THE EROSIVE CHARACTER OF THE SOLONETZ-LIKE *B* HORIZON

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In central Oklahoma numerous so-called alkali spots or slick spots occur bordering the Permian-Pennsylvanian contact. These may be only a few feet in diameter or they may be much larger. Where erosion has not removed the *A* horizon the soil is usually sandy loam to loam in texture. This horizon ranges from only a few inches to as much as 18 in. in depth. The natural vegetation is usually some of the short grasses. The organic matter content is quite low, and due to the sodium content it has with the exception of a narrow zone at the surface moved down into the lower part of the *A* horizon, resting on top of the rounded and partially rounded caps of the columnar *B* horizon. The lower portion of the *A* horizon is therefore darker than that portion of the horizon immediately above it. Streaks of the sodium humate may occur down the sides of the columns a short distance. The clay particles from the surface have washed down, hence the columns are usually heavy in texture. When erosion exposes them, the deflocculated material becomes quite sticky after rains. The columns gradually lose their identity with depth merging into a structureless mass containing various salts. Frequently calcium carbonate specks occur in the upper portion of the structureless horizon and with increasing depth more of the soluble salts are encountered. Below the compact structureless *C* horizon sandstone is usually encountered.

In the area mentioned, soil erosion has been very severe and in the cultivated fields the *B* horizon of these solonetz-like soils are often exposed. Because of the highly deflocculated condition of the *B* horizon, water cannot penetrate the profile and as a result erosion occurs. This erosion is more rapid than in the surrounding normal soils because deflocculation leaves very fine particles at the surface to be agitated by the raindrops, and once fine material is in suspension it is carried a long way before it settles out. Investigations** show that after churning samples of normal soils and the *B* horizon of the solonetz soils there is often more material in suspension in the latter after 60 min. of settling than in 2.5 min. with the former. This high degree of dispersion is closely associated with a highly erosive character for if the material is easily brought into suspension and has a tendency to remain in suspension, running water will remove it from its original location. Solonetz *B* horizons have a high dispersion coefficient and a low Ca/Na ratio in the exchange complex. The Ca/Na ratio is usually less than 1.00 and as an average of 32 samples taken from various areas it was 0.58. Nearby normal soils had a Ca/Na ratio of 11.12. The large amount of sodium accounts for the low Ca/Na ratio in the solonetz-like soils.

Where terraces are used in controlling erosion it is well to miss these areas as much as possible but often this cannot be done conveniently. A terrace ridge made of the solonetz *B* horizon readily flattens out even with a few rains and the purpose of the terrace is defeated. In fact the terrace may be of more harm than good because the terrace has concentrated the run-off water at this point and by emptying it into the field a gully is easily formed.

In light of these experiences an experiment was conducted in which the *B* horizon of a given solonetz soil was mixed with nearby normal soil

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**H. F. Murphy and H. A. Daniel, "Some chemical and physical properties of normal and solonetz soils and their relation to erosion," Soil Science 39, 453-461 (1935).

in various proportions. Mounds were made of the mixture and data were taken from time to time. Table I gives some general information on the soil materials used.

TABLE I. *Some chemical properties of the soils used in the mixture.*

Soil	Replaceable Sodium	Replaceable Calcium	Ca/Na ratio
	Milli equivalents per 100 g of Soil		
Solonetz soil B horizon	2.09	1.25	0.60
Normal soil A horizon	.14	1.40	10.00

The mixtures were built into mounds on May 19, 1934, which settled to a height of 14 in. in about 3 weeks. No rainfall occurred during this period. Observations were made from time to time but no exact measurements were taken until January 1, 1935. By the end of August, 1934, however, the mound made of the pure solonetz *B* horizon had flattened out considerably. On October 4, 1935, further data were taken. Rainfall data and erosion data are given in Tables II and III.

TABLE II. *Rainfall data from May* 19, 1934, *until October* 4, 1935.

Month	No. of Rains	Range (in.)	Total Precipitation (in.)
May 19-31, 1934	None	None	None
June, 1934	4	0.05 - 0.94	1.58
July, 1934	3	0.08 - 0.36	0.63
Aug., 1934	4	0.10 - 1.06	2.56
Sept., 1934	5	0.47 - 2.59	6.76
Oct., 1934	4	0.15 - 1.77	2.60
Nov., 1934	7	0.05 - 1.40	2.54
Dec., 1934	4	T - 0.85	0.87
Total—May 19-Dec. 31, 1934	31		18.16
Jan., 1935	5	T - 0.52	0.60
Feb., 1935	9	T - 0.39	1.38
March, 1935	7	T - 1.18	3.05
April, 1935	7	T - 1.40	2.45
May, 1935	15	T - 0.98	3.59
June, 1935	18	T - 4.43	10.31
July, 1935	4	T - 0.39	0.51
Aug., 1935	6	T - 3.00	3.06
Sept., 1935	10	T - 1.10	2.26
Oct. 1-4, 1935	None		None
Total—Jan. 1-Oct. 4, 1935	81		27.23

TABLE III. *Erosion data on soil mounds exposed to the weather. All mounds originally were* 14 *in. high after* 3 *weeks settling with no rain.*

Soil Mixture (%)		Height of Mound (in.)	
Normal Soil	Solonetz B Horizon	Jan. 1, 1935	Oct. 4, 1935
100	0	9.0	6.50
90	10	9.3	6.62
80	20	7.8	5.44
70	30	7.8	5.19
60	40	8.2	5.25
50	50	7.6	4.31
40	60	6.9	5.00
30	70	7.6	4.69
20	80	7.5	5.12
10	90	5.6	1.81
0	100	4.9	1.81
Normal soil with solonetz center		7.8	5.12

The data on the height of the mounds are somewhat misleading in that they do not take into account the shape of the residual mound. The original mounds were oval in shape. The mounds made of normal soil and the 90 per cent normal soil mixture have retained this form while the others have varied from it. Their tendency is to flatten out except for a peak left in the center. This peak becomes very slender as the percentage of the solonetz-like *B* horizon increases and for a terrace ridge such a structure would be undesirable. It would break with any appreciable accumulation of water in the terrace channel on account of its weakness.

The data indicate that it is not advisable to build the terraces through these solonetz-like areas with the material at hand but it is necessary to bring in soil from off the area.

Quite often these solonetz-like areas are the starting point for gullies. The sodium-laden soil complex starts washing away more or less in a channel off the spot and is deposited along the way. Gradually reaction between the normal soil in the channel and this sodium complex occurs, producing a deflocculated soil condition along the slight channel and the soil in the channel is ready for removal with the rains which follow. Fills in these gullies should not be made with solonetz-like material because they will not stand up but will, by their removal and deposition further along the channel, only increase the erosiveness of the soil along the way.

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