*NS*	*NS*	*NS*
Var X Dense	*NS*	*NS*	*NS*	*NS*	NS

10%, * and ** refer to 10%, 5% and 1% levels of significance. NS = not significant.

and 7). Variety had little impact on Gift control. POST treatments did better than PRE at most location/years. There was a linear response with PRE rates at four out of five locations in 1995 but only at DeKalb in 1994. The 0.5 PRE rate provided 5-20% less control than the full PRE rate. The 0.5 POST rate was as good as any other herbicide treatment, indicating that for Gift under these conditions, we may be able to reduce POST rates.

b) Amaranthaceae (Amar). (Waterhemp was reported at the Brownstown location in 1995, all others reported redroot pigweed, Rrpw). These weeds were dense at each of the locations seeded in 1995. but few were found in 1994. Soybean planting rate and variety had little effect on Amar control (Table 8). The 0.5 POST and 0.5 PRE both worked as well as any other treatment. PRE equaled POST at every location.

c) Ilmg lvyleaf morning glories (Ilmg) were found at three of the locations in 1995 only. PRE and POST treatments did about equal at all locations but none controlled much more than about 80% of the Ilmg. Soybean planting rate and varieties had little effect. Other weeds were found at some of the locations, but stands were sparse and the data will not be included in this report.

Table 3. Days from planting to canopy closure at each location, 1995.

Variable	DeKalb	Monmouth	Perry	Brownstown	Dixon Springs
Planting Rate					
140,000	43	49	37	27	50
180,000	41	48	31	28	47
220,000	41	46	31	27	45
Dense lin	**	**	--	*NS*	**
Dense quad	*NS*	*NS*	--	*NS*	*NS*
Variety					
Early	42	49 a	--	27	47b
Mid-season	41	47 b	--	27	47b
Late	42	48 ab	--	28	49 a
LSD	*NS*	*1.4*	--	*NS*	*1.5*
Herbicide					
Check	39	44	--	26	42
0.50 PRE	40	47	--	26	45
0.75 PRE	40	47	--	27	48
1.00 PRE	40	47	--	27	51
0.50 POST	42	50	--	27	49
0.75 POST	43	51	--	27	49
1.00 POST	45	50	--	32	50
Contrasts					
Ck vs others	**	**	--	**	**
PRE vs POST	**	**	--	**	*NS*
PRE lin	*NS*	*NS*	--	*NS*	**
POST lin	**	*NS*	--	**	*NS*
VarX Dense	*NS*	*NS*	--	*NS*	*NS*

10%, * and ** refer to 10%, 5% and 1% levels of significance. NS = not significant.

Summary

Drilling adapted soybean varieties at a seeding rate to deliver final stands between 180,000 and 220,000 should provide for maximum yields and the quickest canopy closure. In our study, density effects on canopy closure helped in weed control, but differences in canopy closure of 3-7 days sooner for the high plant densities, were small compared to the effects of PRE and POST herbicides. At nearly every location, PRE and POST herbicide applications, even reduced rates, provided significantly better weed control than where no herbicides were applied. This accounted for a 10 bushel increase in soybean yields when averaged across the five locations. With $7/bushel soybean prices, this is more than economical compared to the cost of herbicides. For most of the weeds in these plots in 1994 and 1995, the 0.5 POST treatment provided as good of weed control as any other treatment. Many times however, the 0.5 PRE treatment faired worse than the 1.0 PRE treatment. There is an indication that if the farmer has a good knowledge of weeds in his fields, he may be able to use lower herbicide rates with no-till drilled soybean.

Table 4. Soybean grain yields bu/acre) at each location, 1994.

Variable	DeKalb	Monmouth	Perry	Brownstown	Dixon Springs
Planting Rate					
140,000	45	51	40	30	44
180,000	45	50	42	36	48
220,000	45	51	44	35	47
Dense lin	*NS*	*NS*	**	*NS*	*
Dense quad	*NS*	*NS*	*NS*	*NS*	*10%*
Variety					
Early	46 a	50	43 a	32b	48 a
Mid-season	42 b	52	43 a	30b	45 b
Late		50	39 b	39 a	46 ab
LSD	*2.5*	*NS*	*1.6*	*5.6*	*2.8*
Herbicide					
Check	39	38	39	28	42
0.50 PRE	45	51	40	32	47
0.75 PRE	46	50	42	32	43
1.00 PRE	45	53	41	37	44
0.50 POST	39	55	42	37	49
0.75 POST	50	52	49	35	48
1.00 POST	50	54	40	36	48
contrasts					
Ck vs others	*NS*	**	*NS*	*	*10%*
PRE vs POST	*NS*	*NS*	*NS*	*NS*	*
PRE lin	*NS*	*NS*	*NS*	*NS*	*NS*
POST lin	*10%*	*NS*	*NS*	*NS*	*NS*
Var X Dense	*NS*	*10%*	*NS*	*NS*	*NS*

10%, * and ** refer to 10%, 5% and 1% levels of significance. NS = not significant.

Table 5. Soybean grain yields (bu/acre) at each location, 1995.

Variable	DeKalb	Monmouth	Perry	Brownstown	Dixon Springs
Planting Rate					
140,000	38.2	39.7	42.7	24.2	35.3
180,000	41.0	41.9	46.8	24.3	37.5
220,000	39.9		48.8	24.6	37.4
Dense lin	10%	**	**	NS	10%
Dense quad	*	10%	NS	NS	NS
Variety					
Early	39.2	40.8	45.6	25.2	36.4
Mid-season	40.2	42.2	47.0	25.3	37.0
Late		40.9	45.7	22.6	36.7
LSD	NS	NS	NS	NS	NS
Herbicide					
Check	36.1	33.4	41.2	22.4	21.2
0.50 PRE	40.8	43.9	46.6	29.1	33.2
0.75 PRE	41.6	44.4	46.6	25.6	36.1
1.00 PRE	42.5	43.3	44.6	23.0	38.9
0.50 POST	40.3	41.7	45.1	22.0	42.6
0.75 POST	39.1	41.1	47.5	24.5	42.5
1.00 POST	37.5	41.4	46.8	23.7	42.6
Contrasts					
Ck *vs others*	**	**	**	NS	NS
PRE vs POST	**	*	NS	10%	**
PRE lin	NS	NS	NS	*	**
POST lin	*	NS	NS	NS	**
Var X Dense	NS	**	NS	NS	NS

10%, * and ** refer to 10%, 5% and 1% levels of significance. NS = not significant.

Table 6. Giant foxtail (Gift) control at each location, 1994.

Variable	DeKalb	Monmouth	Perry	Brownstown	Dixon Springs
Planting Rate					
140,000	66	93	86	--	92
180,000	69	89	86	--	93
220,000	72	89	92	--	92
Dense lin	*NS*	*NS*	*	--	*NS*
Dense quad	*NS*	*NS*	*NS*	--	*NS*
Variety					
Early	--	--	--	--	93
Mid-season	--	--	--	--	93
Late	--	--	--	--	92
LSD	--	--	--	--	*NS*
Herbicide					
Check	0	0	0	--	0
0.50 PRE	63	92	90	--	95
0.75 PRE	79	81	95	--	94
1.00 PRE	82	95	95	--	97
0.50 POST	85	99	99	--	100
0.75 POST	86	96	100	--	100
1.00 POST	88	99	98	--	100
Contrasts					
Ck vs others	**	**	**	--	**
PRE vs POST	**	*10%*	*NS*	--	*10%*
PRE lin	**	*NS*	*NS*	--	*NS*
POST lin	*NS*	*NS*	*NS*	--	*NS*
Var X Dense	--	--	*NS*	--	NS

10%, * and ** refer to 10%, 5% and 1% levels of significance. NS = not significant.

Table 7. Giant foxtail (Gift) control at each location, 1995.

Variable	DeKalb	Monmouth	Perry	Brownstown	Dixon Springs
Planting Rate					
140,000	84	85.0	82	73	71
180,000	86	85.3	84	75	74
220,000	87	85.4	85	74	76
Dense lin	*	**	*NS*	*NS*	**
Dense quad	*NS*	*NS*	*NS*	*10%*	*NS*
Variety					
Early	87	85.2 ab	85	74	74 a
Mid-season	85	85.4 a	83	74	76 a
Late	87	85.1 b	83	74	71 b
LSD	*NS*	*0.24*	*NS*	*NS*	*2.1*
Herbicide					
Check	0	0	0	0	0
0.50 PRE	92	99	85	70	64
0.75 PRE	94	99	95	82	66
1.00 PRE	97	99	96	84	86
0.50 POST	99	100	99	94	99
0.75 POST	98	100	90	94	100
1.00 POST	99	100	100	93	99
Contrasts					
Ck vs others	**	**	**	**	**
PRE vs POST	**	**	*	**	**
PRE lin	*	*NS*	*10%*	**	**
POST lin	*NS*	*NS*	*NS*	*NS*	*NS*
Var X Dense	*NS*	*NS*	*NS*	*NS*	*NS*

10%, * and ** refer to 10%, 5% and 1% levels of significance. NS = not significant.

Table 8. Amaranthaceae (Pigweed family) control at each location, 1995.

Variable	DeKalb	Monmouth	Perry	Brownstown	Dixon Springs
Planting Rate					
140,000	86	86	--	79	86
180,000	85	86	--	80	86
220,000	87	86	--	80	86
Dense lin	*	*NS*	--	*NS*	*NS*
Dense quad	*10%*	*NS*	--	*NS*	*NS*
Variety					
Early	86	86	--	80	86
Mid-season	87	86	--	79	86
Late	86	86	--	79	86
LSD	NS	*NS*	--	*NS*	*NS*
Herbicide					
Check	0	0	--	0	0
0.50 PRE	99	100	--	84	100
0.75 PRE	99	100	--	95	100
1.00 PRE	99	100	--	96	100
0.50 POST	99	100	--	93	100
0.75 POST	99	100	--	93	100
1.00 POST	99	100	--	95	100
Contrasts					
Ck vs others	**	**	--	**	**
PRE vs POST	*NS*	*NS*	--	*NS*	*NS*
PRE lin	*NS*	*NS*	--	*10%*	*NS*
POST lin	*NS*	*NS*	--	*NS*	*NS*
Var X Dense	*NS*	*NS*	--	*NS*	*NS*

10%, * and ** refer to 10%, 5% and 1% levels of significance. NS = not significant.

Table 9. Morningglory (Ilmg) control at each location, 1995.

Variable	DeKalb	Monmouth	Perry	Brownstown	Dixon Springs
Planting Rate					
140,000	--	69	--	72	62
180,000	--	70	--	73	67
220,000	--	73	--	72	66
Dense lin	--	*10%*	--	*NS*	*10%*
Dense quad	--	*NS*	--	*NS*	*NS*
Variety					
Early	--	69	--	74	62 b
Mid-season	--	73	--	72	64 ab
Late	--	70	--	71	69 a
LSD	--	*NS*	--	*NS*	*5.4*
Herbicide					
Check	--	0	--	0	0
0.50 PRE	--	83	--	81	71
0.75 PRE	--	88	--	82	75
1.00 PRE	--	82	--	85	88
0.50 POST		74	--	85	71
0.75 POST	--	80	--	87	74
1.00 POST	--	80	--	87	75
Contrasts					
Ck vs others	--	**	--	**	**
PRE vs POST	--	*NS*	--	*10%*	*NS*
PRE lin	--	*NS*	--	*NS*	*NS*
POST lin	--	*NS*	--	*NS*	*NS*
VarX Dense	--	*NS*	--	*NS*	*NS*

10%, * and ** refer to 10%, 5% and 1% levels of significance. NS = not Significant.

Determination of Soil Aggregation Indices as a Function of Tillage Systems, Crop Rotations, Sampling Depth and Sampling Preparation

C. Castro Filho[1] & A.L. Podanoschi[2]

Soil aggregation can be determined through the MWD (Mean Weight Diameter), the GMD (Geometric Mean Diameter) and through the AS% (Aggregate Stability Index). These 'three indices have different physical meaning: the MWD is large if the soil has a high percentage of large aggregates; the GMD is an estimate of actual dominant size class; and the AS% index is a measure of total aggregation and does not consider aggregate size class distribution. When detemining soil aggregation indices in heavy clayey oxisols the correct preparation of the soil sample is fundamental to obtain good results. In addition, the type of sample preparation may interact with the type oftreatment (for example, conventional or no-tillage system), and the result may be an overestimation of aggregation indices, and sometimes underestimation. The objective of this paper was to verify the changes in aggregate stability using two soil sample preparations: passing them through a 4 or an 8 mm sieve before the wet sieving procedure. This was tested in soil samples collected from an experiment in the 14th year of duration. Main treatments were two tillage systems (conventional and no-tillage) and three crop rotations (soybeans/wheat/soybeans, com/wheat/corn, and soybeans/wheat/corn). Soil samples were also taken at two depths: 0-10 and 10-20 cm. The soil of the experiment was a Typic Haplorthox (Distrophic Red Latosol) located at IAPAR's experiment station in the State of Parana, Southern Brazil (between 22° 29 30" and 26° 42' 59" of south latitude and between 48° 02' 24" and 54° 37' 38" of longitude west of Greenwich). The aggregation indices determined were the MWD, GMD and the AS%. Climate (Keoppen system) in the experiment place was Cfa. The results showed that MWD, GMD and AS% in No-Tillage systems were significantly higher than in Conventional Tillage. Crop rotations that included corn had higher aggregation indices. Depth of sampling had significant effects (5% level) on MWD and AS% data and soil sample preparation had also asignificant effect for MWD (at 1% level) and GMD (at 5% level). Although aggregation indices were not all significant at the 1% level, the double interaction between tillage systems and depth of sampling, tillage systems and soil sample preparation. and depth of sampling and soil sample preparation were all significant at the 1% level. Also the triple interaction no-tillage x soil sample preparation (8 mm sieve) x 0-10 cm depth had a significantly higher MWD at 5% level. Since these indices are determined in our laboratory in aroutine analysis, the method of soil sample preparation had been changed to using the 8 mm sieve, to better estimate the size of soil aggregates in our soils.

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Soil Properties, Nematode Densities, and Corn Yield From Yard Waste Compost Applications

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Abstract: Urban plant debris or urban yard waste can be processed into yard waste compost (YWC) for beneficial application to agricultural land. This reduces the amount of waste deposited into .sanitary landfills. The objective of this research was to determine the changes in soil properties. plant-parasitic nematodes and corn yield from application of YWC to farmland in Alachua County, Florida. Two adjacent experiments received large amounts of YWC used as a mulch for no-tillage corn or YWC incorporated into the soil for conventional tillage corn. Both experiments had control treatments with either no YWC applied or applied only the first year (1992) of the 4 year study. Both experiments were in randomized complete block designs with five replications. By the summer of 1995. soil organic matter was 50 to 100% greater from application of YWC. Soil N, CEC, pH and extractable nutrients were all in much greater quantities and nematodes were reduced in soil treated with YWC.

Introduction

Application of urban plant debris to agricultural land can improve soil properties and result in increased crop yield (Gallaher and McSorley, 1994; Gallaher and McSorley, 1995; Kidder, 1993; Kluchinski, et al., 1993). Urban plant debris can be applied in the fresh form (Kluchinski, et al., 1993) or after it has been processed as yard waste compost (YWC) (Gallaher and McSorley, 1994; Gallaher and McSorley, 1995). Reports of plant-parasitic nematode suppression from application of urban plant debris have also been published (Gallaher and McSorley, 1995; McSorley and Gallaher, 1995; Kluchinski, et al., 1993). While many questions remain regarding the application of urban plant debris to agricultural land, most information to date is positive. The objective of this research was to determine the changes in soil properties, plant-parasitic nematodes and corn yield from application of YWC to farmland in Alachua, County, Florida.

Materials and Methods

Two adjacent experiments were conducted for 4 years on the Haufler Brothers farm, Gainesville, Florida from 1992 to 1995. Soil type was a Bonneau fine sand. Three treatments of < 5 cm particle size, 4- to 6-month old YWC were as follows for experiment one: Treatment one had no YWC applied in 1992, had 269 mt/ha YWC applied evenly over the soil surface for a mulch followed by a planting of in-row subsoil no-tillage corn in 1993 and again in 1994. This YWC mulch was incorporated following corn silage harvest each year. No YWC was applied in 1995. Total YWC for treatment one was 538 mt/ha for the 4 years. Treatment two was the same as for treatment one except that the YWC was incorporated prior to planting corn each time in 1993 and 1994. Treatment three received no YWC any year and was the control treatment. Adjacent to experiment one was experiment two which used the same YWC type and source with the same three treatments as used in experiment one with the following exception. All three treatments received 269 mt YWC/ha that was incorporated in 1992. Tables 2 and 4 further illustrate the application and rates of YWC each of the 4 years of the study. Both experiment one and two were randomized complete block designs with five replications.

Yard waste compost was analyzed for dry matter by drying in a forced air oven at 70 C. Dry samples were ground using a Wiley mill to pass a 2.00-mm stainless steel screen and stored in air-tight plastic bags. Samples were then analyzed for organic matter (by combustion), C (estimation from organic matter), pH, N [microKjeldahl digestion (Gallaher, et al., 1995) and colorimetry], P (colorimetry) K (flame emission spectrophotometry), Ca, Mg, Cu, Fe, Mn and Zn (atomic absorption spectrophotometry) (Table 1). Soil samples were taken from the 0.0 to 0.2 m depth prior to application of YWC and corn planting each year and at harvest time each year for testing for Mehlich I (Mehlich, 1953) extractable elements [P (colorimetry), K, Na (flame emission spectrophotometry), Ca, Mg, Cu, Fe, Mn and Zn (atomic absorption spectrophotometry)], N [microKjeldahl digestion (Gallaher, et al., 1975) and colorimetry], CEC (cation summation), pH (electrode and water), and soil organic matter (potassium dichromate). Soil test data is only shown for July sampling in 1995 (Table 2).

Both experiments were fertilized with 202 kg inorganic N, 22 kg P, and 200 kg K per ha each year except 1995 when no P or K was used. Pioneer brand 3154 hybrid corn was planted each year in early march, in six row plots, 0.75 m

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Table 1. Analysis of yard waste compost used on the Haufler farm research/demonstration plots in 1992, 1993, and 1994.

	Haufler farm		
Analysis	1992	1993	1994
DM g/kg	572.0	507.0	515.0
OM g/kg	772.0	665.0	635.0
C g/kg	398.0	335.0	320.0
N g/kg	8.6	9.2	9.0
C:N ratio	46.3	36.4	35.6
pH chopped	5.7	---	6.5
pH ground	5.8	7.0	6.2
Ca g/kg	14.3	23.0	24.4
Mg g/kg	1.3	2.0	1.8
K g/kg	1.9	3.2	2.8
P g/kg	0.8	1.9	1.5
Cu mg/kg	11.7	16.3	16.0
Fe mgikg	1580.0	1473.0	1793.0
Mn mg/kg	146.0	142.0	173.0
Zn mgikg	91.0	112.0	96.0

DM = dry matter; OM = organic matter in DM: chopped =compost samples were chopped into coarse particles using a grinder: ground = sub-samples of the chopped samples were ground with a Wiley mill to pass a 2 m mstainless steel screen. Values are the average of four replications. The source of the, <5 cm size 4 to 6 month old. compost was Wood Resource Recovery. Gainesville, Florida

apart and 30 m long. Whole corn plants were cut from the center two rows of each plot and forage yield measured at 30% dry matter.

All plots were sampled for nematodes at planting time and harvest time each year. Each sample consisted of six soil cores, 2.5 cm diam. and 20 cm deep, collected within the center two rows in each plot. The cores were composited and mixed, and a 100-cm^3 subsample was removed for nematode extraction using a modified sieving and centrifugation procedure (Jenkins, 1964). Yield and nematode data were examined by analysis of variance, followed by mean separation with Duncan's New Multiple Range Test using MSTAT software (Michigan State University, East Lansing, MI).

Results and Discussion

Based upon YWC analyses large quantities oforganic matter and plant nutrients were applied from the amendment treatments (Table 1) However due to the large C:N ratio it would not be expected that immediate benefits from the N in the YWC would be observed for corn growth. Final soil test data at corn harvest time of the 4th-year indicated that the addition of YWC had increased soil organic matter by 90 to 100% over the control for experiment one and was 50 to 80 % greater than the control for experimenttwo (Table 2). However, for experiment two the control had received 269 mt/ha of YWC in 1992 and was still having an impact on organic matter 4- years later. Estimates of the C:N ratio from soil organic matter and N in Table 2 would indicate ratios ranging from 3.6:1 to 4.6:1 which would favor release of N to help meet crop needs. The YWC appeared to have an impact on buffering the soil by observation of the soil pH being higher than for the control. No doubt the addition of large quantities of cations played a major part in moderating change in soil pH and the resulting increase in CEC (Table 2). Generally the addition of YWC had a significant impact on improving soil quality that would favor improved crop growth.

The plant-parasitic nematodes *Criconemella* spp. (mostly *C. ornata* with some *C. sphaerocephala)* and *Pratylenchus* spp. (mostly *P. scribneri* with some *P. brachyurus)* were present in both experiments and tended to be lower in plots amended with compost than in unamended control plots (Table 3). On the other hand, *Meloidogyne incognita* was not consistently affected by compost treatment. *Paratrichodorus minor* numbers were lower in plots receiving YWC for experiment two but not for experiment one. By the end of the fourth year of these experiments (1999, densities of several different nematodes were affected by YWC application. By this time, more of the woody compost material had broken down and soil organic matter had increased substantially in the amended plots. It is not known whether breakdown products may have affected nematodes directly, or whether the increased organic matter and related improvement in soil properties provided a more suitable habitat for

Table 2. Soil properties from use of yard waste compost on the Haufler farm after four years, Gainesville, Florida, 1996.

Compost Treatment				Total													
1992	1993	1994	1995	4 year	pH	OM	CEC	N	P	K	Ca	Mg	Cu	Fe	Mn	Zn	Na
mt/ha						g/kg	meq/100g	mg/kg									
Experiment number one																	
0	269MI	269MI	0	538	6.1	31.2	11.00	1000	113	114	1354	106	0.31	10.2	8.40	7.0	4.5
0	2691	2691	0	538	5.9	33.0	11.40	1220	109	93	1133	110	0.29	11.3	9.54	7.7	4.7
0	0	0	0	0	5.5	16.6	7.47	670	84	77	542	45	0.56	16.5	5.68	4.7	3.6
Experiment number two																	
2691	269MI	269MI	0	806	6.4	42.8	15.90	1530	149	148	2165	133	0.27	19.3	11.24	9.4	5.0
2691	2691	2691	0	806	6.2	36.1	13.20	1190	132	137	2103	139	0.26	21.4	9.65	7.8	6.0
2691	0	0	0	269	5.6	24.0	8.06	800	100	75	812	61	0.44	17.2	6.40	5.7	4.6

MI = compost used as a mulch during the corn crop growing season and incorporated immediately after harvest each year. I = compost incorporated 10 days before planting (DBP) in 1992, 40 DBP in 1993, and 110 DBP in 1994. No compost was applied in 1995. Values are an average of five replications for the top 0.2 m of soil, Estimated C:N ratios Exp l:MI=4.59:1; 1=3.98:1; O=3.64:1 and for Exp 2:MI=4.11:1; I=4.46:1; O=4.41:1.

Table 3. Effect of yard waste compost treatments on initial (March) and final (June/July) nematode population densities on corn during 1995 at a site not previously treated with compost and a site previously treated with 269mt compost/ha in 1992.

Compost Treatment	Site untreated in 1992 with 0 mt/ha			Site treated in 1992 with 269 mt/ha		
	mt/ha	10 Mar	21 June	mt/ha	10 Mar	21 June
	---------- *Criconemella* spp. per 100³ soil ---------					
Mulch	538	6 B	155 b	807	12 ab	40 B
Incorporated	538	22 AB	92 b	807	3 b	69 B
Control	0	62 A	660 a	269	26 a	172 A
	---------- *Meloidogyne incognita* 100³ soil ---------					
Mulch	538	6	72	807	15	164
Incorporated	538	11	28	807	9	125
Control	0	6	70	269	15	59
	-------- *Paratrichodorus minor* per 100³ soil --------					
Mulch	538	8	28	807	4 b	20 B
Incorporated	538	4	28	807	4 b	27 B
Control	0	9	60	269	12 a	63 A
	---------- *Pratvlenchus* spp. per 100³ soil ----------					
Mulch	538	21 b	120	807	30 b	289 a
Incorporated	538	20 b	138	807	23 b	137 b
Control	0	43 a	126	269	56 a	123 b

Data are means of five replications. For each site, means in columns among compost treatments within each nematode not followed by the same letter are significantly different at the 0.05 (small letters) level of probability or at the 0.10 (capital letters) level of probability, according to Duncan's New Multiple Range Test. No letters indicate no differences at the 0.10 level of probability for a given nematode.

naturally-occumng antagonists ofnematodes (Stirling, 1991), since these were not measured in the experiments.

The addition of YWC greatly improved corn forage yield (Table 4). Improvement in forage yield from addition of YWC was greatest in 1993 and 1994 comparedto 1995 (year in which no YWC was added). It is suspected that soil water storage was greater in 1993 and 1994 compared to 1995, due to the YWC mulching or incorporation near the soil surface (Gallaher and McSorley, 1994). The farmers were impressed with the improvement in yield from application of YWC. Since they routinely sell the corn forage as silage and because the YWC had been donated, they realized an immediate economic benefit from its use to improve soil quality for better crop growth and development.

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Table 4. Corn forage yield from use of yard waste compost (YWC) on research/demonstration plots for 1992, 1993, 1994, and 1995, Gainesville. FL

Compost Treatments				Total	Year			
1992	1993	1994	1995	4-yr	1992	1993	1994	1995
Experiment number one								
mt/ha					Forage, Mg/ha @ 30% DM			
0	269MI	269MI	0	538	28.0	23.1a	33.6a	37.6a
0	2691	2691	0	538	28.0	21.3a	30.2ab	37.1a
0	0	0	0	0	28.0	9.9 b	23.1 b	33.6 b
Experiment number two								
2691	269MI	269MI	0	806	26.2	28.5a	41.0a	38.8A
2691	2691	269	0	806	26.2	26.0a	38.5a	39.9A
2691	0	0	0	269	26.2	20.4 b	29.8 b	34.8 B

MI = compost used as a mulch during the corn crop growing season and incorporated immediately after harvest each year. I = compost incorporated 10 days before planting (DBP) in 1992, 40 DBP in 1993, and 110 DBP in 1994. No compost was applied in 1995. For yield data, values in columns among compost treatments not followed by the same letter are significantly different at the 0.05 (small letters) level of probability except for 1995 experiment two which is significant at the 0.10 (capital letters) level of probability.

Dealing with Perennial Broadleaf Weeds in Conservation Tillage Systems

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Introduction

Troublesome weeds encountered today differ somewhat from .the plants which were of major concern in field crop production 20 years ago. The weedy plants found in crops are not necessarily newly introduced species, but a shift in the types of economically important weeds has evolved. Two factors that influenced this shift are: 1) an alteration or change in tillage practices, and 2) the introduction of new herbicide products and their impact on weed management practices.

General trends in weed population dynamics have been observed when tillage practices are reduced (Buhler, 1995). A population shift often occurs toward the increased presence of perennial, biennial, and winter annual weed species. Whereas, populations of some large-seeded broadleaf weed species have been shown to decline. Some examples of decreased weed populations observed include common cocklebur *(Xanthrumstrumarium* L.) (Wrucke and Arnold, 1985), sicklepod *(Cassia obtusifolia* L.) (Banks et al., 1985) and velvetleaf *(Abutilon theophrasti* Medik.) (Buhler and Daniel, 1988).

The idea that weed problems intensify under conservation-tillage systems can be a misconception. A more realistic view is that under conservation-tillage practices, fields within a few years tend to revert more quickly towards their "native" climax vegetation. In conservation-tillage systems weed control practices must be implemented to control vegetation that is present when the crop is planted and to maintain adequate weed control levels throughout the crop growing season. Thus, innovative crop production and weed management strategies are essential for maintaining adequate control levels of the more common weeds and to curtail the introduction and spread of other weeds, especially those plants with biennial and perennial life cycles.

The repeated use of the more recently introduced herbicide products have also impacted the presence of escaped weed species observed in field crops. The development of new herbicide technology has given field crop producers additional options for dealing with many of the commonly occurring annual species. An added benefit has been the effectiveness of newer herbicide products as weed management tools for control ofproblem weeds such asjohnsongrass. However, some weed species such as broadleaf signalgrass *(Brachiara platyphylla* (Grieseb.) Nash.) and several perennial broadleaf species have been observed more frequently in Kentucky.

A selected list of troublesome weeds that occur in agronomic crops and their life cycle are listed in Table 1. Most of these species are perennials that are capable of reproducing assexually by creeping root stocks or by rhizomes.

Field Studies

Two perennial broadleaf weeds of increasing concern are honeyvine milkweed *(Ampelamus albidus* (Nutt.) Britt.) and common pokeweed *(Phytolacca americana* L.). Both of these weed species are more evident in corn and soybean fields and have become of economic importance to corn and soybean producers in Kentucky.

Honeyvine milkweed is a climbing vine that can grow up to 10 feet in length. It becomes entangled with the crop and can cause lodging of corn and soybean plants. Honeyvine milkweed plants seldom reduce crop yield, but can create harvest problems in fields with large populations. It is considered a creeping perennial that is capable emerging from seed or producing new shoots from root buds. This plant is identified from other viney-type weeds by its simple lanceolate to cordate (i.e. heart-shaped) leaves attached in pairs at the stem nodes.

Control methods for honeyvine milkweed are limited. Cultural control options suggested for this plant generally consist of tillage. However, the benefit of tillage has been debated by scientists for several years. The freqency and timeliness oftillage can be factors in the success of this practice. Few herbicide options for suppressing growth are known.

Field studies have been conducted in Kentucky to evaluate the effectiveness of foliar applied herbicides used in corn. Traditional herbicide options such as dicamba (Banvel) and 2,4-D were compared with sulfonylurea type herbicides that have become recently available for foliar applications. Sulfonylurea herbicides included nicosulfuron (Accent), primisulfuron (Beacon), a premix formulation of primisulfuron:prosulfuron (Exceed), and halosulfuron (Permit). Complete control of honeyvine milkweed was not obtained with any of the treatments evaluated. Partial control or suppression of the above-ground growth was noted, which ranged from 60 to 75% based on visual observations. How-

Table 1. Selected troublesome weeds found in Kentucky's agronomic crops and their life cycle.

WEED SPECIES	ANNUAL	PERENNIAL	
		Simple	Creeping
Bindweeds			X
Broadleaf Signalgrass	X		
Burcucumber	X		
Curly Dock		X	
Groundcherry, Smooth			X
Hemp Dogbane			X
Johnsongrass			X
Milkweed, Common			X
Milkweed, Honeyvine			X
Morningglory, Bigroot		X	
Nightshade, Eastern Black	X		
Pokeweed, Common		X	
Ryegrass, Italian	X		
Trumpetcreeper			X

ever, measured vine length of honeyvine milkweed plants was significantly reduced by treatments evaluated compared with the untreated plots. Control observed with the sulfonlyurea herbicides tended to be somewhat better than dicamba alone. Tank mixtures of sulfonylurea herbicides with 2,4-D or dicamba did not greatly improve their effectiveness for suppressing growth.

Common pokeweed is an herbaceous perennial that reproduces from seed and large, fleshy taproots. Therefore, it is considered a simple perennial. Common pokeweed is a widely branched plant that can grow up to 10 feet in height during a growing season. This plant traditionally occurs along fence rows and other non-cropland sites, and is spreading into fields which have been subjected to long-term conservation-tillage practices. After it becomes established, common pokeweed is extremely difficult to control in both corn and soybeans. Curtailing the establishment and spread of individual plants is important for successful long-term control of common pokeweed.

Deep plowing and frequent cultivation can be an effective may of depleting root reserves, but is not a desirable option in conservation-tillage systems. A field study was initiated in 1995 to evalute the effectivenessoffoliar applied herbicides in corn. Treatments consisted of dicamba (Banvel), primisulfuron (Beacon), primisulfuron tank mixed with dicamba, a premix formulation of primisulfuron:prosulfuron (Exceed), and halosulfuron (Permit). The dicambatreatment provided the best results for suppressing plant growth. Common pokeweed growth has also suppressed by primisulfuron tank mixed with dicamba, the premix combination of primisulfuron:prosulfuron, and halosulfuron. Primisulfuron applied alone was not as effective in suppressing common pokeweed growth. Plant height measurements at six weeks after treatment also reflected differences noted between treatments. Plant height measurement prior to corn harvest; however, indicated that plant regrowth had occurred with some treatments evaluated.

Results from these field studies indicate that growth of some perennial broadleaf weeds can be suppressed with herbicide options currently available. However, further research efforts are warranted to discover acceptable weed management options to combat troublesome perennials.

Summary

Special crop management skills are often needed to deal with troublesome weed species, especially perennials. These skills include monitoring fields for the presence of potentially troublesome weeds before they become serious problems. It is also essential to select the appropriate weed management tools when a problem develops. In some cases, management approaches such as crop rotations, between crop herbicide treatments, and fallow-land programs can be beneficial in the development of an overall weed control strategy.

With the introduction of herbicide tolerant crops additional weed control options may be available for consideration. However, herbicide application rates required to obtain acceptable control and the size of weedy plants at time of application must be considered.

The cost of an intensive weed control program must also be evaluated relative to the long-term and economic benefits of implementing weed control strategies for perennial weeds. Not all weed species encountered will cause an economic yield loss compared to a field left untreated. However, the cost associated with curtailing the introduction and spread of future weed problems can reap long-term benefits.

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Nitrate Leaching Under Corn Is Not Well Related to Choice of Conservation Tillage System

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Introduction

In Kentucky, row crop agriculture's contribution to impaired water quality is controversial, especially as regards nitrate nitrogen (nitrate-N). The nitrogen cycle is affected by many agronomic management practices, including tillage. There is some concern that continued use of N containing inputs will result in elevated levels of nitrate-N in Kentucky's surface and ground waters. Nitrogen fertilizer is heavily used in corn *(Zea mays* L.) production and that crop is often planted on well-drained soils in the state.

Well-drained soils are a special challenge in water quality research. Water moves both through the soil (as leachate) and across the soil surface (as runoff) during a precipitation event of sufficient intensity. Tillage can affect the partitioning between infiltration and runoff. In many soils, no-tillage (NT) management preserves macroporosity that enhances infiltration and retards runoff.

The evidence that the greater infiltration of water under NT is necessarily associated with greater nitrate leaching is conflicting. In Kentucky, initial reports found that nitrate leaching under NT corn was often greater than that observed under moldboard plow (MP) corn, especially early in the summer (Thomas et al. 1973; Tyler and Thomas, 1977). Later work, on the same soil, suggested that there was no difference in nitrate leaching between these two tillage systems (Kitur et al., 1984). In Iowa, Kanwar et al. (1985) reported greater removal of nitrate from the surface 30 cm of the MP soil, as compared to the NT soil, after simulated precipitation. Randall and Kelley (1986) did find greater quantities of nitrate in 4 years of tile flow under NT corn, but the difference was small (ave. 2.7 kg/ha/yr).

There are several reasons for the different effects of tillage on nitrate leaching. First, any additional infiltration may not result in similar increases in leaching potential. The greater infiltration of water may permit greater water use by the crop, from more replenished stores of soil moisture. Water used is not available to transport solutes deeper in the soil profile. Greater crop water use is also associated with greater crop yield and greater nitrogen removal from the soil. This would reduce the amount of nitrate available for leaching. Second, there is evidence that solute-soil water interactions (or lack thereof) play a large role in whether solutes move when water flows through macropores. If the solute in entrained in micropore water contained within soil aggregates, then water moving through macropores might "bypass" considerable quantities of the solute. If the solute has not had time to dissolve and diffuse into these intraaggregate volumes, then macropore water will "wash" larger quantities of solute through a well-drained soil.

Many important well-drained corn soils are formed in limestone residuum in Kentucky. Because karst topography is often associated with limestone soils, leachate and runoff waters can be mixed to some degree. The issue of tillage and nitrate leaching remains of interest in the region, as evidenced by our ongoing studies (reported here) and those in Tennessee (Wilson et al., 1994). The focus of our research was on the quality of water leaving the root zone. We assumed this depth to be about 90 cm (3 ft), under corn, and that soil biology would not further modify the chemical character of leachate beyond this point.

Methodology

We have used zero tension pan lysimeters (Tyler and Thomas, 1977) to collect leachate samples at a depth of 90 cm in the soil profile at two locations under continuous corn production. One was on a Crider silt loam (Ultic Paleudalf) near Glasgow, Kentucky, and the other was on a Maury silt loam (Typic Paleudalf) near Lexington, Kentucky. Pan dimensions were 60 x 60 cm on the Crider soil and 90 x 60 cm on the Maury soil. We looked for effects of tillage, fertilizer nitrogen (N) rate (168 vs. 252 kg N/ha) and weed control strategy on agrichemical leaching at the Glasgow site, and similarly at tillage, fertilizer N rate (0, 84 and 168 kg N/ha, but only the 0 and 168 kg N/ha rates were instrumented with lysimeter pans) and dairy manure at the Lexington site. This report will focus on the elements common to both experiments, tillage and fertilizer N rate. The experimental design was a split plot at both locations, with tillage system as the main plot and fertilizer N rate as the subplot. Four replications of each conservation tillage treatment (NT vs. chisel plow (CH)) were used on the Crider soil, while eight lysimeter pans were located under each tillage system (NT vs. CH) used on the Maury soil.

Tillage plot size was 3.7 m (4 rows) wide by 27.4 m long on the Maury soil and 5.5 m *(6* rows) wide by ***36.6*** m long on the Crider soil. Subplots were of similar width, but were only 9.1 m long. Chisel plowing was done between middle April and middle May of each year, to a depth of 20 cm, using twisted, 10 cm wide shovels on 30 cm centers. Secondary tillage consisted of disking twice. Corn was planted at a 91 cm row spacing using a John Deere 7000 Max-Emerge no-till corn planter. The seeding rate was 57,100 seed/ha. Nitrogen fertilizer (ammonium nitrate) was broadcast at planting on the Crider soil and over the top of the crop 4 wk after planting on the Maury soil. The subplots were hand harvested and a random set of **5** ears was retained from each for grain N analysis.

We partitioned our leachate collection into "seasons", based on the hydrologic cycle, for our region. "Spring" ran from middle April to late June (planting/early crop development]. "Summer" went from early July until middle *Octo*ber or November (late crop development/harvest). "Fall" was from middle October or November until late December (soil moisture recharge), and "Winter" began in early January and ended in middle April (soil moisture excess-drainage).

Soil samples were taken between the "summer" and "fall" seasons, and also between the "winter" and "spring" seasons, each year. Soils were sampled (4 cores per plot) to a depth of **90** cm and subdivided into 0-15, 15-30, 30-60, and 60-90 cm depth increments. Soil samples were air dried and crushed to pass a 2 mm screen opening. Soil bulk density was determined across the plot area, at each depth increment, using cores that did not exhibit any compression during sampling.

Grain N concentrations were determined by microKjeldahl digestion (Nelson and Sommers, 1973), with automated N detection by the colorimetric indophenol-blue reaction (Keeney and Nelson, 1982). Soil nitrate was found by extraction with molar KCI (25 mL solution:l0 g soil for 30 min), filtering the extract through Whatman 42 paper, and automated determination of nitrate by the colorimetric Greiss-llosvay method (Keeney and Nelson, 1982) after reduction of nitrate to nitrite by cadmium. Soil nitrate was expressed in kg N/ha after correction of soil nitrate concentrations for the bulk density. Results were then summed across all the depth increments. Nitrate in water samples was determined using the same filtering and colorimetric procedures as for soil nitrate. above.

Results and Discussion

Leachate was collected for three years at Glasgow and two years at Lexington (Table 1) Leachate yield, as a Fraction of precipitation, was generally higher on the Crider soil than on the Maury soil. Leachate distribution among the seasons differed considerably from one year to the next. Usually, greater amounts of leachate were observed in either the fall or the winter season. The 1992/93 growing season was unusually moist at the Crider soil's location and there was more leachate during the spring and summer seasons that year.

The differences in spring and summer rainfall were also reflected in corn yields on the Crider soil (Table 2). The 1992/93 growing season gave higher yields than those observed in the other two years. The greater rate of fertilizer nitrogen did not raise corn yields that year, but did so in the other two years. As expected, fertilizer nitrogen rate had no effect on the amount of leachate that was collected in the year subsequent to fertilization, but both the flow-weighted concentration and total quantity of nitrate-N in the leachate were positively affected.

Chisel tillage resulted in a higher yield than did NT in 1992/93 on the Crider soil (Table 2), but there was no difference between conservation tillage systems in the other two years. The amount of leachate collected over the year following fertilization was always greater under NT soils. Flow-weighted nitrate-N concentrations in the leachate were not influenced by tillage, but the greater amount of leachate under NT resulted in greater quantities of leached nitrate under that system.

Corn grain yields on the Maury soil were positively influenced by N fertilizer rate both years (Figure I). Yields were generally better the first year at this location. There was a significant tillage by fertilizer N rate interaction in the second year. In that year NT corn yielded less than CH corn at the lowest N rate, but more at the two higher rates. Such a response would be expected, given that NT conserves more soil moisture for the crop to use, and that places the crop in a better position to respond to additional fertilizer N. The response at this site contrasts with that observed on the Crider soil, where no benefit of NT to yields in more dry years was found.

Chisel tillage resulted in greater amounts of leachate than did NT on the Maury soil (Figure 2). These differences occurred largely in the fall and winter seasons (periods 3,4 in 1993/94; periods 7,8 in 1994/95). Again, fertilizer N rate had no effect on leachate quantities (data not shown). Leachate nitrate concentrations (Figure 3) were highest in the fall and winter seasons, and were positively influenced by fertilizer N addition. During these periods, leachate from NT soils was often higher in nitrate-N than leachate from CH soils, but the greater flow under the CH soils resulted in greater quantities of nitrate-N being lost (Figure 4).

When comparing these two sites, it appears that tillage does not contribute a great deal to our ability to predict leachate water quality. On the Maury soil, chisel plowing was associated with greater leachate volume and lower nitrate concentrations, while on the Crider soil, no-tillage was observed to give higher leachate volume, but similar nitrate concentrations. Because of this, we tried other approaches to predicting nitrate concentrations in leachate during the fall and winter seasons, when so much is usually being lost under our conditions.

When we related leachate nitrate concentrations to an above-ground nitrogen budget (fertilizer N applied - N removed in the grain) on the Crider soil (Figure 5), there was a positive relationship, but there was considerable dispersion

Table 1. Rainfall and seasonal leachate collection at the two locations.

Glasgow			Lexington		
Season	Rainfall	Leachate	Season	Rainfall	Leachate
	- - - - mm - - - - -			- - - - mm - - - - -	
	1991/92			**1993/94**	
Spring	**161**	**8**	spring	**269**	**25**
Summer	**188**	**2**	summer	**467**	**18**
Fall	**300**	**216**	Fall	**144**	88
Winter	**344**	**106**	winter	**427**	**178**
Total	**993**	**331**	Total	**1307**	**309**
	1992/93				
Spring	**357**	**144**	spring	**209**	**55**
Summer	**412**	**150**	summer	**343**	**2**
Fall	**208**	**10**	Fall	**126**	**14**
Winter	**376**	**108**	winter	**255**	**83**
Total	**1352**	**412**	Total	**933**	**154**
	1993/94				
Spring	**153**	**10**			
Summer	**214**	**1**			
Fall	**328**	**198**			
Winter	**640**	**373**			
Total	**1334**	**582**			

Table 2. Effect of fertilizer N rate and tillage on corn grain yield and water and nitrate-N losses on the Crider soil.

Year	Fert. N Rate	Tillage System	Grain Yield	Leachate	Flow-Weighted Nitrate Conc.	Nitrate Flux
	kg/ha		Mg/ha	mm	mg N/L	kg N/ha
			Main Effect of Fertilizer N Rate			
91/92	168		7.28b*	347a	18.1b	62.8b
	252		7.72a	316a	23.9a	75.6a
92/93	168		10.30a	418a	14.0b	58.5b
	252		10.53a	406a	18.0a	72.9a
93/94	168		8.55b	573a	9.8b	56.3b
	252		9.14a	591a	13.5a	80.1a
			Main Effect of Tillage System			
91/92		NT†	7.50a	378a	19.0a	71.7a
		CH	7.50a	284b	23.5a	66.6a
92/93		NT	9.60b	474a	16.6a	78.4a
		CH	11.24a	351b	15.1a	53.0b
93/94		NT	8.90a	631a	12.2a	76.9a
		CH	8.78a	533b	11.2a	59.5b

* Means followed by the same letter are not significantly different at the 95% level of confidence

† NT = no-tillage; CH = chisel plow.

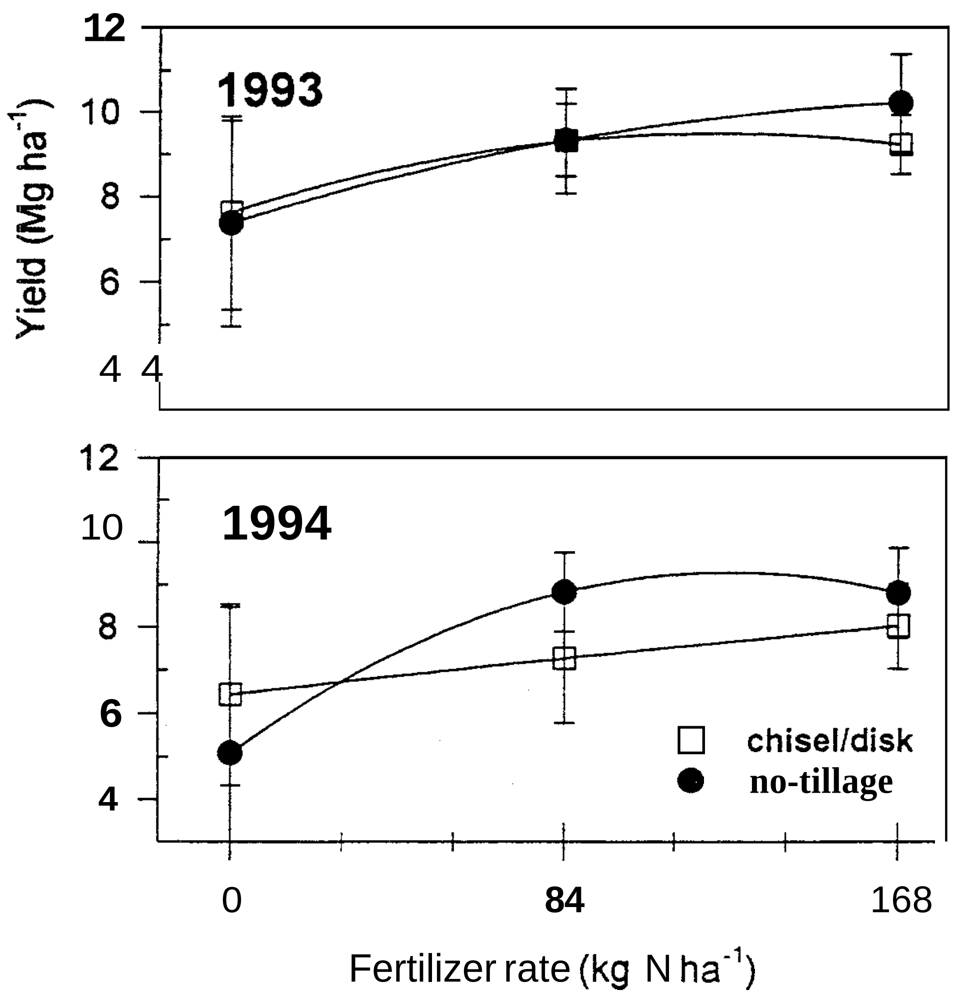

Figure 1. Corn grain yield response to fertilizer nitrogen on the Maury soil. Error bars are+/- one standard deviation.

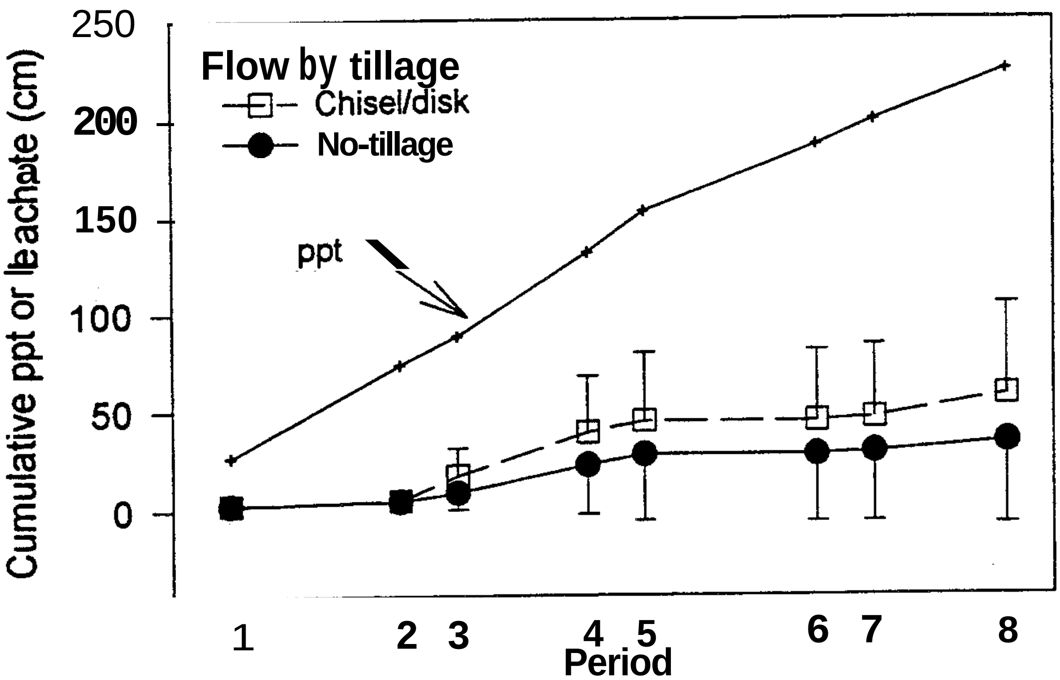

Figure 2. Cumulative precipitation (ppt) and leachate, by season, as affected by tillage on the Maury soil. Error bars are +/- one standard deviation, with center portions removed for clarity.

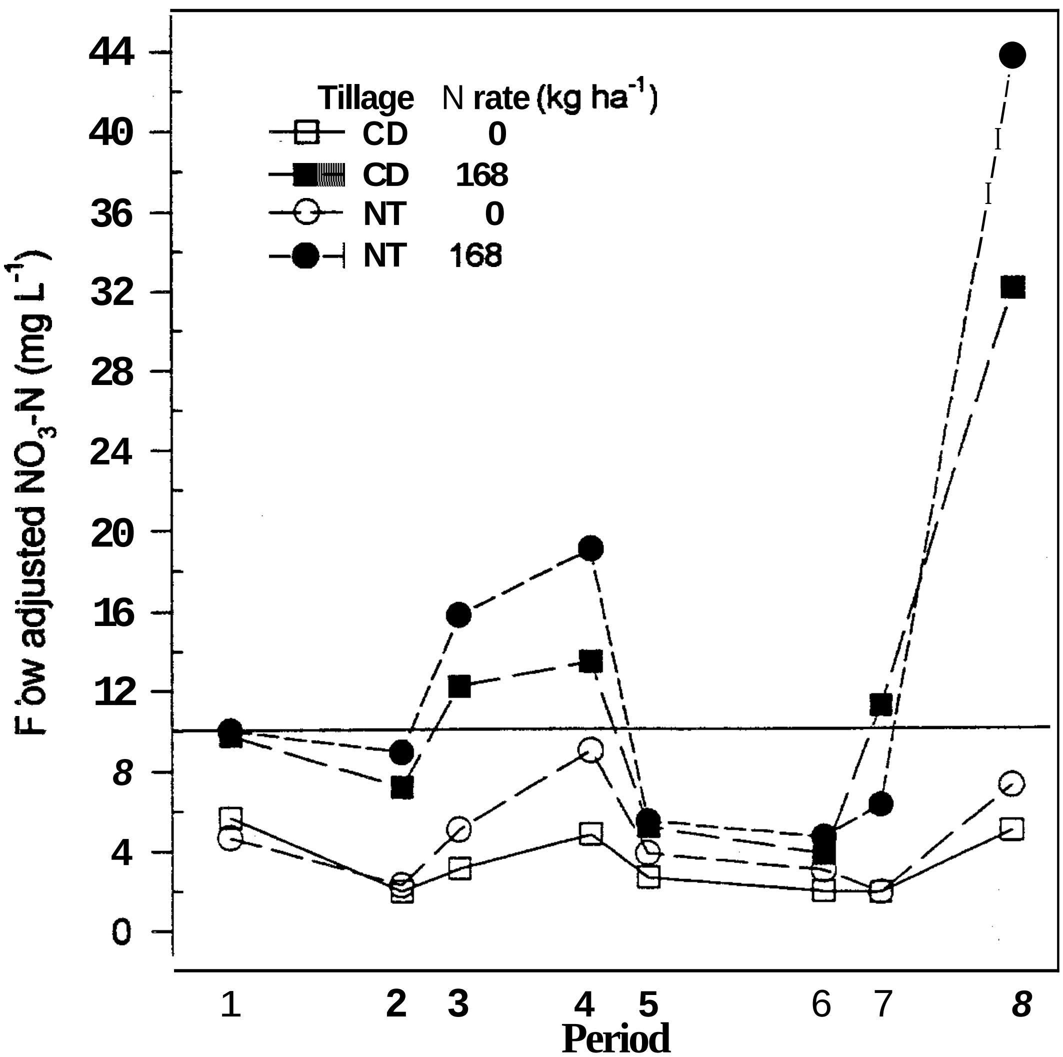

Figure 3. Flow-weighted nitrate concentrations, by season, as affected by tillage (CD = chisel/disk, NT = no-tillage) and fertilizer N rate on the Maury soil.

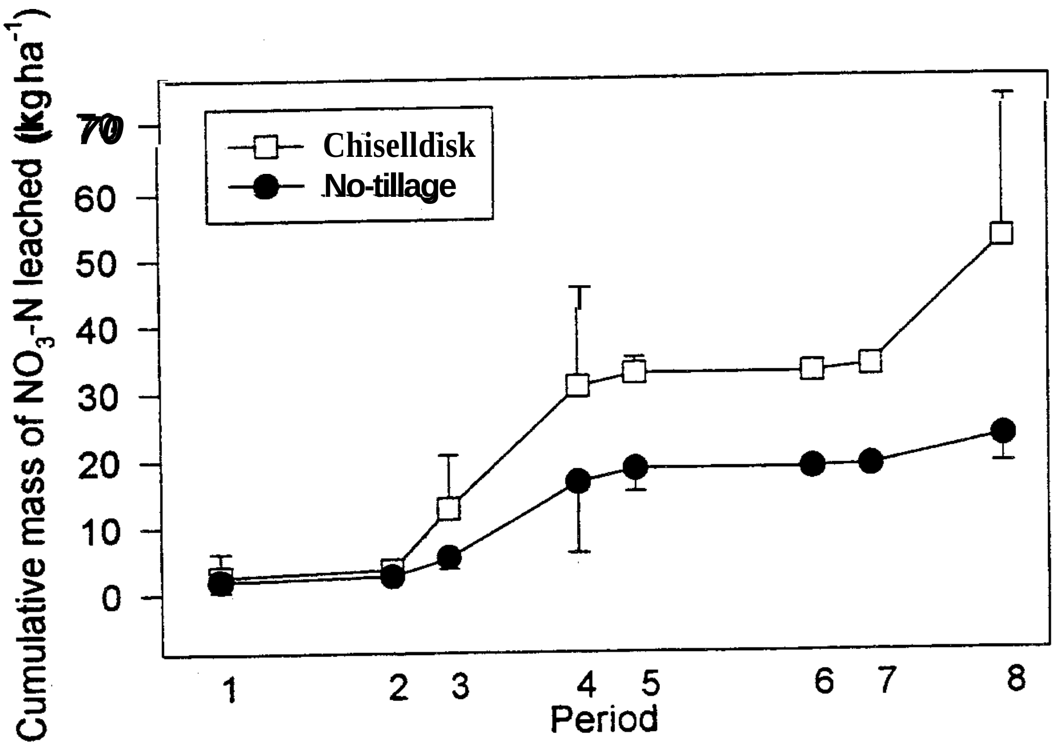

Figure 4. Cumulative quantity of nitrate-N leached, by season, as affected by tillage on the Maury soil. Error bars are +/-one standard deviation, with center portions removed for clarity.

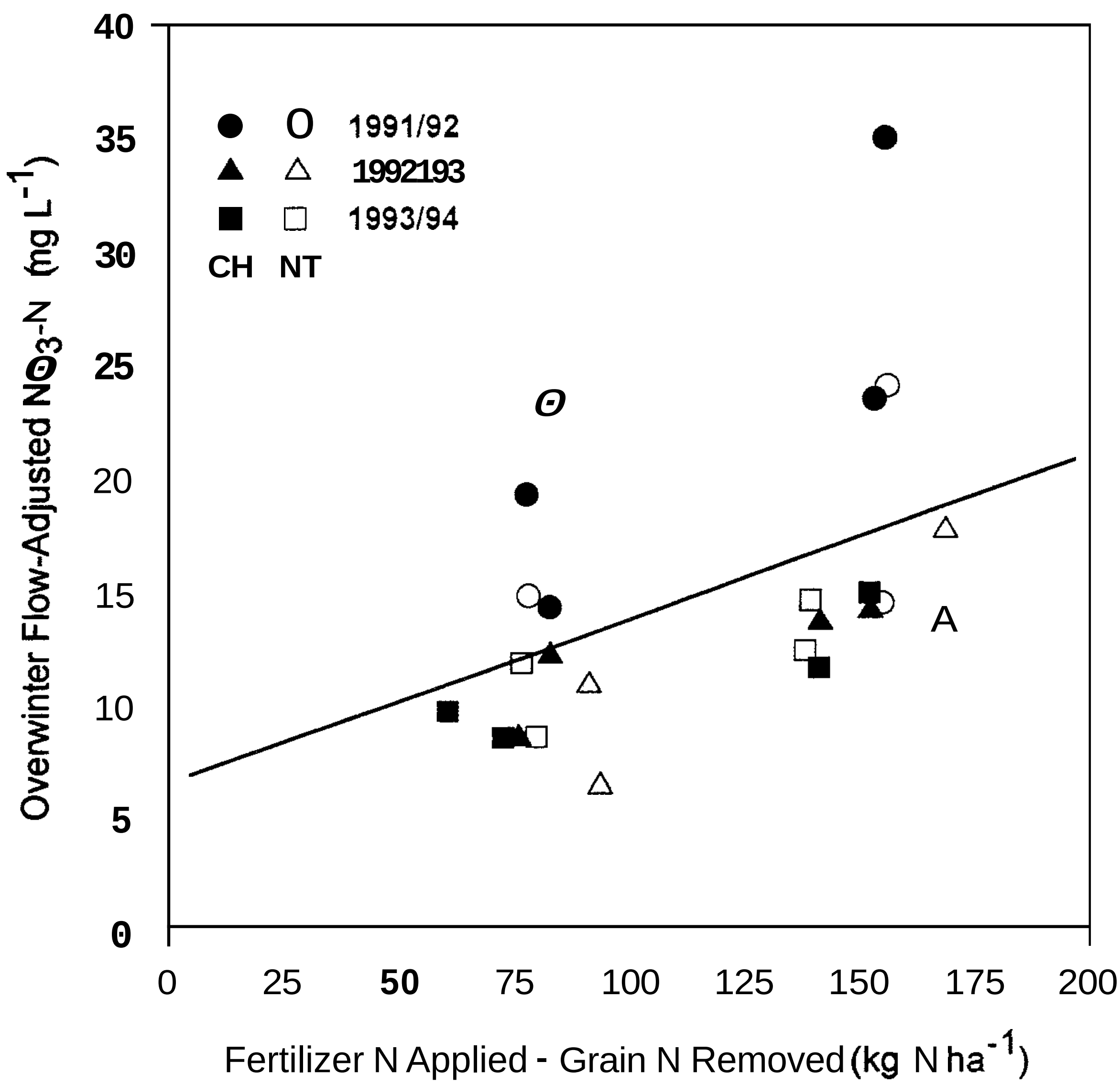

Figure 5. Overwinter (November-April) flow-weighted nitrate concentrations, for three years, as related to the above-ground N budget for continuous corn grown on the Crider soil.

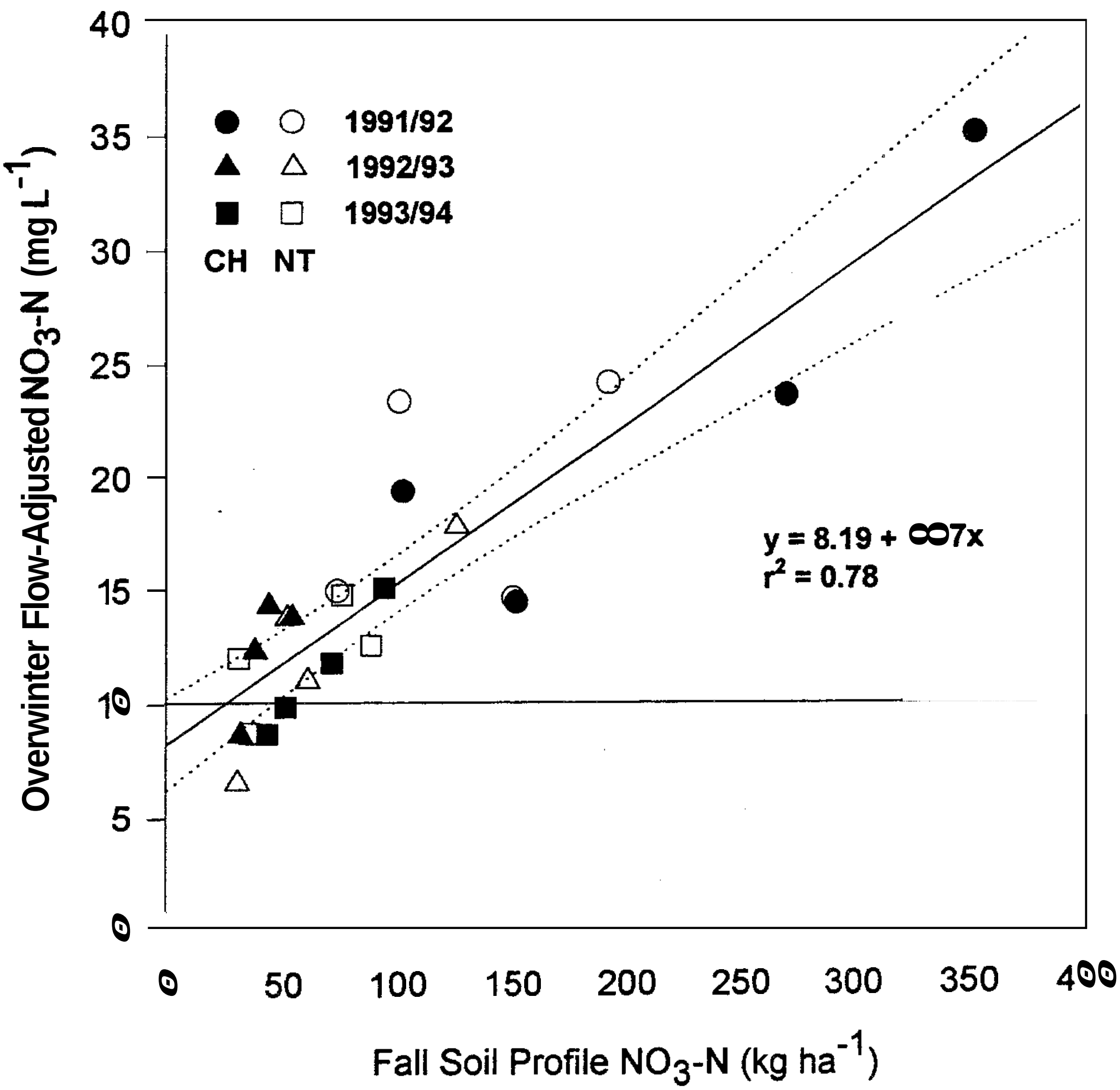

Figure 6. Overwinter (November-April) flow-weighted nitrate concentrations, for three years, as related to quantities of nitrate-N in the soil profile after corn harvest on the Crider soil. Dashed lines represent 95% confidence limits on the regression relationship.

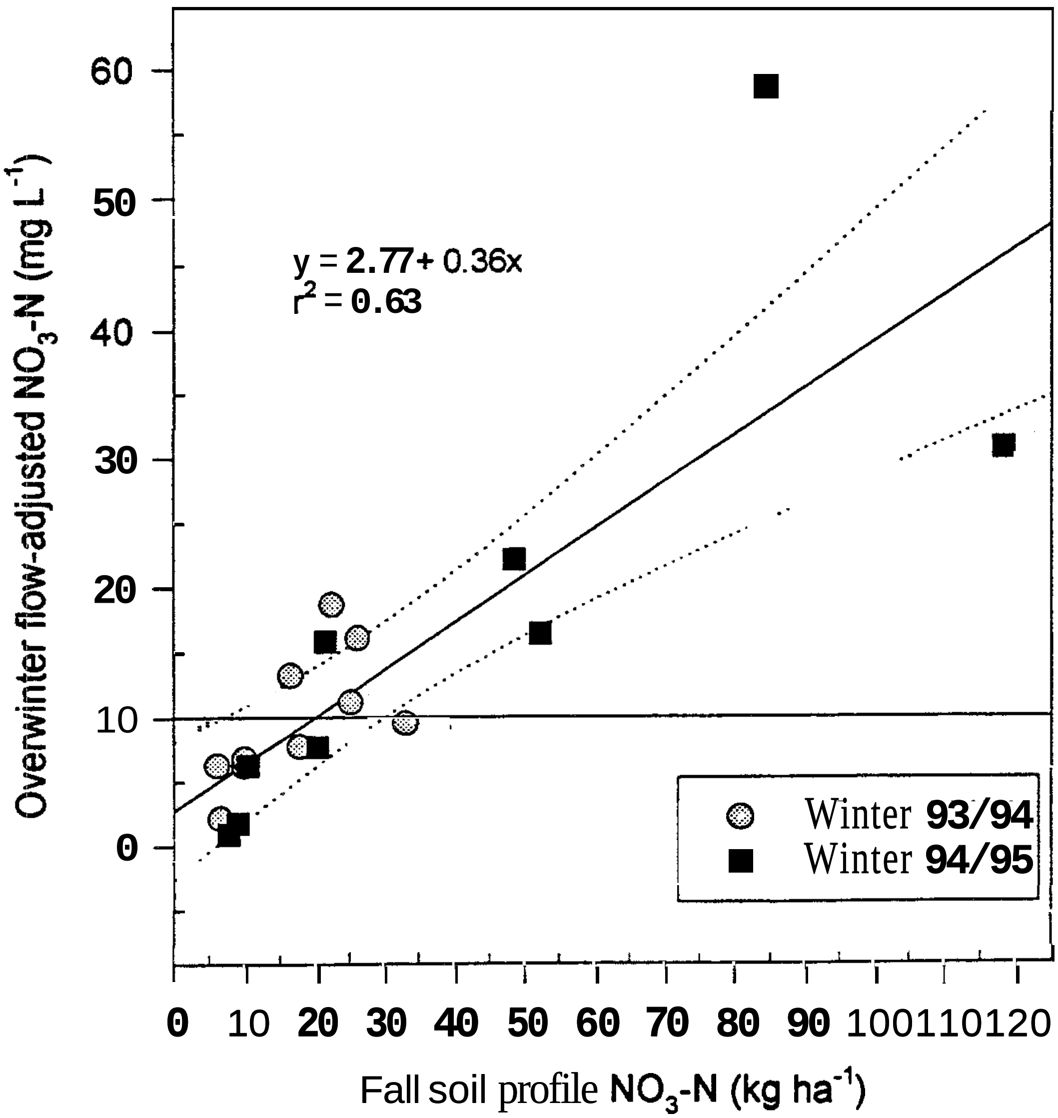

Figure 7. Overwinter (November-April) flow-weighted nitrate concentrations, for two years, as related to quantities of nitrate-N in the soil profile after corn harvest on the Maury soil. Dashed lines represent 95% confidence limits on the regression relationship.

about the region defined by each of the two N rates used in the study. A stronger relationship over the three years was observed when we related leachate nitrate concentration to the quantity of nitrate-N found in the soil profile after corn harvest (Figure 6), though there are fewer than desired data points for soil profile nitrate levels greater than 150 kg N/ha.

On the Maury soil, an above-ground budget was not attempted because of the complication of the addition of N as dairy manure to some of the plots. Still, when leachate nitrate concentrations were related to fall soil profile nitrate over the two years, a relationship, similar in strength to that observed for the Crider soil, was observed (Figure 7). Our analysis suggests that fall soil profile nitrate, regardless of tillage, is a much better predictor of leachate nitrate concentrations. Though continuous corn was grown at both locations, and though these soils are quite similar in many profile characteristics, the difference in slope between the two regression lines does suggest that more knowledge is needed if we are to predict the potential for nitrate leaching in well-drained soils in Kentucky.

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No-Till Cotton Production in Southeast Arkansas

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No-till cotton acreage is increasing in southeast Arkansas. This is true no-till production, nothing but the double-disc openers on the planter disturb the soil surface. At present, ‘all of the no-till cotton is following a previous cotton crop, and all of it is on bedded ground. No-till production in this area started in 1992, and in Desha County there are nine producers that I have had the pleasure of working with. It is through these growers that I have learned about successful no-till cotton production. This article is to describe how these growers have implemented no-till production on their farms.

Bill Teeter was the first in the area to try no-till. He started with a 40 acre field in 1992 and has dedicated over 700 acres to no-till in 1996. Bill starts by cutting the cotton stalks in the fall with a flail shredder, a requirement in Arkansas because of the pink bollworm regulations. Bill leaves the stalks about 8 to 12 inches tall. This allows for the double-disc openers on the planter to knock the stalks off at ground level as opposed to riding over the stalks if they are cut too close to the ground.

The next operation is the application of phosphorus and potassium fertilizer. This is usually done in late winter, and the fertilizer is applied to the soil surface. Most soil scientists tell us that P and K will stratify with surface applications and thus reduce yield potential. What these soil scientists are not considering is that these no-till fields are usually never plowed and root activity at the soil surface is high. After a heavy rain at mid-season you can brush back the residue on the soil surface and observe a mat of white roots. It is obvious that these roots can easily get the P and K that has stratified at the soil surface. Bill does not apply any preplant nitrogen. Nitrogen is applied as a side dress with a coulter rig prior to blooming.

After applying the P and K fertilizer the fields are scouted for winter weeds and burndown herbicide selections are made. We usually start scouting in early February and will start making applications in late February or early March. We are far enough south that by the middle of March ground cover is 100% with just native vegetation. Because of the need for early treatment we usually use a residual herbicide in our burndown program. The most common residual herbicide is cyanazine. This herbicide is relatively inexpensive and has exhibited good safety to cotton when applied several weeks before planting A tank mix of cyanazine with paraquat is the most common treatment. This treatment has failed to control large horseweed (marestail), however. If horseweed is present a very early application of 2,4-D followed by paraquat plus cyanazine works well. If the 2,4-D is not an option then we use glyphosate and add cyanazine if cutleaf eveningprimrose and ryegrass are not present.

The no-till producers in our area have used a variety of planters. Bill uses a 900 International, and others have used John Deere 7100 or 7300 planters. I like the disc-closure system with a single press wheel best, but several growers have used planters with a V-press wheel closure system without problems. Bill has purchased coulters for his planter, but has never needed them. In fact all the producers I have worked with have not had to make any planter modifications when switching to no-till.

There are several in-season weed control programs used in our area. Bill uses a tank-mix of fluometuron, norflurazone and pendimethalin broadcast behind the planter. Paraquat is added regardless of how clean the fields look. In addition a very low rate of a pyrethroid insecticide is used for cutworm prevention. Other producers have used fluometuron plus clomazone for preemergence weed control with good results. We are starting to shift from broadcast preemergence herbicide applications to banded treatments because of cost. When using banded preemergence herbicides the row middles are treated later with a residual herbicide applied with a hooded sprayer.

Most of the no-till acreage in southeast Arkansas is row irrigated. We have not encountered any special difficulties in watering the no-till cotton. We thought that the water would run down the row middles too quickly and not soak in, but this has not occurred. Some fields have required the use of disc-bedders to pull out the soil left where the irrigation pipe has washed a hole and pushed up soil in the row middle. This is accomplished by backing in a few feet to pull the beds out to the top of the field. The no-till fields have needed watering about the same time our conventionally tilled fields, we thought they would last longer between irrigations, but they have not.

No-till fields have maintained adequate bed height for row watering for as long as three years, and may possibly last longer. We try to start with a relatively tall bed to begin with. Soil types have included clays and silt loams. Some growers have had problems with the picker tires making cleat marks on the beds, and thus making planting difficult. Bill has addressed this problem by using narrow picker tires.

We have developed a yield history on these no-till fields and have observed no yield loss when converting to no-till. The expenses compare equally with conventionally tilled cotton, but we realize numerous benefits when changing to no-till. The advantages are both agronomic and economic in nature.

The agronomic advantages include an increase in early season plant vigor. The no-till fields exhibit less injury from soil applied herbicides and are usually have healthier foliage compared to conventional fields. We see a good improvement in soil tilth especially after two or more years, and we have observed improvements in areas with hard pans.

As previously mentioned yearly expenses are about equal comparing no-till and conventionally tilled fields. Higher herbicide costs are offset by reduced fuel consumption and labor costs. The real economic advantage to no-till has come in timeliness. The planting operation is much quicker and takes only one tractor which frees up labor and equipment to do other tasks. No-till production has reduced tractor hours substantially. Bill has reduced the number oftractor trips to produce a crop from eleven or more when he has conventionally farming, to 6 to 8 when no-tilling. Thad Freeland of Tillar has the record in our area for the least number of trips to grow a no-till crop. He had 160 acres of no-till with just five tractor trips in 1994 that picked over 1000 lbs of lint per acre.

No-till cotton production is well suited for southeast Arkansas. I believe we will see a steady increase in no-till acres in the near future, it is too easy of a way to grow cotton to ignore.

Ultra-Narrow-Row Systems of No-Till Cotton Production: Research Progress in Tennessee

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Abstract: Recent progress in production technology warrants a reevaluation of ultra-narrow-row (UNR) cotton in West Tennessee. Three field studies were conducted at the Milan (TN) Experiment Station in 1995 to evaluate UNR systems of no-till cotton production. Lint yields of 'Deltapine 20' were higher in stripped 10" and 20" wide rows than in spindle-picked 20" or 40" rows, despite lower gin turnouts from the stripped plots. Pix increased lint yields most in UNR (10" rows). Trash percentage was higher in lint from stripped than picked plots. Other HVI fiber properties were not affected by row spacing or harvest method. Two picker varieties (Deltapine 20 and Stoneville 132) had higher lint yields, gin turnouts, and micronaire than two stripper varieties (Hyperformer HY007 and Paymaster HS200) in stripped 10" rows. Row spacing did not affect weed biomass or lint yields of 'Chembred 830' grown in 7.5" and 40" rows. Over-the-top weed control was most effective in UNR and wide-row cotton. More research is needed on harvesting technology and economics of UNR to complement these ongoing studies.

Introduction

Cotton performance in ultra-narrow rows (UNR) was evaluated by the University of Tennessee in the early 1970's (Rugh et al., 1973; Hoskinson et al., 1974). Those researchers concluded that UNR cotton offered few advantages to West Tennessee farmers with the technology available at that time. Progress in production technology since then warrants reevaluation of UNR cotton. New technologies include no-till cotton production methods, earlier-maturing cultivars, improved over-the-top herbicide systems, growth regulators such as mepiquat chloride (Pix), and HVI classing procedures.

Meanwhile, rising costs of producing and harvesting picker cotton have revived interest in alternative production systems. More economical cotton production is especially needed in erodible upland fields where no-tillage is being adopted, but where yields are below average. One alternative to traditional row cropping involves drill planting of cotton, as has been widely adopted for soybeans in Tennessee. Cotton grown in UNR (10" or less) may enhance erosion control in no-tillage and may also compete better with certain weed species than cotton in traditional 40" rows. UNR cotton is harvested with a finger stripper that has a single wide-swath header instead of a 4- or 5-row spindle picker.

Current studies in Tennessee are intended to evaluate performance of ultra-narrow-row systems of no-till cotton production as influenced by row spacing, weed competition, Pix, and harvest method.

Materials and Methods

Field experiments were conducted at the Milan (TN) Experiment Station in 1994 and 1995, using notillage. The 1994 pilot study was intended to evaluate effects of row spacing, Pix, weed competition, and harvest method. It was planted on 10 May, but replanted on 2 June due to poor stands. Little weed competition occurred in this study, and results are not reported here.

Three UNR field experiments were conducted at Milan Experiment Station in 1995: a row spacing study, a test of varietal adaptation to UNR, and a study of weed competition in drilled and row-planted cotton. All of these studies used University of Tennessee recommendations for no-till cotton production (Shelby and Bradley, 1995). The 1995 study of row spacing, Pix (mepiquat chloride), and harvest method was planted on 10 May on a Loring silt loam soil. In this study, 'Deltapine 20' was planted in 10", 20", and 40" rows as main plots, using a Kinze tandem planter. Multiple Pix applications (totalling 0 and 0.08 lb ai./acre) were subplot treatments in a RCB split-plot arrangement. Row-spacing-by-harvest-method treatments included 10" and 20" rows harvested with an Allis Chalmers 760 finger stripper equipped with a bur extractor, and 20" and 40" rows harvested with a John Deere 9930 spindle picker. This experiment was harvested once on 7 October, after applications of harvest aids (thidiazuron and ethephon followed by paraquat and sodium chlorate) to all plots. Before picking 20"-row plots, plants between the two harvest rows were removed.

A study of varietal adaptation to UNR was planted with a Kinze tandem planter in 10" rows on 11 May 1995 on a Memphis silt loam soil. Two stripper varieties (Hyperformer HY007 and Paymaster HS200) were compared to two picker

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varieties (Deltapine 20 and Stoneville 132), using a RCB design. Three blanket applications of Pix, totalling 0.04 lb a.i./acre, limited plant height to less than 30 inches. Harvest aids consisted of a defoliant (thidiazuron) and boll opener (ethephon) applied on 7 September, and desiccants (paraquat and sodium chlorate) applied on 15 September. This experiment was harvested with an Allis Chalmers 760 finger stripper on 27 September.

A study of weed control in drilled and row-planted cotton was planted on 12 May 1995 on a Memphis silt loam soil. A stripper cotton variety, Chembred 830, was planted with a John Deere 750 drill in 7.5" rows and with a no-till planter in 40" rows. Three levels of weed control treatments were applied: low (Prowl [pendimethalin] at 1 lb a.i./acre); medium ("low" plus Cotoran [fluometuron] at 1.5 lb a.i./acre); and high ("medium" plus Staple [pyrithiobac] at 0.06 lb a.i./acre, Poast [sethoxydim] at 0.28 lb a.i./acre, and 32 oz crop oil concentrate/acre). Treatments were arranged in a RCB split-plot, with row spacing and corresponding harvest method as main-plot treatments, and weed control as subplot treatments. Aboveground fresh weed biomass from a 33 ft^2 area of each plot was weighed on 10 August. Harvest aids were applied to all plots prior to harvest as in the other studies described above. Drilled plots were harvested with an Allis Chalmers 760 finger stripper on 9 October, and row-planted plots were harvested on 9 and 30 October with a John Deere 9930 spindle picker.

For all experiments. seed cotton harvested from each plot was weighed and a subsample of seed cotton was collected, weighed, and air dried. In the row spacing study, subsamples were bulked across Pix treatments. Gin turnout was determined using a 20-saw gin equipped with two lint cleaners at the West Tennessee Experiment Station. Lint yield of each plot was calculated using seedcotton weight, gin turnout, and harvested area. Fiber properties of lint samples were determined by HVI procedures at the USDA-AMS Cotton Classing Office in Memphis TN.

Results and Discussion

Row Spacing Study

Plant populations per acre averaged 79,000 in 10" rows, 60,000 in 20" rows, and 36,000 in 40" rows. Effects of row width were thus due in part to plant population. Plant height did not vary significantly with row width, but Pix reduced average maximum height from 39" to 26".

Main effects of row spacing, harvest method, and Pix on lint yields were significant (Table 1). Cotton in 10" or 20" stripped plots yielded more than 20" or 40" picked plots, but yields did not differ between 10" and 20" rows. Yield differences between stripped and picked 20" rows (999 and 846 lbs lint/acre respectively) may be attributed to differences in machine harvesting efficiency, as gin turnouts averaged 31% in stripped plots and 36% in picked plots (Table 2). Picked 20" rows outyielded 40" rows by 30%, possibly due to lower leaf area and fewer bolls/acre in 40" rows, especially at first position sites (data not shown). Lint yields were significantly higher in Pix-treated, stripped 10" and 20" rows (at 1021 and 1034 lb/ac respectively) than in picked 20" or 40" rows with or without Pix (Table 1). The greatest yield response to Pix (12%) occurred in 10" rows.

Gin turnout and fiber quality were strongly influenced by harvest method, but not by row spacing (Table 2). Although gin turnouts from stripped plots were lower than from picked plots, they were relatively high by stripper cotton standards due to efficacy of the harvest aids applied, dry weather at harvest, and bur extraction by the harvester. These same factors ameliorated fiber quality of finger stripped cotton. HVI trash percentage was significantly higher in lint from stripped (1.0%) than picked (0.5%) plots. Yellowness of fiber (+b) was also slightly higher in lint from stripped plots, but this did not change HVI color grade (41-3) appreciably. Other fiber quality traits measured were not significantly affected by row spacing or harvest method

Varietal Adaptation Study

Plant populations per acre averaged 78,000 in the 10"rows of this study, and varieties did not differ significantly in plant stand.

The two picker varieties, ST 132 and DPL 20, had higher lint yields and gin turnouts in stripped 10" rows than the stripper varieties, HS 200 and HY 007 (Table 3). Some of the differences in lint yields among varieties may be attributed to gin turnout. Virtually all harvestable bolls were open at harvest, and favorable weather conditions at harvest maintained fiber quality in these varieties. Harvest aids were generally effective, but leaf dehiscence from Paymaster HS200 was incomplete. Consequently, trash percentage in HS200 lint was significantly higher than in the other varieties. The two stripper varieties had slightly more fiber length and strength, but lower micronaire than ST 132 and DPL 20.

Results are generally consistent with comparisons of picker and stripper varieties conducted by Hoskinson et al. (1974), who found that stripper varieties were no better adapted to UNR in Tennessee than high-yielding picker varieties.

Weed Control Study

Plant populations per acre of Chembred 830 averaged 98,000 in 7.5" rows, and 59,000 in 40" rows in this study.

Weed biomass and cotton lint yields were strongly influenced by the level of weed control, but not by row spacing (Table 4). Row spacing by weed interactions were not significant. An inverse relationship was observed between fresh weed biomass and lint yield. A low level of weed control resulted in 90% yield reduction due to weed competition in 40"rows, and a 66% yield reduction in 7.5" rows. A medium level of weed control also incurred a significant yield loss in either row spacing, relative to the maximum. These results suggest that despite crop competition, over-the-top weed control may be necessary for UNR cotton to achieve its yield potential.

Table 1. Lint yields of 'Deltapine 20' cotton as affected by row spacing, harvest method, and Pix in 1995.

Row Spacing	Harvest Method	Pix	Lint Yield
		lb a.i./acre	lb/acre
10-inch	Stripped	0	912
		0.08	1021
20-inch	Stripped	0	964
		0.08	1034
20-inch	Picked	0	844
		0.08	848
40-inch	Picked	0	625
		0.08	671
------------------- Means across Pix Rates ----------------------			
10-inch	Stripped		967 a[1]
20-inch	stripped		999 a
20-inch	Picked		846 b
40-inch	Picked		648 c
---------- Means across Row Spacing and Harvest Method ----------			
		0	836 b
		0.08	893 a

Row spacing by Pix interaction is not significant (P = 0.31).
[1] Means within treatment groups that are followed by the same letter do not differ significantly at P = 0.05.

Table 2. Gin turnout and fiber properties of 'Deltapine 20' cotton as affected by row spacing and harvest method in 1995.

Row Spacing	Harvest Method	Gin Turnout	Micronaire	Fiber Strength	Fiber Length	HVI Trash	Color Rd	Color +b
		%		g/tex	in.	%		
10-inch	Stripped	31.8 b	40 a	29.8 a	1.11 a	1.0 b	74 a	8.5 bc
20-inch	Stripped	30.9 b	41 a	27.9 a	1.09 a	1.0 b	74 a	8.7 c
20-inch	Picked	36.8 a	42 a	28.3 a	1.10 a	0.5 a	73 a	8.1 a
40-inch	Picked	35.5 a	41 a	30.2 a	1.12 a	0.6 a	74 a	8.3 ab
Mean		33.8	41	29.0	1.11	0.8	74	8.4
LSD (0.05)		2.8	ns	ns	ns	0.3	ns	0.3

Means within columns followed by the same letter do not differ significantly at P = 0.05.

Table 3. Lint yields, gin turnouts, and fiber properties of four cotton varieties grown in 10-inch rows in 1995.

Variety	Lint Yield	Gin Turnout	Micro-aire	Fiber Strength	Fiber Length	HVI Trash	Color Rd	Color +b
	lb/ac	%		g/tex	in.	%		
<u>Picker varieties:</u>								
ST 132	975 a	33.2 a	40 ab	30.3 b	1.11 b	0.9 a	74 b	8.3 a
DPL 20	930 ab	31.1 ab	42 a	28.7 c	1.11 b	0.9 a	77 a	8.2 a
<u>Stripper varieties:</u>								
HS 200	882 bc	29.8 bc	37 b	32.4 a	1.14 a	1.2 b	76 a	8.4 a
HY 007	807 c	28.8 c	37 b	32.0 a	1.12 ab	0.8 a	77 a	8.3 a
Mean	898	30.7	39	30.8	1.12	1.0	76	8.3
$LSD_{.05}$	84	2.2	3.3	1.5	0.02	0.3	1.8	ns

Means within columns followed by the same letter do not differ significantly at $P = 0.05$.

Table 4. Weed biomass and lint yields of 'Chembred 830' cotton as affected by row spacing and weed control in 1995.

Row Spacing	Harvest Method	Weed Control[1]	Weed Biomass[2]	Lint Yield
			T/acre	lb/acre
7.5 in.	Stripped	High	0.5	687
		Medium	6.5	426
		LOW	6.7	236
40 in.	Picked	High	0	742
		Medium	4.9	399
		Low	8.7	68
------------------ Means across Weed Control --------------------				
7.5 in.	Stripped		4.6 a	450 a
40 in.	Picked		4.6 a	403 a
---------- Means across Row Spacing and Harvest Method ----------				
		High	0.3 a	715 a
		Medium	5.7 b	412 b
		Low	7.7 b	152 c

Row spacing by weed control interactions are not significant (P>0.41). Means within treatment groups that are followed by the same letter do not differ significantly at P = 0.05.

[1] Low = 1 lb a.i.Prowl/acre;
Medium = "low" + 1.5 lb a.i.Cotoran/acre;
High = "medium" + 0.06 lb a.i. Staple, 0.28 lb a.i. Poast, and 32 oz crop oil concentrate/acre.

[2] Aboveground fresh weight in **U.S.** tons/acre.

Conclusions

These preliminary results suggest that UNR may offer an alternate cotton cropping system for some situations in Tennessee in the future. So far, UNR cotton appears compatible with no-tillage systems. It responds favorably to growth regulation with Pix and to over-the-top weed control. More research is especially needed on planting and harvesting technology, weed management, grade optimization, production economics, and marketing.

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Comparison of Weed Control Systems for Roundup Ready™ Cotton

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Abstract: Control of weeds in no-tillage cotton after the crop emerges is needed, While graminicides are available to control grasses, antagonism often occurs with tank mixtures of other herbicides. DSMA (disodium methanearsonate) controls some species, but weed resistance and cotton injury limit its effectiveness. Buctril (bromoxynil) herbicide applied to bromoxynil resistant (BXN) cotton can be used to control pitted morningglory *(Ipomoea lacunosa)* but Palmer amaranth *(Amaranthus palmeri)* is not adequately controlled. Staple (pyrithiobac) controls most pitted morningglory and Palmer amaranth but some escapes may reduce yield and quality. Roundup Ready™ cotton allows the use of postemergence Roundup (glyphosate) but a single overtop application is inadequate to control these species for a full-season. However, a postemergence application followed by a post-directed treatment controls both pitted morningglory and Palmer amaranth through harvest without adversely affecting quality.

Introduction

Weed control in no-tillage cotton ranks with stand establishment in relative importance. The lack of availability and cost of herbicides to control weeds that escape preemergence herbicides slows the adoption ofno-tillage cotton. Until 1995, overtop herbicides were limited to the graminicides [Poast (sethoxydim), Fusilade (fluazifop), etc.], the arsenicals [DSMA, MSMA (monosodium methanearsonate)] and Cotoran (fluometuron). Control of dicot weeds from these herbicides was erratic and seldom complete. Furthermore, crop injury, delayed maturity, and reduced yield have been associated with both the arsenicals and Cotoran (Shankle, 1996, Guthrie, 1986).

Calgene-Stoneville Pedigreed Seeds, Inc. developed bromoxynil resistant (BXN) cotton that became commercially available for the first time in 1995. This genetically engineered variety permits overtop treatment with Buctril (bromoxynil) herbicide. Buctril quickly kills common cocklebur *(Xanthium strumarium)* and momingglories *(Ipomoea* spp.) but is inconsistent on pigweed *(Amaranthus* spp.) and sicklepod *(Senna obtusifolia)*.

Staple is active on many dicot weeds but is incompatible in mixtures with most graminicides. Staple is an inhibitor of acetolactate synthase, an enzyme in the biosynthesis of the amino acids valine, leucine, and isoleucine. Control of weeds is slow and regrowth may occur after a period of inhibited growth. Staple received full registration from the EPA in September 1995.

Roundup Ready cotton has been under development for several years and was first made available to university researchers in 1995. Roundup controls most troublesome grasses and dicot weeds in cotton. We conducted this experiment to evaluate how the Roundup Ready weed control system compares with currently available systems in no tillage cotton.

Materials and Methods

A field experiment was conducted at the West Tennessee Experiment Station (Lexington silt loam) near Jackson, TN. Cotton was planted 10 May 1995 without tillage in previous cotton stubble. Winter weeds were killed with Roundup (glyphosate) at 0.75 Ib ai/acre. Plots consisted of four rows spaced 40" apart and 30' in length. Each treatment was replicated three times in an fractional factorial design. Roundup Ready cotton was planted in all treatments except those with Buctril, where BXN (bromoxynil resistant) cotton was planted. Annual weeds that emerged after the Roundup application were killed with Gramoxone Extra (paraquat) after planting on 10 May.

Other than weed control, University of Tennessee recommendations for production of no-tillage cotton were followed (Shelby, 1995). Postemergence herbicides were applied 6 June 1995 to 5"-tall cotton with five leaves. Palmer amaranth *(Amaranthus palmeri)* was 2" tall with six leaves and pitted morningglory was 3" tall with six leaves. A second application of Roundup or Caparol (prometryn) plus MSMA was post-directed on 16 June when cotton was 10" tall and had 12 leaves. Palmer amaranth was 4" tall with eight leaves and pitted morningglory was 6" tall with 10 leaves.

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Postemergence broadcast herbicides were applied in 10 gallons per acre (gpa) of water carrier. Post-directed applications were made in 15 gpa. Induce (alkylaryloxyethylene, free fatty acids, isopropanpol, and propylene glycol) surfactant was included as indicated in Table 1.

Cotton injury and weed control were recorded on 16 June (10 days after treatment) and on 30 August (10 weeks after the post-directed applications). Prep (ethephon) at 1.3 pt/acre, Folex (tribufos) at 1 pt/acre and Dropp (thidiazuron) at 0.1 lb/acre were applied as a harvest aid on 11 September. Plots were harvested with a John Deere 9930 spindle picker on 29 September and again on 11 October. Seedcotton from each plot was weighed, a subsample of seedcotton was collected, weighed and air dried. Subsamples were bulked across replications. Gin turnout was determined using a 20-saw gin equipped with two lint cleaners. Lint yield (Ib/acre) of each plot was calculated using seedcotton weight, gin turnout, and harvested area. Fiber properties of lint samples were determined by HVI at the USDA-AMS Cotton Classing Office in Memphis, TN. Weed control and lint yield data were subjected to ANOVA and means were separated using Fisher's protected LSD at P<0.05.

Results and Discussion

Cotton Growth and Injury

Stand and early season vigor of Roundup Ready and BXN cotton varieties were comparable to that of 'Deltapine 50' planted in the border surrounding the test. Weed control differed initially among the levels of preemergence herbicides (data not shown). Postemergence herbicides were applied under near optimum environmental conditions for herbicide activity (84°F, 70% RH, moist soil and 2% cloud cover). Staple injured Roundup Ready cotton 30% at 4 DAT. By 10 DAT injury declined to 20% and was not apparent at later evaluations. No other herbicide injury to cotton was observed.

Weed Control

The predominant weeds were pitted morningglory and Palmer amaranth. Pitted morningglory was controlled better when Cotoran was included as a preemergence herbicide (Table 2 and 4). Prowl did not control pitted morningglory (37%) at 4 weeks aftertreatment. Roundup alone controlled pitted morningglory 80% at 10 DAT, and control did not differ with or without preemergence herbicides. Similar results were obtained with Staple postemergence. Buctril controlled pitted morningglory >86% at 10 DAT. Pitted morningglory was not controlled with DSMA following Prowl (62%) or Cotoran (76%), but reached 98% control following Prowl plus Cotoran. There was a significant (P<0.0001) interaction between preemergence and postemergence herbicides at the early evaluation because control with Roundup and Staple was not influenced by the preemergence herbicides while control with DSMA varied depending on the preemergence herbicide (Table 2). No interaction occurred at the later rating because the preemergence herbicides had lost their effectiveness (Table 4).

Neither Prowl nor Cotoran alone controlled Palmer amaranth (<43%), but when combined control nearly doubled to 77% (Table 3). However, without subsequent control, yield loss was as much as 50% (Table 6). Roundup controlled Palmer amaranth 96% at 10 DAT with or without preemergence herbicides (Table 5). Similar control was achieved with Staple. Both Buctril and DSMA improved Palmer amaranth control over Prowl or Cotoran alone, but only DSMA improved control over the combination of Prowl plus Cotoran.

At 10 weeks after the last treatment (WALT), pitted morningglory was controlled >96% with Roundup applied postemergence followed by either Roundup post-directed or Caparol plus MSMA post-directed (Table 4). Pitted morningglory was controlled <90% with Staple treatments and <68% with Buctril or DSMA regardless ofpreemergence herbicide. No preemergence herbicide controlled Palmer amaranth >33% at 10 WALT (Table 5). Buctril did not control Palmer amaranth following any preemergence herbicide. DSMA, while better than Buctril, never controlled Palmer amaranth more than 73% at 10 WALT. Staple controlled Palmer amaranth best (83%) following Prowl plus Cotoran. Roundup early postemergence followed by Roundup post-directed controlled pitted morningglory >96 and palmer amaranth >92% alone or following any preemergence herbicide. Caparol plus MSMA post- directed was as effective as Roundup post-directed (Table 4 and 5).

Cotton Lint Yield

Roundup Ready cotton produced over 1100 lb lint/acre (Table 6). BXN 57 yield was only 775 Ib/acre, largely due to lack of weed control. Lint yield of Roundup Ready cotton esd lower where Staple was applied. The lower yield was likely due to a combination of early injury from Staple, slower removal of weed competition and reduced weed control. It is very possible that the yield with Staple, Buctril and DSMA could have been improved with a post-directed herbicide. Lint yield with DSMA lagged behind that of Staple due to the failure to control morningglory and Palmer amaranth. DSMA has also been implicated in subtle adverse effects on fruiting (Shankle, 1996) which may have contributed to the lower yields.

Percent First Harvest, Gin Turnout and Lint Quality

Percent first harvest averaged –75% and did not differ among treatments on Roundup Ready or BXN 57 cotton. Gin turnout averaged –34% with Roundup Ready cotton and –36% with BXN 57 cotton. Micronaire ranged from 3.8 to 4.3, length from 1.10 to 1.16 inches, strength form 29.3 to 32.8 g/tex, length uniformity of 82 +/- 1%, color Rd of 73 and +b of 8.4, and HVI color grade of 41-1 to 41-4; all of which compare favorably with the average values from the nearby variety trial (Gwathmey, 1996). However, trash content ranged from 1.4 to 2.5% with Roundup Ready and 1.4 to 1.6% with BXN 57, more than double the average in the nearby variety trial. While weed control may have contrib-

Table 1. Herbicides, rates, methods and date of application.

Herbicide	Rate	Method	Date	Surfactant (Induce)
	lb ai/acre			%
Roundup	0.75	Early Preplant	17 Mar	0.5
Gramoxone Extra	0.31	Preemergence	10 May	0.5
Prowl	1.0	Preemergence	10 May	0.5
Cotoran	1.5	Preemergence	10 May	0
Roundup	0.5	Postemergence	6 June	0.5
Roundup	1.0	Post-directed	16 June	0.5
Staple	0.06	Postemergence	6 June	0.25
Buctril	0.38	Postemergence	6 June	0
DSMA	1.8	Postemergence	6 June	0
Caparol + MSMA	0.5 + 2.0	Post-directed	16 June	0

Table 2. Pitted morningglory control in cottton 10 days after postemergence treatment following selected preemergence herbicides.'

	Preemeraence				
Postemergence	None	Prowl	Cotoran	Prowl+Cotoran	Avg.
			%		
Roundup	80	80	93	76	83
Roundup		88	81	83	84
Staple		87	99	89	92
Buctril		96	96	86	93
DSMA		62	76	98	79
None		37	96	83	72
AVG.		67	90	86	
		$LSD_{0.05}$	PRE = 12	POST = 15	PRE x POST = P=0.0001

"Herbicide rates are in Table 1.

Table 3. Palmer Amaranth control in cotton 10 days after last poetemergence treatment following selected preemergence herbicides.*

	Preemeraence				
Postemergence	None	Prowl	Cotoran	Prowl + Cotoran	Avg.
			%		
Roundup	99	99	99	99	99
Roundup		99	98	99	99
Staple		94	92	98	95
Buctril		70	65	82	72
DSM		81	85	94	87
None		35	43	77	52
AVG.		81	79	91	

$LSD_{0.05}$ PRE = NS POST = 20 PRE X POST = NS

'Herbicide rates are in Table 1.

Table 4. Pitted morningglory control in cotton 10 weeks after last treatment following selected preemergence herbicides:

POST TRT.	Preemergence				
	None	Prowl	Cotoran	Prowl+Cotoran	Avg.
			%		
Roundup fb[b] Roundup	96	99	99	99	99
Roundup fb[b] Caparol + MSW		96	98	99	98
Staple		38	90	76	68
Buctril		10	55	58	41
DSW		17	31	68	40
None		0	53	40	31
AVG.		43	12	73	
		$LSD_{0.05}$	PRE = 19	POST = 21	PRE X POST = NS

"Herbicide rates are in Table 1.

[b]fb = followed by.

Table 5. Palmer Amaranth control in cotton 10 weeks after last postemergence treatment following selected preemergence herbicides.

	Preemergence				
Postemergence	None	Prowl	Cotoran	Prowl+Cotoran	Avg.
			%		
Roundup fb[b] Roundup	92	99	93	99	97
Roundup fb[b] Caparol + MSMA		99	99	99	99
Staple		53	65	83	61
Buctril		20	23	52	32
DSMA		70	55	73	66
None		33	10	20	21
AVG.		62	58	71	
		$LSD_{0.05}$	PRE = NS	POST = 20	PRE X POST = NS

[a]Herbicide rates are in Table 1.
[b]fb = followed by.

Table 6. Lint yield of Roundup Ready cotton and selected postemergence treatments compared with BXN cotton treated with Buctril following selected preemergence herbicide treatments.’

	Lint Yield				
	Preemeruence				
Postemergence	None	Prowl	Cotoran	Prowl+Cotoran	Avg.
	lb/acre				
Roundup fb[b] Roundup	970	1175	992	1111	1093
Roundup fb[b] Caparol + MSMA		1156	1146	1181	1161
Staple		867	973	948	930
Buctril - BXN 57		776	750	775	767
DSMA		505	739	890	711
None	373	579	558	513	
AVG.		807	863	916	
		$LSD_{0.05}$	PRE = 86	POST = 122	PRE X POST = NS

“Herbicide rates are in Table 1.

[b]fb = followed by.

uted, the hirsute characteristic ofthese lines may contribute to these higher than expected values.

Summary

Roundup herbicide applied postemergence to Roundup Ready cotton offers a promising alternative for weed control, especially for Palmer amaranth. A single application under near optimum conditions was inadequate to control weeds throughout the season, but when followed by a post-directed spray nearly complete control was obtained. Staple, like Roundup, is inadequate to control Palmer amaranth full-season without a supplemental post-directed treatment. Buctril, while effective on pitted morningglory, failed to control Palmer amaranth. DSMA, while failing to completely -control weeds, was partially effective following Prowl plus Cotoran.

Based on this limited testing, Roundup Ready cotton offers some exciting opportunities for control ofthese two important weeds. Further refinement of rates and timing on these and other weeds plus agronomically adapted varieties are needed before commercialization.

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No-Till Weed Control with Conventional and Roundup Herbicides Applied Over-the-top of Roundup Ready Soybean

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An experiment was established on a silt loam soil (sand 31%, silt56Y0,clay 13%) with 1.2% O.M. and pH 5.6 in 1994 and 1995 at the Delta Research and Extension Center, Stoneville, MS. Roundup Ready@ soybeans (from Asgrow 5403 background) were planted May 6, 1994, and May 1, 1995, with a John Deere 7100 planter without coulters. No supplemental irrigation was used.

The 1994 experiment was designed to compare conventional-till and no-till soybean systems using low and normal (recommended) inputs for weed control with conventional preplant and preemergence herbicides and Roundup 4E postemergence over-the-top. Plots were two rows 40 inches wide by 40 feet long. A randomized complete block design with four replications was used. There were four Roundup 4E postemergence treatments: 0.375 lb ai/A applied 4 times, 0.56 lb ai/A applied 2 times, and 0.75 lb ai/A applied 2 or 3 times. Each treatment was broadcast applied to both conventional till and no-till plots with a tractor-mounted boom sprayer in 10 gal/A spray volume. Induce surfactant was
1 used with Roundup 4E at 0.5% v/v. All other herbicides were applied in 20 gal/A broadcast. Induce surfactant was used with Roundup D-Pak at 1% v/v and Latron AG-980 or Activate Plus surfactant were used with Gramoxone Extra at 0.5% v/v. The conventional-till plots were disk harrowed in early November 1993 (2 times for normal input) and again in April 1994 shortly before planting. Plots were not cultivated. In mid-March, Roundup D-Pak was applied at 0.5 lb ai/A (low input) or 0.67 lb ai/A (normal input) to no-till plots as a "burn-down" treatment to destroy winter weeds. Treflan (0.75 lb ai/A) was applied to the conventional-till normal input plots before the April disking at which time the no-till plots received an application of Gramoxone Extra at 0.5 lb ai/A (low input) or 0.94 lb ai/A + Lexone 0.25 lb ai/A (normal input). At planting, Sencor + Gramoxone Extra was applied at 0.25 + 0.75 lb ai/A (low input) or 0.375 + 0.75 lb ai/A (normal input) to a 20-inch band on the row on the conventional-till plots. On the no-till plots, Sencor was applied alone preemergence at 0.375 (low input) or 0.5 lb ai/A (normal input).

Plots used in 1994 were consolidated into 4 rows each and soybeans were planted no-till in 1995. Roundup 4E was applied over-the-top to the same areas as in 1994; low and normal rate treatments were made at 0.5 and 0.75 lb ai/A 3 times. Applications were made to continuous no-till soybeans and first year no-till soybeans. An application of Gramoxone Extra at 0.94 lb ai/A was made to the entire area on November 14, 1994, for initial "bum-down" of winter weeds. This was followed on March 10 with Roundup D-Pak applied for "bum-down'' of winter weeds at 0.65 lb ai/A (low input) or 0.8 lb ai/A (normal input). At planting, Sencor + Gramoxone Extra was applied at 0.25 + 0.75 lb ai/A to low input plots and at 0.375 + 0.94 lb ai/A to normal input plots. No preplant tillage or cultivation was used in 1995. All herbicides were applied broadcast with a tractor-mounted boom sprayer in 10 gal/A spray volume for Roundup and in 20 gal/A for all other herbicides.

In 1994, soybeans from each plot were harvested while in 1995 the two center rows of each plot were harvested with a Massey-Harris 8 plot combine. Yields were adjusted to 13% moisture and reported as bushels/A.

Weed and soybean stand counts and weed control ratings (0-100%) were obtained during both years for an evaluation ofherbicide efficacy and crop injury.

Winter weed control in early April 1994, was 85 to 93% with preplant Roundup with no difference between 0.5 and 0.67 lb ai/A in no-till. Conventional-till plots disked 1 or 2 times the previous November resulted in 46 to 79% control by early April 1994. In 1995, Roundup at 0.65 or 0.8 lb ai/A controlled winter weeds 97+% at 28 days after treatment with no difference between rates in no-till.

In 1994, summer annual weeds were controlled better (10 to 38%) in conventional-till as compared with no-till using preemergence treatments of Sencor and Gramoxone applied tankmixed or sequentially. In 1995, the preemergence application of Sencor + Gramoxone tank mix controlled summer annual weeds 93 to 99% in early May.

Summer annual broadleaf weeds in 1994 were controlled 75 to 93% 6 days after two applications of Roundup at 0.56 or 0.75 lb ai/A or with three applications at 0.375 lb ai/A. Lowest control was with the no-till at 0.563 lb ai/A. Annual grasses werecontrolled 94 to 100% at the same date. In 1995, Roundup at 0.5 lb ai/A controlled summer annual broadleafs from 73 to 86% 17 days after the first application, 93 to 97% 15 days after the second application, and 81 to 84% 14 days after the third application. At the 0.75 lb ai/A rate, control was as 90 to 99%, 97 to 99%, and 94 to 97%. respectively.

Rhizomejohnsongrass control in 1994 ranged from 97 to 100% 34 days after one application of Roundup at 0.56 or

0.75 lb ai/A and 14 days after the second application at 0.375 lb ai/A. Control in mid-August ranged from 93 to 100% after two applications of Roundup at 0.56 lb ai/A, two or three applications at 0.75 Ib ai/A, or four applications at 0.375 lb ai/A. Tillage had no effect on control.

In 1995, johnsongrass was controlled 92 to 97% 8 days after one application and 99 to 100% 14 days after the third application at 0.5 lb ai/A. The respective control for the 0.75 Ib ai/A rate was 96 to 99% and 100%. In late-July (24 days after the last treatment) control was 96 to 100% and was not affected by rate of application.

Soybean yield averaged 36.4 bu/A in no-till and 22.9 bu/A in conventional-till in 1994. In 1995, soybean yield in continuous no-till averaged 3 1.4 bu/A and in the first year of no-till the yield averaged 36.8 buiA.

Summary of Conservation Tillage Effects on Grain Yield in the Blackland Prairie

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Introduction

Conservation tillage received renewed interest with the passage of the 1985 and 1990 Food Security Act. This is especially true for the Blackland Prairie area, a land resource of approximately 2 million acres. The soils of this region are predominately heavy, expanding clays and are highly erodible when tilled. The soils are underlain by soft limestone or chalk as the main soil-forming parent material with topography ranging from level to sloping. This formation, coupled with a relatively high cropping intensity, causes this land resource region to be one of the nation's most susceptible to productivity losses from soil erosion (USDA, 1989; U. S. Army Corps of Engineers, USDA-SCS, 1990). Research (Hairston et al., 1984; Hairston et al., 1987) in the Blackland Prairie has shown that a positive correlation exists for higher yields on soils with a greater soil depth. Continued loss of top soil to erosion will eventually expose the unproductive chalk subsoil and render the region unsuitable for row crops.

Conservation tillage, such as stale seedbed systems (ridge-tillage and no-tillage) and rotation systems, have the potential to minimize production costs, enhance productivity, and meet conservation compliance. The objectives of this study were to evaluate crop yield response to selected tillage and crop rotation/tillage systems on several soils in the Blackland Prairie Region.

Materialsand Methods

Studies were initiated in the fall of 1991 at the Mississippi Agricultural and Forestry Experiment Station's Prairie Research Unit, Prairie, and the Northeast Branch Station, Verona. The Prairie site was a Vaiden silty clay (very-fine, montmorillonitc, thermic, Vertic Hapladalfs) with generally acidic topsoil and with a 1 to 2% slope. The Verona site was a Leeper silty clay (fine, montmorillonitic, nonacid, thermic, Vertic Haplaquepts) with alkaline top-soil and 0.15 to 0.3% slope. The experimental design was a randomized complete block design with four plot replications of 20 feet x 60 feet each. Annual surface broadcast fertilizer applications of P_2O_5 and K,O and nitrogen for soybean, corn and wheat were made according to soil test recommendations.

The following continuous cropping tillage treatments were evaluated on both sites: (I) no-tillage (NT) corn: (2) ridge-tillage (RTl) corn, planted no-till and cultivated once with a high-clearance cultivator equipped with ridgers; (3) turf aerator (TA) corn, with turf aerator knives operated one month prior to planting at 10° angle from vertical and at a 4- to 6-inch depth (Prairie site); (4) conventional raised-bed tillage (CTB) corn chiseled, disked, bedded, and do-alled before planting, and cultivated once; (5) NT soybeans; (6) ridge-tillage (RT2) soybeans planted no-till and cultivated twice with a high-clearance cultivator equipped with ridgers; (7) TA soybeans; and (8) conventional smooth seedbed tillage (CT) soybeans chiseled, disked, and do-alled before planting, and cultivated twice during the growing season.

The following tillage/crop rotation treatments were evaluated on both sites: (1) RTI corn followed by RT2 soybeans; (2) RT2 soybeans followed by RTI corn, (3) NT corn followed by minimum tillage MT wheat (diskedtwice after corn harvest and do-alled before planting wheat) with NT doublecropped soybeans followed by NT corn; (5) NT corn followed by MT bed wheat and NT doublecrop soybeans (Verona site); (6) MT bed wheat with NT doublecrop soybeans followed by NT corn (Veronasite); (7) fall paratill bed (FPTB) soybeans followed by FPTB corn; and (8) FPTB corn followed by FPTB soybeans.

Corn plots were planted in 30-inch rows with 1.5 seeds/foot of row. Burndown and preemergence herbicides were applied to RTI, TA, and NT corn. Preemergence herbicides were applied to CTB corn plots. A post-directed herbicide was applied broadcast to NT and TA, and in a 15-inch band to RTl corn. Nitrogen (N) as ammonium nitrate was applied broadcast over the top of all corn plots at 160 lb N/A (split application).

The herbicide 2,4-D was applied as an early (mid-February to mid-March) spring broadleaf weed control method on all monocrop soybean stale seedbed (RT2, NT, TA) and wheat-doublecrop soybean treatments. Two weeks prior to planting soybeans, a bumdown herbicide was applied to NT, TA, and RT2 soybean plots. Soybeans were planted in 30-inch rows with 9 seeds/ft of row in May-June on monocrop treatments and in June on doublecrop treatments. A preemergence herbicide was applied to all monocrop soybean plots. Soybean weed control during the cropping season involved the use of broadcast over-the-top postemergence herbicides and/or post-directed herbicides applied on TA and NT treatments. Postemergence over the top and/or post-directed herbicides in a 15-inch band with two cultivations were applied to RT2 and CT soybean treatments.

The center 6-foot wide swath of wheat was harvested for grain yield in both studies and the center two rows of corn and soybean plots, at both studies, were harvested for grain yield. Soybean and corn yields were adjusted to bushels per acre at 13.5 and 15.5% seed moisture, respectively. Data were subjected to statistical analysis (SAS, Cary, NC, 1991) and means were separated by Least Significant Difference (LSD) at the 0.05 probability level.

Results and Discussion

The first year data (1992) was an establishment year for crop rotation and tillage systems. This data is not being reported. The data being reported is for both locations for 1993-1995 growing season. Rainfall for the growing seasons of May-October (1993-95) is presented in Table 1. Rainfall for 1993 ranged from normal for the Prairie site to above nomal for the Verona site. The rainfall for 1994 was above normal for both sites, ranging from 150% to 170% of normal. Sufficient early rainfall in 1995 was good for corn production but less than needed in August and September for optimum soybean yield.

Wheat

Wheat yields for 1993-1995 for both sites are presented in Table 2. Low yields for I993 resulted from a late spring freeze which caused cold injury to seed heads. 1994 yields were higher on the Vaiden soil than the Leeper soil, possibly because of better surface drainage on the Vaiden site. Wheat yields for 1995 were low on the Vaiden site. Environmental conditions were not favorable to high wheat yields due to a cool wet spring. Wet soil conditions in the fall of 1995 caused no wheat to be planted on the Leeper site.

Corn

Continuous CTB and RTI corn, and rotation of RT2 soybeans followed by RT1 corn on the Vaiden soil on raised-bed systems in I993 showed no corn yield difference, but produced higher yield than the flat systems of continuous TA and NT corn and a rotation of MT wheat NT double cropped soybeans followed by NT corn. The higher yields for the raised bed treatments are attributed to better surface drainage than the smooth surface system of NT and TA. Crop rotation had no effect on yield. The 1994 yield on the Vaiden soil was lower than 1993, and neither tillage nor crop rotation had any effect on yield. The lack of yield difference and the lower yield may have been due to plant injury caused by post emergence herbicide applications. Environmental conditions for corn for 1995 were exceptional. The raised-bed systems (continuous CTB and RTI corn and FPTB Bn; Fb RPTB corn) on the Vaiden soil in I995 were no different in yield, but were higher than the flat systems of continuous NT, and TA corn and NT corn following MT wheat with NT double cropped soybeans in a rotation. Crop rotation nor tillage system had no effect on yields in 1995.

Corn yield on the Leeper soil in 1993 was no different between tillage and crop rotation systems (Table 3). Corn yields for 1994 were similar to results on Vaiden soil in 1993, which showed higher yields for the raised-bed systems. The Leeper site in 1994 indicated an interaction between raised-bed systems and smooth tillage systems. The raised-bed rotation treatments, RTI corn following RT2 soybeans, FPTB soybeans followed by FPTB corn and MT bed-wheat-double cropped NT soybeans followed by NT corn produced higher yield than smooth tillage systems continuous NT corn, NT corn following MT wheat-double crop soybeans, but were not different from continuous CTB and RTI corn treatments. Continuous RTI and CTB corn yields, however, were no different from MT wheat-doublecrop NT soybeans followed by NT corn.

In 1995 no corn yield showed any significant difference between tillage and crop rotation systems and these results could be attributed to a warm dry spring and good soil moisture growing conditions.

Soybeans

1993 soybean grain yields, on the Vaiden site, were not different between continuous CT, NT, and TA and rotations of RTI corn followed by RT2 soybeans, and NT double cropped soybeans produced higher yield than continuous R R soybeans (Table 4). The lower continuous RT2 soybean yield in I993 is attributed to a severe infestation of stem canker, which caused plant death in that treatment but did not affect other treatments. In 1994, all tillage and crop rotation, except NT soybeans doublecropped following MT wheat, produced similar yields. NT doublecrop soybeans were replanted on July 5,1994, because of poor stands caused by excessive rainfall in June, followed by a dry August, which resulted in no harvestable yields. All tillage and crop rotation treatments except NT doublecrop soybeans following MT wheat and RT2 soybean following RTI corn in 1995 produced similar yields. The lower double crop yields can be attributed to late plantings, dry conditions and higher temperatures in August and September. RT2 soybeans following RTI corn, produced higher yield than FPTB corn followed by FPTB soybean.

Soybean yield on the Leeper site for 1993 varied with tillage and crop rotation (Table 4). Continuous CT and NT soybeans, and rotations of RTI corn followed by RT2 soybean and NT corn followed by MT Wheat-NT doublecropped soybeans drilled into wheat stubble were not different in yield, but all produced higher yields than RT2 continuous soybeans. Lower yields for RT2 continuous soybeans were due to stem canker disease, which caused plant death in this treatment but did not effect other treatments. Continuous CT, NT, RT and RT2 soybeans following RTI corn produced similar yields, but were higher than NT double crop soybeans in **30**-inch rows and drilled rows (7.5 inch). FPTB soybeans following FPTB corn produced higher yield than other treatment.

Table 1. 1993-1995 rainfall at Prairie Research Unit, Prairie, MS and Northeast Mississippi Branch Station, Verona, MS

Month	Prairie[1] 1993	Prairie[1] 1994	Prairie[1] 1995	Verona[2] 1993	Verona[2] 1994	Verona[2] 1995
	inches			inches		
May	4.40	3.27	4.00	5.54	4.39	2.94
June	2.92	12.92	4.26	4.36	7.57	4.15
July	4.60	11.10	4.26	2.04	9.57	3.13
August	5.03	1.14	1.89	5.51	2.91	4.46
September	4.80	5.56	.80	6.83	5.09	2.01
October	2.45	5.72	4.28	2.70	6.22	3.93
Six-month total	24.20	39.71	19.62	26.98	35.75	20.62

[1]Prairie average rainfall totals for May, June, July, August, September, and October: 4.72, 5.04, 3.78, 2.58, 3.44, and 3.08; a 6-month total of 25.97 inches.

[2]Verona average rainfall totals for May, June, July, August, September, and October: 4.04, 3.50, 4.49, 3.08, 3.39, and 2.61, a 6-month total of 21.11 inches.

Table 2. Effect of tillage and rotation on wheat yield in a soybean-wheat double croppping system in 1993-1995, at the Northeast Branch Station, Verona, MS, and at the Prairie Research Unit, Prairie, MS

	Wheat 1993	Wheat 1994	Wheat 1995	Avg.
	bu/acre			
1. Corn-Wheat/Soybean Rotation				
A. Leeper silty clay - Verona[1]				
1. NT Corn; fb[2] MT - Wheat NT Beans	17.1	37.0	----	27.0
2. NT Corn; fb MTBd - Wheat NT Beans	16.4	38.2	----	27.2
B. Vaiden silty clay - Prairie[3]				
1. NT Corn: fb MT - Wheat NT Bean	26.2	70.0	22.8	39.6

[1]Previous crop (1991) was conventional tillage soybeans.
[2]fb = followed by.
[3]Previous crop (1982-91) was native grasses cut for hay. Since 1992 was first year of the study, data for rotation effects are not available.

Table 3. Tillage and crop rotation effect on corn yield on Vaiden silty clay and Leeper silty clay soils, Prairie and Verona, MS. 1993-1995.

Crop Rotation/ Tillage System	Vaiden Silty Clay[1]				Leeper Silty Clay[2]			
	1993	1994	1995	Mean	1993	1994	1995	Mean
	bu/acre				bu/acre			
I. CONVENTIONAL TILLAGE								
Continuous Corn (CTB)	92.1	89.3	156.7	112.9	86.6	126.9	133.5	115.6
II. STALE SEEDBED SYSTEMS								
A. Continuous Corn								
1. No Tillage (NT)	72.0	76.8	131.6	93.4	80.1	113.4	137.1	108.3
2. Ridge Tillage (RT1)	100.4	76.3	151.3	109.3	100.4	121.9	136.6	120.9
3. Turf Aerator-Renovator (TA)	62.1	84.4	138.2	94.9	-----	-----	-----	-----
B. Corn-Soybean(Bn) Rotation (2-year)								
4. RT2 Bn; fb[3] RT1 Corn	109.2	82.4	132.7	108.1	89.7	136.6	136.6	119.5
5. FPTB Bn; fb FPTB Corn	-----	-----	168.5	-----	-----	141.5	135.6	-----
C. Corn-Wheat/Soybean Doublecrop Rotation (2 year)								
6. MT Wheat NT Bn; fb NT Corn	56.2	76.8	139.7	86.7	90.9	109.6	139.3	114.9
7. NT Corn; fb MT Bed Wheat NT Bn	-----	-----	-----	-----	93.8	138.1	151.5	129.9
LSD (0.05)	17.7	NS	22.9	13.9	NS	20.2	NS	11.5
CV%	14.4	26.8	10.3	13.4	15.9	11.4	10.1	12.4

[1]Previous crop was native grass for hay production 1982-91. Prior to initiation of study, the site was disked twice and harrowed

[2]Previous crop (1991) was conventionally tilled soybeans.

[3]fb = Followed by

Table 4. Tillage and crop rotation effect on soybean yield on Vaiden silty clay and Leeper silty clay soils, Prairie and Verona, MS. 1993-1995.

Crop Rotation[1] / Tillage System	Vaiden Silty Clay 1993	1994	1995	Mean	Leeper Silty Clay 1993	1994	1995	Mean
	bu/acre				bu/acre			
I. CONVENTIONAL TILLAGE								
Continuous Soybean (CT)	41.5	34.5	30.5	35.5	31.2	41.7	39.4	37.4
II. STALE SEEDBED SYSTEMS								
A. Continuous Soybean (Bn)								
1. No Tillage (NT)	40.7	33.7	34.3	36.2	38.6	41.7	44.3	41.9
2. Ridge Tillage (RT2)	29.2[1]	37.4	33.8	33.5	21.5	40.5	45.5	35.3
3. Turf Aerator-Renovator (TA)	40.7	37.8	30.2	36.2	----	----	----	----
B. Corn-Soybean Rotation (2-year)								
4. RTI Corn; fb RT2 Bn	41.2	36.4	39.4	39.0	37.7	41.5	48.7	42.6
5. FPTB Corn; fb FPTB Bn	----	35.5	32.7	33.8	----	49.7	50.0	49.8
C. Corn-Wheat/Soybean Doublecrop Rotation (2-year)								
6. NT Corn; fb MT Wheat NT Bn	42.7	---[2]	13.3	----	35.5[3]	23.9[1]	47.1	35.5
7. NT Corn; fb MT Bd Wheat NT Bn	----	----	----	----	28.1	26.0	45.7	33.3
LSD (0.05)	6.8	NS	6.6	NS	7.5	5.7	5.8	3.9
CV%	11.9	13.4	13.9	14.2	18.4	11.1	9.3	13.1

[1]Low yield is due to plant death caused by stem canker disease.
[2]No yield data due to stand failure and an extremely late replanting date.
[3]Drilled soybeans

1995 growing conditions were good in early and mid-growing season, but little rainfall and high temperatures were recorded in late August and early September. Yields were not different between NT, RT, RT2 soybean following RT corn, FPTB soybean following FPTB corn, NT corn followed by MT wheat NT soybean and NT corn followed by MT bed wheat NT soybean. Although CT was lower in yield than other treatments it was not different from NT. Soybeans showed no yield response in the 2 yr corn rotation system. These yields resulted in no difference between CT and NT soybeans yield and is in contrast to previous tillage research on Prairie soils which showed lower yield for NT. (Buehring et al., 1981; Buehring et al., 1988; Hariston et al. 1984; and Hariston et al., 1990). The similar yields for NT and CT soybeans is possibly due to the early March 2,4-D application followed by a burndown herbicide application 2 weeks prior to planting which removes weed competition and reduces soil water loss. These results are contrary to results from previous research (Buehring et al, 1981; and Buehring et al, 1988) where NT burndown treatments were applied at planting.

Summary

Summary of data for 1993-1995 indicated that corn and soybean tillage systems showed differences in yield response. Corn yields were generally higher on raised beds than on the non-raised treatments with tillage having no effect on yield in either system. Raised beds can enhance yield and increase stands and is especially beneficial for corn emergence and development during periods of above normal rainfall. Neither corn nor soybeans in a two year rotation, showed any yield response to rotation. Unfavorable growing conditions were the limiting factors for wheat-soybean yield in the two year double crop rotation treatments.

Yields at both sites for double crop soybeans following wheat were reduced due to wet soil conditions at planting, followed by below average rainfall which resulted in low yields or no harvestable soybeans. Soybean response to tillage differed by year and by location. Environmental conditions determined the yield response to the different tillage systems. Both corn and soybean yields can be maintained with NT, RT and PTB. PTB soybean treatment, on the bottomland Leeper site, has the potential to increase yield above CT. However, PTB soybean on the Vaiden site showed no added yield response over CT. These studies will be continued in order to determine the long-term effects oftillage and rotation systems on both corn and soybean yield.

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Cotton Response to Tillage Rotation and Row Spacing

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Abstract: Mississippi grower interest in narrow row cotton and reduced tillage is supported by the need for a cotton row spacing that is complimentary with other agronomic row crops, and tillage systems which meet the conservation compliance mandates of the 1990 Food Security Act. Row spacing, tillage. and rotation studies indicated that 3-yr (1993-95) avg. row spacing (30 and 38-in.) had no effect on lint yield on the Marietta silt loam soil, and there was a tillage by row spacing interaction on the Leeper silty clay soil. The 30-in. rows produced more lint than 38-in. no-tillage with no difference between minimum tillage 30 and 38-in. row. Conversely. the 38-in. rows produced more lint than 30-in. rows in conventional tillage All continuous cotton tillage treatments on the Marietta silt loam and all 30-in. row cotton tillage treatments on the Leeper soil showed no lint yield differences. The 3-yr avg. lint yield for MT cotton following ridge-tillage corn in a 2-yr rotation was higher than continuous MT on both soils. Two-yr (1993-94) cotton fiber quality data indicated tillage, rotation and row spacing on both soils had no effect on fiber length. uniformity index, and strength. Row spacing had no effect on micronaire and lint yellowness and reflectance on the Leeper silty clay and Marietta silt loam soils. RT 30-in. in the Marietta had lower micronaire than all other treatments.

Introduction

Cotton producers are not only interested in meeting conservation compliance for the 1990 Food Security act but also narrow row cotton production systems which are complimentary to row spacings of other crops grown on their farms. Research (Mutchler et al., 1983) indicates that cotton in a continuous conventional tillage system on sloping soils (5% slope) in Mississippi had annual soil erosion losses of 30 ton/acre/yr. This is 25.5 ton/acre/yr in excess of the tolerable levels established by the USDA Natural Resource Conservation Service. The report also indicated that no-tillage and reduced tillage soil losses on the 5% slope silt loam soil were in excess of the 4.5 ton/acre/yr, established tolerable level. Research also indicated that cotton in rotation with high residue crops such as corn under reduced tillage satisfied the conservation compliance requirement for the cotton crop and produced higher yield than continuous cotton (Spurgeon et al., 1963; Keeling et al., 1988).

John Deere Company's narrow row cotton picker introduction in the 1980's enhanced narrow row cotton production system research. In California (Kerby, 1991) and the lower Rio Grande Valley of Texas (Heilman and Namken, 1987) reported that 30-in. row produced 6.6 and 14% more yield than 40-in. rows, respectively. However, in the mid-south rainbelt, results have been inconsistent and ranged from no yield difference (Hutchinson et al., 1985) between 30 and 40-in. row to 19% higher yield for 30-in. rows on a Dundee silty clay (Williford et al., 1986; Williford, 1990). The objective of this study was to evaluate the effect tillage, row spacing and rotation on clay and silt loam soils had on cotton lint yield and fiber quality.

Materials and Methods

Cotton tillage studies (1993-95) were established in the fall of 1992 on bottom-land Leeper silty clay loam and bottom-land Marietta silt loam soils at the Northeast Branch Station, Verona, MS. These studies were established on both soils as randomized complete blocks with 5 replications and 8 row wide plots x 60 ft long. Studies were established in the fall of 1991 where soybean and cotton had been grown in 1991 on clay and silt loam soils, respectively. The first year (1992) tillage and crop rotation treatments were allowed to go through one complete crop cycle before data collection was initiated in 1993.

The following continuous cotton tillage treatments were evaluated on both soils and in both 30- and 38-in. rows: 1) no-tillage [(NT) - mowed cotton stubble and applied burndownherbicide 10-28 days before planting (DBP) and no cultivation during the growing season]; 2) minimum tillage [(MT) - mowed cotton stubble + bedding followed by (Fb) a burndown herbicide 10-28 DBP and 2 cultivations during the growing season]; and 3) conventional tillage [(CT) - mowed stubble + chisel + disk + bed Fb a harrow before planting and 2 cultivations during the growing season]. Continuous ridge-tillage [(RT), mowed cotton stubble and applied burndown herbicide 10-28 DAP and 2 cultivations (formed a 4 to 6- in. raised bed) during the growing season with a high clearance cultivator] system was also evaluated

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in 30-in. rows on both soils.

Cotton tillage, following corn in a 2-yr rotation, evaluated on both soil types in 30-in. rows were: 1) RT corn (planted no-till and cultivated once during the growing season with a high-clearance cultivator) Fb MT cotton (fall disk corn stubble + bed with a burndown herbicide applied 10-28 DBP and 2 cultivations during the growing season); and 2) RT corn (planted no-till and cultivated once to form a 4 to 6-in. raised bed with a high clearance cultivator during the growing season) Fb RT cotton (planted no-till cotton Fb 2 cultivations during the growing season with a high clearance cultivator.

All NT, RT, and MT cotton plots in 30 and 38-in. rows on both soils received a preplant application of Gramoxone (paraquat) or Roundup@ (glyphosate) + surfactant applied 10-28DBP. Cotton was seeded at 70,000 seed/acre in both 30 and 38-in. rows on April 30, 1992, May 27, 1993, May 10, 1994, and May 16, 1995. All plots were planted with planters equipped with granular pesticide applicator boxes, bubble coulters, and an inverted disk-flat press wheel seed-slit closing system. Appropriate granular insecticides (thrip and aphid control) and fungicides (seedling disease control) were applied at planting. Weeds were controlled on all plots through the use of appropriate burndown, preemergence, post-directed, and postemergence herbicides and cultivation where appropriate. All NT treatments received broadcast applications of herbicides. All cultivated treatments (CT, MT, and RT) received band (15-in.) applications of herbicide.

Granular ammonium nitrate at 40 lb of N/acre was applied on both soils as a preplant sidedress application (6 in. from the row and 4 in. deep) with a granular fertilizer applicator equipped with coulters. The silt loam and clay soil studies received sidedress applications of an additional 50 and 80 lb of N/acre at pinhead square, respectively. All sidedress applications were made in the same manner as preplant applications.

Cotton plots were scouted twice weekly for insects (boll weevil, bollworm, and budworm) and appropriate insecticide applications were made when insects exceeded threshold levels. Cotton plots in both studies were defoliated in late September-early October when all harvestable bolls were within 4 nodes above the node with a cracked boll in the first fruiting branch position. Both studies were harvested as a once-over harvest in mid to late October. The center 2 rows of all plots were harvested with a single-row picker with picker wheels adjusted to travel between the 30 and 38-in. rows. Individual grab seedcotton samples were taken from each treatment plot for 3 replications on both soils. The seedcotton samples were ginned with a micro-gin and the lint samples (1 993 and 1994) were sent to the USDA Cotton Classing Division, Dumas, AR for high volume instrumentation (HVI) fiber analysis. All data was subjected to analysis of variance (SAS. Cary, NC, 1988) and means were separated by Least Significant Difference at the *5%* probability level.

Results and Discussion

Leeper Silty Clay

Lint yield data (1993-95) indicated tillage by yr, rotation by yr, and row spacing by yr by tillage interactions (Table 4). Lint yield data indicated that NT 3 of 3 yr, MT 1 of 3 yr, and CT 2 of 3 yr showed no response to row spacing. Three yr (1993-1995) avg. data showed that CT (38-in. rows) and NT (30-in. rows) produced more yield than CT-30 and NT-38, respectively, while MT showed no yield difference between row spacing.

Continuous cotton tillage data also indicated a yr by tillage interaction. During all 3 yr of the study, MT-30 and CT-30 showed no lint yield difference. In 1993. RT-30, NT-38, NT-30, CT-38, and MT-38 were not different in yield but produced more lint than MT-30 and CT-30. All 30-in. row tillage treatments in 1994 were equal in yield. Yields for RT-30, NT-38, and RT-30 following RT-30 corn in 1995 were lower in yield than all other treatments except NT-30 and CT-30. The 3-yr avg. lint yield for all continuous cotton tillage treatments indicated no difference between all 30-in. rows.

The corn-cotton rotation results showed that in only 1 of 3-yr (1993), did both MT-30 and RT-30 following RT-30 corn in a 2-yr rotation produce more lint than continuous RT-30 and MT-30 cotton. Both RT-30 and MT-30 cotton in a rotation following RT-30 corn, 3-yr (1993-1995) avg. had more lint yield than continuous RT-30 and MT-30 cotton. These results concur with reports (Spurgeon et al., 1963 and Keeling et al., 1988) that cotton in rotation with corn produced higher yield than continuous cotton.

Cotton fiber properties data (Table 2) indicated that tillage, rotation, and row spacing had no effect on fiber length, uniformity, strength, and reflectance. The NT-38, however, showed lower micronaire than RT-30 cotton following RT-30 corn and RT-30 continuous cotton. All other treatments showed no difference in micronaire. RT-30 cotton following RT-30 corn and MT-30 cotton following RT-30 corn had lower yellowness color than all other treatments, except RT-30 continuous cotton. All continuous cotton tillage treatments except RT-30 cotton showed no difference in yellowness and had higher yellowness values than the rotation tillage treatments.

Marietta Silt Loam

With the exception of 1993, row spacing had no effect on lint yield (Table 3). In 1993, CT-38 and MT-38 produced more lint than NT-30 and CT-30, respectively. The 3-yr (1993-95) avg. indicated no lint yield response to row spacing. These results concur with other research (Hutchinson et al., 1985) in the mid-south that indicated row spacing had no effect on yield.

In continuous 30-in. row cotton, except for CT-38 in 1993 and 1994, tillage had no effect on yield during all 3 yr. However, CT-38 produced more lint than CT-30 in 1993 and 1994. NT-30, and RT-30 in 1993; and NT-30 and MT-38 in 1994.

Table 1. Lint yield response to row spacing and tillage system on a Leeper silty clay loam 1993-1995 at the MAFES Northeast Branch Station, Verona, MS.

Tillage/rotation	Row spacing (inches)	Clay soil, Lint, lb/ac: 1993	1994	1995	3 yr mean
A. Continuous cotton					
1. No-till (NT)	38	550	352	255	386
2. NT	30	546	502	346	465
3. Minimum till (MT)	38	482	356	491	443
4. MT	30	355	550	522	476
5. Conventional till (CT)	38	481	423	562	489
6. CT	30	354	415	431	400
7. Ridge till (RT)	30	477	533	218	409
B.					
8. RT corn Fb RT cotton	30	634	572	314	507
9. RT corn Fb MT cotton	30	675	636	518	610
	Mean	506	482	406	465
	LSD	97	164	129	73
	CV%	15	24	18	19
	R^2	73	63	84	73

Table 2. Influence of tillage and row spacing (1993-1994) on fiber properties on a Leeper silty clay soil at the MAFES Northeast Branch Station, Verona, MS.

Tillage/rotation	Row spacing (inches)	Fiber: Length (in.)	Unf. index	Strength gm/tex	Mic.	Color: yellow +b	Color: reflect rd
A. Continuous cotton							
1. No-till (NT)	38	1.13	85.3	30.74	4.26	81.3	66.4
2. NT	30	1.12	85.7	31.12	4.48	83.8	66.9
3. Minimum till (MT)	38	1.12	85.2	30.58	4.33	81.9	67.5
4. MT	30	1.12	84.7	30.51	4.45	81.3	67.2
5. Conventional till (CT)	38	1.13	85.5	30.89	4.34	82.3	67.3
6. CT	30	1.14	85.9	31.12	4.37	82.2	68.3
7. Ridge till (RT)	30	1.13	85.6	30.75	4.56	79.4	67.0
B. Corn-cotton rot.							
8. RT corn Fb RT cot.	30	1.13	85.1	30.68	4.67	76.3	79.3
9. RT corn Fb MT cot.	30	1.13	85.4	31.04	4.50	78.3	66.9
Mean		1.13	85.4	30.86	4.45	80.1	67.0
LSD.05		NS	NS	NS	0.26	2.7	NS
CV %		1.89	1.5	4.32	6.69	3.7	3.3

Table 3 Lmt yield response to row spacing and tillage system on a Marietta silt loam soil 1993-1995 at the MAFES Northeast Branch Station, Verona, MS.

Tillage/rotation	Row spacing (inches)	Silt loam 1993	1994	1995	3 yr mean
		Lint, lb/ac			
A Continuous cotton					
1 No-till (NT)	38	717	735	547	665
2 NT	30	624	630	615	623
3 Minimum till (MT)	38	687	591	525	601
4 MT	30	649	738	604	664
5 Conventional till(CT)	38	730	780	577	695
6 CT	30	600	751	571	641
7 Ridge till (RT)	30	611	700	505	625
B. Rotational cotton					
8. RT corn Fb RT cotton	30	776	777	366	639
9. RT corn Fb MT cotton	30	789	917	607	771
	Mean	687	735	559	658
	LSD	100	161	157	80
	CV %	13	18	14	16
	R^2	46	38	59	55

Table 4. Tillage and row spacing influence (1993-1994) on fiber properties on a Manetta silt loam sod at the MAFES Northeast Branch Station, Verona, MS.

Tillage/rotation	Row spacing (inches)	Fiber Length (in.)	Unf. index	Strength gm/tex	Mic.	Color yellow +b	reflect rd
A. Continuous cotton							
1. No-till (NT)	38	1.12	90.9	29.64	4.20	78.46	68.60
2. NT	30	1.12	90.5	29.71	4.10	81.62	68.46
3. Minimum till (MT)	38	1.11	90.1	29.47	4.08	79.85	69.00
4. MT	30	1.12	90.3	29.54	3.86	80.30	67.54
5 Conventional till (CT)	38	1.12	91.4	29.78	4.37	79.39	68.62
6. CT	30	1.13	91.3	29.68	3.88	79.08	67.15
7. Ridge till (RT)	30	1.11	89.8	29.14	3.39	81.31	68.62
B. Corn-cotton rot.							
8. RT corn Fb RT cot.	30	1.13	90.3	29.64	3.82	79.15	66.77
9. RT corn Fb MT cot.	30	1.13	90.7	29.47	3.89	77.46	67.00
Mean		1.12	90.5	29.54	4.00	79.88	67.71
LSD.05		NS	NS	NS	0.34	2.71	1.72
CV %		1.57	13.4	3.63	10.82	4.35	3.25

Three yr (1 993-95) avg., however, indicated no yield differences between all continuous cotton tillage treatments.

With the exception for 1995, MT-30 cotton following RT-30 corn rotation had higher lint yield than continuous MT-30 continuous cotton. The RT-30 cotton following RT-30 corn only produced more lint than RT-30 continuous cotton in 1993. The 3-yr avg. indicated that MT-30 rotation treatment was the highest yield treatment but was not different from continuous CT-38 cotton.

Cotton fiber quality data (1 993-1994) indicated crop rotation, tillage, and row spacing had no effect on fiber length, uniformity, and strength (Table 4). All treatments had higher micronaire than continuous RT-30. All treatments, except for NT-30, MT-30, and RT-30 cotton, showed no differences in yellowness color. RT-30 cotton following RT-30 corn had the lowest reflectance and was lower than MT-38, CT-38, NT-30 and NT-38. All other treatments showed no difference in reflectance.

Acknowledgment

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Energy Requirements of Conservation Tillage Tools in Coastal Plain Soils

A. Khalilian and R. R Hallman[1]

Abstract: Draft and energy requirements are an important consideration in selecting tillage systems. Tests were conducted to determine the effects of speed and depth on draft characteristics of three tillage tools in two typical coastal plain soils. Tillage tools included a 4 shank Tye Paratill, a 4 shank French Durou plow, and a 4 bottom Switch plow. The experiments were designed to operate each implement at three speeds and three depths. Draft was quadratic with speed for the Tye Paratill, French Durou plow, and Harrell Switch plow in both soil type. Draft was linear with depth for all tillage tools. Draft-speed relationships can be used to predict the power requirements of these tillage tools in similar soil types.

Introduction

Soil hardpans limit root penetration into the clay layer and are a significant problem in many soils in the Southeast. Deep tillage implements, such as an in-row subsoiler or Paratill, have been shown to improve yields in coastal plain soils and are a requirement for breaking hardpan layers (Garner et al., 1986; Khalilian et al., 1991). Since the early 1980s, the greatest change in tillage systems has been a significant shift to conservation farming. The trend has been intensified by conservation compliance requirements. There are a number of new tillage tools, such as the Tye Paratill and the French Durou plow, on the market. However, there are no technical data available to advise farmers on the energy requirements and tractor sizes necessary to operate these tools. The Harrell Company has developed a new bottom plowing concept called the "Switch Plow." Although the Switch Plow is not a conservation tillage tool, bottom plowing is still the recommended practice for peanut disease and weed management. In 1990 some 1,000 Switch plows were sold to farmers, primarily in the Southeast.

Draft and energy requirements of tillage tools are an important consideration in selecting tillage systems. The draft requirements depend on the soil type and condition, tool shape, travel speed and depth of operation. The objective of this study was to determine the effects of speed and depth on draft characteristics of three tillage tools in two typical coastal plain soils.

Materials and Methods

Tests were conducted at the Edisto Research & Education Center of Clemson University at two locations. Soil type at the first location was Clarendon loamy sand (depth 0-7 in loamy sand, 7-13 in sandy loam, 13-30 in sandy clay loam). At the second location soil type was Dunbar sandy loam (0-7 in sandy loam, 7-60 in clay). Both locations were disked in the fall of 1991 and the fields were left fallow until tillage in April 1992.

Prior to tillage tests, a microcomputer-based, tractor-mounted recording penetrometer was used to quantify soil penetration resistance. Soil cone index values were calculated from the measured force required to push a 0.5 in' base, 30° cone into the soil at constant velocity.

A randomized complete block design with 27 treatments (3 tillage tools x 3 ground speeds x 3 tillage depths) replicated 4 times was used in both locations. Tillage tools included a 4 shank Tye Paratill, a 4 shank French Durou plow, and a 4 bottom Switch plow. The Tye Paratill uses a slanted shank with subsoiler type points and an adjustable shatter plate behind each shank (Figure I). The shanks slice through the ground at a 45° angle, gently lifting the soil, allowing it to fracture along natural cleavage plains. This action loosens the bottom soil without disturbing surface residue. The Durou plow also has slanted shanks (20° from vertical position) with a 10-in long wing attached to the side of the shank (Figure 2). Each bottom on the switch plow is made of a 24x24-in curved plate with 17-in radius of curvature (Figure 3). The switch plow is a reversible moldboard plow designed for plowing in both directions. Width of cut for each bottom is 18 inches.

A mechanical front-wheel-assist. 120-HP instrumented John Deree tractor, with a microcomputer-based data acquisition system, described by Hale et aL (1989) was used to gather information on draft, ground speed, drive wheel slip, and fuel consumption. Implement depths were measured by hand at random locations in each plot following implement

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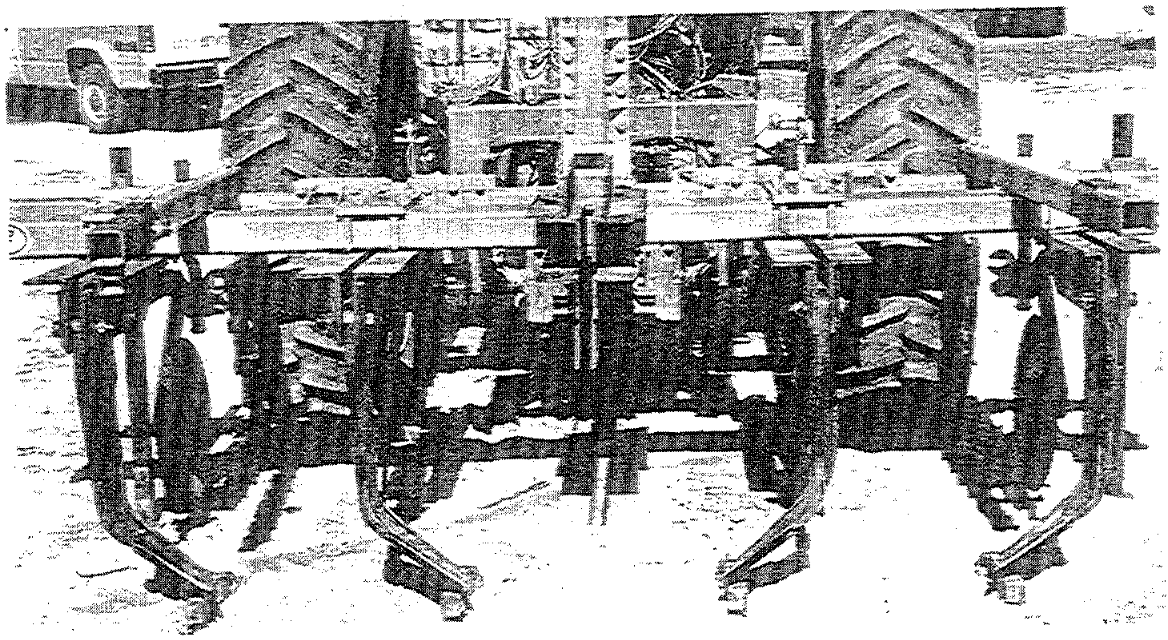

Figure 1. The Tye Paratill.

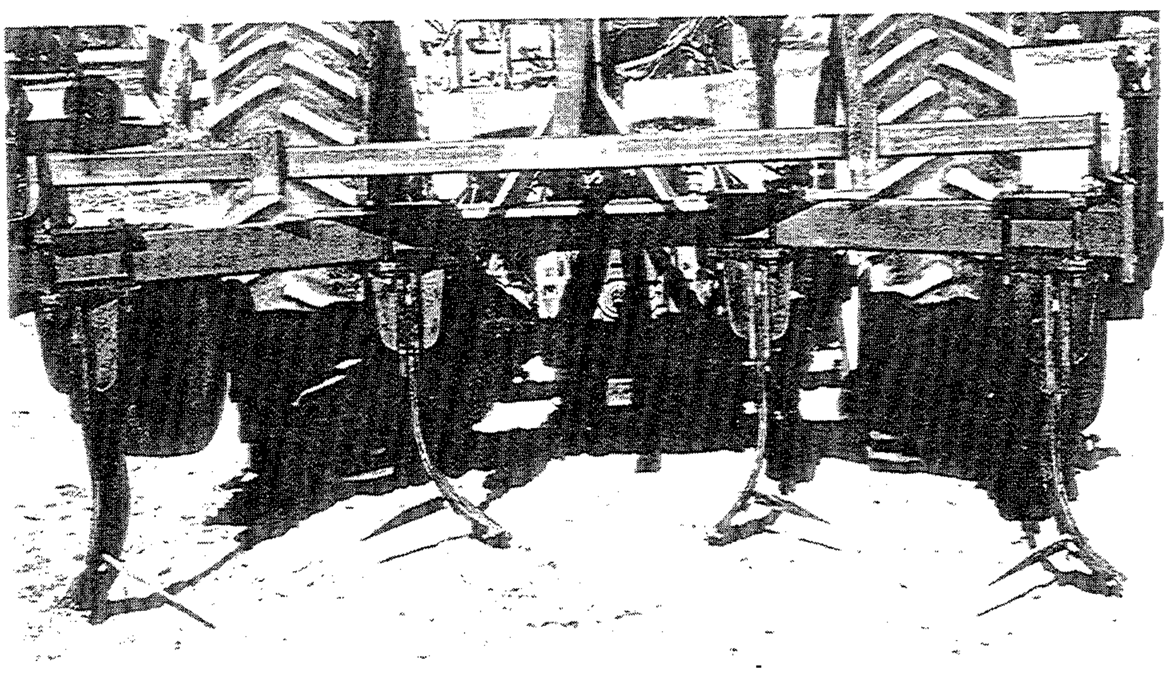

Figure 2. The French Durou plow.

passes. A reference was assumed to be level with the undisturbed soil surface adjacent to the tillage area.

The experiments were designed to operate each implement at three speeds and three depths. The speeds and depths were chosen to be within the normal range of field operations for each tool. Tillage tests were conducted when the soil moisture content was near optimum for both locations.

Results and Discussion

Figure 4 shows cross-sections of actual tillage depths for the three tillage tools measured at one-inch increments. The Tye Paratill with shank spacings of 22-26 in. and the Durou plow with shank spacings of 18-20 in., will create a broadcast tillage. Figure 5 shows profiles of cone index versus depth for the two experiment locations. Cone index values before tillage indicated that the test fields had a hardpan in the E horizon at about 10 to 13 in. depth. Soil resistance to penetration in Dunbar sandy loam field was higher than those for Clarendon loamy sand field. This effect is reflected in draft data presented later.

Depths of tillage for the implements are listed in Table 1. Variations in depths are due to not having an accurate reference when setting the plow depth and non-uniform nominal soil surface elevation. Figure 6 shows the relationship between draft and speed for the French Durou plow for the two tillage sites. Multiple linear regression was done on the data with powers of the velocity as the dependent variables. Draft was divided by depth and power of depth prior to regression. The best-fit draft relationships were the quadratic relationships shown in Table 2. The draft values for the Durou plow are given in lbs./ shank per inch of tillage depth.

Regression data for the Tye Paratill are given in Figure 7 and Table 2. Speed dependency was determined to be quadratic. Again draft values for the Paratill are in lbs./shank per inch of tillage depth. Figure 8 shows the relationship between draft and ground speed for the Switch plow. Draft data for the Switch plow was divided by depth and width of the plow prior to regression. Therefore the draft values are given in lbs. per unit cross-section of furrow slice ($in.^2$). The best-fit draft relationships were quadratic as shown in Table 2. Draft increased linearly with depth for Paratill, Durou plow and Switch plow. Also, draft values for all tillage tools in Dunbar sandy loam were greater than those in Clarendon loamy sand soil. This is due to greater compaction of the Dunbar soil as determined by the resistance to penetration shown in Figure 5.

The draft-speed relationships can be used to estimate the tractor horsepower required to pull each tillage implement for a given ground speed and operating depth. A formula for calculating drawbar power is: Drawbar power= speed (mph) x draft (lbs.)/ 375. To determine the PTO power we must use a factor to account for the traction capability of different soil conditions. These factors for different soil surface conditions are :0.64 (firm soil): 0.55 (tilled soil); and 0.47 (soft/sandy soil). For example the tractor size (PTO power) required to pull a Switch plow with four 18-in. bottoms operating 10 in. deep in a tilled Clarendon loamy sandy soil at 5 mph is calculated as follows:

from Table 2, draft per square inch of cross section at 5 mph $= 6.1 + 0.05\ (52) = 7.35$ lbs./in²; Cross-section $= 18 \times 4 \times 10 = 720$ in²; Then total draft $= 720 \times 7.35 = 5292$ lbs.

Drawbar power = 5 (mph) x 5292 lbs./375 = 70.56 horsepower.

PTO power = drawbar power / 0.55= 70.56 / 0.55 = 128.3 horsepower.

Conclusions

Draft was quadratic with speed for the Tye Paratill, French Durou plow, and Harrell Switch plow in both soil type. Draft was linear with depth for all tillage tools. Draft-speed relationships can be used to predict the power requirements of the three tillage tools in similar soil types.

Acknowledgment

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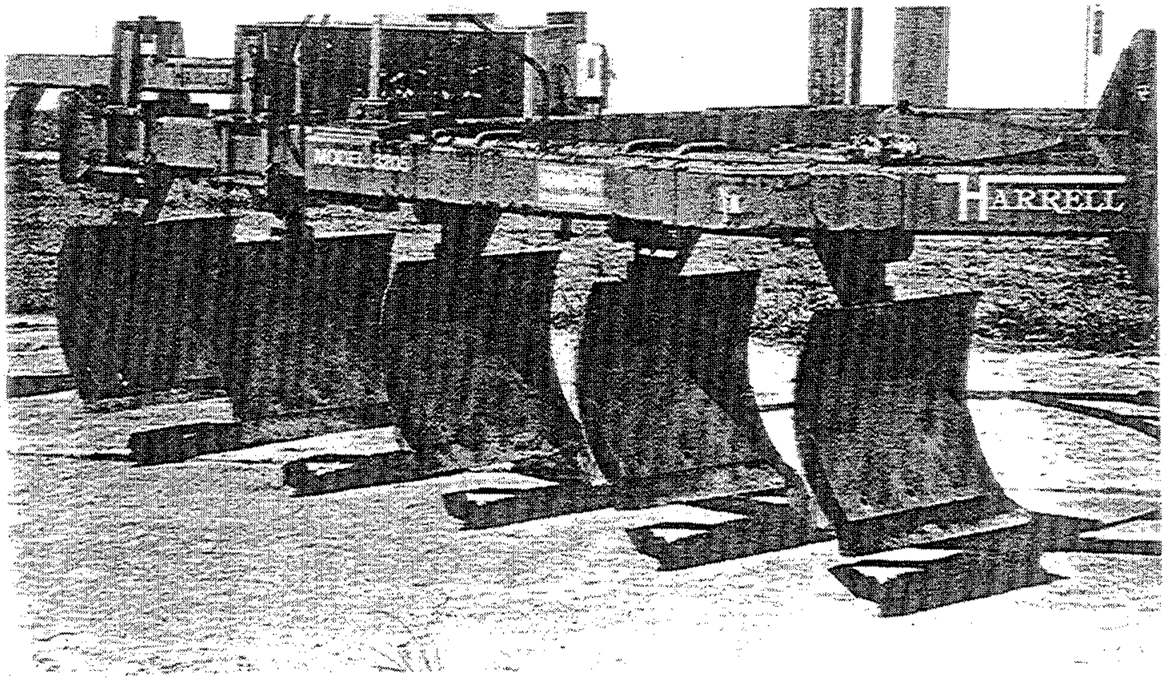

Figure 3. The Harrell Switch plow.

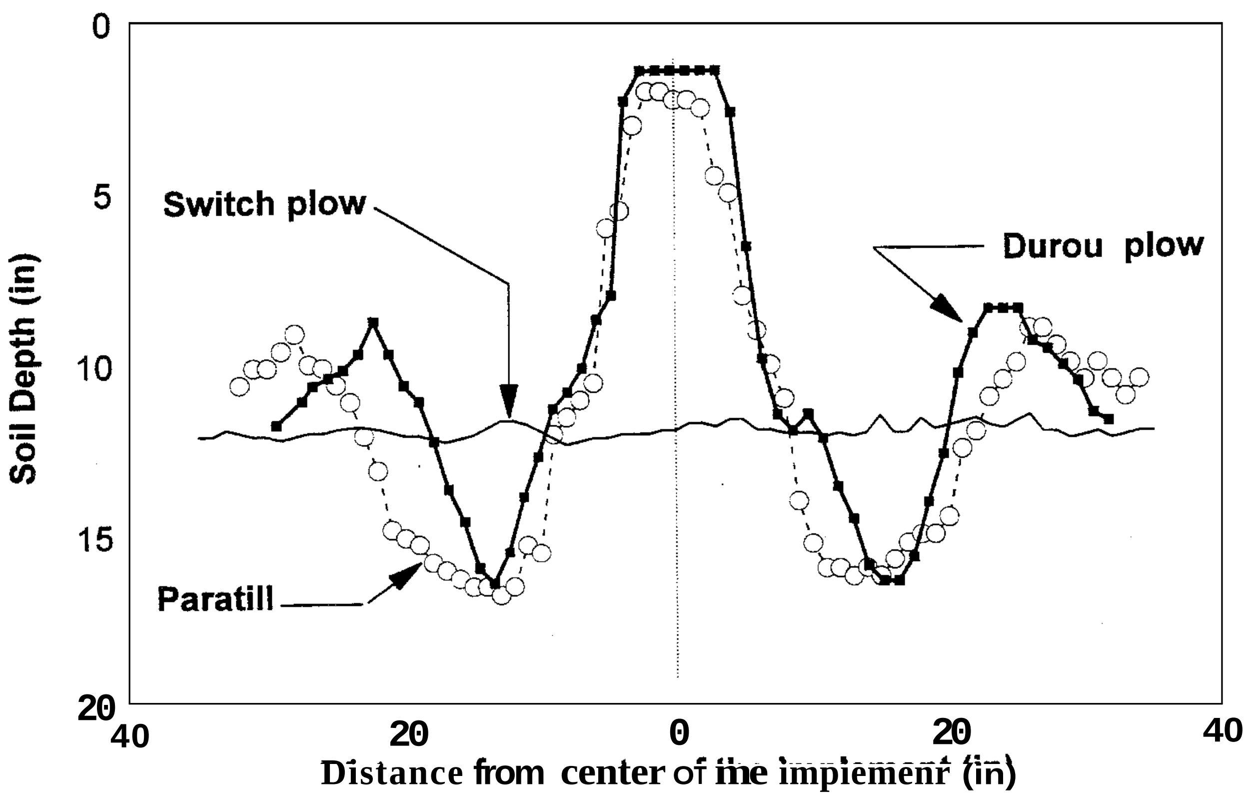

Figure 4. cross section of actual tillage depth for three tillage tools.

Table 1. Average tillage depth for the three primary tillage tools.

Implement	Relative Depth	Soil Type Clarendon loamy sand Depth (in.)	 Dunbar sandy loam Depth (in.)
Paratill	1	10.50	11.75
	2	14.50	14.25
	3	16.00	16.50
Switch Plow	1	8.00	7.75
	2	9.00	10.50
	3	13.00	13.00
Durou Plow	1	9.50	10.00
	2	14.00	14.00
	3	17.00	16.50

Table 2. Regression data for Paratill [*draft* (lb/in) = **A** + B $(S)^2$]; Switch plow [*draft* (lb/in^2) = **A** + B $(S)^2$]; and Durou plow [draft (lb/in) = **A** + B $(S)^2$], where S is ground speed in mph.

Implement	Soil type	**A**	B	R^2
Paratill	Clarendon loamy sand	64.6	0.50	0.846
	Dunbar sandy loam	73.7	0.27	0.892
Switch plow	Clarendon loamy sand	6.1	0.05	0.967
	Dunbar sandy loam	6.6	0.04	0.884
Durou plow	Clarendon loamy sand	66.4	0.49	0.826
	Dunbar sandy loam	66.5	0.61	0.905

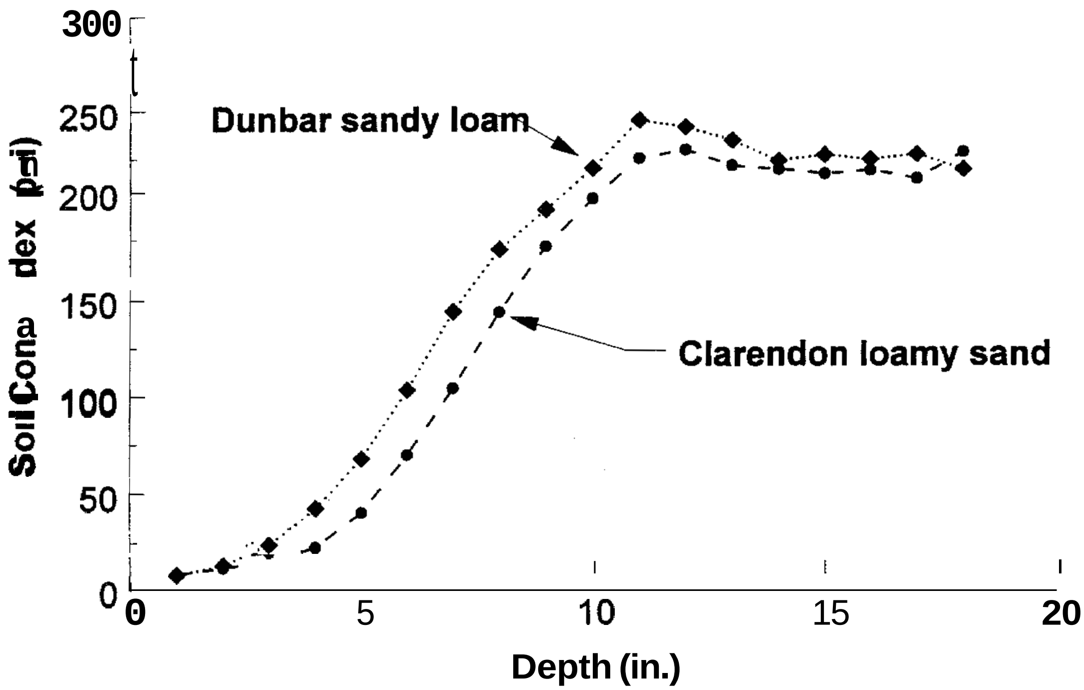

Figure 5. Average soil cone index profiles for the two tillage experiment locations.

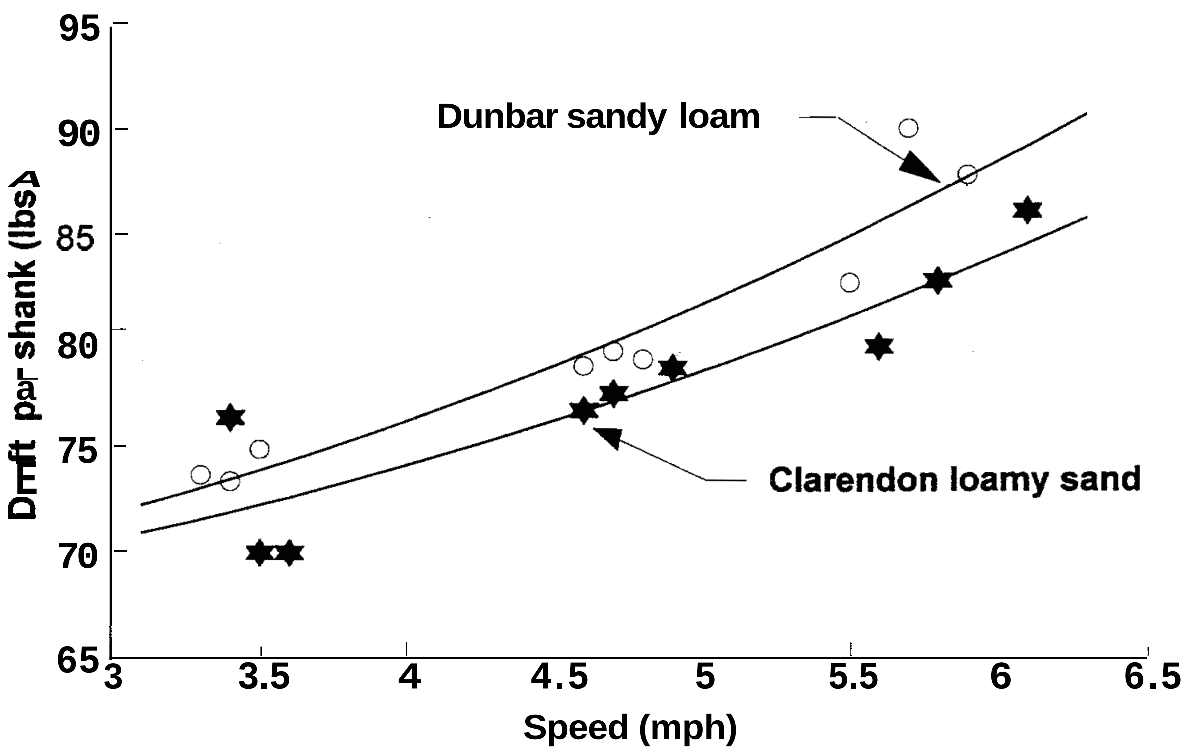

Figure 6. Durou plow draft requirements as a function of ground speed expressed in lbs. per inch of depth for the two tillage sites.

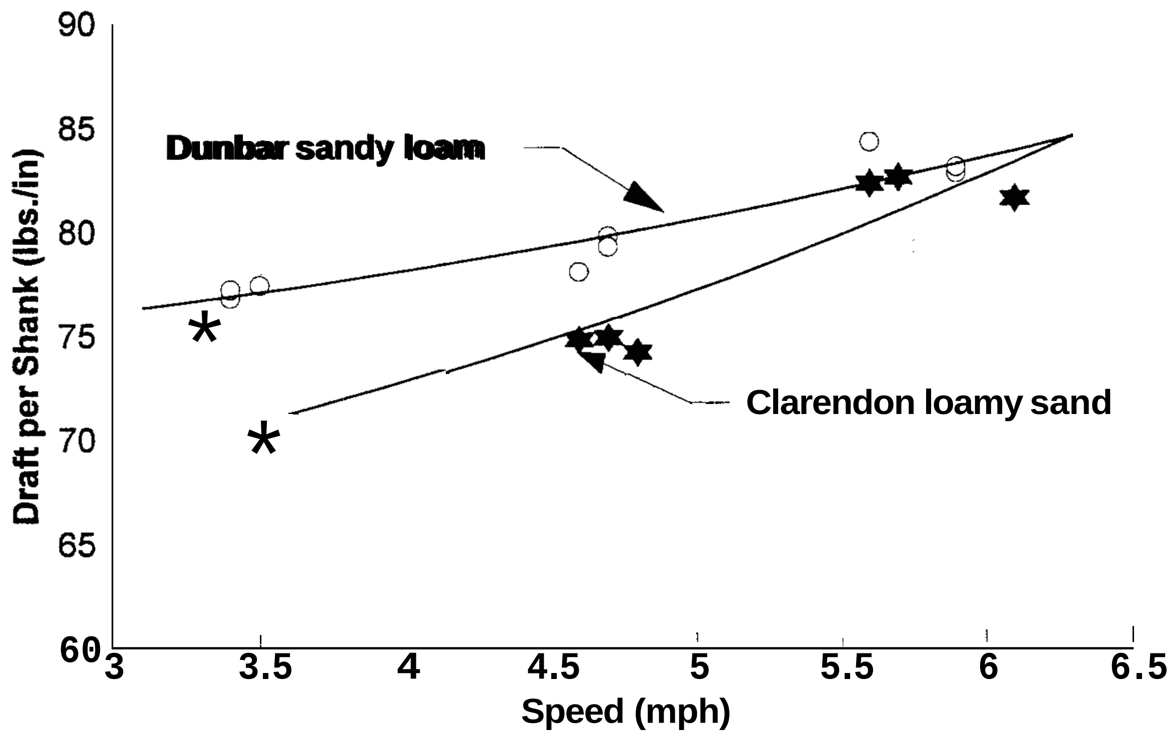

Figure 7. Paratill draft requirements as a function of ground speed expressed in lbs. per inch of depth for the two tillage sites.

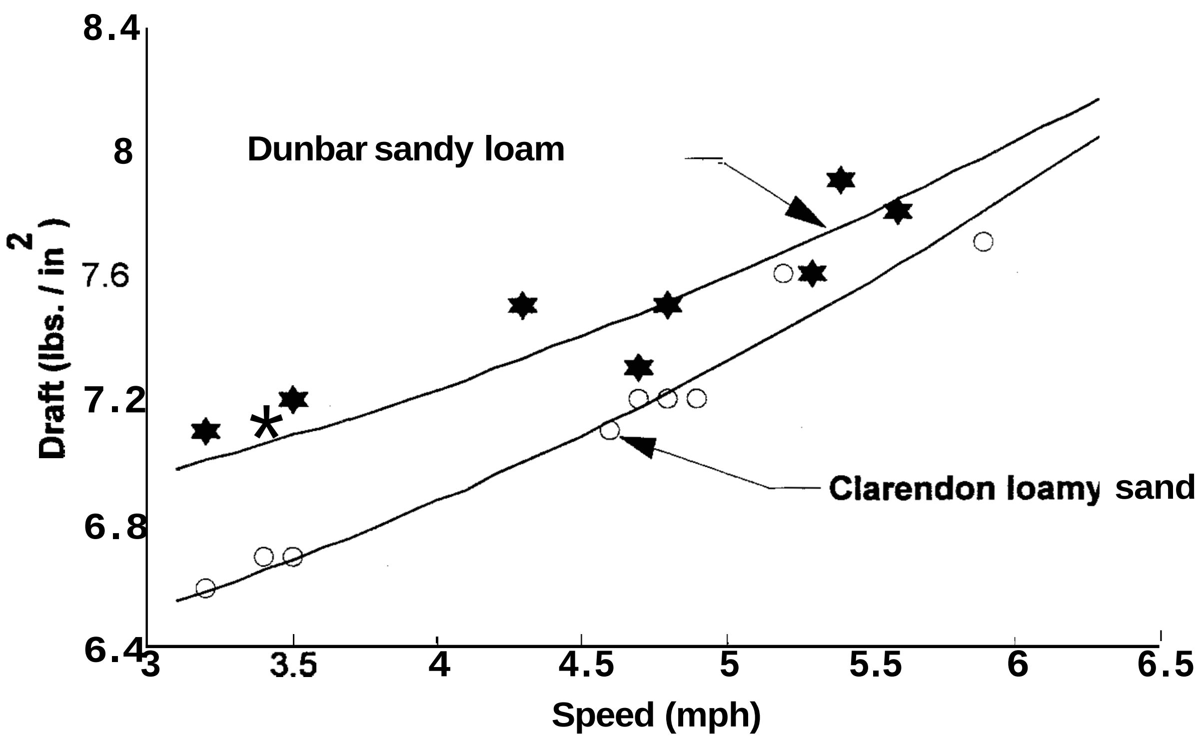

Figure 8. Switch plow draft requirements for the two tillage sites.

Doublecropping with the "One Pass Tillage/Plant System" in Georgia

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Introduction

Doublecropping soybeans and wheat is a common cropping system in the southeast. In fact, the majority of soybeans in the southeast are doublecropped with wheat. This system can be very profitable if both crops are managed properly. As costs of production rise, it is critical to design more efficient means of producing both crops.

Research in Georgia and other states has shown a critical need for deep tillage and close row cultures to maintain top yields of both crops in the Coastal Plains of Georgia. The most popular production system for Georgia's summer crop acreage is in-row subsoil followed by planting in 30" to 38" rows. Attempts to plant in close rows either conventionally or no-till without disrupting compacted soil layers have usually resulted in reduced growth and yield.

Tillage and planting systems that permit disruption of compacted layers and allow close row planting with conservation tillage are needed for the Coastal Plains of Georgia. Such systems may increase profit by improving yield, reducing cost and increasing energy conservation.

Since Southeastern producers typically are involved in several commodities such as cotton and peanuts, low profitable crops such as soybean and wheat do not get intensive or timely management. Reducing the time between harvest and planting of the doublecrop could improve efficiency and increase yields.

Procedure

A one-pass tillage/plant system designed by Clemson University (Hood et al., 1992) was used to determine its effectiveness in increasing yield and profit of doublecrop soybeans and wheat in Georgia. The system consist of a Gandy Orbit - Air Seeder set on a tool bar with Yetter No-till seeder coulters pulled behind a Terra-Max Worksaver deep tillage winged-plow. The seeder was attached with a bridge hitch. Proponents of the system suggest and have shown that the system both increases yield, profits and improves soil conservation over more conventional methods (Hood et al., 1991; Khalilian et al., 1990; Palmer et al., 1993).

Farm studies in Georgia were begun in 1995 to compare the one-pass tillage/plant system with a conventional method. Six farms in east-central Georgia were chosen that were currently using some form of minimum or conservation tillage. Each farm had a history of successful soybean production. Soybeans in the one-pass system were planted in 8" rows. The comparison method was a KMC four-row rip-strip tillage unit with either KMC planters or John Deere Flex 71 planter units. Soybeans in the conventional methods were planted in 36" rows. Fields were planted doublecrop behind wheat in late May to mid-June as dryland production. Group VII or Group VIII maturity soybeans were used. Varieties were consistent across comparisons of methods. All fields were fertilized according to University of Georgia Cooperative Extension Service soil test recommendations. Pre-emerge broadcast applications of pendimethalin and metribuzin were used for weed control. Two applications of insecticides were made to control velvetbean caterpillars and stinkbugs.

Results

Results of the first year soybean trials are listed in table one. On three of the six farms, the one-pass system was more profitable than the strip tillage method. Fields in which the one-pass system was used averaged 37.3 bu/A as compared to 31.9 bu/A for the strip tillage production. Average cost (fixed and variable) per bushel was $3.73 and $4.83. respectively. The one-pass system was equal to or better in yield to the strip tillage method on five of six farms.

The cost of production was slightly higher per acre on the Lowndes farm due to greater variable cost of seed, chemical and machinery costs. However as a whole, the total cost per acre for the one-pass system was $15.00 per acre less than the comparison method.

The initial start to this study indicates that the one-pass tillageiplant system is a promising method for improving yield and efficiency of double cropping systems in Georgia.

Wheat and canola trials were begun in the fall of 1995 to compare winter production with a conventional drill system followed by doublecrop soybeans either interseeded into standing wheat (prior to harvest) or after harvest.

Table 1. Summary of Production Costs, yield and Costs/Bu of Producers Comparing One-Pass Plant and Strip or No tillage.

	One pass Plant			Strip Tillage		
Producer	Yield (bu/A)	Total Cost ($)	Cost/Bu ($)	Yield	Total Cost ($)	Cost/Bu ($)
Malone	44.3	126.97	2.87	27.5	133.48	4.85
Green	42.0	131.51	3.07	26.8	133.29	4.97
Lowndes	21.7	152.06	7.01	26.4	128.94	4.90
Powell	32.0	147.77	4.61	28.0	142.79	4.73
Waller	41.8	130.20	3.11	41.4	112.17	2.71
Black	41.8	146.68	3.51	41.3	119.96	2.90
Average	32.27	139.09	3.73	31.9	154.13	4.83

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Results of a CRP Survey in Kentucky

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Introduction

Fields enrolled in the Conservation Reserve Program (CRP) are often viewed as being troublesome with several problems. Some of this perception is based on the fact these fields were generally highly eroded and had a low yield potential at the onset of the program. There is concern that these fields have numerous weeds since the only requirement for maintaining weed control is to mow fields once per year by August 15. Having a wide variety of sod and weedy species may be a favorable environment for soil insects such as white grubs *(Scaraaeidae:Melolonthinae)* and wireworms *(Elateridae)* and possibly soybean cyst nematode *[(Heteroderaglycines* (SCN)].

A field survey was conducted in 1995 to help identify potential problems with soil fertility and pests that might affect the management of these fields after the CRP contracts expire. A number of factors were evaluated including the levels of soil pH, phosphorus, potassium, vegetative cover, soil insects, and SCN.

Methods

A survey of 50 fields enrolled in the Conservation Reservation Program (CRP) was conducted in 1995. Fields were located in ten counties in west and central Kentucky where most of the CRP fields occur. Each field was surveyed at five to ten random sites depending on size of field. Scouts collected and combined ten soil cores at each site for laboratory analysis of phosphorus, potassium, pH, organic matter, and SCN. A cube of soil of 216 in^3 volume was dug and sifted at each site for collecting certain soil insects. Vegetative ground cover of individual plant species occurring within a I00 ft by 100 ft area at each site was estimated as: light (up to 10%, medium (11 to 30%), or heavy (> 30% ground cover). The first field visit was done in the spring when scouts collected soil and recorded information concerning vegetative cover. The vegetative cover was also recorded during the summer to determine shifts from cool-season species to warm-season species.

Results and Discussion

Soil Fertility

The organic matter content was greater than expected in most fields and averaged 2.3% (Table 1). Slightly more than one-third of the fields (36%) had the lowest O.M. content (1.5 to 2.0%), and usually occurred where fescue stands were poor. Nearly 90% of the fields had a pH between 6.0 to 7.0 (Table I), therefore, the amount of lime that will be needed to return these fields back to production will not be great. The level of soil phosphorus appeared to be the most limiting nutrient food in most CRP fields. The level of phosphorus was in the low range for 62% of the fields and 28 % in the medium range (Table 2). Soil test results for potassium indicated that only 10% of the fields tested in the low range and that 42% of the fields were in the high range (Table 2). The fact that several fields had a high potassium content may be due to potassium being deposited at the soil surface by growing plants over time without any removal.

Soil fertility records prior to the CRP enrollment were available for 34 of the 50 fields and were used to compare with the survey results to determine if changes in soil pH or nutrient levels occurred during the CRP. Comparisons indicated an increase in pH in 50% of the fields and a decrease in 41% of the fields. The average soil test phosphorus level decreased approximately 41 lb/A whereas the average soil test level of potassium increased about 12 lb/A while in the CRP.

The soil test results of the 1995 survey indicate that the fields in the CRP program had a reasonable fertility status when placed into the program and the changes have not been great. The soil pH has been maintained under these conditions and the need for lime will not be great for most fields. The phosphorus level is low on most fields and has decreased over the time of the program. This will be one of the most limiting nutrients on most fields and will require a significant amount of phosphorus fertilizer to be placed back into production. The potassium content of most fields is medium or high and most fields will require none or only moderate amounts of potassium fertilizer for production purposes. There are high amounts of variability between fields: so each field must be tested and treated separately to assure adequate fertilization and liming for good production.

Vegetative Cover

A total of 75 species or groups of species were identified and included 28 annuals, 2 biennials, 29 herbaceous perennials, and 16 woody perennials. The number of species reported for the spring survey was 66 compared with 62 for the summer survey.

Tall fescue *(Festuca araundinaceu)* was obviously the dominant species during the spring visit and was present in all fields (Table ***3).*** Orchardgrass *(Dactylus glomerara)* ranked as the second most common species in the spring and was found in 76% of the fields. Examples of other species that frequently occurred in the spring included white clover *(Trifolium repens),* broomsedge *(Andropogon virginicus),* hairy vetch *(Vicia villosa),* common milkweed *(Asclepias syriaca),* fleabanes *(Erigeron* spp.), wild garlic *(Allium, vineale),* ragweeds *(Ambrosia* spp.), and docks *(Rumex* spp.).

The spring survey was delayed because of wet weather, therefore, the data from this portion of the survey may not accurately reflect the presence of certain cool-season species. Less than ten percent of fields had cool-season annuals such as common chickweed *(Stellaria media),* henbit *(Lamium amplexicaule),* and cheat *(Bromus secalinus).* The low incidence reported for these species may be attributed to their maturing before the spring visits were completed. However, the spring survey seemed to accurately reflect the presence of cool-season species that usually mature in late spring to early summer [e.g. hairy vetch, docks, musk thistle *(Carduus nutans),* mustards *(Brassica* spp.), and wild garlic].

Results of the summer survey indicated an increased emergence of warm-season weeds (Table 3). The fields having ragweeds increased in number and ranked second after tall fescue. Several other warm-season species emerged in CRP fields in the summer and included such weeds asjohnsongrass *(Sorghum halepense),* marestail *(Conyza canadensis),* Korean lespedeza (Lespedeza stipulacea), and foxtails *(Setaria* spp.).

Growers who elect to grow to row crops in CRP fields will need to develop control strategies for managing fescue sod. There may be certain cases where special attention is needed to control orchardgrass or white clover. A few fields may have woody perennials such as blackberry *(Rubus* spp.), eastern redcedar *(Juniperus virginiana),* or trumpetcreeper *(Campsis radicans)* These species are extremely difficult to control and will require a combination of several strategies to manage them effectively after CRP. Certain cool-season weeds such as docks, fleabanes, hairy vetch, musk thistle, mustards, and wild garlic may be a problem in fields that are planted to a fall-seeded crop. Examples of weed species that are most likely to occur in corn or soybeans after CRP include ragweeds, johnsongrass, marestail, common milkweed, Korean lespedeza, broomsedge, and foxtails.

It *is* important to recognize that some weed species may be suppressed by sod and other weeds: therefore, current survey results may not provide a complete inventory of potential weed problems that may be encountered in CRP. Once the vegetative cover is killed, pigweeds and other weeds may emerge in large numbers. Tillage can also encourage a shift to different spectrum of weeds by bringing buried dormant weed seed near the soil surface where they germinate. These types of scenarios emphasize the importance of maintaining a long-term weed inventory to help plan for future weed control programs. Without the historical record of weeds growers will need on the lookout for unexpected problems during the process of converting CPR land back to row crop production.

Soil insects

Soil insects were found in 22% of the fields. The white grub complex accounted for the majority of soil insects surveyed. Samples from 18% of the fields had white grubs only, while 2% had a sample containing a white grub and a wireworm. The remaining 2% had a sample with a wireworm only.

The survey results for soil insects were both surprising and important. It has been the general recommendation when bringing "new ground", especially sod ground, into corn production to apply a granular soil applied insecticide during the first and even second season. The potential for damage has been perceived to be high and farmers typically have no information on soil insect numbers to use as aguideline. Since stand loss in some fields has been severe, at least in spots, the tendency is to use a preventive approach rather than having to replant if damage develops. However, the most important of these pests. the wireworm was found in only 2 of 275 samples! In the most conservative case, if detection of a single wireworm in a sample warranted control, a soil insecticide treatment would have been recommended in only 2 of the 50 fields that were examined. This survey indicates a blanket recommendation, to use a soil insecticide on fields that have been held out of production and covered with a mixture of grass or broadleaf cover, may not be justified. If possible, during the first season plant soybeans instead of corn. If corn is planted, use wireworm traps or soil core sampling to determine the presence of wireworms and/or white grubs before planting.

Soybean Cyst Nematode

SCN was detected in 20 of the survey sites that occurred in 8 of the 50 fields. Approximately half of these sites had less than 10 cysts per pint ofsoil. Two fields had at least one site with more than 100 cysts per pint ofsoil. Weed species reported in the spring survey did not account for the greater than expected SCN populations.

It appears as though CRP fields with a prior history of soybean production may be at some risk of having damaging levels of SCN at the end of the CRP period. Weeds in existence at the end of the period cannot be used to estimate SCN populations. It is possible that weeds present in years and seasons prior to surveying may have been responsible for maintaining SCN populations. The surveying technique in relation to soil sampling may have also resulted in poor ap-

Table 1 **Soil organic matter content and pH for *50* CRP fields in Kentucky (1995).**

Organic Matter [1]		pH [2]	
O.M. Content	Percent of Fields	pH Range	Percent of Fields
1.5 - 2%	36	< 6.0	8
2.1 - 2.5%	40	6.0 - 6.5	60
3.6 - 3.0%	16	6.6 - 7.0	28
> 3.0%	8	> 7.0	4

[1] Soil organic matter content ranged from 1.5 to 3.8% with an average of 2.3%

[2] Soil pH range was from 5.3 to 7.5.

Table 2. **Soil phosphorus and potassium for 50 CRP fields in Kentucky *(1995).***

Phosphorus [1]		Potassium [2]	
Range (lb/A)	Percent of Fields	pH Range	Percent of Fields
Low (0 - 30)	62	Low (0 - 199)	10
Medium (31 - 59)	28	Medium (200 -299)	48
High (60+)	10	High (300+)	42

[1] Soil phosphorus ranged from 3 to 187 lb/A.

[2] Soil potassium ranged from 139 to 493 lb/A.

Table **3. Ten most common species in 50 CRP fields in Kentucky during spring and Summer (1995).**

SPRING		SUMMER	
Species	Percent of Fields	Species	Percent of Fields
Tall fescue	100	Tall fescue	96
Orchardgrass	74	Ragweeds	78
White clover	54	Orchardgrass	76
Broomsedge	36	Johnsongrass	70
Common milkweed	34	White clover	54
Hairy vetch.	30	Marestail	26
Annual Fleabane	26	Common milkweed	48
Wild garlic	26	Broomsedge	28
Ragweeds	11	Korean lespedeza	28
Docks	20	Foxtails	24

parent relationships between weeds present and SCN levels. Past experience tells us that it is unlikely that populations *>50* cysts/pint of soil could be maintained in a field without some low level reproduction. Failure to pick up SCN in 254 sites suggests that damaging levels of SCN in CRP acreage is not widespread. This was expected since the bulk of CRP fields was in predominately tall fescue (an SCN non-host) for the past 10 years. Nonetheless, without an SCN soil analysis it will be impossible for farmers to know the potential for damage due to SCN in fields planted to soybeans the first year following CRP.

A general recommendation would be to test fields for SCN prior to planting former CRP fields to soybeans. Do not assume that fields will not be affected by SCN simply because the fields have been out of soybean production for the last 10 years. Do not use existing weed composition in a field to estimate the potential for SCN related problems.

Summary

Based on these results a high level of management may be required to convert certain CRP fields back into production. Growers who anticipate utilizing CRP land for grain production may want to collect soil for pH and nutrient analysis, especially phosphorus. Controlling the perennial sod and other vegetation will be difficult for some fields. In order to achieve the best possible control of the sod and weedy vegetation may require implementing a control strategy in the summer or fall before converting the land back into production. Although the results indicate that a blanket treatment of a soil insecticide may not be warranted in most instances following CRP, the use of wireworm traps or soil core sampling may help verify the insecticide needs for a particular field. The fact that SCN was present in damaging levels in some fields makes it necessary to consider testing for SCN in fields to be converted to soybean production.

Tall Fescue Control in No-Till Soybean

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Introduction

Tall Fescue *(Festuca arundinacea)* is a perennial cool-season grass that grows in Kentucky under a wide variety of environmental conditions (Lacefield and Evans, 1984). The ability of tall fescue to develop a sod cover on highly eroded soils is a major reason it is the primary grass used in pastures and in Conservation Reserve Program (CRP) fields. Returning CRP fields back to row-crop by utilizing conservation tillage practices (ie. no-tillage) would be beneficial since many of these fields have a high potential for soil erosion.

Research has shown that glyphosate (Roundup) or paraquat (Gramoxone Extra) generally provide consistent control of tall fescue when used in combination with atrazine in no-tillage corn (Witt et al., 1995). However, atrazine is not a viable tank-mix component for no-till soybeans because of crop sensitivity to this herbicide. Therefore, control of tall fescue sod in a no-till soybean production system is limited to glyphosate or paraquat without residual herbicides.

Results of studies on replacing endophyte-infected fescue with endophyte-free tall fescue (Smith, 1989; and Defelice and Henning, 1990) indicate that complete eradication of tall fescue plants including crown buds is difficult to achieve with glyphosate or paraquat. A high level of management was needed to obtain optimum control of tall fescue with these herbicides.

An experiment was conducted to compare various management practices on controlling tall fescue sod in no-till soybeans. Practices included timing of herbicide application, mowing, and tank mixing bumdown herbicides with 2,4-D.

Methods

A study was initiated in the fall of 1994 in a CRP field in Crittenden County, Kentucky. The field was sown to tall fescue in 1986 and has been previously used for no-till corn production. The field had an excellent cover of fescue sod.

The bumdown herbicides included either glyphosate at 1.5 lb ai/A plus nonionic surfactant at 0.5% v/v, or paraquat at 0.47 lb ai/A plus nonionic surfactant at 0.25% v/v. The ester formulation of 2,4-D at 0.5 lb ae/A rate was tank mixed w'ith certain glyphosate treatments to evaluate potential antagonism of 2,4-D to giyphosate's control of tall fescue. Metribuzin (Sencor) at 0.38 lb ai/A plus metolachlor (Dual) at 1.5 lb ai/A were applied to all plots for preemergence control of annual grasses and broadleaf weeds. All treatments were applied with a CO_2 pressurized back-pack sprayer. Glyphosate treatments were applied in a spray volume of 10 gallons per acre (GPA), whereas, all other treatments were applied in a spray volume of 26 GPA.

The dates for herbicide applications included October 11, 1994 for the fall early preplant treatments (EPP); May 29, 1995 for the spring EPP treatments; and June 22, 1995 for the preemergence treatments (PRE). Soybeans were planted on June 22, 1995.

The site was divided in two blocks, with one block being mowed and the other block left non-mowed. Tall fescue in the mowed block was clipped with a rotary mower on May 1l and allowed to regrow to a height of about ***6*** inches before treating with spring EPP herbicides. The tall fescue in the non-mowed block was treated with Fall and spring EPP applications. Plot size was 10 feet wide by 40 feet long. Soybeans were planted with a no-till planter in rows 30 inches wide.

Tall fescue control was rated at various times throughout the season **as** percent brown vegetation. Soybean stand counts were made August 8, 1995. Plots were harvested with a plot combine October 22, 1995. Data from the mowed and non-mowed blocks were analyzed separately as a randomized complete block design with four replicates.

Results and Discussion

Timing of Herbicide Application

Multiple herbicide applications were usually needed to achieve optimum control of tall fescue in a no-tillage soybean system (Table I). None of the fall or spring EPP treatments provided complete control of tall fescue control at soybean planting, therefore, paraquat was applied as a PRE treatment to all plots.

The long-term control of tall fescue was greater when control programs were initiated in the fall than in the spring. Glyphosate applied as a fall EPP treatment followed by paraquat applied as a PRE treatment at planting resulted in 95% control of tall fescue at soybean harvest, compared with only 33 % control of tall fescue when this sequential program was initiated in the spring.

Paraquat applied as three sequential sprays (fall EPP +

Table 1. **Effect of glyphosate and paraquat sequential applications on tall fescue control and soybean stands and yield in non-mowed sod (1994-1995).**

HERBICIDE TREATMENT[1]			TALL FESCUE CONTROL (%)						SOYBEAN	
FALL EPP	SPRING EPP	SPRING PRE	11/11	3/2	5/29	6/22	7/7	10/22	STAND[2] (Plants/1')	YIELD (BU/A)
glyphosate	-	paraquat	98	99	93	87	97	95	9.8	38
glyphosate + 2,4-D ester	-	paraquat	90	98	68	63	83	85	9.1	36
glyphosate + 2,4-D ester + AMS		paraquat	91	96	73	68	94	93	8.9	38
	glyphosate	paraquat		-		73	97	33	1.3	12
	glyphosate + 2,4-D ester	paraquat			-	70	96	33	2.5	20
-	glyphosate + 2,4-D ester + AMS	paraquat			-	73	99	20	1.9	26
paraquat	paraquat	paraquat	78	81	15	75	96	87	8.5	39
-	paraquat	paraquat			-	73	90	43	3.6	24
LSD (0.05)			4	7	10	14	7	29	1.9	17

[1] Herbicide treatments:
- paraquat 0.47 lb ai/A; glyphosate lb ai/A; AMS = Ammonium Sulfate 2%; 2,4-D ester 0.5 lb ae/A.
- Spray Volume: glyphosate 10 GPA, paraquat = 26 GPA
- Metribuzin at 0.38 lb ai/A and metolachlor at 1.5 lb ai/A were applied 5/29/1995 to all plots.
- Fall EPP = Fall Early Preplant on 101111994; Spring EPP = Spring Early Preplant on 5/29/1995; Spring PRE = Spring Preemergence on 6/19/1995
- Spring EPP and Spring PRE treatments were delayed due to wet spring weather.

[2] Soybean stands were collected Aug. 8 and represent plants per ft. of row in 30 in. row width.

Table 2. **Effect of glyphosate and paraquat sequential applications on tall fescue control and soybean stands and yield in mowed sod *(1994-1995)*[1].**

HERBICIDE TREATMENT[2]		FESCUE CONTROL (%)			SOYBEAN	
SPRING EPP	SPRING PRE	6/22	7/7	10/22	STAND[3] (Plants/1')	YIELD (BU/A)
glyphosate	paraquat	80	96	68	8.0	20.8
glyphosate + 2,4-D ester	paraquat	70	99	60	7.1	22.1
glyphosate + 2,4-D ester + AMS	paraquat	80	98	68	7.6	31.7
paraquat	Paraquat	65	88	65	7.5	28.3
LSD (0.05)		6.2	6.2	NS	NS	NS

[1] Mowed tall fescue. with a rotary mower May 11,1995.
[2] Herbicide treatments:

- paraquat 0.47 lb ai/A; glyphosate 1.5 lb ai/A; AMS = Ammonium Sulfate 2%; 2.4-D ester 0.5 lb ae/A.
- Spray Volume: glyphosate 10 GPA, paraquat = 26 GPA
- Metribuzin at 0.38 lb ai/A and metolachlor at 1.5 lb ai/A were applied 5/29/1995 to all plots.
- Spring EPP = Spring Early Preplant on 5/29/1995; Spring PRE = Spring Preemergence on 6/19/1995
- Spring EPP and Spring PRE treatments were delayed due to wet spring weather.

[3] Soybean stands were collected Aug. 8 and represent plants per ft. of row in 30 in. row width.

spring EPP + PRE) provided 87% control of tall fescue at soybean harvest compared with 43% fescue control with two sequential sprays in the spring (spring EPP + PRE).

The low soybean stands and yields associated with programs initiated in the spring were attributed to feeding damage from prairie voles. Initiating the control program in the fall appeared to minimize the damage by forcing the voles to move outside the area in advance of soybean planting in order to find a food source. Delaying the treatments until spring left a food source for the prairie voles until soybeans emerged.

Spring Mowing

Rotary mowing tall fescue in the spring tended to enhance the long-term control of tall *fescue*. The application of glyphosate in the spring followed by paraquat at planting provided 68% tall fescue control in the mowed plots (Table 2) compared with 33% where fescue was not mowed (Table 1).

Similar results were observed with sequential applications of paraquat (Witt et al, 1995). Results of a study in no-tillage corn indicated that spring mowing did not improve tall fescue control except where gIyphosate at the low rate of 1 lb ai/A was applied. However, spring mowing did improve corn stands of all treatments by changing the habitat of voles and other pests that feed on corn seed and emerging plants.

Tank Mix Antagonism

A slight reduction on fescue control occurred where 2,4-D ester was mixed with glyphosate and applied in the fall. lncludingammonium sulfate with the tank mixture helped to overcome the antagonism. Results of a similar study in no-tillage corn also indicated a tendency for 2,4-D to delay fescue control with glyphosate applications, yet the affect was small and temporary (Witt et al, 1995). Antagonism of glyphosate's toxicity to other grass species has been reported by other researchers (Flint and Barrett, 1989).

Conclusions

Results of this research indicate that a high level of management is needed to achieve effective control of tall fescue in no-till soybeans. Sequential treatments of a burndown herbicide will probably be needed for optimum control of fescue in no-tillage soybeans. Furthermore, long-term control of fescue may be more consistent when the initial treatment of either glyphosate or paraquat is applied in the fall compared to when it is applied in the spring. Spring mowing may improve the long-term control of tall fescue with glyphosate or paraquat treatments. Antagonism of glyphosate's toxicity can occur with 2,4-D ester, yet it is usually temporary. Ammonium sulfate can help limit the antagonism caused by 2,4-D.

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Influence of Cover Crop and Tillage on Grain Yield and Nitrogen Status of Corn Grown on a Loessial Silt Loam and Alluvial Clay in Louisiana

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Introduction

Corn acreage has increased in recent years in Louisiana. Much of this acreage is on mixed to heavy Mississippi River alluvial soils and to a lesser extent on loessial silt loams of the Macon Ridge. Each of these soil groups are unique in their physical and chemical characteristics and different management strategies may be required to produce optimal grain yield.

Recent government policies involving soil conservation has increased the need for research developing minimum tillage systems. According to Boquet and Coco (1993), one of the principal advantages of no-till systems is more timely planting, especially on the poorly drained, clayey soils. Herbek et al. (1986) found a trend for corn yield to increase as planting date increased from late April to mid-May for the no-till system on a poorly drained soil, while for the conventially tilled plots yields decreased with delayed planting date.

In a Louisiana study, Hutchinson et al. (1993) found on the Macon Ridge only small differences in corn yield among conventional-till, reduced -till, and no-till treatments. Although limited tillage research on corn has been conducted in Louisiana, no-till or minimum-tillage production systems for cotton have shown promise, when compared to the more traditional tillage practices on alluvial clays of the Mississippi River (Boquet and Coco, 1993; Crawford, 1992; Reynolds. 1990) and on the Macon Ridge (Hutchinson and Shelton, 1990). The inclusion of winter cover crops in combination with conservation tillage was found to be an important component ofthe systems.

The use ofminimum-tillage systems may reduce soil erosion, especially on the sloping silt loams ofthe Macon Ridge (Hutchinson et al., 1991); increase soil organic matter (Boquet and Coco, 1993); reduce soil moisture evaporation (Wilhelm et al., 1986); and modify soil temperature (Wilhelm et al., 1986). The use of a leguminous cover crop, i.e. crimson clover, contributes biologically fixed N (Ebelhar et al., 1984), thus reducing the N fertilizer requirement and the potential of polluting ground water with nitrate-N.

Information is needed for corn production systems that will enhance profitability and protect the environment from unnecessary pollution of soil and water. Objectives of these experiments were to evaluate the influence of tillage systems, cover crops, and N rate on corn grain yield and N uptake.

Materials and Methods

Field experiments were conducted in 1994 and 1995 to evaluate the effects of tillage systems, cover crops, and N rate on corn grown on Sharkey clay (very-fine, montmorillonitic, nonacid, thermic Vertic Haplaquepts) at the Northeast Research Station, St. Joseph, LA, and on a Gigger silt loam (fine-silty, mixed, thermic Typic Fragiudalf) at the Macon Ridge Research Station, Winnsboro, LA. Tillage treatments were conventional tillage (CT) and no-till (NT). Cover crop treatments were native vegetation, crimson clover (‘Tibbee’) and wheat (‘Florida 303’, except Winnsboro 1995- ‘Coker 9803’). Nitrogen rates evaluated were 50, 100, 150, and 200 lb NIA.

The experimental design was a randomized complete block with a split plot arrangement of treatments having four replications. Tillage treatments were main plots and cover crops and N rates were factorially arranged as split plots. Plots were four rows wide (40-inch row width) and ranged from 28 to 50 feet long.

Conventional-till consisted of double-disking, bedding, and a bed-smoothing operation just before planting. No-till consisted of no spring primary tillage operations. At Winnsboro, the last cultivation of cotton helped rebuild the bed and no fall tillage was performed. At St. Joseph, beds were rehipped and smoothed (rolled) for planting in the fall.

Cover crops (crimson clover and wheat) were hand broadcast in 1994 and drill planted in 1995. Seeding rates were 25 lb/A for crimson clover and 120 lb/A for wheat when broadcast and 15 lb/A for crimson clover and 90 lb/A for wheat when drilled. At Winnsboro, seeds were were broadcast into standing cotton stalks. After seeding, cotton stalks were cut with a rotary mower. At St. Joseph in 1994, beds were smoothed (rolled) immediately

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after seeding the cover crops.

Cover crops were burned back in early spring each year. In 1994, two burndown applications of 0.6 lb ai/A of paraquat plus 0.25% surfactant were applied in early to late March across all cover crop treatments at both locations. A similar rate of paraquat was also applied with preemerge treatments. In 1995 at both locations, 0.6 lb ai/A ofparaquat plus 0.5% surfactant on the crimson clover and native vegetation and 1 lb ai/A of glyphosphate plus 0.5% surfactant was applied on the wheat cover crop in mid-March. A second application of 0.6 lb ai/A of gramoxone was applied about a week later St. Joseph. A similar rate of paraquat was also applied wih preemerge treatments at both locations.

Preemerge treatments consisted of labelled rates of alachlor or metolachlor and atrazine at each location. Postemerge applications were 1.5 lb ai/A of linuron and 1 lb ai/A of atrazine plus 0.25% surfactant at St. Joseph in 1994. In 1995 at St. Joseph, 1.0 lb ai/A of linuron and 1.0 lb ai/A of atrazine plus 0.5% surfactant was applied at layby. Insecticide treatment was 1 lb ai/A of carbofuran applied in-furrow in all tests.

Corn ('Pioneer 3165') was planted at about 27,000 seeds/A using a John Deere 7100 or 7300 planter. Ripple coulters, if needed, were mounted on the planter for no-till planting. At Winnsboro, planting dates were April 8 in 1994 and April 5 in 1995. At St. Joseph in 1995, planting date was April 4; however, planting dates were different for the different tillage treatments in 1994 due to inclement weather affecting the CT seedbed preparation. Planting dates were March 21 for NT and April 11 for CT.

Nitrogen treatments were broadcast at about the four-leaf growth stage. Nitrogen source was ammonium nitrate. Whole above-ground plant samples were taken from each plot at the early silk growth stage each year. Plants were dried, ground, and analyzed for N using Kjeldahl procedures. Nitrogen uptake was determined by multiplying the total dry weight at early silk by plant N concentration.

Corn was harvested from two center rows of each four-row plot, Grain yields were adjusted to 15.5% grain moisture. Analyses of variance of yield data were conducted using GLM procedures of SAS. The LSD (P=0.05) was calculated for mean separation.

Results and Discussion

Grain yields were not affected by tillage in any of the experiments (Tables 1 and 2). Although tillage treatments were confounded by planting date in 1994, the delayed planting for the CT treatment was considered part of the treatment effect. Rainfall distribution was excellent throughout the 1994 growing season. Planting date for NT (March 21) and CT (April 11) were within the recommended planting window for north Louisiana (March 15 to April 15).

Grain yields were influenced by cover crops each year at St. Joseph (Table I). Highest grain yields occurred when corn followed crimson clover and native vegetation. At St. Joseph, corn growth was severely reduced by the wheat cover crop treatments regardless of tillage treatment (Table I). Yields following wheat were decreased 24% in 1994 and 29% in 1995. Although plant populations were decreased approximately 10%following wheat, this would not account for the large differences in grain yield among cover crops.

Averaged across cover crops, yields continued to increase as N rates increased at St. Joseph each year and Winnsboro in 1995(Table I). In 1995 at Winnsboro, maximum yield occurred at 150 lb N/A. There were no significant cover crop X N rate interactions for yield, which indicates that the yield response to N rate was similar among cover crops. This is illustrated in Figs. 1 and 2 for the St. Joseph location. The increase in yield as N rates increased was very similar among cover crop treatments.

Averaged across cover crops, whole-plant N uptake at early silk continued to increase as N rates increased at St. Joseph each year, while at Winnsboro maximum N uptake occurred at 150 lb N/A (Table 2). Similar to yield response, there were no significant cover crop X N rate interactions for N uptake. At St. Joseph, the rate of N uptake was similar among cover crop treatments (Figs. 3 and 4). Nitrogen uptake ranged from 66 to 175 lb N/A in 1994 and 53 to I75 lb N/A in 1995.

The lack of a significant cover crop X N rate interaction for yield and N uptake indicates that crimson clover did not contribute significant quantities of plant-available N during the growing season. This was due in part to the slow growth of crimson clover in these experiments resuting in relatively low biomass production. The N equivalent averaged less than 40 lb N/acre at burndown (data not shown). Also, yield and N uptake response data indicates that the reduced corn yield following the wheat cover crop at St. Joseph was probably not due to N fertilizer immobilization. Other factors that might be influence the cover crop affect on yield include alleopathic effects and immobilization of the native soil N by the wheat plant.

Conclusions

Preliminary data indicate that minimum tillage systems may be equivalent to the traditional tillage systems on the alluvial clay soils and the loessial silt loam soils of northeast Louisiana. There was little agronomic benefit from cover crops in these studies. Crimson clover did not produce enough biomass and plant N for corn production systems in northeast Louisiana. Corn yield was reduced following wheat, particularly on the alluvial clay soil. The mechanism causing this yield reduction is not clear and needs to be determined.

Table 1. Influence of tillage, cover crop, and N rate on corn grain yield at St. Joseph and Winnsboro in 1994 and 1995.

Treatment	St. Joseph 1994	St. Joseph 1995	Winnsb 1994	Winnsb 1995
	bu/acre			
Tillage[1]				
No-till	136	119	129	99
Conventional	140	120	128	107
LSD(0.05)	NS	NS	NS	NS
Cover Crops				
Native	155	131	127	108
Wheat	102	95	124	99
Crimson Clover	157	131	134	104
LSD (0.05)	7	7	6	NS
N rate, lbs/acre				
50	83	78	104	79
100	130	106	129	105
150	162	136	141	109
200	178	157	141	120
LSD (0.05)	8	9	10	11

NS = Nonsignificant at the 0.05 probability level.
'No-till and conventional planted on March 21 and April 11, 1994, respectively.

Table 2. Influence of tillage, cover crop, and N rate on total plant N uptake at early silking at St. Joseph and Winnsboro in 1994 and 1995.

Treatment	St. Joseph 1994	St. Joseph 1995	Winnsboro 1994	Winnsboro 1995
	lbs N/acre			
Tillage[1]				
No-till	123	107	113	117
Conventional	136	114	106	120
LSD(0.05)	NS	NS	NS	NS
Cover Crops				
Native	141	121	104	122
Wheat	107	87	108	116
Crimson Clover	139	124	118	117
LSD(0.05)	14	17	NS	NS
N rate, lbs/acre				
50	84	76	76	95
100	126	92	109	111
150	141	124	126	130
200	165	149	130	138
LSD(0.05)	16	20	16	13

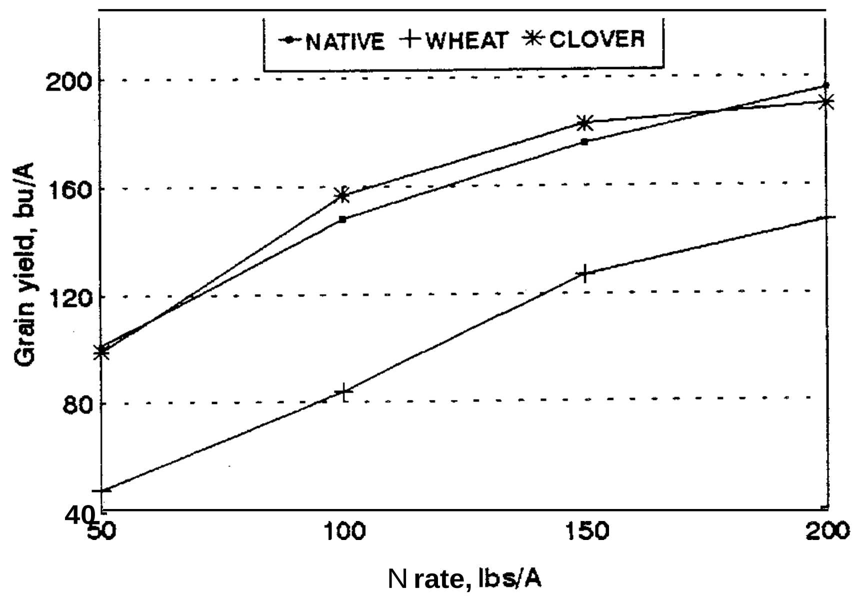

Figure 1. Influence of cover crop, and N rate on grain yield averaged across tillage treatments at St. Joseph in 1994.

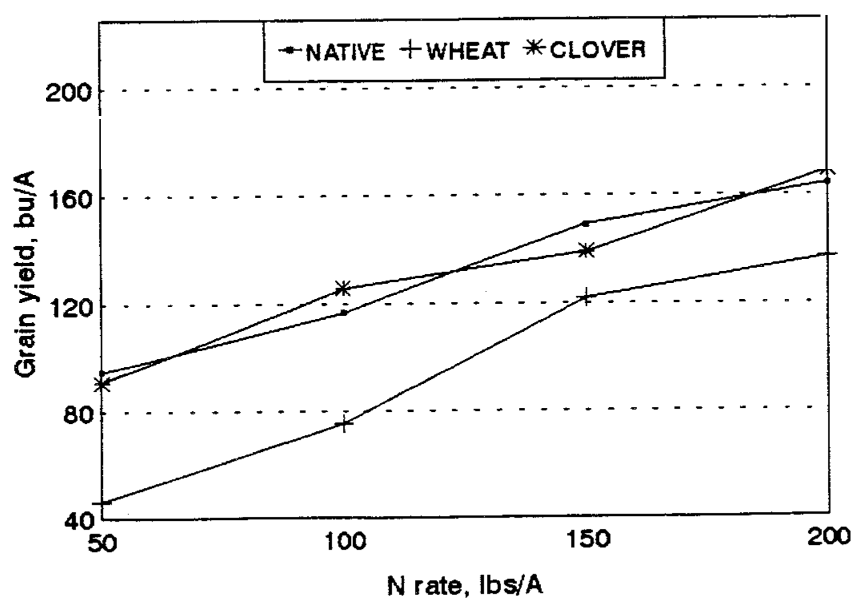

Figure 2. Influence of *cover* crop, and N rate on grain yield averaged across tillage treatments at St. Joseph in 1995.

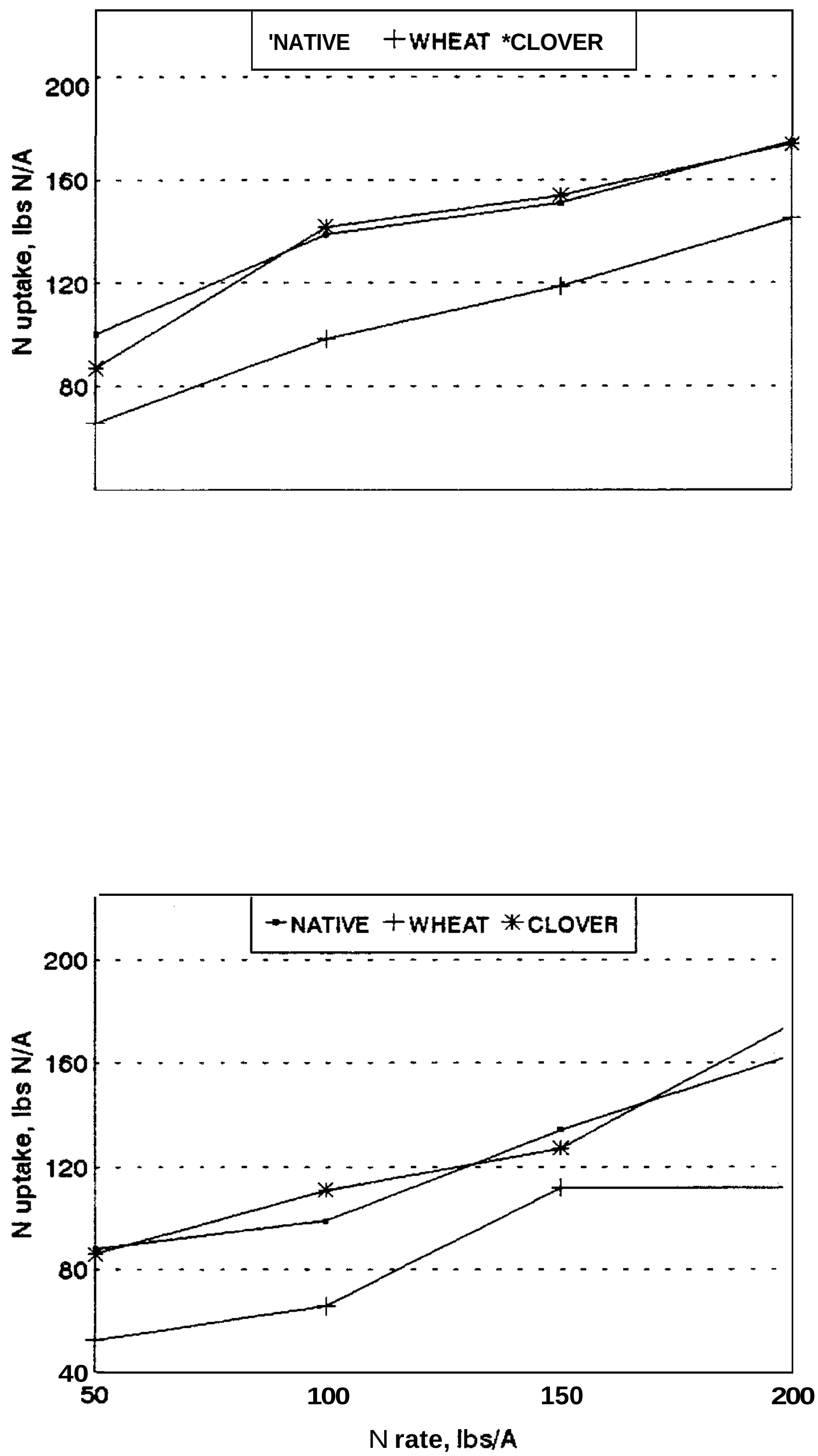

Figure 4. Influence of cover crop, and N rate on total N uptake at early silking averaged across tillage treatments at St. Joseph in 1995.

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Effect of Yard Waste Compost on Crop Tolerance to Root-knot Nematodes

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Abstract: The effects of a yard waste compost amendment and crop establishment on nematode populations and yields of susceptible vegetable crops were determined in two tests in Florida in sites infested with the root-knot nematode, *Meloidogyne incognita.* Main plot treatments consisted of 269 mt/ha of a yard waste compost applied as a mulch, 269 mt/ha of the compost incorporated into the soil, and an untreated control. Subplots involved two methods of crop establishment, transplanted three-week-old seedings of yellow squash *(Cucurbitapepo,* test 1) or okra *(Hibiscus esculentus,* test 2) and direct seeding. Root-knot nematode population densities were unaffected by all treatments and increased greatly on both vegetable crops. However, yield of yellow squash was improved ($P \leq 0.05$) by incorporation of yard waste compost and by use of transplanted seedlings rather than direct seed. The yield of plots with incorporated compost and transplanting was more than 3.5 times that of direct-seeded, unamended plots. Similar results were obtained on okra. with maximum yields from transplanted seedlings and incorporated compost. Results show the potential of compost amendment and planting method for improving the tolerance of susceptible crops to damage by root-knot nematodes.

Introduction

Numerous methods are available for managing damaging species of plant-parasitic nematodes (McSorley, 1994; McSorley and Duncan. 1995; Trivedi and Barker, 1986). Most of these methods involve the reduction of nematode population densities to levels below damage thresholds (McSorley and Duncan, 1995). Less attention has been devoted to methods which improve plant health for the purpose of increasing tolerance to existing nematode populations.

The advantages of organic amendments in improving crop performance are well known (Gallaher and McSorley, 1994; 1995). Organic amendments have also been used to reduce nematode populations, but results have not been consistent (McSorley and Gallaher, 1995b; Trivedi and Barker, 1986). Opportunities for using organic amendments in crop production are increasing as large amounts of yard waste accumulate from the urban landscape (Gallaher and McSorley, 1995). Previous work with compost derived from urban yard waste has revealed consistent benefits in crop production, but not in reduction of plant-parasitic nematode populations (Gallaher and McSorley, 1994; 1995; McSorley and Gallaher, 1995a. b). The objective of the research presented here was to use a yard waste compost amendment and crop establishment with three-week-old seedlings for improving the tolerance of highly-susceptible vegetable crops to root-knot nematodes *(Meloidogyne spp.).*

Materials and Methods

Two separate experiments, one with yellow squash *(Cucurbita pepo* L.) and the other with okra *(Hibiscus esculentus* L.), were conducted during I994 at the University of Florida Green Acres Agronomy Research Farm in Alachua County on an Arredondo fine sand (92% sand, 4% silt, 4% clay). Similar methods were used in each experiment, and in both cases the experimental design was a split-plot, with three compost treatments as main plots and two methods of crop establishment as subplots, with four replications. The compost treatments consisted of a yard waste compost applied to the soil surface as a mulch, compost applied to the soil surface and incorporated by rototilling, and an unamended control. The compost contained about 50% dry matter and consisted of 592g organic matter/kg dry weight, with pH = 7.5 and a C:N ratio of 34.4 (Table 1). Additional descriptions of the compost and its acquisition and application are described elsewhere (Gallaher and McSorley, 1995; McSorley and Gallaher, 1995a).

Main plots were 3.0 m wide and 4.5 m long, and contained four rows of plants. Plots were split on 12 April 1994, when half of each plot (2 rows, 4.5 m long) was planted with seeds of 'Dixie' yellow squash (or 'Clemson Spineless' okra in the other test), and the remaining subplot received three week-old seedlings. Crop management is described in detail elsewhere (McSorley and Gallaher, 1995a). Total yield of squash per subplot was determined from 12 harvests between 9 May and 20 June, and total okra yield was determined from 7 harvests between 27 May and 5 July.

Main plots were sampled for nematodes on 13 April and all subplots were sampled on 30 June. Each nematode sample consisted of six cores of soil (2.5-cm diameter x 20 cm deep)

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Table 1. Nutrient analysis of yard waste compost (YWC) used on research site in 1994.

Macronutrient	Amount (g/kg dry YWC)	Micronutrient	Amount (mg/kg dry YWC)
C	313.0	Cu	18
N	9.1	Fe	1825
Ca	34.1	Mn	188
Mg	1.9	Zn	118
K	2.9		
P	1.8		

collected in a systematic pattern and then combined into a plastic bag for transport. In the laboratory, a 100-cm^3 soil subsample was removed for nematode extraction using a modified sieving and centrifugation procedure (Jenkins, 1964). Extracted nematodes were then identified and counted under a dissecting microscope. Following the final harvest of each crop, five root systems were removed from each subplot, and the number of root-knot nematode galls per plant were determined. All data were analyzed using an analysis of variance (ANOVA) for a split-plot design (Freed et al., 1991), followed by Duncan's multiple-range test to compare means of main effects or means within treatment combinations if the treatment x planting method interaction was significant.

Results and Discussion

The root-knot nematode *Meloidogyne incognita* (Kofoid and White) Chitwood was the dominant nematode pest present in both test sites; data on other nematodes present are reported elsewhere (McSorley and Gallaher, 1995a). In the experiment with yellow squash, numbers of *M. incognita* present in soil increased greatly from 13 April to 30 June, reaching very high population densities regardless of compost treatment or crop establishment method (Table 2). At final harvest, more than 100 root-knot nematode galls per root system were observed on every plant examined in all subplots, regardless of treatments. Despite this lack of treatment effects on *M. incognita* populations, yield of squash was affected ($P \leq 0.05$) by both compost treatment and planting method (Table 3). Average yield of plots in which yard waste compost had been incorporated was 155% greater than that of unamended control plots, and using transplanted seedlings rather than direct seed improved yield by 38%. The yield of the best treatment combination (incorporated compost and transplanting) exceeded the state average of 12,983 kg/ha (Florida Agricultural Statistics Service, 1994) by 46% and was more than 3.5 times that of direct-seeded, unamended plots (Table 3).

Root-knot nematode densities also increased greatly over time in the experiment with okra, although lower final densities were reached on the stunted plants resulting from direct seeding than on the transplanted material (Table 4). Root systems from all subplots were heavily galled (more than 100 galls per root system). Growth of okra was poor, and plants in the direct-seeding treatment were especially stunted and had minimal yield. Greatest okra yields were obtained from transplanted plants in plots with incorporated yard waste compost (Table 5).

The lack of effect of yard waste compost on root-knot nematode numbers is not unexpected. In other tests, this material has not shown consistent activity against several species of nematodes (Gallaher and McSorley, 1994; McSorley and Gallaher, 1995b). On the other hand, the beneficial effects of yard waste compost on plant growth are well documented (Gallaher and McSorley, 1994; 1995; McSorley and Gallaher, 1995a, b). It is significant that these benefits of improved plant growth and increased yield can be achieved even in the presence of high numbers of a damaging nematode pest such as *M. incognita.*

The benefits realized through addition of an organic amendment, such as improved soil fertility, increased soil organic matter, and improved water-holding capacity, are apparently quite important in improving plant tolerance to nematode damage and infection (McSorley and Gallaher, 1995a). In contrast to direct seeding, the larger root systems of transplanted material early in the season can improve plant establishment and performance in nematode-infested sites.

Table 2. Effect of yard waste compost (YWC) treatment and crop establishment treatments on root-knot nematode densities in yellow squash.

	Nematodes per 100 cm³ soil			
		30 June		
Compost[1]	13 April	Transplanted	Seeded	Mean
YWC incorporated	6	416	303	360
YWC mulch	8	270	362	316
Control	16	460	340	400
Mean	10	382	335	
ANOVA effects:[2]				
Compost	ns	ns		
Planting method	--	ns		
Compost x Planting	--	ns		

[1]YWC incorporated or YWC mulch applied at 269 mt/ha.
[2]Analysis of variance (ANOVA) effects not significant (ns) at $P \leq 0.10$.

Table 3. Effect of yard waste compost (YWC) treatment and crop establishment treatment on yield of yellow squash.

	Yield (kg/ha)[2]		
Compost'	Transplanted	Seeded	Mean
YWC incorporated	18,900	15,300	17,100a
YWC mulch	14,800	9,800	12,300ab
Control	8,100	5,200	6,700b
Mean	13,900A	10,100B	
ANOVA effects:			
Compost	*		
Planting method	*		
Compost x Planting	ns		

'Analysis of variance (ANOVA) effect significant at $P \leq 0.05$; ns = not significant at $P \leq 0.10$. Means in column followed by the same small letter or means in row followed by the same capital letter do not differ at $P \leq 0.05$.
'YWC incorporated or YWC mulch applied at 269 mt/ha.
Total of 12 harvests.

Table 4. Effect of yard waste compost (YWC) treatment and crop establishment treatment on root-knot nematode densities in okra.

	Nematodes per 100 cm³ soil			
		30 June		
Compost[1]	13 April	Transplanted	Seeded	Mean
YWC incorporated	3	330	94	212
YWC mulch	6	276	206	241
Control	24	106	110	108
Mean	11	237 A	137 B	
ANOVA effects:				
Compost	ns	ns		
Planting method	–	*		
Compost x Planting	–	ns		

*Analysis of variance (ANOVA) effect significant at $P \leq 0.10$; ns = not significant. Means in row followed by different capital letters differ at $P \leq 0.10$.
[1]YWC incorporated or YWC mulch applied at 269 mt/ha.

Table 5. Effect of yard waste compost (YWC) treatment and crop establishment treatment on yield of okra.

	Yield (kg/ha)[2]		
Compost[1]	Transplanted	Seeded	Mean
YWC incorporated	2,270 a A	340 a B	1,310
YWC mulch	450 b A	30 a A	240
Control	610 b A	40 a A	330
Mean	1,110	140	
ANOVA effects:			
Compost	ns		
Planting method	ns		
Compost x Planting	*		

*Analysis of variance (ANOVA) effect significant at $P \leq 0.10$; ns = not significant. Means in columns followed by the same small letter or means in rows followed by the same capital letter do not differ at $P \leq 0.10$.
[1]YWC incorporated or YWC mulch applied at 269 mt/ha.
[2]Total of 7 harvests.

Unfortunately, the ability of a host plant to tolerate nematode damage varies with the plant cultivar, characteristics and dynamics of the nematode population, and numerous physical and environmental factors (McSorley and Duncan, 1995; Roberts, 1982). Much future research will be needed to improve the consistency and reliability of this promising strategy for nematode management.

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Suitability of Sunn Hemp as an Alternative Legume Cover Crop

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Abstract: The tropical legume sunn hemp *(Crotalaria* juncea L.) may have potential as an alternative legume cover crop for southeastern cropping systems. The objective of this study was to determine dry-matter production and N accumulation and release from sunn hemp under conventional tillage and no-tillage systems as might be used in a corn *(Zea mays* L.) production system. 'Tropic Sun' sunn hemp was sown in mid August and mowed in early December (after killing freeze) in 1991 and 1992 on a Norfolk sandy loam (fine-loamy, siliceous, thermic. Typic Kandiudults) in east-central AL and in 1992 on a Lucedale tine sandy loam (tine-loamy. siliceous. thermic Rhodic Paleudults) in southwestern AL. Mesh bags were used to determine residue decomposition and N release. Average dry-matter production was 5.9 Mg ha.' 9-12 wk (dependent on killing freeze date) after planting. Nitrogen content of residue averaged 126 kg N ha.' at this time. Residue was left on the soil surface (over-wintered) until early April when corn would normally be planted. Approximately 75 to 80 kg N ha^{-1} was released from the residue during winter. In April, (16 wk after sunn hemp was mowed). N remaining in over-wintered residue was 38% (45 kg N ha^{-1}) of that after fall mowing. Nitrogen release from over-wintered residue during the subsequent corn growing season was 13% in no-tillage and 43% in conventional tillage. Sunn hemp produced sufficient dry-matter to cover and protect soil from erosion and provided N to benefit a succeeding summer crop. Sunn hemp thus has potential as an alternative to winter legume cover crops in southeastern cropping systems.

Introduction

The practical use of winter legume cover crops is often limited by asynchronization of cover crop planting windows and biomass accumulation with planting/harvesting windows for summer cash crops like corn and cotton *(Gossypium hirsutum* L.). An alternative to winter annual legume cover crops may be adapted tropical legumes that quickly produce biomass to provide soil cover and accumulate N. One tropical legume that may be adapted to residue management systems in the Southeast is sunn hemp. This legume has been used extensively for soil improvement or green manuring in the tropics (Lales and Mabbayad, 1983). This *Crotalaria* species is nontoxic and can be used as a forage as well as a green manure (Rotar and Joy, 1983). Although not winter hardy, sunn hemp may produce sufficient biomass during fall (until killing freeze) to provide ground cover and N to a following summer cash crop in southern temperate regions.

This study was conducted to determine the suitability of late-summer planted 'Tropic Sun' sunn hemp [released by USDA-NRCS and the University of Hawaii, Hawaii Institute of Tropical Agricultural and Human Resources (Rotar and Joy, 1983)] as a green manure and cover crop for summer grain production systems in the Southeast. Specific objectives were to: (i) determine total biomass production and N accumulation of sunn hemp during a period extending from corn harvest until the first killing freeze (September through November); and (ii) determine N release from over-wintered (December through March) sunn hemp residue under no-tillage and conventional tillage during the period when a subsequent summer cash crop would be grown.

Materials and Methods

This research consisted of two studies. The first study determined biomass and N accumulation of sunn hemp used as a cover crop. It was conducted at the E.V. Smith Research Center (EVS) of the Alabama Agricultural Experiment Station, Shorter, Alabama, on a Norfolk fine sandy loam in fall of 1991 and at both EVS and the Monroeville Experimental Field (MEF), Monroeville, Alabama., on a Lucedale fine sandy loam in fall of 1992. On 16 August 1991, sunn hemp was sown following conventional tillage (moldboard plowing, disking and leveling) at EVS. In 1992, sunn hemp was sown using conventional tillage at EVS on 2 September and at MEF on 18 August. These dates corresponded to a feasible sowing time for cover crops following summer corn harvest. Sunn hemp seed was inoculated with cowpea *(Vignu unguiculata* (L.) Walp.] type rhizobium and drilled at *56* kg ha^{-1}, 2 to 4-cm deep. The experimental design was a randomized complete block with eight replications. Above ground sunn hemp herbage was harvested (two- 0.25 m^2 areas) at 3, 6, 9, and 12 wk after planting (WAP) or until fall-freeze killed the plants. Whole plants were separated into a fraction containing leaves and flowers (leaves) and a fraction containing stems and petioles (stems) and oven-dried at 55 °C for 72 h. After weighing, plant fractions were ground to pass a I-mm screen and analyzed for total N using a LECO CHN-600 C-H-N analyzer

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(Leco Corporation, 3000 Lakeview Ave., St. Joseph, MI).

The second study was conducted at EVS to determine decomposition of over-wintered sunn hemp residue under no-tillage and conventional tillage during spring and summer 1992, corresponding to the period when corn would normally be grown. On 24 March 1992, at EVS, sunn hemp residue that had been mowed and left in place in the field during winter was collected, cleaned of loose soil particles, and air-dried in a greenhouse. Twenty-gram subsamples of residue were placed in 15 by 30 cm nylon mesh bags, having 1-mm openings and 57% open area. The 20-g residue subsample size was based on the average residue weight for a 15 by 30-cm area, corresponding to the bag size. Mesh bags were placed in the field on 17 April 1992, which is within the normal planting window for corn or cotton.

The experimental design was a split plot with four replications. Main plots were no-tillage and conventional-tillage residue management systems that would have been used for a corn crop following sunn hemp. Over-wintered residue that had been mowed and left on the soil surface from December until April was left in place in no-tillage plots. In conventional tillage plots, residue was disked into the soil (I 5-cm depth). Subplots were sampling dates of 0, I, 2, 4, 8, and 16 wk for bag retrieval. Bags were placed on the surface of no-tillage plots or buried to the plow layer depth (10 to I5 cm) in conventional tillage plots. Glyphosate *[(N-(phosphonomethyl))glycine]* was used to keep the area weed-free during the study.

Collected bags were carefully cleaned to remove soil. Residue material inside each bag was oven-dried at 55 °C for 72 h, and then weighed. Samples were ground to pass a 1-mm screen with a Wiley Mill. Total N was determined on an ash-free basis using a LECO CHN-600 analyzer.

Data were subjected to analysis of variance and regression analyses using the Statistical Analysis System (SAS Institute Inc., 1988; Littell et al., 1991). Nonlinear models were fitted using TableCurve (Jandel Scientific, San Rafael, CA 9490I). Models were selected based on F statistics ($P \leq 0.05$). In all cases the simplest model that best fit the data was used.

Results and Discussion

Dry Matter Production

Dry matter production varied by site-year and sample date ($P \leq 0.01$, data not shown). Sunn hemp biomass 12 WAP averaged 7.3 and 4.8 Mg ha^{-1} at EVS in 1991 and 1992, respectively, and 5.7 Mg ha^{-1} at MEF in 1992. Average sunn hemp biomass production for the three site-years (5.9 Mg ha^{-1}) was comparable to reported values for the two most common cover crops in the Southeast, i.e., hairy vetch *(Vicia villosa* Roth) (4.9 Mg ha^{-1}; Touchton et al., 1984) and crimson clover *(Trifolium incarnatum* L.) (5.0 Mg ha^{-1}; Reeves et al., 1993). For all site-years, after 3 wk, sunn hemp grew rapidly until 9 WAP (late October) and then slowed as temperatures declined.

Nitrogen Accumulation

Nitrogen accumulation was higher in leaves than stems (Fig.1). Nitrogen accumulation ranged from 46 to 50 kg h a' in stems and from 61 to 78 kg ha^{-1} in leaves 9 WAP. Total N accumulation was 136 kg ha^{-1} 12 WAP at EVS in 1991, 120 kg ha^{-1} 9 WAP at EVS in 1992, and 123 kg ha^{-1} 12 WAP at MEF in 1992. Nitrogen accumulation from sunn hemp in our study was similar to the range reported for hairy vetch and crimson clover cover crops (Reeves, 1994).

Decomposition/N release from Over-Wintered Residue

Residue decomposition of over-wintered residue at EVS during spring-summer 1992 (corresponding to corn growing season) depended on tillage system employed (Fig. 2). In conventional-tillage, residue decomposition was best described by a quadratic function. For no-tillage, however, a linear function provided a superior fit. Dry-weights of residue decreased to 36 and 69% of initial values at 16 wk in conventional and no-tillage systems, respectively.

Loss of N from over-wintered residue in both conventional-tillage and no-tillage systems was described by two quadratic models, dependent on the time period (Fig. 3a-c). Net immobilization was shown during 0 to 4 wk (Fig. 3b), and mineralization occurred from 2 to 16 wk (Fig. 3c). Little mineralization occurred in the no-tillage system. As explained before, most plant N was in leaves which decomposed during the winter; remaining over-wintered material was primarily stems. Stem tissue had a high lignin content and C/N ratio (data not shown), which would reduce N mineralization. Nitrogen remaining in residue at 16 wk after corn planting date was 57% and 87% in conventional-tillage and no-tillage, respectively (Fig. 3a,c).

At mowing in fall 1992, sunn hemp residue contained approximately 120 kg N ha^{-1} at both locations (Fig. I). During the 16 wk over-wintering period, approximately 75 kg h a' of this N was released. At corn planting the next spring, approximately 45 kg N ha-'was left in the residue.

Conclusions

As an alternative to winter cover crops, sunn hemp produced a large quantity of dry matter during the late summer/ fall season (average 5.9 Mg ha^{-1} in 9-12 wk). The residue contained approximately 120 kg N ha^{-1}, and when mowed provided excellent soil coverage. Approximately 75 kg N ha-I was released from residue to the soil during the winter. Nitrogen release from the 45 kg N ha^{-1} in the over-wintered residue during a subsequent corn growing season averaged 13% under no-tillage and 43% under conventional tillage. The ability to rapidly accumulate biomass and N during such a short period after normal harvesting windows for summer cash crops shows that sunn hemp has potential to be managed as an alternative to winter legume cover crops in Southeastern cropping systems.

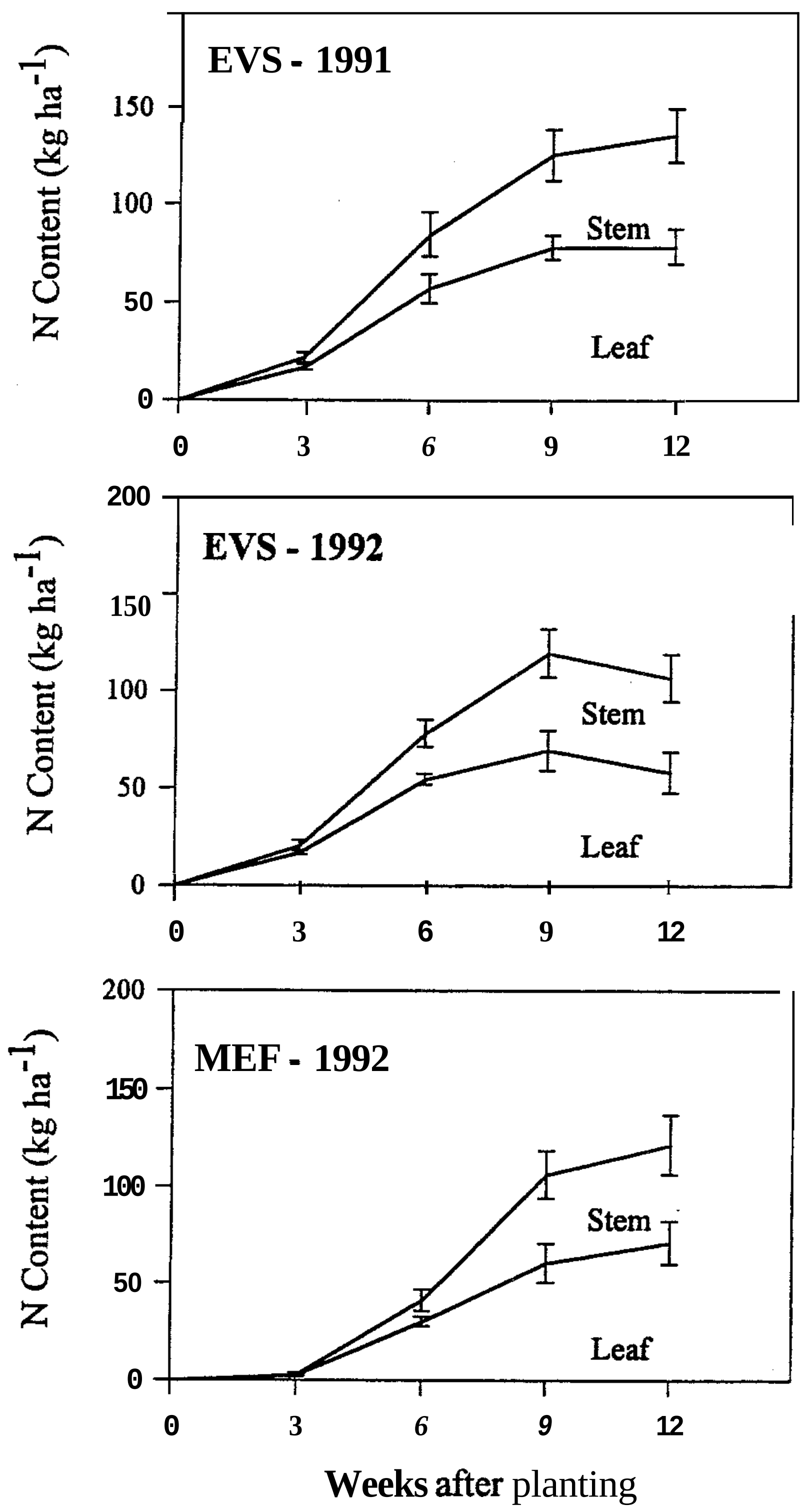

Fig. 1. Nitrogen accumulation in sunn hemp at EVS in 1991 and 1992, and MEF in 1992. Vertical bars are standard errors.

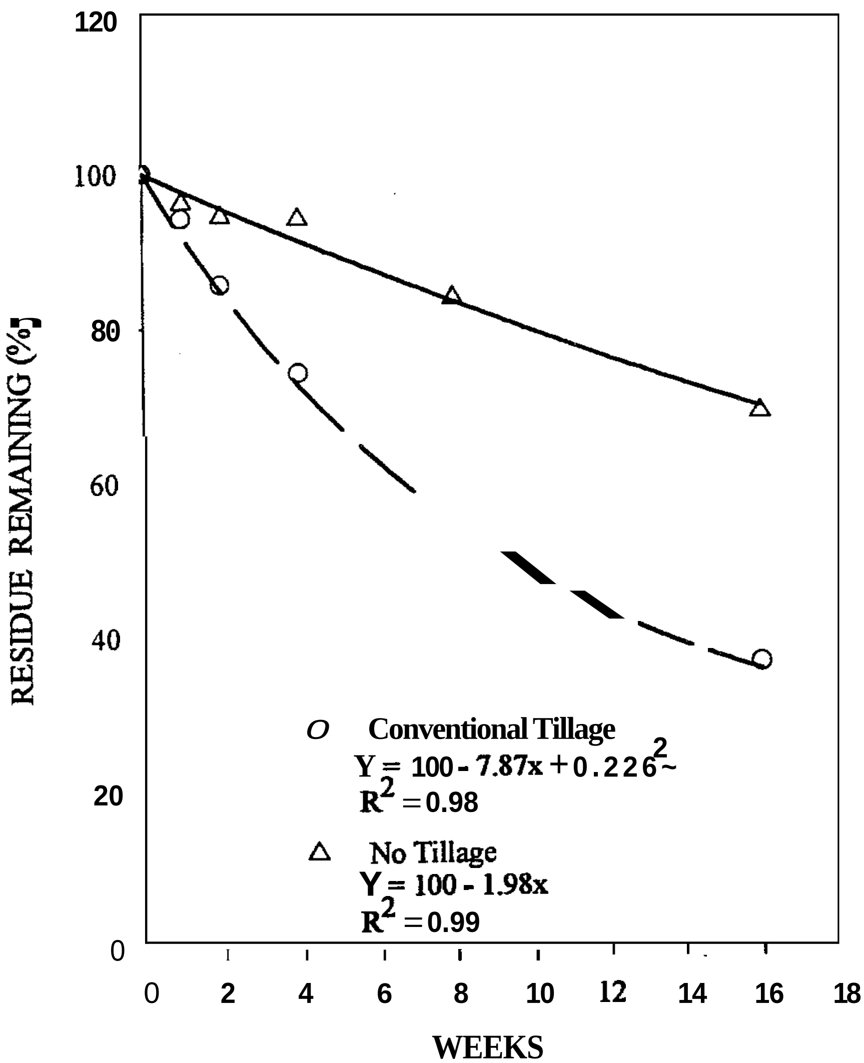

Fig. 2. Decomposition of over-wintered sunn hemp residue from 17 April to 7 August 1992 (normal corn growing season) *at* EVS as affected by tillage system.

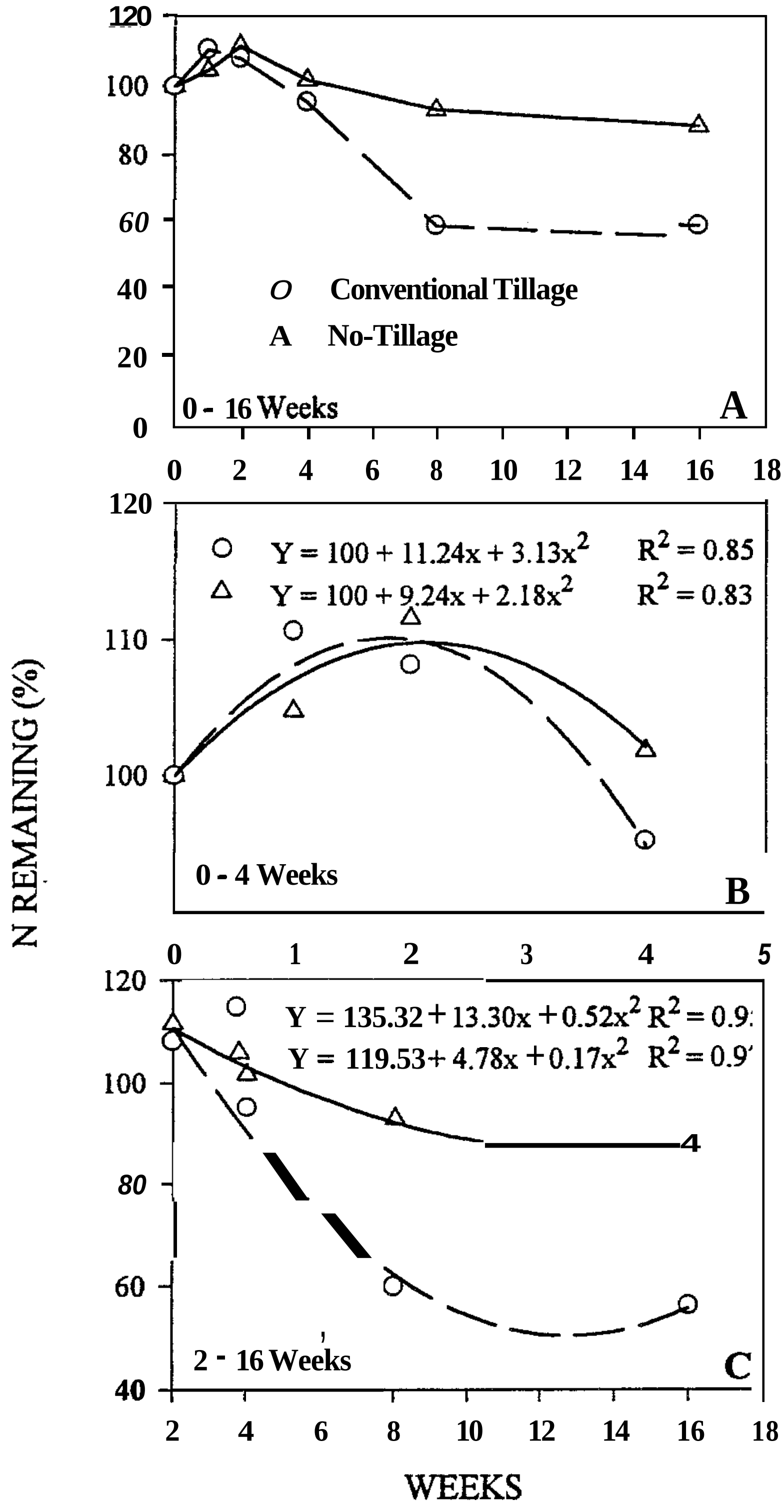

Fig. 3. Percentage of initial N remaining in over-wintered sunn hemp residue from 17 April to 7 August 1992 at EVS as affected by tillage system. A) during entire 16 wk period, B) during 0 to 4 wk period, and C) during 2 to 16 wk period.

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Pasture Soil and Vegetation Response to Renovation Tillage

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Abstract: Information is needed to determine if renovation tillage improves soil quality and forage productivity in Southeastern pastures. A study was conducted at Crossville AL on a Hartsells fine sandy loam (tine-loamy, siliceous thermic, Typic Hapludult) to determine soil and vegetation responses to renovation tillage in grazed and ungrazed pastures. A I.6-ha endophyte-infected tall fescue *(Festuca arundinacea,* Schreb.)-bermudagrass *(Cynodon dactylon* (L.) Pers.) pasture was subdivided into 18 7.3-m x 30.5-m plots: one-half of the plots were continuously grazed, and one-half cut for hay in May and September 1994-1995. Renovation tillage treatments *(Aer-way* pasture renovatort. Paraplow@.and no-tillage) were applied in March 1994 and 1995. Although changes in bulk density related to tillage treatment were detected one year after initial treatment. well-defined trends were not observed. The Paraplow effectively lowered soil strength to 32 cm in both grazed and ungrazed plots. However, Paraplow tillage of ungrazed plots resulted in a 26% decrease in root length density at 0-5 cm. *Aer-Way* treatment of grazed plots resulted in an 19% higher root biomass at 0-5 cm one year after initial treatment. Paraplow and *Aer-Way* treatments increased residue and bare ground percentages in grazed plots in 1994. In 1995. residue percentage increased in all Paraplow-treated plots, grazed and ungrazed. Renovation tillage increased dry matter yields compared to no-tillage under dry soil conditions and this increased yield translated into greater removal of herbage N and P. The Paraplow appears to be an effective pasture renovation tillage method for reduction of layers of high strength in the soil studied. Further study is needed to determine if alterations in pasture cover composition and root biomass induced by repeated renovation tillage impact forage yield and quality, pasture hydrologic condition, and water quality.

Introduction

Grazing has both direct and indirect effects on hydrologic processes in pastures (Thurow, 1991). The direct physical effect of an animal's hoof action causes mechanical injury to plants or loss of vegetation. Indirect effects include creation of compacted layers that can result in reduced infiltration rates and increased surface runoff. As pasture infiltration rates decrease, less water is available for forage production (Abdel-Magid et al. 1987) and quality of forage produced is lowered. Little information is available on the impacts of grazing on hydrologic condition of Southeastern pastures, but the impacts may be significant. Renovation tillage has been presented as a management technique that increases infiltration rates and thus, may enhance pasture hydrologic condition. There is currently widespread producer interest in improved hydrologic condition of southem region pastures through the use of renovation tillage. A major reason for this interest in Alabama is the desire to reduce surface runoff and increase nutrient retention on pastures to which poultry waste has been applied. Producers are also interested in pasture productivity responses to various renovation techniques.

High infiltration rates are often associated with large, interconnected macropores that are open to the soil surface (Helalia, 1993). Tillage usually increases infiltration in the short term since breaking the surface soil generally decreases bulk density and increases porosity and potential water storage (Mukhtar et al. 1985). However, in pasture situations where permanent sods exist, tillage is kept at a minimum. Tillage implements used in pasture situations generally concentrate on loosening surface soil while as much vegetation is left intact as possible. Pasture renovators that resemble 'pitting' implements used on rangeland and the Paraplow (Tye Manufacturing, Lockney TX), or the more recently available Paratill (Bigham Brothers, Inc., Lubbock TX), tillage tools that loosen surface soil but do not drastically invert it, are tillage options available for pasture use.

The *Aer-Way* Renovator (Holland Hitch Inc., Wiley TX) is a ground-driven rolling-tined aerator/cultivator being marketed as an implement that can improve pasture conditions relative to surface soil porosity and soil microbial activity. However, there has been no published study of the effectiveness of this practice for enhancement of pasture soil quality or hydrologic condition. Information is also unavailable on the effects of off-set shank deep-tillage in Southeastem pastures. However, limited research in England found that soil loosening by the Paraplow after an initial forage harvest resulted in an annual yield loss of approximately 25

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percent, which was attributed to damage to the grass root system (Douglas, 1994).

The objective of this study was to quantify and compare the effects of the *Aer-Way* pasture renovator and Paraplow tillage treatments on soil physical properties and vegetative characteristics of grazed versus ungrazed tall fescue *(Festuca arundinacea* Schreb.)-bermudagrass *(Cynodon dactylon* (L.) Pers.) pastures.

Materials and Methods

The study site was located on a Hartsells fine sandy loam (fine-loamy, siliceous, thermic, Typic Hapludult) at the Sand Mountain Substation of the Alabama Agricultural Experiment Station, DeKalb County AL. One 1.6-ha endophyte-infected tall fescue-bermudagrass pasture was subdivided for the study; the pasture had been used to graze cows and calves continuously since 1981. One-half of the pasture was grazed continuously at a moderate to heavy stocking rate of 26 cow-calf pairs, and one-half of the pasture was excluded from grazing. Experimental design was a randomized complete block with three replications per treatment. Nine 7.3 x 30.5-m plots were located within each pasture. Renovation treatments in both pastures included 1) Paraplow, 2) *Aer-Way* pasture renovator and, 3) no-tillage. Renovation treatments were applied annually on 24 April 1994 and 11 May 1995. Cattle were returned to the grazed pasture upon completion of renovation treatments.

Soil cores were collected using a tractor-mounted soil probe (Giddings Machine Co., Fort Collins, CO) and 5-cm diameter x 92-cm length soil tubes on 21 March 1994 (five locations per plot), and 17 March 1995 (three locations per plot). Bulk density was determined on core sections from 8-13 cm, 18-23 cm, 28-33 cm, 43-48 cm, and 58-63 cm using the core method (Drew and Saker, 1980). Soil strength was measured prior to application of initial renovation treatments (2I March 1994), two months subsequent to initial treatment **(6** June 1994), then six months and one year after initial treatment (14 October 1994, and 17 March 1995, respectively). Soil strength was measured to 50 cm using a cone penetrometer (American Society of Agricultural Engineers, 1988, Standard ASAE S313.2).

Soil cores were sampled for root analyses as described for bulk density at five different locations within each plot on 21 March 1994, and 17 March 1995. Cores were separated into seven segments: 0-5 cm, 5-10 cm, 10-15 cm, 15-20 cm, 20-31 cm, 3 1-46 cm, 4 6-61 cm, then roots washed from each segment using a hydroneumatic elutriation system (Smucker et al. I982 [Gillison's Variety Fabrication Inc., Benzonia MI]), and stored in 150ml L-1 ethyl alcohol. Root length was determined using a Comair Root Length Scanner (Hawker de Havilland, Ltd. Salsibury, SA), and root biomass determined after samples were dried (60°C, 48 h).

Cover composition was determined from five transects (45 points per transect) per plot. Forage yield was determined on ungrazedplots 14 May 1994, 14 September 1994, and 2 May 1995. Forage quality measurements: acid detergent fiber, permanganate lignin, neutral detergent fiber (Goering and Van Soest, 1970) and in vitro dry matter digestibility (Tilley and Terry, 1970), were determined on samples ground to pass a I-mm mesh (Udy Cyclone Mill). Plant P concentrations were determined as molybdovanadophosphoric acid for 0.1 N HCI acid extracts of dry ash from 0.25 g tissue (Hue and Evans, 1986); nitrogen tissue concentrations were determined by the Kjeldahl method.

Data were analyzed using ANOVA (SAS Institute, Inc., 1990). Mean differences were separated using Fisher's protected LSD (Steele and Torrie, 1980). Means for response variables measured in grazed and ungrazed plots were compared using the t-test. Probability level for rejection of the null hypothesis was set at 0.10.

Results and Discussion

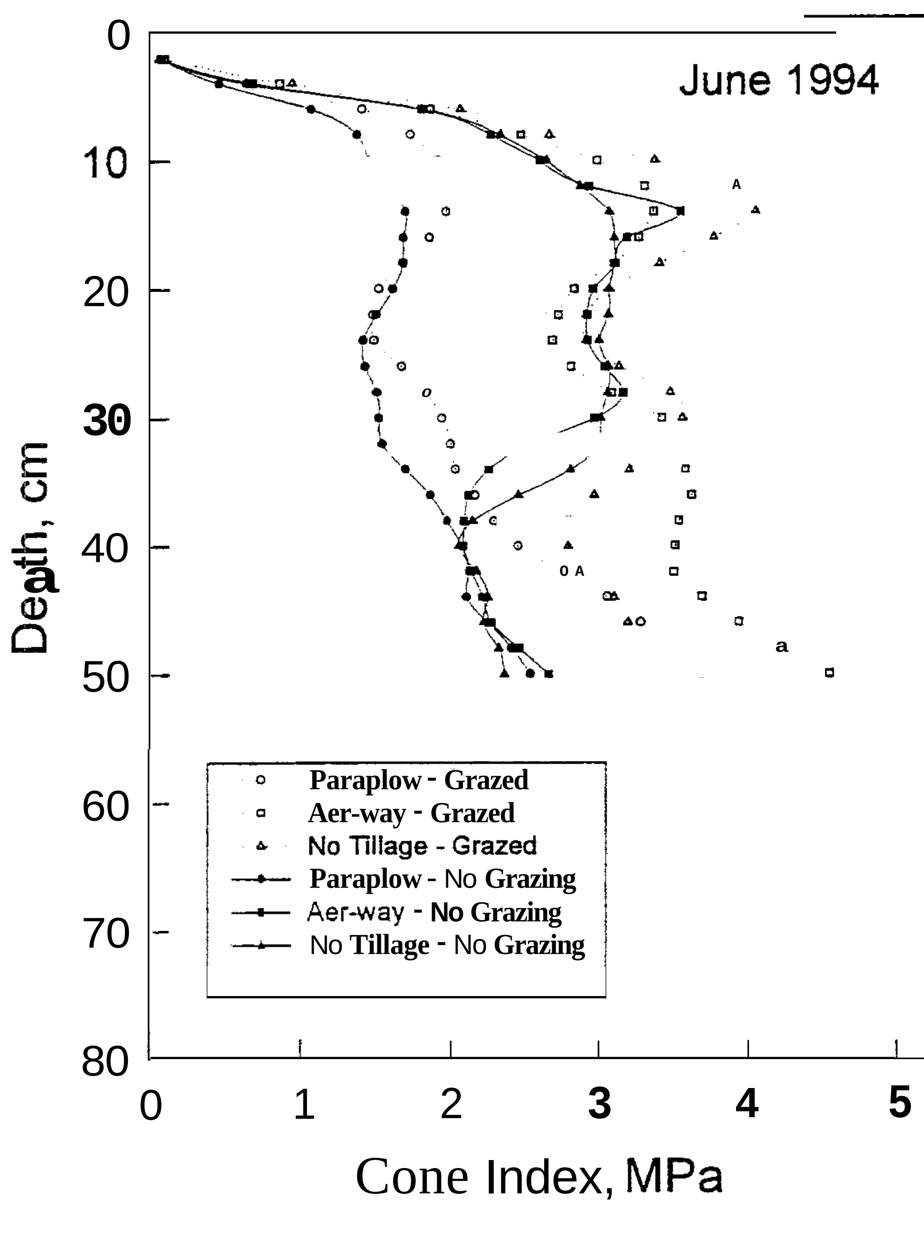
Soil Response to Renovation Tillage

Initial soil bulk density and cone index profile values were relatively uniform among designated treatment areas prior to renovation tillage. As expected, both bulk density and cone index varied with depth. Although changes in bulk density attributed to tillage were detected one year after initial treatment, well-defined trends were not observed. However, significant differences in cone index values related to tillage treatment were detected two (Fig. 1), six, and twelve (Fig. 2) months after initial renovation tillage treatments. Paraplow-treated sods had consistently lower cone index values when compared to the *Aer- Way* and no-tillage sods, regardless of grazing treatment. Also, annual Paraplow treatment effectively lowered soil strength to a depth of 32 cm compared to initial cone index values. Treatment with the *Aer- Way* renovator did not maintain lower soil strength compared with initial cone index values.

Plant Response to Renovation Tillage

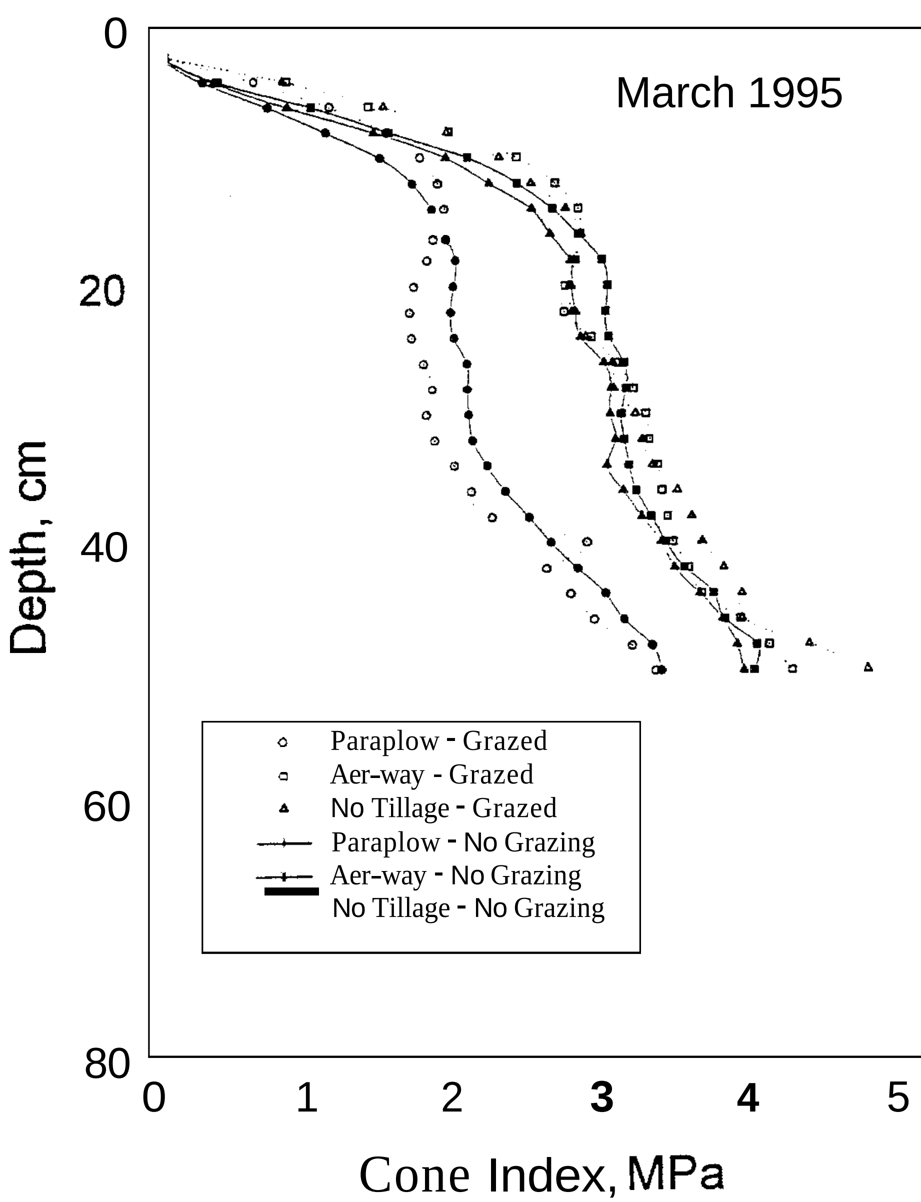
Ground cover composition revealed that in grazed plots, treatment with the Paraplow or the *Aer-Way* increased residue and bare ground percentages compared to no-tillage in May 1994 (data not shown). Cover composition measured in May 1995 indicated that treatment with the Paraplow resulted in greater amounts of residue in both grazed and ungrazed areas compared to *Aer- Way* or no-tillage treatment.

Root length density was approximately 26% lower at 0-5 cm in ungrazed plots one year after Paraplow treatment: 70.1 versus 52.3 cm cm^{-3} for 1994 and 1995, respectively. Root biomass increased approximately 19% at 0-5 cm in grazed plots one year following *Aer-* Way treatment: 9.I versus 15.9 mg cm^{-3} for 1994 and 1995. respectively. When total root length density of each core was analyzed, grazed and ungrazed Paraplow-treated plots had lower root length densities compared to *Aer-Way* or no-tillage plots (Table 1). However, there were no significant differences in total core root



Depth cm	$LSD_{0.10}$ G	NG
2	ns	ns
4	ns	0162
6	0.448	0.298
8	0.595	0.305
10	0.775	0421
12	0.760	0.387
14	0.610	0.370
16	0.573	0.462
18	0.419	0.554
20	0.353	0.593
22	0.218	0.548
24	0.276	0.598
26	0.474	0.792
26	0642	0.972
30	0.625	1.192
32	0.902	ns
34	1.067	ns
36	0.886	ns
38	0.687	ns
40	0.659	ns
42	0.513	ns
44	ns	ns
46	ns	ns
48	ns	ns
50	ns	ns

Figure 1. Cone index (June 1994) at 25 soil depths as influenced by renovation tillage treatments in a tall fescue-bermudagrass pasture, Crossville AL. G = grazed; NC = not grazed; ns = not significant ($P \leq 0.10$).



Depth cm	$LSD_{0.10}$ G	$LSD_{0.10}$ NG
2	ns	ns
4	0.165	ns
6	0.212	ns
8	0.175	ns
10	0.103	0.396
12	0.166	0.428
14	0.195	0.379
16	0.236	0.318
18	0.204	0.198
20	0.151	0.200
22	0.183	0.274
24	0.336	0.367
26	0.419	0.182
28	0.502	0.251
30	0.515	0.310
32	0.384	0.257
34	0.410	0.324
36	0.471	0.279
38	0.509	0.178
40	0.374	0.184
42	0.554	0.150
44	0.591	0.236
46	0.451	0.322
48	0.511	0.578
50	0.445	0.516

Figure 2. Cone index (March 1995) at 25 soil depths as influenced by renovation tillage treatments in grazed and ungrazed tall fescue-bermudagrass pasture, Crossville AL. G =grazed: NG = not grazed; ns = not significant ($P \leq 0.10$).

Table 1. Total root length density and total root biomass prior to and one year after renovation tillage treatments in grazed and ungrazed tall fescue-bermduagrass pasture, March 1994 and March 1995, Crossville, Al.

	Initial root measurements (1994)		Root measurements one year after treatment (1995)	
	Designated Grazed	Designated Ungrazed	Grazed	Ungrazed
	Total root length density			
	cm cm^{-3}			
Paraplow	103 8	101 4	101 [illegible]	35 Z5
Aer-way	103 4	104 4	1Z8 8	120 5
No Tillage	100 5	88 01	13≤ 0	110 ≤
$LSD_{0.1}$	ns	ns	23 19	Z1 71
	Total root biomass			
	mg cm^{-3}			
Paraplow	12 03	10 43	14 01	10 6Z
Aer-way	11 51	13 ≤Z	13 1Z	14 45
No Tillage	13 7[illegible]	10 44	13 08	10 45
$LSD_{0.1}$	ns	3 201	ns	ns

ns = Differences between treatments within a grazing pressure were not significant at the 10% probability level biomass values between treatments. This data suggests that Paraplow treatment may alter structure and distribution of forage root systems, but not total biomass.

Despite decreased root length densities for Paraplow-treated plots, forage dry matter yield was not reduced. Comparison of dry matter yields revealed no significant differences between tillage treatments during the wet year of 1994. However, during the exceptionally dry spring of 1995, dry matter yields in *Aer- Way*-treated plots were 23% higher than yields in Paraplow plots. Also, Paraplow tillage and *Aer-Way* renovation increased forage yield 24% and 53%, respectively compared to plots that did not receive tillage.

Within a season, forage quality differed little between renovation tillage treatments (data not shown). However, forage harvested from ungrazed plots treated with either the Paraplow or *Aer- Way* renovator had higher N and P contents compared to forage harvested from no-tillage plots in May 1995 (data not shown).

Conclusions

Preliminary data suggest that reduction and maintenance of lower soil strength in compacted soil layers is a potential advantage of using the Paraplow for pasture renovation on the soil studied. From the standpoint of soil loss, a potential advantage of *Aer- Way* renovation tillage is increased root biomass at shallow depths. Also, while plants may produce a larger root system than is needed simply for uptake of soil nutrients and water, the extra investment serves primarily for increased competitive effectiveness (Caldwell 1987). Thus, weed invasions may be decreased in pastures renovated with this implement. Both renovation tillage practices appear to have the potential to increase dry matter yields from hayed pastures. and thus, increase nutrients removed in hay.

Even though hay yields were not reduced, a potential disadvantage of Paraplow tillage is a decrease in root length density at shallow depths. Long-term observations should help determine whether or not this decrease translates into a loss of competitive effectiveness of the desirable grasses. Another potential disadvantage of treatment with either the Paraplow or *Aer-Way* is that an increase in percentage bare ground in grazed pasture may result and this increase may also occur in ungrazed Paraplow-treated pastures.

Additional data are being collected through 1998 to determine if observed trends in soil and vegetative characteristics continue and if cumulative effects occur. Also, data are being collected that will allow correlation ofchanges in sediment and nutrient loss through runoff, and nutrient loss through leaching, to modifications in soil and vegetative properties. Energetic and economic analysis of power requirements will also be obtained. Based on the current data, a final recommendation about the effectiveness of either tillage practice for sustaining pasture soil quality or forage productivity is premature at this time.

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Physical Characteristics of Kentucky Soils with Different Tillage Histories

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Introduction

No-till soils tend to have higher organic matter content compared to conventionally tilled soils. Organic carbon content is an important factor influencing soil chemical (pH, CEC, etc.) and physical (bulk density, compactibility, aggregate stability, etc.) properties. Continuous conventional tillage has been shown to have a negative effect on soil aggregate size and stability as compared to continuous no-tillage (Baldock and Kay, 1987). Soils with high aggregate stability are better aerated, more resistant to compaction, have higher water holding capacity, and provide better conditions for plant root growth.

The effect of various soil constituents on soil aggregate stability may differ in different soils. Chaney and Swift(1987) observed highly significant correlations between soil aggregate stability and organic matter content in 26 British soils and little or no correlation between aggregate stability and other soil constituents.

This study was initiated to determine the effect of different tillage histories on soil bulk density, aggregate stability, and organic matter content.

Materials and Methods

Soil samples of Lonewood loam (Fine-loamy, siliceous, mesic Typic Hapludult) were collected at 16 locations having different tillage histories in Russell County, Kentucky. Soil samples for chemical analysis and bulk density were taken from four depths in 5-cm increments. Nine sites had 10 to 20 years of no-tillage history, except for one field which had only two years in no-tillage. Four locations had a history of conventional tillage (up to 20 years), and three sods had not been tilled at all. Soil organic carbon was measured using a dry combustion analysis in a Leco CR-12 Carbon Analyzer.

Additional soil samples from 0 to 5 cm were taken in each location for aggregate stability measurement. These soil samples were crushed by hand while still slightly moist, air dried, and a 1 to 2 mm fraction separated. A single sieve modification of Yoder's (1936) method was used. Six g of aggregates was evenly layered into a I-mm sieve 7.5 cm in diameter. Samples were gradually wetted with a fine mist sprayer for 20 minutes. Then sieves were placed in a holder and submerged in water at room temperature. A motor raised and lowered sieves 1.5 cm, 20 times/min for 10 min. At the end of this time sieves containing the stable aggregates were dried in an oven at 110oC to determine the weight of stable aggregates. To separate sand particles from the stable aggregates the aggregates were wetted again and rubbed across the sieve screen with a rubber tipped rod until they disintegrated. Sand particles remaining on the screen were oven dried and weighed. Soil aggregate stability was expressed as % of aggregates that remained on the sieve.

Results and Discussion

Figure 1 shows the bulk density of soils with different tillage histories plotted versus % of organic carbon including data from four depths. Sod samples had higher variability of bulk density and organic carbon content compared to soils conventionally tilled. This was due to a rapid decrease of organic carbon content in the soil profile of sods. No-tillage soils varied greatly in both organic carbon content and bulk density. This was probably due to differences in the tillage histories of the fields. For example, the no-tillage field which had a bulk density of 1.71 g cm^{-3} and 0.56 % of organic carbon (Figure 1) has been under no-tillage only for 2 years following many years of rough use under conventional tillage. In contrast, a field with bulk density of 1.08 g cm^{-3} and organic carbon content of 2.13% (Figure 1) has been under no-tillage for over 20 years. Soils with long histories of no-tillage had values of organic carbon content and bulk density close to those of sods. In contrast, soils with short histories of no-tillage following years of conventional tillage were close to conventionally tilled soils in organic carbon content and bulk density. Similar results were reported by Douglas and Goss (1982). The bulk density varied from 0.95 to 1.71 g cm^{-3}. The lowest organic carbon was 0.56% in a no-tillage subsurface sample and the highest was 3.22 % in sods. The results had a relatively high r^2 of 0.72.

The relationship between soil aggregate stability and organic carbon content is shown in Figure 2. A two compartment equation was used to tit the results:

$$Y = -112.2 + 156.8X \ (X < 1.26) + 156.8 \times 1.26 \ (X > 1.26)$$

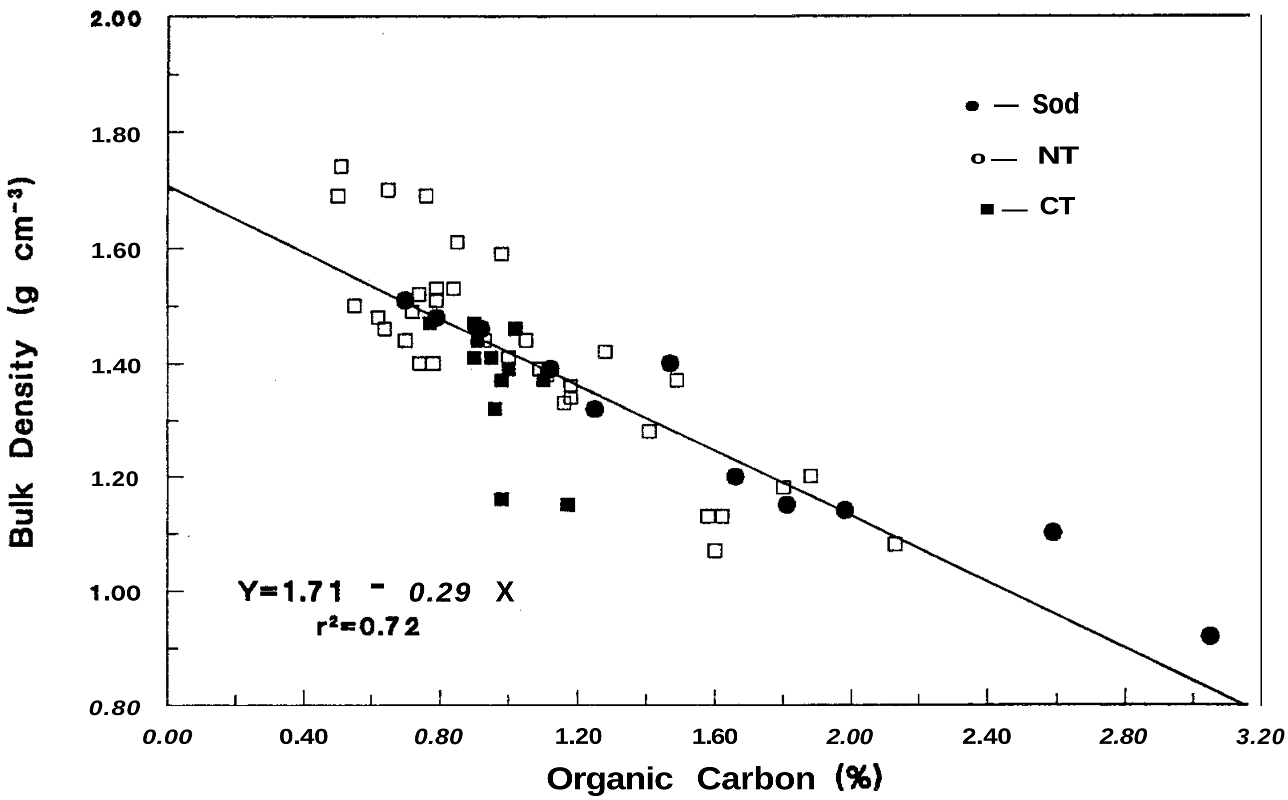

Figure 1. Relationship between bulk density and organic carbon percentage for Lonewood soil under different tillage systems.

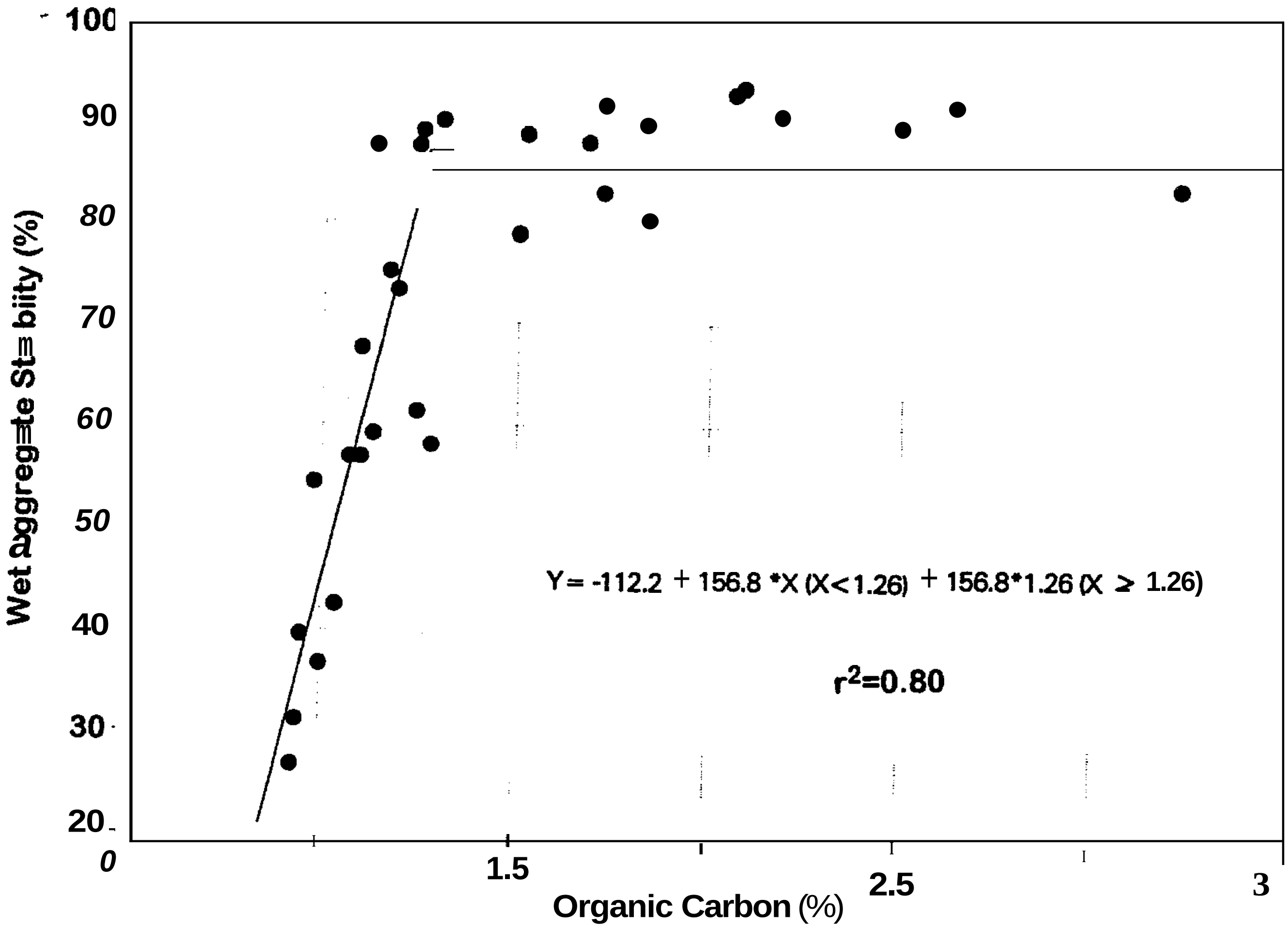

Figure 2. Relationship between wet aggregate stability and organic carbon content.

The intersection of the two lines occurred at 1.26 % organic carbon (Figure 2). It seems that this is a critical structural stability value in this soil. This value, probably, depends on the soil texture and chemical composition, and therefore, varies in different soil series. Aggregate stability increased linearly and rapidly as organic carbon percentage increased up to 1.26%. Past this point further increase in organic carbon content did not significantly affect soil aggregate stability.

These are preliminary results, and similar studies of other Kentucky soils are currently being conducted.

These results show even a slight increase in organic carbon content in soils low in organic carbon significantly improves their physical properties, however this effect is less prominent in soils relatively high in organic carbon.

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Summary of Cotton Response to Nitrogen in Conventional Tillage and No-Till Vetch Cover Crop System

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Abstract: On highly erodible land. cover crops may be necessary to meet conservation compliance with the 1990 Food Security Act. Cotton growth and yield response to tillage, nitrogen rates, and winter cover crops were evaluated on an Ora fine sandy loam soil. The average vetch winter cover crop dry matter biomass yield was 1816 lbiacre (1989-1994) producing a N content equivalent to 94 lb of N/acre. Soil organic matter at the 0 - 2 in. depth in 1992 was the only depth the no-tillage cotton cover crop had more organic matter than conventional tillage (no vetch). Stand failures in no-tillage (1989-1991) may have been due to soil compaction caused by the planter cast-iron seed slit closing wheels and the soil surface containing more moisture under the vetch mulch. Changing the cast-iron closing wheels to small inverted disk and flat press wheels resulted in good stands with the first planting. All treatments at harvest had adequate populations for good seedcotton yield and there was no tillage by year interaction for yield. The 7-yr (1989-1995) average seedcotton yield for no-tillage + 40 lb of N/acre and no-tillage + 80 lb of N/acre were not different but both produced more seedcotton than no-tillage + no N. conventional tillage (no vetch) + 40 lb of N/acre and conventional tillage + 80 lb of N/acre. Plant mapping data indicated first fruiting branch node and percent bolls in first and second position on the fruiting branches were not influenced by tillage and N rate. No-tillage + 80 lb of N/acre plants had more nodes than conventional tillage + 80 ob of N/acre and was taller than all other treatments. No-tillage + no N had fewer harvestable bolls/plant than all conventional tillage treatments.

Introduction

Cotton farmers may need to change production practices to meet the 1990 Food Security Act conservation compliance mandates for highly erodible soils. Research on highly erodible soils indicated that no-tillage and reduced tillage were effective in reducing soil erosion to within tolerance levels only when winter cover crops were included in the production system (Mutchler and McDowell, 1990). Winter cover crops have been shown to increase subsequent cotton yields without additional N. Several reports indicated that winter legumes, especially vetch provided sufficient N for good cotton yield (Buehring and Reginelli, 1993; Millhollon and Melville, 1991; Hoskinson et al., 1988; Brown et al., 1985; Touchton et al., 1984; and Varco, 1993). The purpose of this study was to evaluate the influence of vetch as a cover crop on soil organic matter, and no-till cotton growth and yield response to fertilizer N management.

Materials and Methods

The field study was conducted over a 7-yr period (1989-1995) on an ora fine sandy loam soil which had been double-cropped with cool season and warm season forages since 1960 at the Northeast Branch of the Mississippi Agriculture and Forestry Experiment Station, Verona, MS. The study was conducted as a randomized complete block design with 6 replications. Plots were 4 rows (38 in.) by 40 ft long and were located on the same site each year. Selected N rates (0, 40, and 80 lb of N/acre) were applied to 2 cotton tillage systems [no-tillage (cotton planted no-till in killed vetch sod) and conventional tillage (subsoil + disk + harrow with no vetch)].

Hairy vetch was planted (30 lb seed/acre) no-till in mowed cotton stubble in early November each year. Vetch biomass samples were harvested in mid-April from the no-tillage cotton (0 lb of N/acre) prior to the burndown herbicide application. Composite samples of each treatment were dried at 140° F for 72 hours and analyzed for N content by the Kjeldahl procedure. Soil samples were taken from the conventional tillage + 80 lb of Nacre and the no-tillage cotton + 80 lb of N/acre plots from 4 replications in the fall of 1989 and 1992. Sampledepth was 0-2, 2-6, 6-12, 12-18, and 18-24 inches, Soil samples were analyzed for organic matter content by the Debolt procedure.

Plot management cultural practices are listed in (Table l). Cotton was planted (5 seed/ft row) no-till in killed hairy vetch and in conventional tillage with a four row planter equipped with colters and cast-iron seed-slit closing wheels in 1989-1991. Due to cotton stand failures, conventional tillage and no-tillage plots were replanted in 1989, 1990, 1991, and 1995. In 1992, the planter seed slit closing wheels were changed to an inverted disk with a flat closing wheel. Appropriate N rates were surface broadcast as ammonium nitrate within 3 weeks after cotton seedling emergence.

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Table I. Plot management cultural practices and dates performed in 1989-95 in a tillage cotton cover crop study on an ora fine sandy loam soil at the MAFES Northeast Branch Station, Verona, MS

Operations performed	1989	1990	1991	1992	1993	1994	1995
Plant no-till cover crop	Nov	Nov	Nov	Nov	Nov	Oct	Nov
Subsoil[1]	March	March	March	March	February	April	April
Disk	April	April	April	April	April	April	April
Harrow	May 2	April 24	May 24	June 5	May 10	May 10	May 10
Vetch burndown herbicide application	April 14	April 12	April 16	April 6	April 14	April 15	April 17
Cotton variety	DES 119	DES 119	DP 50	DES 119	DES 119	SG 501	SG 501
Planted cotton	May 2	April 24	May 24	June 5	May 10	May 10	May 10
Replanted cotton	May 17	May 8	June 4				
N application	June 16	May 30	June 12	June 15	May 20	June 2	June 8
Defoliation date	Oct. 18	Sept. 12	Sept. 30	Oct. 9	Sept. 28	Oct. 1	Sept. 26
Harvest date	Oct. 30	Sept. 23	Oct. 18	Nov. 6	Oct. 20	Nov. 17	Oct. 15

[1] Subsoil 12-14 inches deep with shanks spaced 30 inches apart

Table 2. Vetch dry matter yield and N content at the MAFES Northeast Branch Station, Verona, MS, 1989-94.

Year	---Vetch dry matter--- lb/ac	lb N/ac
1989	2849	131
1990	1675	92
1991	1409	73
1992	2524	121
1993	1165	62
1994	1273	85
Mean	1816	94

Recommended herbicide and insecticide applications were used to control weeds and insects. None of the cotton plots were cultivated during any of the 7-yr growing seasons.

Five plants were selected at random from each of the 2 center rows of 3 replications and mapped about 7 days prior to harvest. Plants were mapped for height, harvestable bolls/plant, nodes/plant. first fruit position node, and percent of harvestable bolls in first and second position. The 2 center rows of each 4-row plot were harvested with a 2-row cotton picker (modified for plot harvest) and weighed for seedcotton vield. Analysis of variance and Least Significant Difference (LSD) at the 5% probability level were used to separate treatment means (SAS, Cary, NC, 1988).

Results and Discussion

Vetch Dry Matter-N Content

The dry matter yield of hairy vetch ranged from 2849 Ib/acre in 1989 to 1165 lb/acre in 1993 (Table 2). Dry matter production and lb of N/acre in the dry matter in 1989 and 1992 were similar but higher than 1990, 1991, and 1993. The year to year yield variation was related to weather conditions during the cover crop emergence and growing season. Since vetch N content was relatively constant, yield of N/acre would be proportional to dry matter yield. The N yield ranged from 62 to 131 lb of N/acre with a 6-yr (1989-94) average of 94 Ib.

Soil Organic Matter

Soil organic matter comparisons (Table 3) at all depths for no-tillage and conventional tillage in 1989 were not different (P>.05). Initial organic matter content in 1989 for conventional tillage was I.24, 1.I I, 0.56, and 0.40% at 0-2. 2-6, 6-12, and 12-18 in. depths, respectfully. Both no-tillage and conventional tillage treatments in 1992 showed less organic matter at the 0-2 and 2-6 in. depth than in 1989. However, no-tillage had more organic matter than conventional tillage at the 0-2 in. depth with no difference between conventional tillage and no-tillage at all other depths.

Stand Problems

Plantings the first 3 yr (1989-91) into no-tillage (killed vetch sod) plots resultedin poor cotton stands while acceptable stands were achieved in conventional tillage plots. The stand failure seem to be due to a more moist soil surface than conventional tillage and compaction from the planter cast-iron seed-slit closing wheels. The seed-slit closing wheels were changed in 1992 to small inverted disk with a flat rubber press wheels. This change resulted in good stands with the first planting in both no-tillage (vetch) and conventional tillage (1992-1994). However, due to heavy rains after planting in 1995, the first planting resulted in poor stands in both no- tillage and conventional tillage plots. Harvest plant population were adequate all years for good cotton yields in both no-tillage and conventional tillage plots.

Seedcotton yield

Cotton planted in no-tillage and in conventional tillage plots showed variable yield response to additional N (Table 4). Since there was no year by tillage interaction, 7-yr treatment mean comparisons were made. Seedcotton yield for no-tillage + no added N was equal to conventional tillage + 80 lb of N/acre. These results are similar to reports (Buehringand Reginelli, 1993 and Varco, 1993) showing no-tillage cotton following a vetch winter cover crop produced

Table 3. Influence of tillage system on organic matter in an Ora fine sandy loam soil at the MAFES Northeast Branch Station, Verona, MS.

Soil depth (in.)	1989 Conv.tillage[1]	1989 No-tillage[2]	1992 Conv.tillage[1]	1992 No-tillage[2]
	% organic matter			
0-2	1.24	1.30	0.97	1.19
2-6	1.11	1.10	0.90	1.02
6-12	0.56	0.75	0.79	0.70
12-18	0.40	0.52	0.63	0.56
18-24	0.34	0.52	0.46	0.60
LSD.05 tillage w/depth	NS		0.21	
LSD.05 depth w/tillage	NS		0.06	
% CV	15.3		2.95	

[1] Conventional tillage (no-vetch) cotton.
[2] No-tillage cotton with a vetch winter cover crop.

Table 4 Cotton yield response to tillage and N rate at the MAFES Northeast Branch Station, Verona. MS, 1989-95

Cotton tillage system	N lb/ac	Seedcotton yield lb/ac 1989	1990	1991	1992	1993	1994	1995	Mean
No-tillage (vetch cover crop)	0	2023	1657	2541	2547	1936	2042	1967	2099
	40	1977	1662	2596	2837	2369	2799	2083	2334
	80	2447	1720	2940	2765	2080	2430	1842	2297
Conventional tillage (no-vetch)	40	1892	1688	2119	2654	1435	2201	1498	1943
	80	2085	1588	2239	2535	1620	2218	1529	1970
	LSD.05	NS	NS	717	NS	302	453	290	159
	% CV	17	23	19	10	12	13	11	15

Table 5. Six-year (1989-94) average cotton plant variables as influenced by tillage system and N rate **MAFES** Northeast Branch Station. Verona. MS.

Tillage system	N lb/ac	Height at maturity (in)	Bolls/ plant[1]	Nodes/ plant	First F.B. node[2]	% Bolls first and second position[3]
No-tillage	0	42.3	7.6	17.0	6.1	70.9
(vetch cover crop)	40	42.3	8.9	16.7	6.0	71.5
	80	48.0	8.4	18.5	6.3	71.2
Conventional tillage	40	38.8	9.4	16.6	5.9	73.5
(no	80	38.9	9.4	16.4	6.1	73.5
	Mean	42.1	8.7	17.0	6.1	72.1
	LSD.05	5.3	1.6	1.9	NS	NS
	% CV	9.7	11.2	7.8	7.4	7.6

[1] Harvestable bolls/plant.

[2] First fruiting branch node.

[3] Percent of bolls in the first and second position.

yield equal to no-tillage cotton + 70 and 80 lb of N/acre. These results also are in agreement with other reports (Millhollon and Melville, 1991; Hoskinson et al., 1988; Brown et al., 1985; and Touchton et al., 1984) which showed vetch provide sufficient N for the cotton crop. However, our results indicated no-tillage + 40 lb of N/acre and no-tillage + 80 lb of N/acre had similar yield but both produced more seedcotton than no-tillage + no N, conventional tillage + 40 lb of N/acre, and conventional tillage + 80 lb of N/acre.

Plant Mapping

Plant mapping data averaged over years (1989-1994) indicated first fruiting branch node, and percent of bolls in first and second position on the fruiting branch were not influenced by tillage or N rate (Table 5). No-tillage + 80 lb of N/acre had more nodes/plant than conventional tillage + 80 lb of N/acre and was taller than all other treatments. The other treatments showed no difference in plant height and nodes/plant. Harvestable bolls/plant for no-tillage + 40 lb of N/acre and no-tillage + 80 lb of N/acre were not different from conventional tillage + 40 lb of N/acre and conventional tillage + 80 lb of N/acre. However, no-tillage + no N had fewer harvestable bolls/plant than conventional tillage + 40 lb of N/acre and conventional tillage + 80 lb of N/acre.

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Influence of Tillage, Previous Crops and N Rates on Pearl Millet

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Abstract: Two experiments were conducted in 1994 and 1995 on a Dothan sandy loam (fine, loamy siliceous, thermic Plinthic Kandiudults) at the North Florida Research and Education Center, Quincy, FL. The first experiment was conducted to test the influence of previous crops [white lupin *(Lupinus albus* L.) and wheat *(Triticum aestivum* L.)], and four Nitrogen rates (N rates: 0, 60, 120 and 180 lb. NIA) on silage yield, %Nitrogen in silage and grain yield of pearl millet *[Pennisetum glaucum* (L.) R. Br.. HGMTM I00]. The second experiment was conducted to test the influence of strip tillage and conventional system, previous crops (white lupin and wheat), and Nitrogen rates (0. 60, 120, and 180) on pearl millet. In the first experiment the grain yields of pearl millet were higher in 1995 than in 1994 (2859.3 lb./A versus 991.8 lb./A); this was due to extremely high rainfall (88.2 inches) and low light conditions of 1994. There were no statistical differences at the 95% confidence limit between white lupin and wheat in grain yields of pearl millet following these crops in 1994 (924.9 and 1058.8 Ib./A respectively), but the calculated grain yields of pearl millet were higher after white lupin than wheat in 1995 (3113.5 lb./A versus 2605.I). The silage yields of pearl millet in the first experiment were higher in 1995 than in 1994 (10.6 and 4.6 TIA respectively) due to weather conditions as explained above. and higher after white lupin than wheat. In the second experiment grain yields of pearl millet were not statistically different for tillage systems, but they were higher after white lupin than wheat (1603.7 versus 1386.0 Ib./A). Silage yield of pearl millet in the second experiment were statistically higher in strip tillage than conventional tillage and they were higher after lupin than after wheat. The percent N in silage of pearl millet was different between years and between previous crops and it was significantly higher after white lupin than wheat; but it was not significantly different for tillage systems. The differences in percent N in silage of pearl millet between 1994 and 1995 were also due to weather conditions.

Introduction

Pearl millet [Pennisetum glaucum **(L.)** R. Br.] is grown today as a food crop on 64 million acres in semi arid tropics (Andrews and Rajewski, 1995). It is the most reliable staple cereal for sandy soils of hot, drought prone (low rainfall) regions. Pearl millet grain is nutritious with higher protein and lysine levels than corn or sorghum. This plant has been used only as a forage crop in the U.S. until recent breeding developments began to exploit its potential as a grain crop for U.S. agricultural systems. (Rajewski and Andrews, 1995). Pearl millet can be grown for silage and grain in multicropping systems, when too late to plant temperate corn. When grown in a strip till system it gave a higher yield of fresh silage than in a conventional system. However the fresh matter contained less dry matter in the strip tillage system than in the conventional tillage, therefore dry matter yields were not statistically different (Wiatrak et al., 1994). Green forage was higher for pearl millet than for corn and dry matter yield of conventionally planted pearl millet was significantly higher than dry matter of conventionally planted corn.

Bationo et al. (1990) showed that increasing fertilization and plant density increased grain yield of pearl millet in average or wet years and slightly reduced yield in drought year. Powell and Fussell (1993) have shown the importance of fertility on DM, N, P, and structural carbohydrate distribution in plant parts of pearl millet. Fertilizer N [45 kg/ha (40.1 lb./A)], increased total millet DM by 13%, N uptake by 63%, and P uptake by 29%. Fertilizer P [17.4 kg/ha (15.5 lb./A)] increased total millet DM by 100%, N uptake by 80%, and P uptake by 140%.

The objectives of the study were to compare different tillage systems, previous crops and N fertilizer on silage and grain yield of pearl millet.

Materials and Methods

The research was conducted in 1994 and I995 on a Dothan sandy loam (fine-loamy, siliceous, thermic Plinthic Kandiudults) at the North Florida Research and Education Center, Quincy, FL.

The experimental design was a split-plot (main plots were previous crops and sub-plots were N fertilizer rates for pearl millet) with four replications. The N fertilizer treatments were: 0, 60, 120, 180 lb. N/A. In the first experiment the influence of two previous crops (white lupin and wheat) on response of pearl millet to N fertilizer rates was determined. The influence of tillage systems (strip tillage and conventional

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system), previous crops (white lupin and millet), and Nitrogen rates (0, 60, 120, and 180 lb./A) on response of pearl millet were evaluated in the second experiment. The pearl millet hybrid used in this study was Agra Tech HGM™100 developed by W.W. Hanna from Georgia.

Exp. 1

This was a two-year experiment in which the plots after white lupin and wheat were rotary moved and broadcast sprayed with Gramoxone @ 1 pt/A + Induce @ 1 pt/100 gal. H_2O to control the weeds. On June 27 and 28,1994 and June 21, I995 the Gandy fertilizerspreader was used to broadcast all plots with 0-0-60 (Muriate of Potash) @ 150 lb./A and 0-46-0 (Triple Super Phosphate) @ 100 Ib./A. Pearl millet was planted with a Brown Ro-till implement and KMC planters @ 6 1b./A on June 29, 1994 and June 23, 1995. The day after planting pearl millet was broadcast sprayed with Aatrex @ 1 Ib. A.i./A + Prowl @ 1 pt/A. Irrigation was applied at %"/A on June 28 and August 17, 1995. Fertilizer was applied to pearl millet to supply 1/3 of each N rate two to three inches beside the crop row on July I, 1994 and June 26,1995, and 2/3 of each N rate on July 20, 1994 and July 18, 1995. On July 22. 1994 and July 17,1995 a Redball hooded sprayer was used to direct spray Gramoxone @ I pt/A + Induce @ I pt/I00 gal. H^2O between the rows to control the weeds. The same day pearl millet was broadcast sprayed with Lorsban @ 2 pt/A + Dipel @ 1 pt/A + Sunspray oil @ 2 pt/A to control the insects. Penncap M @ 2 pt/A was broadcast sprayed on pearl millet to control the stinkbugs on August 22, 1994. On September 7 and 8, 1994 the experiment was irrigated with ½"/A H_2O. Penncap M @ 2 pt/A + Lannate @ 2 pt/A were broadcast sprayed to control the insects on September 13, 1994. On September 14, 1994 and September 5, 1995 pearl millet at the soft dough stage was cut for silage with the Hesston silage chopper. Due to birds eating the grain before it could be harvested, Dr. Pudelko's formula (Pudelko et al.. 1995) was used to calculate the grain yield of pearl millet. In order to calculate the grain yields of pearl millet, the lengths of 20 grain heads were measured and the number of grain heads counted on 20 feet of row.

Exp. 2

This experiment with pearl millet was conducted in 1994 only. The conventional section of the experiment was disc-harrowed (2x) and s-tine harrowed (2x) on June 28. On July 12 all plots after white lupin and wheat were mowed. All plots were broadcast sprayed on July 15 with Gramoxone @ 1½ pt/A + Aatrex @ 1 Ib. A.i./A + Prowl @ 1¼ pt/A. On July 26 pearl millet was planted '/4 inch deep with a Brown Ro-till implement and KMC planters @ 6 Ib./A. Pearl millet seedlings emerged on August I. On August 8 nitrogen was applied on treatments receiving 60,120 and 180 Ib. N/A (the 180 treatment got only 120). Four weeks later 60 lb. N/A was put on the 180 Ib. N /A treatment. Pearl millet was cut for silage on September 29. The length of 20 grain heads was measured and the number of grain heads on 20 feet of row was counted from each treatment in order to calculate grain yield of pearl millet.

The results of the experiment were analyzed statistically by analysis ofvariance using SAS (SAS Institute, Inc., 1987), and means were separated using Fisher's Least Significant Difference Test at the 5% probability level.

Results

Exp. 1

There were significant differences in silage yields (4.6 and 10.6/T/A), and grain yields ofpearl millet(2859.3 and 991.8 Ib./A respectively) between 1994 and 1995; therefore, data was analyzed separately. Rainfall was excessive in 1994, with 88.2 inches for the year. This increased the potential for leaching of N and reduced light intensity due to higher number of cloudy days. Therefore reduced yields in 1994 were possibly due to N deficiency as a result of leaching and reduced light and photosynthesis. In 1994 silage yields of pearl millet (Fig. 1) were increasing with N rate, but this increase was higher after white lupin than after wheat (averages 5.3 and 3.9 T/A respectively). In 1995 (Fig.1) silage yields of pearl millet were not significantly different for previous crops, but silage yield of pearl millet responded to N rate and was highest at 150.0 Ib. N /A (12.5 T/A). The low silage yield response to Nrates in I994 supports the hypothesis that leaching of N reduced yields that year.

There was an interaction between the year and previous crop for the percent of nitrogen in pearl millet silage. The interaction was shown by a reversal nitrogen in pearl millet silage. The percent N was statistically higher after lupin than wheat in 1995 (1.537 and 1.415% respectively) (Tab. 1.). In 1994 there were no statistical differences for previous crops and N rates, therefore the results are shown for I995 (Fig. 2). The lack of response of N content to N rates also supports the hypothesis that N leaching reduced yield in 1994. In 1995 the percent N for pearl millet silage was the highest after white lupin (Fig. 2) at 157.5 lb N /A (1.67% N) and was slightly decreased with higher than 157.5 Ib. N /A. The percent N for pearl millet silage was statistically lower after wheat (avg. 1.41%N) when compared to percent N in silage of pearl millet grown after white lupin (avg. 1.54% N) in 1995.

The calculated grain yields of pearl millet (Fig. 3) were higher in 1995 (avg. 2859.3 Ib./A after white lupin and wheat) than in 1994 (avg. 991.8 Ib./A after white lupin and wheat). In 1994 grain yields of pearl millet were not significantly different for previous crops (924.9 lb./A after wheat and 1058.8 lb./A after white lupin), therefore the data for this year was combined for previous crops. In 1995 the grain yields of pearl millet were significantly higher after white lupin than after wheat (avg. 3113.5 versus 2605.1). The response of pearl millet to Nitrogen was not significantly different after lupin; therefore the results for grain yield ofpearl millet after wheat are shown only for 199s (Fig. 3). Grain

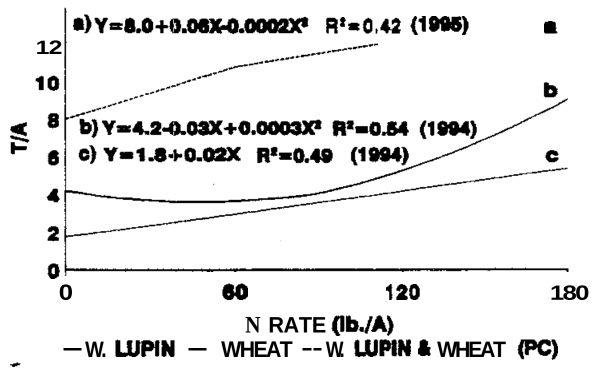

Fig. 1. The silage yields of pearl millet after white lupin and wheat in 1994 and 1995 (Exp. 1).

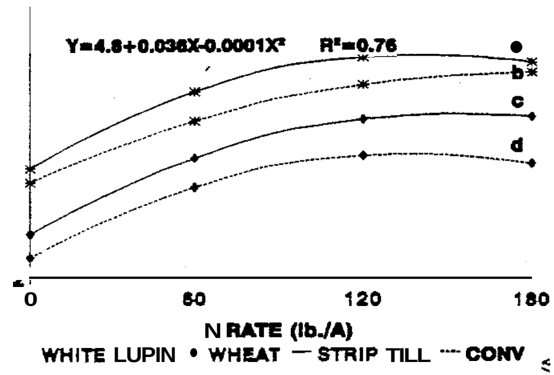

Fig. 4. The silage yields of pearl millet in strip till and conventional system, and after white lupin and wheat in 1994 (Exp. 2).

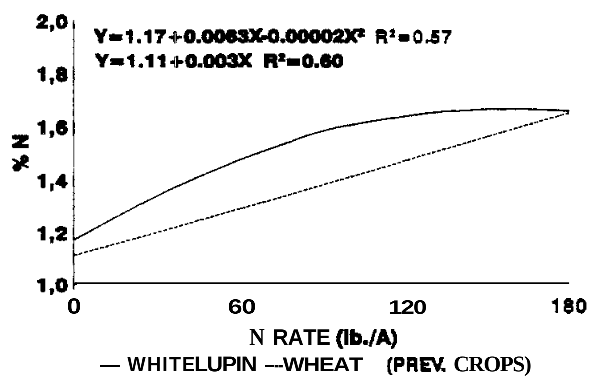

Fig. 2. The percent of nitrogen in pearl millet silage after white lupin and wheat in 1995 (Exp. 1).

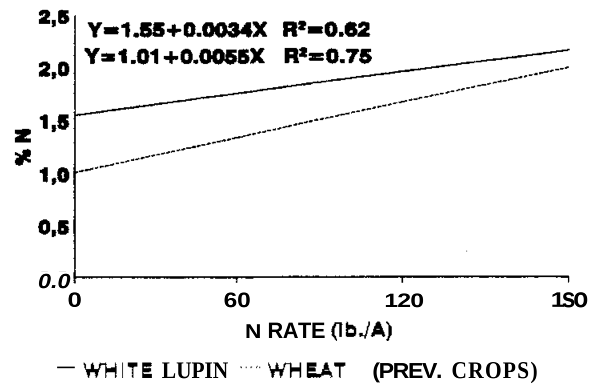

Fig. 5. The percent of nitrogen in the silage of pearl millet after white lupin and wheat in 1994 (Exp. 2).

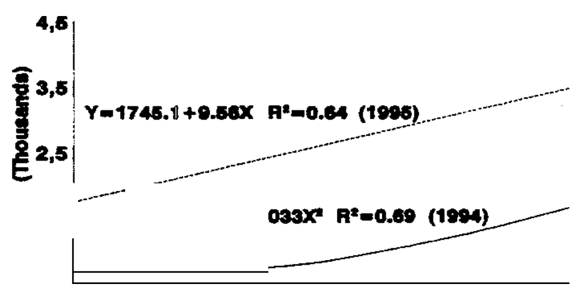

Fig. 3. The grain yields of pearl millet after white lupin and wheat in 1994 and 1995 (Exp. 1).

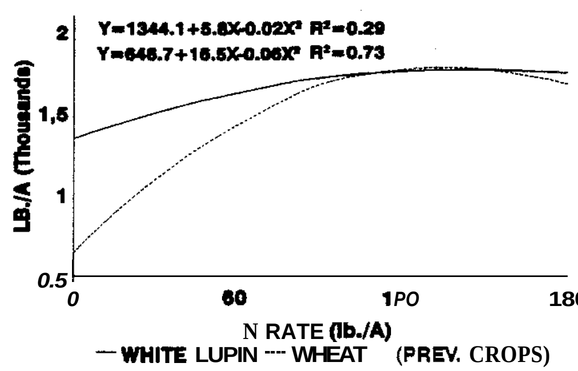

Fig. 6. The grain yields of pearl millet after white lupin and wheat in 1994 (Exp. 2).

Table 1. Percent of nitrogen in silage of pearl millet in 1994 and 1995 after white lupin and wheat.

PC/Year	1994	1995	Mean
White Lupin	**1.459**	**1.537**	**1.498**
Wheat	**1.609**	**1.415**	**1.512**
Mean	**1.534**	**1.476**	

LSD(0.05) **for** PC - **NS**
LSD(0.05) **for** Year - **NS**
LSD(0.05) for PC **x** Year - **0.1884**

yields of pearl millet were higher with higher N rates in 1994 and 1995. However, the week response of grain yield to N rates in 1994 further supports the hypothesis of yield loss due to leaching of nitrogen.

Exp. 2

In this experiment the influence of two tillage systems (strip till and conventional system), two previous crops (white lupin and wheat) and four nitrogen rates (0, 60, 120 and 180 lb. N/A) were analyzed for silage yields, percent N in silage and grain yields of pearl millet. The silage yields of pearl millet (Fig. 4) were significantly different at 95% confidence for tillage systems and previous crops. For all cropping systems the silage yields of pearl millet were increasing with increasing N rates. The silage yields of pearl millet were higher after strip tillage than after conventional tillage, and higher after white lupin than after wheat. The highest silage yields of pearl millet in strip tillage were obtained at N rates of 141 Ib. N/A after wheat and 153 Ib. N/A after lupin (8.6 and 6.8 T/A of silage respectively). Silage yields of pearl millet in the conventional system were highest at the rate of 180 Ib. N/A after white lupin and 137 Ib. N /A after wheat (8.0 and 5.6 T/A of silage respectively). The percent N in silage of pearl millet (Fig. 5) was not different between tillage systems, therefore data for tillage systems was combined. Percent N in silage of pearl millet was significantly higher after white lupin than after wheat (avg. 1.85 and 1.50% N respectively).

The grain yields of pearl millet (Fig. 6) were not significantly different between tillage systems at 95% confidence limit, but they were different between white lupin and wheat. The highest grain yields of pearl millet (calculated using Pudelko's formula) were obtained at the rate of 145 Ib. N/A and 137 lb N/A (after white lupin and wheat respectively).

Conclusions

1. The silage yield of pearl millet was higher after white lupin than after wheat and it was also higher with higher N rates applied to pearl millet.

2. The percent N in silage of pearl millet was dependent on the year and previous crop and it was generally higher with increasing rates of Nitrogen applied to pearl millet.

3. The grain yields of pearl millet were higher with increasing N rates applied to pearl millet, and higher after white lupin than after wheat.

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