
Conservation Tillage— a Hot, New Idea From the Distant Past

Richard S. Magleby, agricultural economist,
Economic Research Service, and

David L. Schertz, national agronomist, Soil Conservation Service

USDA has tracked conservation tillage adoption since 1963, when it was practiced on less than 1 percent of the planted cropland. Ten years later in 1973, conservation tillage was used on nearly 5 percent of the planted acres. By 1983, after 20 years, use of conservation tillage had grown to over 20 percent of the planted cropland. In 1986 conservation tillage was practiced on nearly one-third of our Nation's planted cropland areas and has become one of America's most widely used conservation practices.

The primary difference between conservation tillage and conventional tillage is the percent of soil surface covered by crop residue after planting. Conservation tillage is any tillage and planting system in which at least 30 percent of the soil surface is covered by plant residue after planting (to reduce soil erosion by water). Where wind erosion is the primary concern, at least 1,000 pounds an acre of flat small grain residue-equivalent should be on the surface. Under conventional tillage, fields are plowed with a

moldboard plow or otherwise worked sufficiently to cover all or nearly all of the previous crop residue. With conservation tillage, specialized equipment is usually needed.

Major Types

1. *No-till*: The soil is left undisturbed before planting, which is completed in a narrow seedbed. Weeds are usually controlled with herbicides.

2. *Ridge-till*: The soil is left undisturbed before planting, which is completed in a seedbed prepared on ridges with sweeps or row cleaners. Weeds are usually controlled with herbicides and cultivation. Cultivation rebuilds ridges.

3. *Strip-till*: The soil is left undisturbed before planting. Tillage in the row at planting time may consist of a rototiller, in-row chisel, row cleaners, and so forth. Weeds are usually controlled with herbicides and cultivation.

4. *Mulch-till or reduced-till*: The total soil surface is disturbed by tillage before planting. The same equipment used in conventional tillage (except the moldboard plow) can be used such



On a no-till system in Iowa, soybeans emerge through corn residue. (Gene Alexander, SCS, IA-2,853)

as chisels, field cultivators, discs, sweeps, or blades but with less frequency. Weeds are usually controlled with herbicides and cultivation.

Soil Erosion Slowed

Of the four types of conservation tillage, no-till leaves the most plant residue on the soil surface after planting and conserves the most soil. Depending on the previous crop, no-till leaves the total surface covered by residue. If crops such as soybeans and cotton produce insufficient residue, cover crops are often used to increase it. Although erosion effectiveness will vary, no-till usually achieves a greater than 75 percent reduction in soil loss compared with conventional tillage.

Ridge-till, strip-till, and mulch-till, which leave less residue than no-till, are less effective, but still reduce ero-

sion from 50 to 75 percent from conventional tillage levels.

Popular in the Corn Belt

The Corn Belt has both the largest acreage of any region—34 million acres—and the highest proportion of its cropland, 43 percent, using conservation tillage.

Reasons for regional differences in how much conservation tillage is practiced may be the major crops that are grown and differences in soil and climatic conditions. The residue requirement for conservation tillage is easier to achieve with high residue crops such as corn and small grains than with low residue crops such as cotton, peanuts, and soybeans. Also, where cover crops are needed to supply sufficient residue cover to meet the definition of conservation tillage, the cover crop may use stored soil

Regional use of conservation tillage, 1986

Region	Acres in conservation tillage	Percentage of cropland in conservation tillage
	Millions	Percent
Corn Belt	33.7	43
Appalachian	6.0	40
Northeast	3.5	40
Mountain	8.2	36
Northern Plains	23.6	36
Lake States	8.4	27
Southeast	2.3	21
Southern Plains	6.6	20
Pacific	2.6	19
Delta	2.6	15
Total United States	97.5	33

Source: Conservation Technology Information Center

moisture resulting in less reserve moisture for the primary crop. Cover crops may not be a viable alternative to increasing surface residue in low rainfall areas.

Other reasons for differences among cropping regions include soil and climate. Negative conditions, however, are often overcome by proper management, changes or shifts in cropping patterns, and use of improved technology.

A major advantage of conservation tillage in areas of the Northern Plains with winter-seeded small grain has been to keep soil temperatures in the winter from going below the threshold level where the crop is severely damaged. Plant residue on the soil surface also significantly increases snowpack, thereby storing more soil moisture for the next crop. In fact, conservation tillage makes annual

cropping possible in many areas of the Northern Plains. Without the practice, the land generally is fallowed every other year to rebuild moisture.

Promising for Irrigated Land

The adoption of conservation tillage on furrow irrigated land has been much slower than on nonirrigated areas. Many farmers are concerned that leaving plant residue on the surface will retard irrigation flows, and cause differences in water coverage between upper and lower parts of the field. Recent research, however, has found that crop residue reduces irrigation-induced erosion, as well as erosion caused by raindrop impact, without significantly impeding the flow of irrigation water. Also, the use of conservation tillage on irrigated cropland may be beneficial in moisture conservation, reducing the number of

irrigations needed and the amount of total water applied.

Reduced Costs and Improved Returns

Economic Benefits. A farmer practicing conservation tillage can be affected economically in both the long run and short run. Reduced soil erosion can, in turn, reduce or eliminate the longrun productivity decline with continued unchecked erosion. This productivity benefit can be sizable where erosion is high relative to the depth of the top soil, and negligible where erosion is low and soils are deep.

In the Twin Falls area of Idaho, for example, conservation tillage reduced irrigation-caused erosion on shallow soils by 60 percent, and produced a 50-year benefit of more than \$150 (present value) an acre on slopes over 2 percent.

In the short run, conservation tillage can economically benefit farmers even with short-term yield reductions if total tillage costs are reduced sufficiently. Because fewer passes are made over the field than with conventional tillage, both fuel and labor costs are reduced. Also machinery costs are lower unless conservation tillage, particularly no-till and ridge-till, requires purchase or leasing of expensive new machinery before conventional tillage equipment is worn out. Medium-to-large acreage operations can achieve cost reductions because of more efficient machine use. Farmers, including those with smaller acreages who have tillage done on a custom hire basis,

may increasingly find conservation tillage less expensive than conventional.

The practice also reduces the time required to complete tillage and planting operations. This may be critical in achieving successful double cropping or in getting single season crops seeded quickly to gain additional growing days.

Some cost items may initially go up. Some first-time users increase pesticide use because of concern over potential increased weed and insect problems. As experience is gained, pesticides are generally not used more than with conventional tillage, and may be less.

Impact on Crop Yield. The impact of conservation tillage on current crop yields depends heavily on soil type, soil temperature, soil moisture, and the type of conservation tillage used. The higher residue cover provided by conservation tillage helps conserve soil moisture, which in dryer climates may actually increase yields. The cover may help protect soils from cold during the winter and give fall-seeded crops an additional edge come spring.

Where soils are cold and wet, however, no-till and mulch-till could retard soil drying and warming in the spring, delaying seeding or plant growth and potentially lowering crop yields. In the Corn Belt, for example, about one-half the cropland is suitable for no-till and two-thirds for mulch-till. However, ridge-till is an acceptable conservation tillage practice on cold wet soils and is increasing in popularity partly because of its adaptability

over a wide range of soil conditions.

Some type of conservation tillage is usually adaptable to most soil and climate conditions. When not adapted, or when the best type of conservation tillage cannot be used because of machinery limitations or personal preferences, crop yields may be reduced. In this case a profit-maximizing farmer would have to compare the value of the reduced yield against the tillage cost savings and long-term productivity benefits. Conservation tillage could still be the best decision.

Environmental Impacts

By reducing erosion and runoff, conservation tillage can significantly reduce sediment and nutrient loadings into streams and lakes.

Some concern exists, however, about the effects of widespread use of conservation tillage on ground-water quality. Because the practice increases water infiltration, and some farmers increase pesticide use, the potential exists for greater movement of pesticides and nitrogen into ground water. Monitoring for potential ground-water contamination in vulnerable areas is increasing as well as research and extension efforts on pesticide and fertilizer management for different areas and tillage situations.

Trends

In addition to increased use of conservation tillage, acreages in no-till and ridge-till have been expanding more rapidly percentagewise than acreages in other types. In 1986, no-till was used on 14 million acres of U.S. planted cropland, an increase of 43 percent from 1983. Ridge-till use on 2 million acres of planted cropland was nearly double its use in 1983. In contrast, acres in mulch-till and reduced-till together increased about 9 percent over 1983.

While some people see use of conservation tillage increasing to 60 percent or more of total cropland within 25 years, factors likely to influence the practice's expansion are mixed. On the positive side are farmers' desire to reduce production costs and increase returns, public interest in cleaner streams and lakes, conservation compliance requirements of 1985 farm bill legislation, and continued technology improvements making the practice better adapted to more areas.

Factors possibly dampening expansion are lower fuel prices that have reduced the cost savings of the practice, and the farm credit crunch and low farm product prices that have stopped many farmers from purchasing new machinery designed for conservation tillage and from making innovations in production methods.