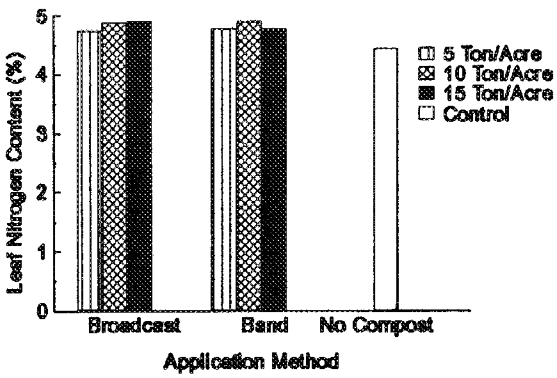


Figure 3. Leaf Nitrogen Content 6 Weeks after planting

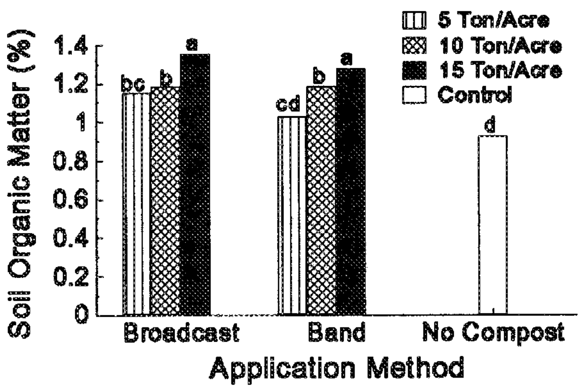


Figure 4. Soil Organic matter content 14 weeks after planting

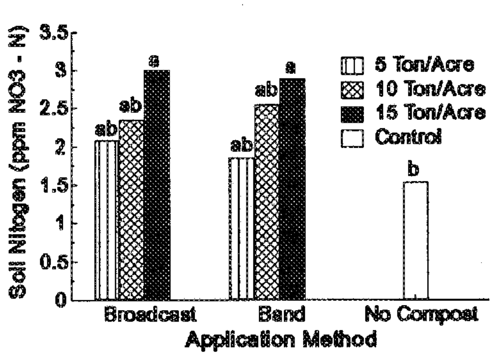


Figure 5. Soil nitrogen content 14 weeks after planting

# TILLAGE SYSTEMS FOR THE TENNESSEE VALLEY: COTTON YIELD AND SOIL WATER USE

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## Abstract

Conservation tillage that utilizes large amounts of organic residues would be beneficial to the low organic matter soils of the Tennessee Valley of northern Alabama. Maintaining competitive yields of conservation tillage cotton (*Gossypium hirsutum L.*) is required for adoption of these systems on the highly erodible soils of the region which have been continuously cropped to cotton. In the fall of 1995, a study was implemented at the Alabama Agricultural Experiment Station's Tennessee Valley Substation at Belle Mina on a Decatur silt loam (clayey, kaolinitic, thermic, Rhodic Paleudults) to develop a practical conservation tillage system that results in competitive cotton yields. The experimental design is a randomized complete block of four replications. Treatments included factorial combinations of fall ridging (with and without) and deep tillage (none, in-row subsoiling, paratilling); as well as spring strip tillage and conventional tillage. All plots, except conventional tillage, were established with a cover crop of rye (*Secale cereale* L.) which averaged 5400 and 3600 lb/A dry matter in 1995 and 1996, respectively . Cotton, 'DPL 51' and 'DPL NuCOTN $35^{B}$' was planted in 1995 and 1996, respectively, on 40-inch rows. Soil volumetric water content was determined twice a week (0-16 in. depth) from the in-row, and trafficked and nontrafficked row middle positions using time domain reflectometry. Cotton performance was evaluated by percent open bolls and yield. Soil penetrometer readings were taken after planting to evaluate soil strength as affected by tillage practice.

In both 1995 and 1996, deep tillage (either subsoiling or paratilling) resulted in greater soil water depletion (an indication of improved rooting) compared to conventional tillage. Soil water depletion was greatest under paratilling with ridging. In both years, paratilling and subsoiling eliminated soil compaction below 10 inches in the profile compared to conventional tillage and the no-tillage control (flat plant without deep tillage). In 1995 ridge tillage resulted in greater seed cotton yields than flat planting (1579 lb/A vs. 1404 lb/A) and was equivalent to conventional tillage (1509 lb/A). In 1996, flat planting with deep tillage and fall ridging without deep tillage resulted in greater yields (3890 lb/A and 3740 lb/A, respectively) than conventional tillage (3130 lb/A), however, fall ridging with deep tillage did not result in greater yields (3230 lb/A). The reduction in yield with ridging in combination with deep tillage was due to the additive effect of both practices on delaying maturity (as measured by percent open bolls). In summary, conservation tillage with high levels of cover crop residue yielded as well or better than conventional tillage both years. Both ridge tillage and deep tillage had a positive effect on soil water extraction and yield. Although further study is needed to evaluate a wider range of environmental conditions, fall ridging and deep tillage appear to be promising conservation tillage practices for the Tennessee Valley.

# CHARACTERIZATION OF COTTON SOILS IN VIRGINIA AND NORTH CAROLINA

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## Abstract

A 2-year study to characterize major soil series' used for cotton in Virginia and North Carolina was initiated in 1996. Five soils were determined to represent 49.6% of the acreage used for cotton. These soils were all Paleudults which ranged from extremely well drained to very poorly drained. The soils were sampled form 4 areas - 3 in North Carolina and 1 in Virginia. Eleven farms were used for sampling across the 2 states. Determination of physical properties included bulk density, available water holding capacity, particle size, depth of surface horizon, and depth to water table. Chemical properties included pH, CEC, and base saturation. Tests were conducted on surface and subsurface horizons. The data determined at present gives no indication that these soils are significantly different from each other except in 2 areas. Depth of surface horizon and depth to water table are the only significant differences among these 5 soils at the .05 level. Of the 300 sites selected and sampled less than one third have been tested for all properties presently. All sites are to have yield samples taken for 2 years to attempt to correlate soil properties to yield.

## Introduction

Cotton ( Gossypium hirsutum L.) production in Virginia has increased 10 fold in the past 5 years to over 107,000 acres. This increase has occurred in the eastern and southeastern corner of the state reaching west as far as the southern piedmont and north as far as the Potomac River. Production of cotton in North Carolina rose to 820,000 acres planted in 1995. This was an increase of 44% from 1994, and the highest acreage planted since 1953. Average yield for North Carolina was 554 lbs. per acre for 1995. Over 75% of the cotton grown in North Carolina is grown in the Coastal Plain region (NCDA, 1995).

Many soils used for cotton in 1995 have never been planted in cotton. Other soils series' have not been planted to cotton for over two generations. Cotton in general, is being planted on many soils that have not been evaluated with modern cotton production practices. Many of these soils have chemical and physical properties that may limit cotton production. The identification of these soils and their properties may provide producers with a better understanding of a soil that will produce high yielding cotton. Evaluation of these soil properties and their potential impact on cotton growth and yield may enable production modifications to make these soils more productive for cotton. Use of deep tillage, no till, crop rotations, irrigation scheduling, additions of organic matter, and fertility practices may be changed based on individual soil characteristics.

## Physical Properties

Soil strength and bulk density influence root penetration in soil. High soil bulk density can reduce cotton root penetration in soil even if moisture levels are high (Taylor, 1971). Soil aggregate size, which is related to texture and structure, influences growth, size, and quantity of cotton roots (Logsdon, et al., 1987). Roots may be restricted due to reduced pore space of less than 60 microns or by soil peds that cannot be displaced by the cotton roots. Soil bulk density in subsoil hardpans below the plow layer has been alleviated by the use of surface applied gypsum on cotton soils in Georgia (Sumner, et. al., 1990). When chiseling under the row, water infiltration and soil bulk density in the seedbed were reduced while increasing yield by 17% (Heilman, 1988).

Water holding capacity and ability to handle drought stress is related to soil texture. Cotton grown on clayey soils have a higher transpiration rate than either a loam or sandy soil due to higher available water content (Talha, et. al., 1981).

Artificial drainage has been widely used on some poorly drained soils to bring them into cotton production. A high water table or short term exposure to saturated conditions can reduce rooting and leaf growth in cotton (Reicosky, et.al., 1985).

## Chemical Properties

Potassium availability influences cotton plant development. Low levels of K has been identified with poor boll development and disease resistance (Kerby and Adams, 1985). High levels of potassium and other basic cations have produced higher cotton root concentrations in all depths of the rooting zone (Kapur and Sekhon, 1985).

On highly acid soils, where soil pH has been less than 6.0, the use of lime increased cotton yield (Hall, 1980). Liming of fine sandy loam soils with CaCO3 when pH was 3.9 -4.0 increased the nitrogen usage in cotton and therefore increased yield (Roth and Fisher, 1973). Lime applications have increased bolls per plant from 1.7 to 3.3 and increased lint length by .2 mm (Shui and Meng, 1990). In greenhouse experiments liming has shown to be important to efficient use of nitrogen and that preplant N levels are a poor indication of N availability in a soil if properly limed (Rosolem, et al, 1990).

Soil pH is a major limiting factor for plant growth in the southeastern Coastal Plain region of the United States. Low soil pH results in Al toxicity and Ca deficiencies on many soils of this region(Adams and Moore, 1983). At a pH of < 5.0 cotton roots grew horizontally and the tap root died in soils of pH less than 4.4 in unirrigated plots in dry years. Unirrigated plots with high subsoil pH did as well has irrigated plots with low pH ( Doss and Lund, 1975).

## Materials and Methods

The project began with the surveying of extension offices in those counties which grew cotton in 1995. Thirty one of the 67 counties responded covering 411,613 acres of the total 905,000 acres grown in 1995. There were 61 soil series represented. Five soils were chosen that represented 49.6% of the soils used for cotton. Included were the Wagram, Norfolk, Goldsboro, Lynchburg, and Rains series:

- Wagram — loamy, siliceous, thermic Arenic Paleudult
- Norfolk — loamy, siliceous, thermic Typic Paleudult
- Goldsboro — loamy, siliceous, thermic Aquic Paleudult
- Lynchburg — loamy, siliceous, thermic Aeric Paleaquult
- Rains — loamy, siliceous, thermic Typic Paleaquult

Each soil may be found in association with any of the others. The soils are upper coastal plain soils from marine sediments. Slopes were less than 5% in all cases. Eleven farmers in 4 locations allowed samples to be taken for testing. Columbus, Sampson, and Bertie were the major counties in North Carolina and Suffolk in Virginia. Sampling occurred over an 10 week period July 1- Sept. 15, 1996. Fifteen samples of each soil were taken from each county for a total of 300 samples, 60 of each soil series. Flags were posted to return at harvest to hand pick a sample for yield and quality.

Each soil was augured to a depth of 60 inches. All horizons were described and a sample was taken for testing. Bulk density cores were taken from all horizons that began no deeper than 24 inches. Water depth was determined by actual free water in the profile or by grey mottling in horizons. All soils were allowed to air dry before other properties were tested. In the lab testing for available water was done by pressure pots at 15 and 1/3 bar using a loose sample. Particle size was determined by the hydrometer method. Depth of surface horizon was determined in the field using Ap and

E horizons when present. ECEC and base saturation was determined by ammonium acetate pH 7.0 extraction of base cations and 1.0N potassium chloride extraction of Al.

## Results and Discussion

All these soils are upland soils. None are to be found in major drainage areas or flood plains. They are soils with less than 5% slope, most of which are less than 1%. Marine sediments across the upper coastal plain areas are the parent material. Elevation above sea level is between 50 and 150 feet. Many of these soils had long tillage histories even back into the 1600's.

Analysis of variance was used at the .05 level on each of the soil properties tested returned mixed results. Across counties there was no significant difference in texture in either the Ap or Bt horizons(sandy loam over sandy loam). By soil only the Wagram was significantly different in Ap sand (highest at 84.1%) and silt (lowest at 13.4%) content. Goldsboro had significantly more clay than other soils in the Bt horizon at 21%. Bulk density (Ap 1.5, Bt 1.6), ECEC (Ap 2.0, Bt 4.5), base saturation Ap 65%, Bt 40%), pH (Ap 5.5, Bt 4.6), and available water (3.6 in per 36 in depth) were not different among soils in either horizon. pH in the subsoil did reach below 5 in all cases which may deter cotton root growth. The two major differences were in depth to water table and surface horizon depth. Wagram and Norfolk were greater than 50 inches to the water table, Goldsboro at 33 in., Lynchburg at 28 in. and Rains at 8 in. Depth of surface horizon was again highest for Wagram 22 inches followed by Rains at 14 in., Lynchburg at 13 in, Norfolk at 12 in. and Goldsboro at 8 in.

The data on yield is presently incomplete. Since fewer than 1/3 of all the soils have been sample nothing clear can be determined. To complete this project 200 of the 300 soils are to be tested with yield from 2 years used to compare properties tested against yield and quality.

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# SPATIAL VARIABILITY OF SOIL-TEST NITROGEN AND PHOSPHORUS ON TEXAS SOUTHERN HIGH PLAINS SANDYLAND SOILS


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## Abstract


An irrigated site and a dryland site associated with the AG-CARES facility in Dawson Co., Texas were grid-sampled in 1990 and 1995, respectively. The irrigated site was sampled on a 2-acre grid and the dryland site was sampled on a 0.5-acre grid. Samples were analyzed for Soil-test nitrogen (N) and phosphorus (P), and were subjected to geostatistical analysis.