Chemical fall and water conservation in the Great Plains

L. G. Good and D. E. Smika

ECONOMIC yields make annual cropping of wheat impractical in the Great Plains. Economic stability requires sustained crop production over the long term. In addition, soil and water conservation are needed to maintain the region's productive resource base. Summer fallow has become the accepted means for stabilizing crop production and conserving natural resources.

The first summer fallow method, called black fallow, left the soil bare. This produced intolerable soil losses because of erosion.

Stubble mulching, an improved form of summer fallow, reduced soil losses to more acceptable levels. Wheat yields were somewhat higher also than under black fallow.

Now, research with chemical fallow shows that this system of summer fallow not only minimizes soil losses by leaving all residue standing and attached to the soil but further increases crop yields.

Cropping Patterns and Methods

Research conducted at the Central Great Plains Research Station near Akron, Colorado, has direct application on about 22 million hectares (55 million acres) of farmland in southeastern Wyoming, western Nebraska, western Kansas, and eastern Colorado. This includes the heart of the Dust Bowl area in southeastern Colorado and southwestern Kansas.

A fallow-wheat rotation is the basic dryland cropping system used in this region. Some other crops are grown also, but available water limits crop yields.

Annual precipitation at the Akron station averaged 39.6 centimeters (15.6 in.) for the period from 1907 to 1975. Since 1948, the average has been 34.8 centimeters (13.7 in.).

Most rainfall events are short. Some are intense. About 30 percent of the precipitation occurs in storms of 0.6 centimeter (.25 in.) or less, 50 percent in storms of 0.6 to 2.6 centimeters (.25-.1 in.); and 20 percent in storms over 2.6 centimeters. With the limited rainfall and small numbers of showers it is important to store in the soil as much precipitation as possible.

The wind blows almost constantly throughout the Central Plains. Average velocity is 10.6 kilometers per hour (6.6 mph). From January through August the average is about 10.9 kilometers per hour (6.8 mph), from September through December, about 9.7 kilometers per hour (6.0 mph).

April is the windiest month with an average of 13.5 kilometers per hour (8.4 mph). This increase over the January through August average is primarily the result of short periods of high winds—80.5 to 90.5 kilometers per hour (50 to 60 mph), gusting to 112.6 to 128.7 kilometers per hour (70 to 80 mph).

Evaporation from Bureau of Plant Industries pans placed 30.5 centimeters (1 ft) above ground at the research station averages 182.9 centimeters (72 in.) of water per year. At ground level the amount declines to 132.1 centimeters (52 in.) per year.

Studies using vegetative barriers show that position and orientation of the barriers reduce evaporation from the soil surface (1). Crop residue management is, therefore, a significant factor in any attempt to increase the water available for crop production. The amount of residue produced and conserved is also important for the maintenance of soil tilth and fertility as well as erosion control.

Need for Water Conservation

Tillage by machines other than the chisel tend to reduce the nonerosible soil aggregation (Figure 1), but weed control is limited with a tillage system that relies wholly on chiseling. Al-
In 2.2 metric tons per hectare (4.4 t/ha) or more, appears to have a number of advantages over black fallow or stubble mulching. Black Fallow usually reduces surface residue to 0.6 metric ton per hectare (3,000 lb/ha) or less. Stubble mulching leaves 0.8 to 1.1 metric tons of residue per hectare (4,000 to 5,000 lb/ha) on the soil surface.

The Environmental Protection Agency released atrazine and paraquat for use on wheat stubble in 1976. Other chemicals are available or are being developed to supplement these two.

In research at Akron during the past eight years, chemical fallow conserved 23.6 centimeters (9.3 in) of water during each fallow year. Wheat yields averaged 36.5 quintals per hectare (15.3 bu/ha). In comparison, stubble mulching stored 17.3 centimeters (6.8 in) of water in the soil profile, and wheat yields averaged 25.5 quintals per hectare (33.0 bu/ha) (3, 4). Use of black fallow was discontinued in tests at the Akron station several years ago because soil losses were unacceptable higher and wheat yields were considerably lower than those under stubble mulch systems.

Control of both wind and water erosion is almost complete with chemical fallow. For example, estimated soil loss on a Weld loam with an average slope of 2 percent and black-fallowed on a square field of 60 hectares (148.3 acres) is 55.7 metric tons per hectare (220 t/ha) with black fallow. The estimated soil loss drops to 22.0 metric tons per hectare (8.1 t/ha) under stubble mulching and further declines to only a trace under chemical fallow. The productivity of this particular soil cannot be maintained if the annual soil loss exceeds 13.6 metric tons per hectare (5.1 t/ha) (2, 9).

Use of chemical fallow also reduces operating costs. With a combination of chemicals, such as atrazine and paraquat, costs (1977) are estimated to be about $24.70 per hectare ($10.00/ha) for treatment in the late summer, following wheat harvest. A second and possibly third treatment with contact or short term residual herbicides is usually needed the following summer. The cost of each of these treatments is about $12.35 per hectare ($5.00/ha).

The total possible cost of $47.10 per

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Table 1. Effects of different tillage implements on residue reduction and soil water loss

<table>
<thead>
<tr>
<th>Tillage Implement</th>
<th>Soil Reduction %</th>
<th>Soil and Water Loss (cm) in the 0. to 12.7 cm Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1 Day</td>
</tr>
<tr>
<td>Tandem disc</td>
<td>75</td>
<td>0.84</td>
</tr>
<tr>
<td>One-way disc</td>
<td>50</td>
<td>0.74</td>
</tr>
<tr>
<td>Chisel</td>
<td>40</td>
<td>0.23</td>
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<tr>
<td>Sweep plow</td>
<td>10</td>
<td>0.10</td>
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<tr>
<td>Rod weeder</td>
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</table>

*Data not collected for this implement.

Table 2. Effect of position of previous year's stubble on soil temperature and soil water loss

<table>
<thead>
<tr>
<th>Position of Stubble</th>
<th>Surface Soil Temperature °C</th>
<th>Soil Water Loss (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standing</td>
<td>32.6</td>
<td>0.04</td>
</tr>
<tr>
<td>Flat</td>
<td>41.2</td>
<td>0.05</td>
</tr>
<tr>
<td>Bare ground</td>
<td>47.8</td>
<td>0.06</td>
</tr>
</tbody>
</table>

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As of February 21, 1978, Wink has been referred to Geta-Gony for product sold as Astex

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REFERENCES CITED