Conservation Farming in New Mexico

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The nation was alerted to the urgent need for better farming methods on May 11, 1934, when dust clouds darkened eastern skies over the nation's Capitol. It was not the first time soil erosion was observed, but it was by far the most dramatic. Its importance had an impressive impact on events that followed. Many new soil conservation practices were initiated, followed by decades of research to preserve the soil and to restore and extend the agricultural economy. A new agriculture evolved.

Consequently, New Mexico agricultural producers have practiced conservation farming methods for many years. However, soil conservation also is mandated by the 1985 Food Security Act. The "swampbuster" and "sodbuster" portions of this act required growers who farm highly erodible cropland to initiate an approved conservation plan by 1990 if they were to remain eligible for USDA program benefits (such as price supports and disaster payments). The 1990 Food Security Act further strengthened the conservation requirements for all highly erodible cropland. These plans and compliance with conservation measures were to be fully implemented by 1995.

WHAT IS CONSERVATION TILLAGE?

Bare soils, associated with conventional tillage, lead to severe soil erosion from both wind and water. In contrast, conservation tillage is any tillage or planting practice that maintains at least 30% crop residue cover on the soil surface at planting time to reduce soil erosion by water, or, where soil erosion by wind is the primary concern, maintains at least 1000 lb/ac of flat, small grain residue equivalent on the surface during the critical erosion period (fig. 1).

The most important single contributor to erosion of New Mexico soils is wind. While not as significant or widespread as wind, flash floods can cause isolated, but significant, soil erosion. Wind and water erosion damage is rarely uniform on a farm or even within individual fields.

COSTS OF CONVENTIONAL TILLAGE

Conventional tillage can cost growers soil productivity, poor water use, and wind and water erosion. Long-term increases in production costs occur when erosion alters the soil's productive capacity. Erosion reduces the rooting zone depth and soil quality, the most pervasive long-term causes of soil productivity losses.

Frequent tillage causes low precipitation use efficiency, which results in reduced water availability in the root zone and increased susceptibility to drought. For example, data collected in the central Great Plains during the last 40 years show that normally less than 25% of the precipitation received during a 14-month fallow period is stored in the soil when growers use the dust mulch system with conventional tillage.

A third adverse consequence of conventional tillage is wind and water erosion. Additionally, cultivation increases oxidation of soil organic matter. Together, these factors can alter the physical properties of soils. Organic carbon and nitrogen in the surface soil can be selectively eroded by wind and water. In addition, excess oxidation of organic matter can contribute to further organic matter loss.

Fig. 1

To reduce the potential for soil erosion and comply with provisions of the 1985 and 1990 food security acts, agricultural producers are faced with changing production practices. To comply with these laws, growers must leave and maintain crop residues on the soil surface during periods of high erodibility. For many producers, compliance has meant a change in production practices to implement conservation tillage systems.

IMPLEMENTING CONSERVATION TILLAGE

Conservation tillage has two basic advantages for the agricultural producer: conservation of soil, water, and soil organic matter resources; and reduction of costly inputs while maintaining or improving crop yields and profits.

Conserving Soil, Water, and Soil Organic Matter Resources

Improved soil and water conservation through conservation tillage results in preservation of topsoil and soil organic matter. The primary causes of soil erosion are excessive or poor tillage practices that leave bare soil exposed to the eroding forces of water and wind. The basic principle of conservation tillage is to keep a soil- and water-holding cover on the soil surface, whether by residue or vegetative cover.

Under conditions of limited soil water and precipitation, crop yields under conservation tillage systems are equal and often significantly higher than under conventional tillage. The higher yields under conservation tillage systems generally are attributed to increased soil water content resulting from increased infiltration, decreased runoff, and decreased evaporation. In many areas of New Mexico, evaporation accounts for the major water loss from agricultural soils. Even with the best conventional tillage practices, soils in the Great Plains lose about 60% of the 20" of average annual precipitation directly by evaporation.

Because increased infiltration, decreased runoff, and decreased evaporation often result from converting to conservation tillage systems, growers can change to more intensive crop rotations with fewer summer fallow periods or increase crop yields with traditional cropping systems. When converting to more intensive cropping systems, precipitation use efficiency greatly increases, resulting in less water loss below the root zone and less potential for nitrate leaching. More intensive cropping systems also have higher potentials for reducing soil organic matter losses than do traditional monoculture systems because of more residue production over multi-year cycles.

Reducing Production Costs

Conservation tillage provides cost savings in three principal areas: energy, time and labor, and machinery costs.

Tractor fuel is the single largest use of energy in agriculture. Conservation tillage systems help to reduce fuel use up to 60% with no-till compared to conventional tillage systems (table 1).

Conservation tillage eliminates field trips, which reduces time and labor. Labor reductions of 50–60% are common, while time saved in actual tillage is also greater. However, this savings is often offset by greater management responsibilities, slower operation of planting equipment, and extra herbicide application requirements.

Reductions in machinery costs vary depending upon the conservation tillage system. A straight no-till farming system requires the least equipment of all the conservation tillage systems—only three basic pieces: a tractor, a planter, and an herbicide sprayer. When com-

Table 1. Comparison of fuel requirements for field operation in conventional, chisel, and no-till systems for corn on loam soils.

Tillage system and field operation	Fuel requirement (gal/ac)
Conventional system	
Disking corn stalks	0.45
Moldboard plowing	1.85
Disking	0.55
Field cultivation	0.60
Fertilizer injection (NH_3)	0.70
Planting	0.50
Cultivation	0.35
Total	5.00
Chisel plow system	
Chisel plowing	1.25
Disking	0.55
Field cultivation	0.60
Fertilizer injection (NH_3)	0.70
Planting	0.50
Cultivation	0.35
Total	3.95
No-tillage system	
Shred corn stalks	0.75
Liquid fertilizer application	0.20
No-till planting	0.50
Total	1.45

Source: Purdue University

pared to a conventional tillage system—which requires a moldboard plow, chisel plow, disk, rotary tiller, spring or spike tooth harrow, field cultivator, row crop cultivator, planter, tractor, and sprayer—it is easy to evaluate differences in equipment costs. Harvest equipment for conventional and conservation tillage systems are the same.

In a sprinkler-irrigated wheat study in the Clovis, New Mexico area, irrigated cost and return estimates showed large differences between conventional and conservation tillage systems. While yields and purchased inputs were similar, the conservation tillage system saved $27.71/ac in irrigation fuel and oil savings. The difference was caused by less water loss from evapotranspiration, which allowed growers to reduce the number of irrigations from seven to five. Also, conservation tillage operating expenses for the wheat were $35.24/ac less than the conventional tillage system. Together, the conservation tillage system offered a total savings of $62.95/ac compared to the conventional tillage system. In a similar study at the NMSU Agricultural Science at Clovis in 1990, no significant yield differences between no-till and conventionally tilled irrigated sorghum were found (Jones et al., 1994). This illustrates that not only can yield be maintained with conservation tillage systems, but operating costs and water inputs can be reduced.

Producers may discover additional benefits with conservation tillage or reduced tillage systems, including utilization of marginal land, reduced soil compaction, some harvesting advantages, and conservation compliance.

As a result of changing from conventional tillage to conservation tillage systems, producers also may experience some *short-term* disadvantages while they adapt to the selected conservation tillage system. Growers may experience increased management inputs; yield reductions until crop rotations, residue management, and fertility use patterns and techniques are established for their individual farm situations; changes in weed, insect, and disease pressures; delayed planting times for cooler soils; and purchase of specialty equipment.

TYPES OF CONSERVATION TILLAGE SYSTEMS

Successful substitution of conservation tillage for conventional tillage requires that planting equipment place seed in a rough-surfaced soil partially or completely covered with residues; that weeds and pests be controlled by chemical means; and that fertilizer and other agricultural chemicals be effective with reduced or no tillage incorporation. Five conservation tillage systems are defined here to identify the kind, amount, and sequence of soil disturbance during seed bed preparation.

No-Till (or Slot Planting). A procedure by which a crop is planted directly into a seedbed that has been left untouched since harvest of the previous crop. Generally, planting is completed in narrow (1–3") seedbeds. A device on the planter (a rolling coulter or disk) cuts through the sod and crop residue, and a seed slot opener prepares a slot for the seed. Weed control is accomplished primarily by herbicides to kill all live vegetation on or near the soil surface (fig. 2).

Fig. 2

Ridge-Till. The soil is left undisturbed before planting. Approximately one-third of the soil surface is tilled at planting with "V" sweeps or row cleaners. Planting is completed on a ridge (or bed) usually 4–6" higher than the row middles. Weed control is generally accomplished with a combination of herbicides and cultivation. Cultivation is used to rebuild ridges or beds (fig. 3).

Fig. 3

Strip-Till. The soil is left undisturbed before planting. Approximately one-third of the soil surface is tilled at planting time. Tillage in the row may be accomplished by using a rototiller, in-row chisel, or row cleaners. Weed control is accomplished with a combination of herbicides and cultivation (fig. 4).

Fig. 4

Stubble Mulch (or Mulch-Till). Stubble much tillage is performed with implements such as “V” sweeps and rod weeders that undercut residue, loosen soil, and kill weeds but leave much of the previous crop residue on the soil surface. Tillage tools such as chisels, field cultivators, disks, or blades, often with a combination of herbicides, also are used to control weeds. Because the soil is tilled as often as necessary to control weeds during the period between crops, the stubble mulch system is a tillage-intensive system that requires frequent operations to control weeds. This system was developed primarily for wheat and other small grain crops (fig. 5).

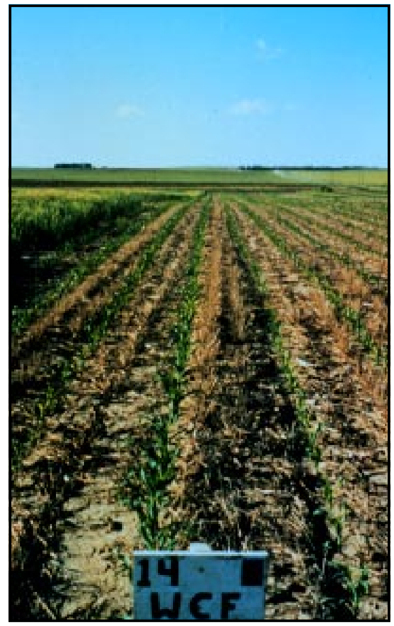

Fig. 5

Reduced-Till. Reduced-till systems are any other tillage and/or planting systems not covered by previous definitions that meet the 30% residue requirement (fig. 6).

Fig. 6

REFERENCE

Jones, J.M., J.D. Libbin, N.B. Christensen, and J. Schroeder. 1994. Economic Comparison of Conventional and Conservation Tillage in Eastern New Mexico. Research Report 687. New Mexico State Univ. Agric. Exp. Sta., Las Cruces, NM.

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