Effect of Crop Residues on Erosion Control and Grain Yields Under Southern Idaho Dryland Conditions

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In recent years both farmers and research workers have shown increasing interest in the use of crop residues for the conservation of soil resources in dryland areas. Numerous studies (1, 2, 3, 4) have demonstrated that surface utilization of crop residues has greatly reduced erosion. Some investigators (1, 2, 3) have proved that crop residues on the surface aid in the conservation of moisture. There has not always been agreement among workers (2, 3, 4, 5, 6) on the effect of utilization of residues on crop yield. Differences in results no doubt are due to variations in soils, cropping systems, and climate in the different areas.

This paper deals with a field experiment at the Tetonia Branch Experiment Station, Tetonia, Idaho, designed to determine the effect of different placement of straw residues in the soil under a wheat fallow rotation system on (a) erosion control, (b) moisture conservation, (c) nitrate nitrogen, and (d) yields.

EXPERIMENTAL CONDITIONS AND METHODS

CLIMATE AND SOIL

The climate at the Tetonia Branch Experiment Station is cool. The mean temperature is 52.6° F from April 1 to August 31, with temperature ranges from 90° F in the summer to -50° F in the winter. Marked variations in rainfall occur which cause large differences in crop yield from year to year. The rainfall varies from about 8 inches in some years to as high as 20 inches in other years, with a mean of 13.1 inches. Little effective summer precipitation is received. The altitude at the Station is 6,200 feet. The type of farming is winter or spring grain, alternating with summer fallow.

The soil type, which is quite widely distributed in southeastern Idaho, has been classified tentatively as Ritzville silt loam. It contains approximately 3% organic matter and 0.17% nitrogen in the surface 6 inches. It is light grayish brown in color and is underlain by a lighter colored subsoil. A calcium carbonate layer is ordinarily present at depths varying from 2 to 6 feet.

PLOT ARRANGEMENT AND METHODS

The plots are arranged in three series. All have a southern exposure and, to all appearances, are comparable. Each plot is 1/32 acre in size, 132 feet long and 33 feet wide. The rotation followed is fall wheat alternating with fallow. The wheat is harvested with a small combine and all straw spread back on the individual plots. On the straw-burned plots, the straw is burned in the spring before the initial tillage operation. During the fallow season, the plots are rod weeded only when necessary to control weeds. The number of rod weedicings vary from two to five, depending upon the rainfall. In some years, an extra weeding on the subsurface-tilled plots is required to obtain a complete weed kill.

In these studies, three placements of straw were used, viz., (a) turned under with the moldboard plow, (b) mixed with the surface soil with the one-way disk and (c) left on the surface with the modified moldboard plow. The modified moldboard plow is a moldboard plow where all moldboards were removed and a metal strip 3 inches wide fastened 3 inches above the share. A detailed description of this tool used may be found in an earlier publication.

All tillage methods were replicated three times where all residues were burned in order to determine the effect of the various tillage operations with and without residues.

Soil samples for moisture and nitrate nitrogen determinations were taken in the early spring and at seeding time in the fall. Samples were taken at four different places in the plot and in 3-inch sections for the first 6 inches, 6-inch sections to a foot, and from there down to 1-foot sections. Nitrate nitrogen determinations were run on the samples from the first 3 feet. The phenoldisulfonic acid method was used in determining nitrate nitrogen.

In determining the amount of residue on the surface of the soil, the straw on the surface was separated into separate square yards per plot. It was weighed, and the amount of residue remaining on the surface was calculated.

The erosion measurements were made during the fallow season. The length, width, and depth of each rill or furrow were measured. The volume of soil displaced calculated. From the volume of soil displaced and the volume weight of the soil lost are determined.

EXPERIMENTAL RESULTS

SURFACE RESIDUES RESULTING FROM VARIOUS TILLAGE OPERATIONS

The erosion control value of crop residues depends upon how much of the residue remains on the surface during the summer fallow season and after initial tillage. The pounds of straw on the surface, after initial tillage, and at the end of the fallow season of 1939 for three methods of initial tillage is shown in Table 1.

As compared to the moldboard plow and one-way disk, the modified moldboard plow leaves a maximum amount of straw on the surface for erosion control. Only 5% of the straw was lost by decomposition processes during the fallow season of 1939 for three methods of initial tillage shown in Table 1.

SOIL EROSION LOSSES

It is recognized that the use of the modified moldboard plow in measuring soil losses is not as accurate as using continuous erosion me