THE EFFECT OF FERTILIZATION ON THE REPLACEABLE BASES IN THE SOIL

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This paper deals with the influence which ten years of fertilization has had on the replaceable sodium and calcium in Kirkland very fine sandy loam soil. No attempt will be made to review the literature on this subject; many investigators having reported various influences of different fertilizers on the reaction and physical condition of the soil.

DESCRIPTION OF THE EXPERIMENT

In the fall of 1924 a series of plots was laid out on Kirkland very fine sandy loam soil. Each plot contained one-twentieth of an acre, except one which was one-fortieth acre in size, was rectangular in shape, and was separated from adjoining plots by alleys 3.5 feet wide. A fertilizer program based on the triangular system has been followed since the establishment of the plots. A total application of 300 pounds per acre of nitrate of soda, kainit, or superphosphate, either singly or in combinations has been made each year in the fall at or near the time of seeding the wheat crop. Turkey Red wheat has been grown continuously on the area.

During July, 1933, composite samples from twenty different locations on the respective plots were taken representing the surface 6 inches of soil. The base exchange capacity and the replaceable sodium and calcium were determined using neutral normal ammonia acetate as the replacing reagent. Replaceable is used here to include both actual replaceable and that which is soluble in the acetate solution.

The results are given in Table I.

DISCUSSION OF RESULTS

When either nitrate of soda or kainit or both was used as the chief ingredient in the fertilizer the amount of active sodium increased. The increase was as great whether the fertilizer was mainly kainit or nitrate of soda. It thus appears that kainit may influence the amount of sodium brought into active form in the soil although no analysis is available on the kainit used, and thus its sodium content is unknown. The increase in replaceable sodium in the surface 6 inches of soil receiving the 300 pounds annual application of nitrate of soda accounts for approximately one-fourth of the sodium applied. A study of the lower horizons of the profile would no doubt be interesting.

Studies (1, 2) recently made of soils in this state indicate the importance of the Ca/Na ratio in alkali soil particularly as regards their ability to produce crops and their behavior toward erosion. Soils having a low Ca/Na ratio tend to deflocculate, are easily puddled, and seal over or run together on the surface after a rain. Such conditions do not allow penetration of water and heavy runoff is the result. Much of our eroded soil in this state is of this nature. Many of the gullies now so prominent in our farm lands had as their origin one of these alkali spots. Such soil has a tendency to remain in suspension once it acquires this state and therefore may be easily carried away in the runoff water.

While the Ca/Na ratios on these fertilized plots are all well above those in the unfavorable soils examined in the erosion-solonetz soil study, yet the plots having the high replaceable sodium content in this study have a poorer physical condition than those with the lower sodium content.

TABLE I.

The Base Exchange Capacity and Replaceable Sodium and Calcium

Per 100 Grams of Soil

Treatment in pounds per Acre*	Base Exchange Capacity in Milliequivalents	Replaceable Na in Milliequivalents	Na saturation in Percent	Replaceable Ca in Milliequivalents	Ca Saturation in Percent	Ca/Na Ratio
Check	9.922	.156	1.57	4.874	49.12	31.2
300 P	10.229	.146	1.43	5.229	51.12	35.8
225 P, 75 K	9.943	.142	1.43	5.181	52.11	36.4
225 P, 75 N	10.373	.142	1.37	5.253	50.64	37.0
Check	9.420	.125	1.33	4.926	52.29	39.4
150 P, 150 K	8.938	.309	3.45	4.842	54.17	15.6
150 P, 75 K, 75 N	9.635	.192	1.99	4.188	43.47	21.8
150 P, 150 N	9.471	.192	2.03	4.067	42.94	21.2
75 P, 225 K	9.430	.268	2.84	3.793	40.22	14.1
Check	8.877	.115	1.29	4.006	45.13	34.8
75 P, 150 K, 75 N	8.928	.291	3.26	3.704	41.47	12.7
75 P, 75 K, 150 N	8.517	.320	3.76	3.801	44.63	11.9
Check	9.348	.182	1.95	6.149	65.88	33.8
300 K	8.610	.693	8.05	5.520	64.11	7.9
225 K, 75 N	11.798	.601	5.09	5.972	50.48	9.9
150 K, 150 N	10.004	.695	6.95	5.955	59.52	8.6
Check	11.234	.192	1.71	5.713	50.85	29.7
75 K, 225 N	10.988	.692	6.29	5.568	50.67	8.0
300 N	11.193	.599	5.35	5.036	44.99	8.4
Check	11.316	.142	1.25	5.375	47.49	37.9
75 P, 225 N	10.947	.376	3.43	4.890	44.67	13.0
AVERAGE OF CHECKS	10.019	.152	1.51	5.174	51.64	34.0

* P=superphosphate; K=kainit, and N=nitrate of soda.

Soils having a good physical condition are soils with a high ratio of calcium to sodium in their base exchange complex.

Many soils in Oklahoma have only a very shallow surface and are underlain with subsoils high in replaceable sodium content. Such soils should never be brought under cultivation or if they are now in cultivation they should be protected from erosion because once this surface soil is removed that which remains has no agricultural value.

REFERENCES

1. Murphy, H. F., 1934. The salt content of some soils near the salt plain in Alfalfa county, Oklahoma, in relation to crop production. Journ. Amer. Soc. Agron. 26:644-650.

2. Murphy, H. F., and Daniel, H. A., 1934. Some chemical and physical properties of normal and solonetz soils and their relation to erosion. (Unpublished).