G80-513 Protect Soil With Vegetative Residues

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Protect Soil With Vegetative Residues

Keeping a protective cover of vegetative residues on the soil surface is the simplest and surest way to control both water and wind erosion.

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Crop residues are vital to conservation of soil and water. Keeping a protective cover of vegetative residues on the soil surface is the simplest and surest way to control both water and wind erosion. Vegetative residues on the soil surface improve infiltration of water into the soil, reduce evaporation, and aid in maintaining organic matter. Residues left upright all winter trap snow which increases soil water.

Erosion

Soil surface residues are important to control wind erosion. In the Great Plains, stubble-mulch farming has been developed to keep residues on the soil surface. An eight-year research study in western Nebraska showed fallow land plowed with a moldboard plow lost an average of 11 tons of soil per acre due to wind erosion compared to 0.8 tons per acre of soil lost from stubble-mulch fallow.

Another study comparing various minimum tillage methods showed a loss of 0.8 tons of soil per acre for stubble-mulch tillage, 1.4 tons per acre for oneway disk fallow and 2.9 tons per acre for bare fallow.

A water erosion study in western Nebraska compared stubble-mulch fallow to bare fallow (moldboard plow) on a 4 percent slope on a medium textured soil. The stubble-mulch fallow had 60 percent less water runoff and lost 86 percent less soil compared to bare fallow. In growing wheat, the stubble-mulched land had 43 percent less runoff and 74 percent less soil loss (*Table I*).

Table I. Runoff and soil loss produced in wheat-fallow rotation at Alliance, Nebraska from 1958 to 1965.

	During fallow period		During growing period	
	Stubble-mulch	Bare	Stubble-mulch	Bare
Runoff (inches water)	1.9	4.7	4.5	7.5
Soil loss (pounds per acre)	3,400	21,900	8,900	34,900

Infiltration and Evaporation

Plant residue mulches on the soil surface increase soil moisture by increasing infiltration and reducing evaporation. Barnes and Bohmount[1] found that the water intake at the end of one hour was 0.3 inches for bare fallow, 1.20 inches for grassland, and 2.26 inches for stubble-mulch. McCalla[2], emphasizing the importance of mulches on soil structure, showed that a surface mulch is more important than soil organic matter in increasing water infiltration. A subsoil devoid of organic matter and not mulched had an intake of 0.44 inches per hour, while the mulched subsoil infiltration rate was 0.76 inches per hour for the same period. Infiltration in a good topsoil was 0.55 inches for mulched, after three hours of sprinkling.

Unger and Parker[3] studied the effectiveness of stubble-mulch farming on water conservation during the fallow period. They found that mulches conserved water during long dry periods. Evaporation from soil over a 16-week period was reduced 57 percent by straw applied and mixed with the soil surface, and 19 percent by straw buried 1.17 inches deep. Other findings in Nebraska, Colorado, and Montana showed a significant increase in fallow moisture efficiency with 1,500 and 6,000 pounds per acre of surface straw mulch, compared with bare fallow.

Organic Matter

Organic matter is vital to soil life. It is difficult to say how much crop residue must be retained by the soil to maintain the organic matter. It depends on the climate, the initial organic matter level, and on crop and tillage practices. Although we know that organic matter is important, it is difficult to determine critical levels. Since tillage began 100 or more years ago, we have lost from one-third to one-half of the organic matter from Corn Belt and Great Plains soils. We cannot afford to lose much more.

Between 1942 and 1960, soil organic matter in South Dakota declined 15,000 pounds per acre for continuous corn where residues were removed, compared to a decline of 2,900 pounds in a corn-oats-wheat rotation where residues were retained. The retained residue increased yield for the three crops between 10 and 18 percent. When manure was added along with the crop residues, the yields increased even more. When plowing was the main tillage method, the resulting residue removal decreased corn yields by 3 bushels per acre, oat yields by 5 bushels, and wheat yields by 2 bushels per acre.

Trapping Snow

Stubble left upright over winter is important to snow catchment and water conservation in much of the Great Plains. According to Greb, Black, and Smika[4], snow-melt moisture is more than 66 percent effective in moisture storage, compared with 0 to 15 percent effectiveness of moisture from a July rainstorm.

Stubble-mulch is a system of cultivation and planting that maintains as much of the crop residue as possible anchored to the soil, while disturbing the surface as little as possible. It is a flexible practice. When there is a large amount of residue left on the surface--such as after a particularly bountiful crop--part can be either incorporated or removed. Stubble-mulch practices vary from season to season and from area to area in the semi-arid Great Plains.

Residue Needed for Wind Erosion Protection

Wind erosion is most prevalent in the western part of the Great Plains, although it can occur any place where wind is strong and rainfall is light.

Formulas have been developed to determine how much residue must be maintained on the surface to lessen the chance of wind erosion. This amount depends on soil type and residue type. A sandy or sandy loam soil needs 1,700 pounds of wheat residue or 3,500 pounds of corn residue per acre to protect it. For a clay loam, 750 pounds of wheat residue or 1,500 pounds of corn residue is sufficient.

To determine how much residue you have, weigh the amount of residue from three separate square yard areas. The total weight of those three areas, in ounces, multiplies by 100, equals the amount of surface residue in pounds per acre. (For metric measurement, weigh the amount of residue from three separate square meter areas. The total weight of three meter areas in grams x 3.33 equals the amount of surface residue in kilograms per hectare.)

Farmers plagued by wind erosion and not having enough residue on the soil surface can take other steps to reduce the damage. These include the use of strip crops, rough tillage, or wind barriers.

[1]Barnes, O.K. and D.W. Bohmount. 1958. *Effect of Cropping Practices on Water Intake Rates in the Northern Great Plains.* Bul. 358, Wyo. Agr. Exp. Sta., Laramie, Wy.
[2]McCalla, T.M. and T.J. Army. 1961. "Stubble-mulch Farming." *Advances in Agronomy*, 13: 125-196.
[3]Unger, P.W. and J.J. Parker, Jr. 1968. "Residue Placement on Decomposition, Evaporation, and Soil Moisture Distribution." *Agronomy Journal*. 60: 469-427.
[4]Greb, B.W., D.E. Smika, and A.L. Black. 1967. "Effect of Straw Mulch Rates on Soil Water Storage during Summer Fallow Period in the Great Plains." *Soil Science Society of America Proceedings*. 31:556-559.

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