Ten Milestones in Conservation Tillage: History and Role in the North Carolina Conservation Program[1]

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Introduction

No-till has evolved in North Carolina over the last 40 years to become the most important conservation practice for cropland. Beginning with those trial and error days in the early sixties and a few brave farmers, visionary conservationists, and researchers and a few innovative chemical and farm implement companies, no-till gradually became a dependable option for the farmer, first for treating erodible cropland and later for soil improvement and moisture conservation on any cropland. The development of no-till often took one step forward and two steps backward, but with better equipment, herbicides, and the need to reduce the farmer's time for planting a crop, no-till has become an accepted method for planting most crops in North Carolina. Although no-till is being practiced for tobacco and vegetable crops, conventional clean tillage is still the norm for these crops.

The change in the attitude of farmers has played a key role in making no-till the most widely used conservation practice in North Carolina. When your father, grandfather, and great grandfather believed that deep plowing and cultivation was essential to grow a crop, it was difficult for a farmer to change to a system with no tillage. Farmers now consider trash farming, as sometimes no-till is called at the country store, a compliment and not an indication of lazy farming.

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1 This article is a reprint of the original paper with some color figures added: Brock BG, Canterberry JH, Naderman GC. 2000. Ten milestones in conservation tillage: history and role in the North Carolina conservation program. In: Sutherland JL, editor. Proceedings of the 43rd annual meeting of the Soil Science Society of North Carolina; 2000 Jan 18–19; Raleigh (NC). Raleigh (NC): SSSNC. p 13–18.

What is No-Till

No-till is one of several versions of conservation tillage that minimizes the soil disturbance during seedbed preparation and while growing a crop. In the early days, it was sometimes called sod planting. There are several types of conservation tillage, including ridge-till, mulch-till, strip-till, no-till, and any other planting method in which the soil surface has at least 30 percent ground cover after planting. In this paper, strip-till and vertical tillage that does not disturb more than one-third of row width is considered no-till. Planting or drilling is accomplished using disc openers, coulters, row cleaners, in-row chisels, or roto-tillers.

No-till planting provides very effective erosion control and moisture conservation. With this form of conservation tillage, the planting equipment places the crop seeds directly into the soil through the residue of a previous crop without any tillage (plowing or disking). This leaves most of the soil surface undisturbed by tillage and protected by the existing crop residue, which reduces runoff, thus preventing erosion and conserving water for crop uses.

The Importance of No-Till in Cropland Management

For the first time, crops can be produced while making soil improvements. Conservationists plan for soil losses not to exceed a tolerance level, or "T" level. Even at this rate, there is some question as to whether a given soil can produce at its potential because of runoff, soil loss, and loss of vital organic matter. Thanks to no-till technology, high yields can be produced while erosion and water runoff are virtually eliminated. With these conditions maintained over time, organic matter and cation exchange capacity (CEC) improvements are possible.

Farmer experience and research results have shown a doubling of soil loss reduction and CEC improvements. For example, Wood and Worsham found soil loss in the coastal plain with no-till tobacco to be reduced by 95 to 98 percent as compared to conventional tillage. In the piedmont, Steve Gibson, Cleveland County Extension Agent, found that CEC and organic matter nearly doubled after 10 years of continuous no-till with corn and soybeans. Sometimes it takes a little longer for benefits of no-till to accrue. In the mountains, where moisture is generally more dependable, Dr. Greg Hoyt noted increased tomato yields during the fourth year of continuous strip-till as compared to the standard black plastic system.

Wildlife Benefits

No-till has proven to have benefits for most wildlife but especially for bobwhite quail. A N.C. State University (NCSU) study found that bobwhite quail chicks found their daily insect needs in only 4 hours in no-till. With conventional tillage there were not enough hours in the day to meet the needs of quail chicks.

Other Benefits

Farmers often find unexpected benefits with long-term conservation tillage. For example, a U.S. Dept. of Agriculture Agricultural Research Service (USDA-ARS) study in Georgia found higher populations of beneficial insects in conservation-tilled fields, resulting in higher predation of bollworm eggs (75 percent compared to 25 percent).

Costly Conservation Practices Not Needed with No-Till

With adequate ground cover, no-till can allow more intensive use of steeper fields. Costly terraces and grassed waterways can be eliminated or minimized. Irregular slopes statewide make true contouring virtually impossible. With a good job of no-till, row direction makes little difference in soil loss.

The efforts of many interests have contributed to no-till technology. Equipment manufacturers, chemical companies, seed companies, researchers, crop and soil consultants, and others have made significant impacts. However, a great deal of credit goes to the forward thinking farmers for their persistence in the refinement of basic concepts relative to this revolution in farming.

Long-Term No-Till

The ultimate in no-till is long-term no-till, which is planting all crops continuously in at least 80 percent plant residue from preceding crops. Long-term no-till not only reduces soil erosion and improves water quality but also improves soil quality. This is the only conservation practice that can be used for continuous row crops, while soil improvement takes place at the same time. The soil improvement is the result of increased organic matter and microbial activity. Through long-term no-till, residue built up on the soil surface reduces the impact of raindrops, increases infiltration, and thus reduces runoff. A big advantage of long-term no-till is the need for fewer structural practices, such as contour farming, terraces, and, in some cases, grassed waterways.

Research shows that long-term no-till also reduces the amount of nutrients and pesticides reaching surface and ground water due to the increase in organic matter content. After three years, yields from continuous no-till are normally better those from conventional tillage on most soils in North Carolina. Troublesome weeds, such as bermudagrass, trumpet creeper, horsenettle, and some briars, may need special control treatment after several years of continuous no-till. Bermudagrass should preferably be eradicated before using no-till. With no-till, farmers have the opportunity to farm larger acreage due to less time and labor inputs.

The three authors of this paper have all been privileged to participate in the development of this important technology. We feel that these ten developments were significant milestones along the way. The following paragraphs provide a brief discussion of each.

Figure 1. In 1962, Haywood County farmer John Kirkpatrick used this homemade unit to prepare a narrow, tilled zone which was later followed with a regular planter. Erosion control on a steep slope was a major goal.

Figure 2. Mr. Kirkpatrick in January 2000. His ideas 40 years ago led to a major farming revolution.

Milestone 1—The Idea

A Kentucky farmer, Harry Young, is generally credited with the first no-till planting (in 1962) in the U.S. In our research into this, we discovered that a Haywood County dairy farmer, John Kirkpatrick, is documented as also having planted no-till corn in 1962 (Figure. 1). It was "sod planted" into an old fescue sod. We also discovered that Mr. Kirkpatrick had earlier produced a good crop of corn by broadcasting the seed and disking it into a fescue sod. He was not, however, able to get his silage chopper to make a good harvest because the corn was not in rows. As of this writing, Mr. Kirkpatrick is still in good health, an octogenarian, living in Haywood County (Figure 2).

Milestone 2—An Effective "Burn Down"

The earliest plantings were made into a sod. At corn planting time, the sod was quite vigorous and competitive. Therefore, it needed to be controlled to an extent sufficient for corn growth and development. All that was available was a pre-emerge herbicide, atrazine. It did a reasonable, but not always dependable, "burn down."

About 1967, Chevron Chemical Company released Paraquat as an effective "burn-down" product. This product, along with pre-emerge herbicides, made no-till corn more dependable. Another important spin-off was the use of Paraquat to eliminate weedy plants in wheat fields. Along with the use of suitable residual herbicides, no-till double-cropped soybean production came to be. Things were looking up!

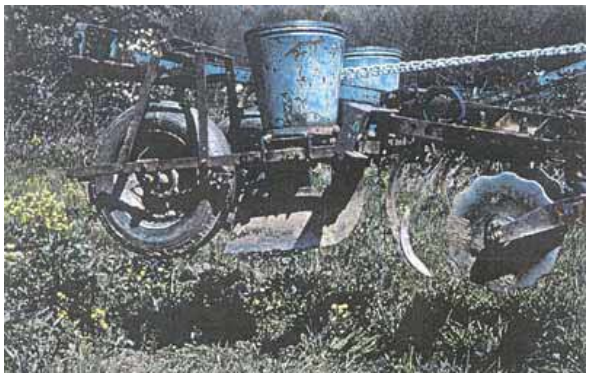

Figure 3. Early innovations and several farmers' adaptations of planting equipment for use under no-till conditions.

Figure 4. More examples of planter adaptations for no-till culture in the 1950s and 1960s.

Milestone 3—Better Equipment

The first plantings were made with homemade planters. Most common were coulters, followed by a narrow chisel of some type, then the standard planters (Figures 3, 4). These rigs were simply not heavy-duty enough to plant in very heavy residue nor dry soil conditions. Stands were generally not sufficient.

Encouraged by the promising results the farmers were seeing, plant manufacturers and the agricultural engineers at NCSU developed planters that were capable of getting improved crop stands. Especially effective were planters developed by Allis-Chalmers, Cole, and Ferguson; grain drills by Tye; and planters engineered by J. C. Ferguson and Eustace Beasley of NCSU.

Milestone 4—Demonstrations and Research

To their credit, the Soil Conservation Service (SCS) —now Natural Resources Conservation Service), NCSU, and various industry personnel saw the merit of what early farmer efforts produced and began to work with the early leaders in making research trials and on-farm demonstrations. Though there are surely others, the following people come to mind:

SCS
- Dan Windley, Beaufort County
- J. E. Pollock & C. C. Abernathy, State Agronomists
- Paul Britt, Moore County
- Howard Williams, Haywood County
- Bobby Brock, Lee County
- Sam Yound, Alleghany County

NCSU
- J. A. Phillips, Soil Science
- E. O. Beasley, Agricultural Engineering
- H. D. Bowen, Agricultural Engineering
- Steve Barnes, Soil Science/Research Station
- Wallace Baker, Agronomy/Research Station
- John Clapp, Extension Soybean Specialist
- R. L. Lovvorn, R. J. McCracken, P. H. Harvey, G. D. Jones, F. J. Hassler, W. D. Toussainant, Department Heads
- G. C. Klingman, Weed Science
- J. C. Ferguson, Agricultural Engineering
- J. M. Spain, Soil Science
- C. K. Martin, Soil Science
- C. D. Sopher, Soil Science
- W. M. Lewis, Weed Science
- A. D. Worsham, Weed Science
- Dick Perrin, Agricultural Economics

Private Sector

- John York, Chevron Chemical
- John Bell, Bell Implement Company of Goldsboro
- Thomasson Implement Company of Yadkin County.

The numerous forward-thinking farmers in all regions of the state who cooperated with on-farm demonstrations were very instrumental in getting this technology adopted. Without their assistance, it would have been a slow development indeed.

Milestone 5—Better Weed Control

Both pre-emerge and post-emerge herbicide improvements continued. A broader selection gave the no-till farmer most of the same options as the conventional farmers. Non-selective post-emergence herbicides made it possible to control troublesome perennials, thus allowing the use of continuous no-till. Soil quality improvements of unprecedented proportions were not possible with elevated organic matter levels in the upper inch or two of the soil profile.

Many farmers began to use “wait and see” management to tailor a post-emerge spray program to the weed crop rather than continue a broad-based pre-emerge program. Among the numerous chemical companies, BASF was notable in the early promotion of such an approach.

The development of crops which are tolerant to post-emerge herbicides allowed still another advance in refinement of weed control technology. Troublesome broadleaf weeds, especially in cotton, can now be controlled with broadcast sprays. The Monsanto Chemical Company was especially active in developing this improvement.

Milestone 6—The 1985 Farm Bill

Called the Food Security Act of 1985, this farm bill requires that erosion reductions be made on the Nation’s most erodible lands. It is left up to the farmer and his personal preferences to select the methods of erosion reductions to employ. Conservation tillage is the method of choice for the vast majority of grain farmers and a few peanut producers. It is safe to say that this Federal legislation proved to be a major incentive for adoption of conservation tillage. Fortunately, the technology was advanced sufficiently to make this economical and technically sound choice.

Numerous trial plantings of no-till tobacco and vegetables were made as an attempt to meet Farm Bill requirements with these crops. Some successes were made; however, dependable results have been slow to emerge, and as a result, wide use with these high-value crops has been sporadic. However, there is promise enough for optimism that these crops will also one day be commonly produced with conservation tillage.

Milestone 7—The Asheville, Statesville, and Greenville Meetings

In late summer of 1992 and early 1993, two of the more significant no-till conferences were held in Asheville and Statesville. In each instance major presentations were made by successful farmers and by notable research scientists. Static equipment displays showed state-of-art planters.

John Bradley of Milan, Tennessee, was a major attraction as a readily recognizable research figure in a successful no-till production. Phillip Davis, a farmer, discussed his successes as a consistent top producer in grain farming.

A highlight of the Statesville meeting was an inspiring presentation by a farmer from Chile, Carlos Crovetto. His contagious enthusiasm helped to encourage many farmers to use continuous no-till.

A year later, a similar session was held in Greenville. It too was well attended even though it had to be rescheduled due to icy weather.

In each of these informational meetings, there were excellent cooperation and hard work by the N.C. Dept. of Agriculture, USDA, NCSU, and private industries. These events were no doubt of considerable importance in helping our farmers to better understand and appreciate the potential of conservation tillage.

Milestone 8—Still Better Equipment

After a relative lull in equipment advances, a fresh round of improvements came rapidly in the late 1980s (Figure 5). A major weakness was overcome by the introduction of dependable, highly effective grain drills by several companies. Small grains could now be drilled into heavy residue, thus closing the circle for continuous no-till. Numerous other lines of equipment included

- straw choppers and spreaders for combines that uniformly dispense residues for easy double-crop planting,
- row cleaners that brush aside heavy residue concentration for better planter performance,
- in-row rippers for row planters that make it possible to minimize the effects of root-restricting pans,
- numerous rippers that can give a shattering effect to pans with minimal disturbance to the ground cover,
- spray equipment that makes it easy to cover the target pest with post-emerge applications, and
- coulter designs that are available for any possible soil condition.

Milestone 9—Media Coverage

Without question, farmers learn tremendously from other farmers—those both local and distant. Innovators have often paved the way for widespread use of better farming methods. This has been true with the adoption of conservation tillage. News of what others are doing stimulates ingenuity and often leads to a better way.

Newspapers, magazines, radio, and television have all contributed by bringing success stories to the attention of farmers throughout the state. These stories give encouragement to try and provide ideas that are often improved by others. From the small weekly newspaper to the large regional newspaper, success stories have been covered. Radio and television have hosted numerous programs featuring an encouraging word for this technology. Farm magazines have consistently given coverage of success stories over a wide area for many years. Extensive coverage has been provided by *Carolina Farmer*, *Progressive Farmer*, and *Southeast Farm Press*. *Southeast Farm Press* has also been the sponsor of several no-till conferences.

Milestone 10—Monetary Incentives

There is a long and successful history of publicly funded incentives to encourage adoption of conservation measures. Numerous financial advantages have been offered to those farmers who are willing to try this new technology. Among these are

- incentive payments from the Agriculture Conservation Program (ACP);
- tax credits from North Carolina;
- equipment rebates from the State of North Carolina and private industry,
- the Agriculture Cost-Share Program, as administered by local soil and water conservation districts (SWCDs);
- low-cost equipment rentals by local SWCDs, the Cattlemen's Association, county Extension offices, equipment dealers, and others;
- incentive payments from the Environmental Quality Incentives Program (EQIP);
- pesticide rebates from chemical companies.

Summary

The development and adoption of conservation tillage assuredly must be listed among the significant revolutions in the history of farming. It is true that there remain a number of refinements to be made. So, we will always look for a better way. Conservation tillage is truly that better way (Figure 6).

We have made every reasonable effort to give due credit to the many contributions to the development and refinement of this technology. Any shortfalls are regretted.

Figure 5. In the summer of 2000, there were major changes in production techniques on the Washington County farm of Charles Allen, pictured with a 42-foot-wide no-till planter.

Figure 6. Obvious effects of about 25 years of long-term no-till culture on a Cecil soil.