# Twenty-five year Review of Conservation Tillage in the Southern U.S.: Perspective from Industry

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## ABSTRACT

**Twenty-five years ago, conservation tillage was a concept that many of us had varying degrees of experience and vision of it's potential. Conservation tillage was considered a method to control soil erosion and conserve moisture. There were many barriers including proper planting and spraying equipment, crop protectants for weed, insect and disease control, knowledge of how to apply fertilizers, a negative attitude of "No-Till equal No-Yield" and of course, little expertise. The concept had been introduced over sixty years ago with Edward H. Faulkners Plowman's Folly. Today, through years of agronomic research, extension demonstration, partnerships of industry, farmer and grower experience and much positive publicity, conservation tillage is as commonly accepted in most states as conventional tillage with all major crops. We now have excellent conservation tillage planters, drills and sprayers. We have ten times the crop protectants available to control weeds. Biotechnology has made it simple, affordable, and effective weed control. Fertilizer can now be applied successfully and environmentally acceptable in no-till fields. Attitudes have changed. Farmers who once said they would never no-till now would quit farming if they had to go back to plowing fields. The number and level of experts of conservation tillage is great, but not large enough. We still need more people involved in promoting and refining conservation tillage. During the next twenty five years, we will witness CT mature in growth with many new technologies being introduced by industry to make the agronomic system even easier, more profitable, and environmentally safe.**

## KEYWORDS

Adoption practices, planting equipment, crop protection, fertilizer use

## INTRODUCTION

"You have come a long way Baby" partially describes the development and adoption of conservation tillage in the Southern United States. And I add to this commercial phase "in a relative short period of time." Tremendous strides of success can be and should be shared among all of us in this organization. In the past 25 years, and to some of us, three to four decades, we have seen agricultural crop production in the South transition from preparing our fields for planting from as many as a dozen tillage trips or passes prior to planting to zero. We have the value of 6 and 8 bottom mold board plows being sold in auctions for scrap iron prices. We have seen chisel plows parked and weeds grow up between the shanks, we have 'V' rippers with no tractor large enough to pull them on our farms anymore. We have discs whose blades are changed every few years due to the lack of use and we have young farm labor that does not know how to set the half sweeps on a cultivator. I have a 25 year old son who has asked me if I am ever going to teach him to plow with our old 3 bottom Massey Ferguson mold board plows. He asks, "What is back furrowing?"

According to Doane's Agricultural Research Service last year, the following acres and major crops were produced in conservation tillage and no-tillage. Twenty five years ago, practically no one or no organization documented the change in tillage or the methods of tillage practiced on producing crops. And I use the word "practiced" purposefully, because if we did not till or plow it perfectly the first time we performed it over and over and improved and learned the new and ever evolving Agronomic System. The Tennessee Agricultural Statistics Service started in 1983, through the request and encouragement of the late Tom C. McCutchen, pioneer and leader of no-till at the University of Tennessee Milan Experiment Station (1962-1983). Tennessee leads the South in percentage of acres farmed with no-till technologies, although it is not the largest producer of any particular crop.

The success of conservation tillage in the South and individual states can only be attributed to team work and

*IN* E. van Santen (ed.) 2002. Making Conservation Tillage Conventional: Building a Future on 25 Years of Research. Proc. of 25th Annual Southern Conservation Tillage Conference for Sustainable Agriculture. Auburn, AL 24-26 June 2002. Special Report no. 1. Alabama Agric. Expt. Stn. and Auburn University, AL 36849. USA.

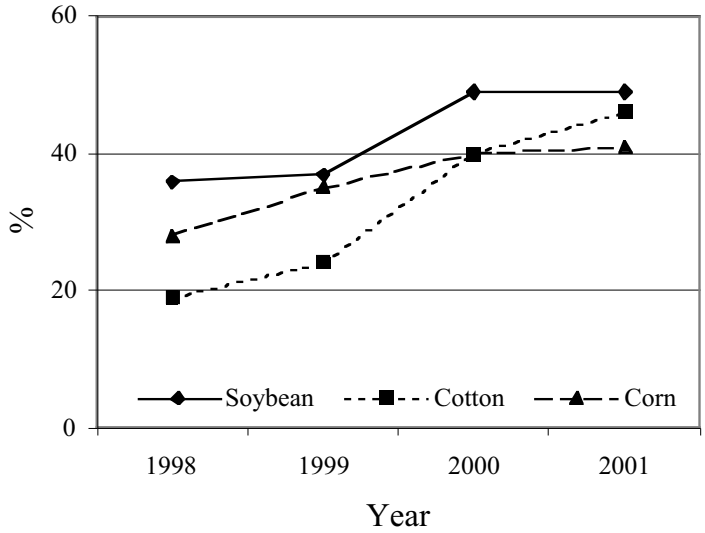


**Fig. 1.** Percent increase in no-till and conservation tillage acreage for soybean, cotton, and corn in the southern USA. Source: Doane's Agricultural Research Service, 2002.

excellent leadership and partnerships between research, extension, farmers, equipment companies (large and small), crop protectant companies, the fertilizer industry, the ag or farm media, environmental groups and last but not least National Resource Conservation Service and their local Soil Conservation District affiliates as well as ARS.

Success has been achieved in five major areas. These include:

(1) Planting , Seeding and Spray Equipment

(2) Pest control or crop protectants (weeds, insects, disease, rodents)

(3) Fertilizer rate source and placement

(4) Attitude

(5) Degree of expertise

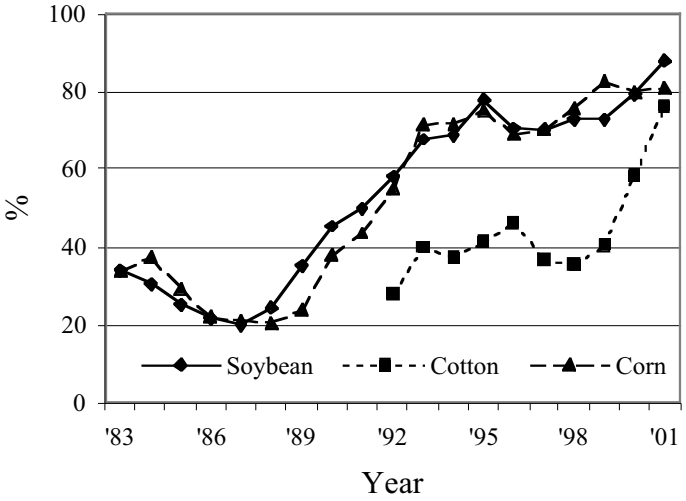


**Fig. 2.** Growth of conservation tillage (including no till) acreage in Tennessee from 1983 to 2001 for soybean, cotton, and corn. Source: Tennessee Agricultural Statistics Service, Nashville, TN.

## PLANTING EQUIPMENT

We all learned early in the trials of no-till that we needed heavier built planting equipment than the '71 model John Deere Flex Planters with shoe or soward type openers. We worked with and tried the Allis Chalmbers. These planters worked with the addition of barrels of water or concrete and available fluted coulters. The AC's planted through fescue sod but were slow (1.5 to 3 mph) for large acreage as growers expanded to row crop production. John Deere introduced the 7100 (3 point hitch) and 7000 (pull type) Max Emerge planter in the mid 70's. The planter with true 'V" disc openers, heavy duty tool bar, heavy duty down pressure springs, 'V' type closing systems with down pressure and the availability of a coulter. These planters cut through reside and cover crops, opened the furrow, placed the seed at a prescribed planting depth, covered the seed for good seed to soil contact, placed fertilizer beside the row and insured excellent stands of no-till and conservation corn, cotton and grain sorghum. At the same time, based on conventional tillage systems and the AC planter, we learned that narrow row spacing, 30 inch or less corn rows and 20 inch or less soybean row spacing, aided in the control of weeds and moisture conservation by quicker shading by the crop canopy. Higher yields were often obtained with reduced row spacing.

In 1977, John Deere introduced the 7100 Soybean Special, conservation tillage planter units on 20 inch spacing to facilitate the advantages of precision planting and narrow rows. International also introduced the off-set double disc openers on its 800 and 900 air seed delivery planters which performed well in no-till. Kinze, Deutz-Allis and White companies introduced heavier-built planters with coulters, openers, and closing systems to enable their customers to direct seed into the roughest of high residue situations. Jerald Hardin and Brown were developing a 'row-till' system or what we now commonly call a rip or strip-till system for the Coastal Plains soil. There were several attachments for different soils and situations with the early strip-till as there still are today. Today there are several manufacturers of strip-till units including Bigham Brothers, Kelly Manufacturing, Powell, Ferguson & PATS.

Conservation tillage drills have advanced as much as precision planters. Tye was one of the first drill manufacturers to build a 'stubble drill' to manage residue and place seed directly into the unplowed soil. This drill was modeled after the "Pasture Pleaser" one of the first forms of no-till, reseeding

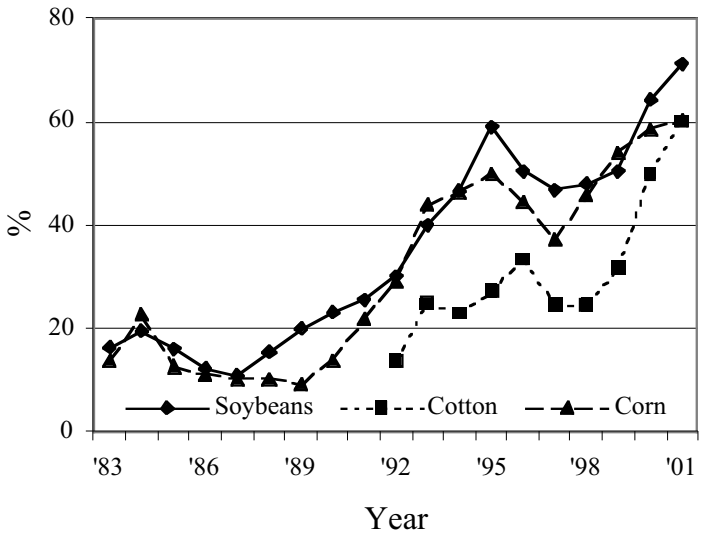


**Fig. 3.** Percent growth of no till acreage in Tennessee from 1983 to 2001 for soybean, cotton, and corn. Source: Tennessee Agricultural Statistics Service, Nashville, TN.

and renovating pastures without tilling.

The first no-till drills were modified and converted conventional till drills. Many did not hold up to the tough field conditions of no-till. In the mid 80's, most major manufacturers of drills increased the size of the tool bars, used heavier down pressure springs and added gauge wheels for controlling seeding depth on varying soil types. In 1992, John Deere introduced the 750 no-till drill, offering many of the desirable features demanded by growers: variable row spacing, depth control, aggressive for tough soil conditions, and adaptability to plant many different kinds of seed.

Today, most major manufacturers of seeding equipment produce excellent no-till planters and drills. During recent years, economics or profitability has been challenging to agricultural producers. Growers have often not had the capital to purchase new no-till drills and planters. Through the years, those of us dedicated to conservation tillage worked closely with industry that was interested in developing retrofit attachments for planters and drills. The attachments included down pressure springs, seed firming wheels and "rebounders", different types of coulters, residue managers, disc openers, furrow closing systems. We learned early that all mechanical devices must cut and roll through residue, cover crops and no-till soils. Companies leading in the CT attachment industry include Yetter Manufacturing Co., Dawn Equipment Co., Martin Industries, Kelly Manufacturing Co., and others. All of these companies also manufacture CT fertilizer placement attachments.

Today we have a choice and a variety of excellent planters and drills to accomplish successful conservation tillage on all soil types and conditions. "We have come a long way baby."

## PEST CONTROL

A close examination of the definition of no-till and conservation tillage reveals that weed control is accomplished by chemicals or crop protectants rather than mechanical tillage. We learned early in our conservation tillage experiences that we must develop weed control systems to ensure success of the planting method. We also learned that an emerging seedling could not tolerate competition from weeds, competition for moisture, nutrients, sunlight and cool soil temperatures. We learned that we must start 'clean' with all vegetation dead or dying.

Weed control has been a challenge. Again, we have come a long way. 'Modern' weed control of the 1950's and 1960's included petroleum-based products that were highly volatile and needed to be tilled or incorporated into the soil, (i.e. Treflan, Eradicane, Sutan, and others). I believe the use of these products actually proliferated tillage to a degree we had never witnessed in history.

Twenty five years ago, we researched and demonstrated available weed control products that did not require soil incorporation or tillage. Pre-plant or "burndown" products included 2, 4-D, Paraquat, Atrazine, MSMA, & Dynap. Each were effective on certain weeds, others only gave partial control. We learned that we could effectively control most weeds in no-till corn with paraquat, 2,4-D, and atrazine as long as we did not have Johnsongrass or bermudagrass and the field received a rain to activate the atrazine with the soil. Soybeans were a different story. The 1970's industry brought us preemergence herbicides that could be surface-applied including Lasso, Dual, Sencor, and Prowl. In 1975, Roundup was introduced offering us the safest broad spectrum "burndown" herbicide we had witnessed. Roundup (non-selective) controlled more weeds including grasses and broadleaves than we had ever experienced. During this same time period we had crop-safe, over-top selective herbicides introduced, including Basagran & Blazer replacing 2, 4-D, Dyanap and Alanap. Good soybean weed control was now possible in no-till soybeans. However, it did take an array of these crop protectants to keep the crops 'clean' or weed free for the entire growing season.

Industry continued in the 1980's to bring excellent products to the conservation tillage farmer. The greatest of these were Accent and Beacon for Johnsongrass and other grass postemergence and weed control in corn. Johnson grass control had been a limiting factor in the expansion of acreage of conservation tillage corn. (note: accelerated growth of NT & CT corn, Figs. 1 and 2,. during 1990s)

Other crop protectants introduced to us in this same time

period included the SU or sulfuania urea herbicides, Classic, Canopy for soybeans. Other classes of chemistry introduced were the ALS inhibitors and IMI's The introduction of these herbicides often reduced the number of herbicides and trips of applications.

CT cotton began in the early 1980's. Many of our traditional soil surface herbicides worked well in no-till cotton. Application and timing were critical. Broadcast applications were expensive, but necessary since we were foregoing mechanical cultivation. New grass control products were introduced in the early 1980's, including Poast, Fusilade, Select and Asure. These products provided excellent over - top Johnsongrass control in cotton as well as soybeans. The 1980's were exciting times for the introduction of weed control products effective in CT systems.

The past decade has been even more exciting. During the 1990's, we saw the introduction of Staple, an over-top or post-directed herbicide for seedling cotton. Through genetic engineering, we now have Roundup Ready Soybeans, Roundup Ready Cotton and Roundup Ready Corn for our southern geography. This technology has been the great enabler to bring safe, effective and simple weed control to conservation tillage systems. Most no-till as well as conventional tillage farmers now use only one herbicide, Roundup, for total and season long weed control. Presently over 69 percent of the cotton grown in the US is genetically engineered for Roundup tolerance, or contains the Bollgard insect tolerance gene, or both. Over 70 percent of the soybeans grown are Roundup Ready and growers are purchasing all the Roundup Ready Corn being produced.

Parelleling the development and evaluation of more effective crop protectants for conservation tillage, has been the quest for better spray equipment. We used to find our way about a no-till field at burndown application with a chain marker or guide. We now have foam markers with various colors of foam. We have the availability of GPS guidance systems. We have reduced the amount of water as a carrier of herbicides from 40 gallons per acre for paraquat to 5-10 gallons for Roundup Ultra Max. We now use ounces and grams of products per acre rather than quarts and gallons. We use low volume, low drift, spray equipment technology.

Twenty five years ago, we were building special post-direct herbicide applicators to post-direct 20" soybean rows, apply contract and residual herbicides to the base of cotton plants and shielding the pasts from drift and spray contact from non-selective herbicides sprayed between the rows.

In 1992, plastic hooded sprayers were introduced to the South from Redball, Inc., based in Minnesota. We were able to spray Roundup and other non-selective herbicides "under the hood" and post-direct safer contact and residual at the base of cotton and other crops. Presently there are several major manufacturers of hooded, shielded and post-directed sprayers, most located in the South. These type sprayers have basically eliminated in-season crop tillage or cultivation.

Two of our greatest fears have not developed - insect and disease damage. Twenty-five years ago, many thought that boll weevils, cut worms, grasshoppers and disease complexes would prevent successful conservation tillage. We have found as we change this growing environment we do, occasionally, have infestations of cut worms, grasshoppers, and grubs. Again, industry provided us with products to control the pests and break our barrier of increased insect damage. Genetic engineering such as Bt cotton & corn are offering season- long protection from a broad spectrum of insects.

We have learned that diseases have not been the perceived barrier or demise of CT crop production. Although disease pressure may increase in a CT environment, we have readily-available genetic resistance in varieties, soil- and seed-applied fungicides and insecticides, as well as traditional crop rotations and cover crop benefits. We have often observed less disease pressure in CT condition due to the natural soil microbes increasing as organic matter builds in CT systems. Two years ago, Monsanto introduced brands of Residue proven corn and soybeans. Yes, we have learned what voles are, that snails and slugs will attack corn and cotton, and that fire ant mounds get larger in CT systems. Yet, we have addressed these barriers successfully by re-registering old products and finding new uses for other crop protectants.

## FERTILIZER

There are no "short cuts" to effective fertilization practices. Of course, a good fertilization program begins with soil testing. Based on USDA and university research, we have learned that we take our CT soil samples at different depths and our soil testing facilities have adapted. We learned that lime, as well as phosphorus (P) and potassium (K), may be soil-surface-applied in the fall or early spring prior to planting if soil is not eroding from the field. We have learned that we may apply one application of P & K for two crops in the rotation of winter wheat followed by double crop soybeans. We have learned that starter fertilizer may be more beneficial in CT crops than conventional especially when planted early. We have adopted our knowledge of nitrogen sources and loss to volatization to properly apply to each crop. Industry has worked closely with us to develop and manufacture applicators that 'cut and roll' rather than 'drag' through residue. Industry has developed urease inhibitors to slow and lower nitrogen loss when surface applied.

Industry has provided custom application equipment for CT systems to place fertilizer correctly and precisely to the CT crop application. Machine application tires and treads are being changed to help avoid 'cleating' of CT fields prior to planting. Industry is continuing to develop manure applicators for CT with lower soil disturbance.

We have also learned that nitrogen-producing cover crops do not have to be tilled into the soil to contribute nutrients to the primary crop. Effective and efficient nutrient management systems can be accomplished in all CT systems.

## ATTITUDE

During the past 25 years, there have been many technological advances in CT systems. We have and know someone in every county or parish of our region practicing cost-effective conservation tillage systems on almost every crop. Crops include corn, soybeans, wheat and grain sorghum as well as peanuts, vegetables, and tobacco. I have seen successful CT on all soil types that normally produce crops. We have learned the many economic, agronomic, and environmental benefits. We have the 'tools'! CT has proven simpler than ever! We have proven yield is not a barrier. We can control erosion cost effectly! The positive list goes on and on! Yet, in a recent survey across the South 30 percent of the growers surveyed stated that 'nothing' would encourage them to adopt CT, they preferred to plow or till. Others gave reasons including:

- Does Not Work on All Soil Types
- Did not Have Equipment
- Past Experience
- Need to Prepare Fields (Straighten Rows)
- Does Not Do No-Till, Prefer Cultivation
- Lower Yields

According to the same survey, factors that would encourage more no-till would be:

- Economics
- Have Equipment
- Better Yields
- Nothing

Industry is working with growers, research, extension, and government to break down these barriers. For example, Monsanto offers these incentives:

- Conservation Tillage Guide
- COE Field Days
- Farm Smart Conferences
- System Sell Brochures
- No-Till Retrofit Equipment Rebates
- Hooded Sprayer Rebates
- Roundup Rewards
- Bottom Line Booster

Attitude is something that we have individual control over everyday. Attitude determines the degree of success or failure of every walk of our lives, our business, our marriage, our church, our research, and our farming system. We have the knowledge, technology, and tools to make CT successful with almost any crop on any soil in any county. We need to continue to be positive and address barriers to CT, adapt new technology to CT and share our expertise with others.

## SHARING EXPERTISE

Where would CT be today if we had not shared what we had learned, what we have developed and what we have practiced with others: research with industry, farmers with extension, industry with farmers, etc.? We all believe in CT! One thing that I believe that has slowed and limited adoption is the number of people in the farming communities sharing and promoting CT systems. We need more focus and activity from CT people at the grass roots level. Look where CT has grown and advanced; there is a local leader, an NRCS, an Extension agent, a Milan Experiment Station, an industry representative, an experienced grower, a Farm Smart conference, an annual field day. We need training, cross training, and recruiting. None of us are islands, none of us can do all there is to accomplish for CT. We must continue to work as teams, interdisciplinary work, partnerships and yet work closely with industry and promote those technologies that work in our area's CT system.

## THE FUTURE

We are going to see great and rapid changes and new technologies from industry for CT Bollgard II insect protection, enhanced Roundup Ready Cotton (Biotechnology cotton allowing the application of Roundup on more mature cotton), new patented Roundup type products (Mon 007), nematode tolerant cotton, cold tolerant seeds, nitrogen-producing monocotyledonous spcies (corn), additional Roundup-tolerant crops, improved precision planters, and site-specific farming technology adapted to CT.

Almost every product or technology that is brought to the marketplace will work with conservation tillage. Conservation tillage will be of highest priority when new products and technologies are developed by the industry.

Industry will continue to work and partner with government agencies, university research and extension, consultants, and of course, our customers, farmers, and growers. Conservation Tillage is an agronomic system with many interdependent parts, and it is interdisciplinary. Conservation Tillage will continue to grow here and abroad.