# Evaluation of Conservation Tillage Effectiveness on Sugarbeet Fields in Northeastern Colorado[1]

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Severe damage to seedling sugarbeets associated with wind erosion chronically occurs throughout northeastern Colorado. Recent expansion of sugarbeet production onto highly erodible soils, concurrent with the installation of center pivot irrigation systems on these soils, has further increased the hazard. Accordingly, a conservation tillage practice (rotary strip-tillage) is being adapted to sugarbeet production in northeastern Colorado in an attempt to protect seedling sugarbeets by maintaining surface vegetative residues. Operating on the principle of a rotary tiller, rotary-strip tillage permits the sugarbeet grower to prepare the seedbed, apply fertilizer and herbicide, and plant, with a single field operation. If surface vegetative residue is present at the time of planting, rotary-strip tillage will leave a portion of this residue on the soil surface to provide protection from wind (Figure 1). This study was conducted in 1973 to evaluate this tillage system under commercial sugarbeet production in Yuma County, Colorado with regards to its effectiveness at reducing wind erosion. Seven historically eroded sugarbeet fields were chosen throughout Yuma County on which rotary strip-tillage was utilized in 1973 in order to maintain surface vegetative residues to protect the soil and emerging sugarbeets from wind.

Surface-inch soil samples and samples of surface vegetative residue were taken during spring, 1973 from approximately 0.25 acre study areas located in the selected sugarbeet fields. The samples were taken following sugarbeet emergence during the period of maximum susceptibility of the seedling sugarbeets to wind-associated damage. The inherent erodibility of the soil, as reflected in the proportion of dry soil fractions of a size greater than 0.84 mm in diameter (generally considered less erodible) was measured by rotary dry sieving of the soil samples from each study location (1).[3] Using the inherent erodibility as determined by rotary dry sieving, the weight of surface vegetative residue collected from each site, a standard field length of 1,320

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[3]Numbers in parentheses refer to literature cited.

**Figure 1.—Residue remaining on soil surface after preparing seedbed, applying herbicide and planting sugarbeets in a single field operation.**

feet and a level surface soil roughness, potential soil loss by wind was estimated for each location with the wind erosion equation (3,4). The climatic variable necessary to predict soil loss was estimated for Yuma County and the month of May.

The predicted erodibilities for the selected study areas are shown in Table 1. Spring, 1973 was not a period of extreme wind erosion hazard in Yuma County due to unusually wet weather. The effects of the moist conditions of 1973 are reflected in the high percentages of dry soil fractions greater than 0.84 mm, considering the soil texture at each location.

Comparison of the unprotected and protected erodibility values for a given study area (columns 7 and 8, Table 1) indicates the effectiveness of the surface residues left on the soil surface by rotary-strip tillage at reducing the potential soil loss. The results show that rotary-strip tillage maintained enough residue on the soil surface at sites B, E-2, F, and G-2 to reduce the amount of soil eroded. These reductions in erosions would be associated with a lesser potential for seedling sugarbeet damage. Study areas A, C, and D, which normally present a hazard to beet production due to wind erosion, indicated low erodibility values, probably due to the moist conditions conducive to maintaining nonerodible aggregates. The presence of surface residues likely encouraged a favorable moisture content in the surface soil, contributing to the less erodible condition.

Table 1. Potential erodibility of Yuma County study sites.

| 1<br>Field Designation | 2<br>Study Area | 3<br>Soil Texture | 4<br>Type of Surface Vegetative Material | 5<br>% Dry Soil Fractions >0.84 mm | 6<br>Estimated Vegetative Residue (lb/acre) | 7<br>Unprotected Erodibility Assuming No Surface Vegetative Residue Tons/acre/year | 8<br>Protected Erodibility Considering Surface Residue Tons/acre/year |
|---|---|---|---|---|---|---|---|
| A | 1 | Sandy Clay Loam | Growing Rye | 69.7 | 131 | 4.0 | 2.7 |
| B | 1 | Sandy Loam | Corn Stover | 58.3 | 2156 | 11.5 | 3.9 |
| C | 1 | Sandy Loam | Corn Stover | 69.5 | 729 | 4.5 | 3.6 |
| D | 1 | Sandy Loam | Silage Corn Stover | 69.2 | 413 | 4.5 | 3.8 |
| E | 1 | Sand | Corn Stover | 47.4 | 125 | 28.0 | 27.0 |
| | 2 | Sand | Corn Stover | 54.6 | 1630 | 14.0 | 7.2 |
| F | 1 | Loamy Sand | Corn Stover | 60.7 | 2295 | 9.5 | 2.8 |
| G | 1 | Loamy Sand | Corn Stover | 55.6 | 1164 | 12.5 | 8.5 |
| | 2 | Sandy Loam | Corn Stover | 49.2 | 2309 | 24.0 | 8.8 |

Vegetative residue on sites E-1, E-2, G-1 and G-2 was inadequate to reduce erosion below a maximum soil loss tolerance of 5 tons per acre per year (2). Sites E and G-1 are areas within the sugarbeet fields characterized by a coarser soil texture and a lower organic matter content than the rest of the field. Residue production is poor on these areas (Fig.2). The combination of highly erosive soil and inadequate vegetative residue on such areas creates potentially extremely erosive conditions. These areas serve as points from which erosion can spread throughout the field. Stabilization efforts could be directed toward increasing the productive capabilities of these areas, or toward permanently vegetating them.

**Figure 2.—Sites where corn residue production would be extremely low due to a coarse soil texture and a lower organic matter content than the rest of the field.**

The study indicates that rotary-strip tillage is capable of reducing wind erosion and protecting seedling sugarbeets. The effectiveness of the practice is dependent on the amount of vegetative residue which is available to protect the soil from blowing. Where adequate residue is present, this system should permit sugarbeets to be grown on soils where conventional cultivation allows chronic wind damage associated with stand reduction. The system is especially attractive under center pivot sprinkler irrigation where surface residues do not hamper early irrigation for sugarbeet germination.

## Summary

Rotary-strip tillage, a no-plow conservation tillage practice which is being adapted to commercial sugarbeet production in northeastern Colorado, was evaluated in 1973 with regard to its effectiveness at reducing wind erosion and associated damage to sugarbeets in the seedling crop stage. Two variables necessary to solve the wind erosion equation, the surface soil fractions greater than 0.84 mm in diameter and the quantity and type of surface vegetation, were measured at seven Yuma County, Colorado commercial sugarbeet fields and the predicted soil loss by wind erosion was calculated. Where adequate vegetative residue remained from the previous growing season, substantial reductions in potential wind erosion were noted due to the surface vegetation remaining after rotary-strip tillage. When sufficient residue is available, rotary-strip tillage will permit sugarbeet production on soils considered too susceptible to wind erosion with conventional tillage. Results from some study locations characterized by low productivity soils indicated the importance of abundant vegetative residue production during the previous year for the rotary-strip conservation tillage system to be of maximum effectiveness.


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