Evaluation of the Erodibility of Field Surfaces with a Portable Wind Tunnel

A. W. Zingg

The purpose of this paper is to present results obtained with the use of a portable wind tunnel in evaluating the erodibility of field surfaces to wind.

The tunnel and dust sampling equipment has been described previously (3). Operational techniques and the calibration of the tunnel to permit the control or determination of the several variables involved in field use were developed in the laboratory. These procedures also have been described (4).

Field use of the equipment and techniques was first made in November 1949. The results serve to demonstrate the possibilities and limitations of the approach. While the data at hand are limited, they throw considerable light on the interrelationships of the many factors governing the stability of field surfaces to the erosive forces of wind.

PROCEDURE

The results reported are confined to tests made on plots at the Soil Conservation Experiment Station near Amarillo, Tex. This location is approximately 500 miles from the laboratory headquarters. The soil is a Pullman clay loam. Six field plots were selected for detailed study. The plots are approximately 10 acres in area. Several contrasting crop and cultural conditions were represented by this choice. Pertinent data concerning their use and cultural status are as follows:

Plot A-1.—Wheat stubble mulch (rotation).—Wheat-sorghum-fallow-grass rotation. During 1949 it was in wheat, following 6 years of grass. It will be seeded to sorghum in the early summer of 1950. The plot was cultivated after wheat harvest with a stubble mulch sweep machine (30 inch sweeps). Approximately 40% of the heavy wheat straw residue was standing. Wheat was combined at a height of 18 inches. Wheat drill rows are at a 14-inch spacing.

Plot A-2.—Sorghum stubble (rotation).—Wheat-sorghum-fallow-grass rotation. During 1949 it was in sorghum, with the grain combined about the first of November. The plot was fallowed after sorghum in 1948 and then fallowed with a sweep machine (30 inch sweeps). Sorghum-fallow-grass rotation. Grass has not yet been seeded in the rotation. During 1949 this plot was in sorghum, with the grain combined about the first of November. The sorghum stubble is approximately 20 inches high and is left undisturbed over the winter. It is then cultivated for weed control prior to fall wheat seeding. The sorghum row spacing is 40 inches.

Plot A-3.—Wheat seeding (rotation).—Wheat-sorghum-fallow-grass rotation. Grass has not yet been incorporated in the rotation. The plot was fallowed after sorghum harvest in the fall of 1948 until wheat seeding in the fall of 1949. Wheat is drilled with a deep furrow Dempster shovel drill with 14-inch spacing.

Plot G-1-3.—Wheat seeding (continuous).—Planted continuously to wheat since 1942. The wheat is drilled with a deep furrow Dempster shovel drill with 14-inch row spacing. A one-way disk plow is used for tillage on this plot.

Plot G-1-4.—Sorghum stubble (continuous).—Sorghum is continuously to grain sorghum since 1942. Grain was combined in the fall of 1949 at a height of about 20 inches. The plot is always left until the spring before a fallow is performed. All plantings are made with a 40-inch row spacing, either one-way disking or blanket-tilling is employed. A variety of residue is left on the surface, depending on the amount of residue remaining on the plot.

Plot J-2.—Clean fallow (rotation).—This field has been in a wheat-sorghum-fallow rotation since 1944 and has been in cultivation for a long period of time. Grain sorghum in 1948 and then fallowed with a sweep in the fall of 1949. Sorghum row rows and were planted in the spring of 1950 and were not tilled until the time of tests in the fall of 1949. The plot is somewhat ridged from cultivation with the 30-inch sweep machine. The crop and cultural conditions were encountered in the spring of 1950, and five tests were performed on each plot. The tunnel was placed over the soil surface at a height of 18 inches above the soil surface during the tests at each force level. The data obtained from the two series of tests are too voluminous to present in their entirety. The reporting of detailed results is, therefore, confined to the tests of March 1950. Differences in results for the two series of tests are brought out by a simple comparison of materials eroded from all plots for the two series of tests at an arbitrary level of wind force.

Wind tunnel studies were made on the plots in 1949 and were repeated in March 1950. The soil is in a very dry condition at the time of both series of tests. More variable conditions were encountered in the spring of 1950. In these tests were performed on each plot. The tunnel was centered in the center of sorghum rows, and tests were carried out perpendicular to the row direction. Tests were made at right angles to the row direction of rows or cultivation on all other plots.

For a given test on a plot, the weight of soil eroded from an area 3 feet wide and 30 feet long is obtained at four levels of wind force. Briefly, the tunnel is operated at a relatively low wind force level but one having sufficient to cause measurable soil loss. This force is maintained until soil removal ceases. The time required for stabilization of the surface varies usually within 5 to 10 minutes. The eroded material is collected by the dust sampler at increment heights of 1, 1.5, or 2 inches above the soil surface. It is then transferred for subsequent weighing and analysis. The total loss is determined by integration of the soil loss-height function graphically or mathematically. The procedure worked out for progressively increasing wind force levels is followed. The cumulative loss at each force level then permits the determination of the amount of material eroded to the level of wind force. During the tests at each force level the pressure distribution and the determination of surface drag, surface roughness, and velocities at the four levels of dust sampling are measured.

The size distribution of the clod structure on each plot is determined by passing samples of the surface material through a rotary sieve (2). Six samples from each plot are sieved independently to obtain representative values and measure of the variability of clod structure.

The data obtained from the two series of tests are too voluminous to present in their entirety. The reporting of differences in results is, therefore, confined to the tests of March 1950. Differences in results for the two series of tests are brought out by a simple comparison of materials eroded from the plots for the two series of tests at an arbitrary level of wind force.

1 Contribution No. 431, Department of Agronomy, Kansas Agricultural Experiment Station, Manhattan, Kansas.

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