

Problem of Soil Analyses

Plant Food Useless in a Soil so Hard and Dry That the Roots Cannot Get It.

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IT IS LITTLE WONDER land values slump in a section where you can put four cement posts and two men on a spike-tooth harrow and then simply "mark" (not scratch) the surface of the iron-like soil, and where "farmers" burn their straw and have not spread a load of barnyard manure (apparently) since the valley was settled.

It makes little difference, practically, how much plant food a soil contains, if it is so hard and dry that the roots cannot get it, hence the word on the physical condition of soils at the close of this letter. This physical condition we can generally control by wise handling. The necessary chemical elements, if lacking in a soil, we must buy and spread.

Fifteen chemical elements enter into or make up the plant body. These may be studied in the per cent composition of corn:

Elements obtained in abundance from air and water—Oxygen, 46.000%; carbon, 45.000%; hydrogen, 6.000%.

Elements that the corn plant must get from the soil and which we must buy, if deficient—Nitrogen, 1.760%; phosphorus, .300%; potassium, .340%.

Elements seldom lacking in the soil in the small amounts required, except calcium (lime), in regions free from limestone. It is also added to "sweeten" or correct acidity of soils—Magnesium, .125%; calcium, .022%; iron, .008%; Sulphur, .004%; Silicon, .014%; Sodium, .013%; Chlorine, .013%.

Necessary Elements in Soil.

A plant cannot make something out of nothing any more than a man can, and while most of the above elements exist in air, water and soil in superabundance for the plant's needs, the three elements, nitrogen, phosphorus and potassium, practically limit and determine soil fertility. Nitrogen, most vital of all, does not exist as a mineral in soil, but must be added from decay of plant and animal bodies. Of the other two, phosphorus is likely to be the limiting element in a soil, but potassium compounds, as well as those of calcium, are so readily soluble that they are likely to be leached away, as is the case with peaty loam soils. No matter what the abundance of the others, lack of any essential element limits plant growth; it is like a storehouse full of food with the key lost. So a black peat soil is loaded with nitrogen and may contain a good amount of phosphorus but be so poor in potassium that corn planted in it will make only so much growth as the potassium contained in the kernel will permit—perhaps three or four stunted leaves. Add a few pounds of potassium to the acre—a 100 bushel crop actually takes 73 pounds of potassium out of an acre—and we get vigorous growth and a large crop.

Similarly the case of lime as limiting element is shown by the following experiments made in Maryland:

Produce during eleven years, per acre—Four crops corn, no lime, 98 bushels, limed (carbonate), 145 bushels; three crops wheat, no lime, 32 bushels, limed (carbonate), 43 bushels; four crops hay, no lime, 2.60 tons, limed (carbonate), 4.29 tons.

Rich bottom land, season fairly dry, 1897—Plat I received 350 pounds of dissolved rock per acre, yield 13,597 quarts; plat II received 700 pounds of dissolved rock per acre, yield 20,066 quarts.

This shows that an addition of \$7 worth of phosphorus caused an increase in the crop to the value of \$353.55.

The plain farmer's land rule is, or has been in the past, "If the soil won't grow crops, go somewhere else where

it will." But this is a foolishly slow, laborious and expensive method of finding out. What might take a farmer from one to ten years to learn uncertainly and imperfectly may be determined scientifically by a few hours' work in a modern laboratory.

Thus we see that for agricultural purposes some land may be dear as a gift. Agricultural nitrogen is worth 15 cents a pound, potassium 6 cents, phosphorus 3 cents and ground limestone about 5-10 of a cent, besides cost of hauling and spreading. With these prices in mind we may compare two samples of land as follows:

Pounds in 2 million (i. e. per acre, about 6 2/3 inches deep).

Plant food—Manitoba.	Value.
Phosphorus 2,530	\$ 75.90
Potassium 17,100	1,026.00
Nitrogen 20,900	3,015.00
Calcium 27,000	135.00

Total values	Value.
Bavarian Barrens.	
Phosphorus, trace	\$ 0.00
Potassium, trace	0.00
Nitrogen, trace	0.00
Calcium, 1380	6.90

Total values \$ 6.90

Of course above the minimal limit at which the plants can get all they need additional supplies of plant foods may not be of immediate value, but the above figures indicate a reason for the rush of agricultural emigration into the Northwest. And yet, with all the experience of the past with exhausted and abandoned lands, the people on these rich soils are still talking of "inexhaustible fertility," burning their straw and manure, or hauling the latter onto the ice to befoul their streams. A comparison of virgin soil in the Canadian Northwest with soil adjoining it that had been cultivated ("mined") for 22 years showed a loss of 2,200 pounds of nitrogen, \$330.00 worth per acre.

This leads us to study losses of plant foods in the soil due to cropping. Too few have counted the cost of a crop to Mother Earth or thought of making any return.

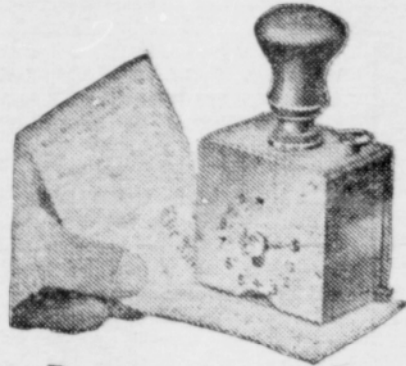
None of the above data are new, but farmers are not learning these facts and not taking them into account as they should. Nothing would, perhaps, benefit our farmers and our country more than the careful study of the problems suggested above. If in each grange, or rural neighborhood, the people would get together and each family buy a good modern book and then study the problems, meet to discuss and compare notes, we could increase soil fertility and often double crops at the same time. Most of the data above was taken from Soil Fertility and Permanent Agriculture by Professor Hopkins of the Illinois Agricultural Experiment Station.

Of course the problem is not so simple as it might seem from this brief statement. As Warren says: "The fertile surface soil may be carried away by erosion, by wind or water. Probably more soil fertility is lost in this way than by cropping." Soil may be too dry, when any amount of plant foods are of no avail; or it may be too wet and require drainage, and too free drainage may rapidly leach away nitrates, potash and lime. Humus and bacterial content of soils indicate matters of great practical importance. It may be almost as easy to spread the straw of a wheat field as it would be to sow the equivalent value of chemical fertilizer and the plant fiber in adding to the humus would greatly increase the power to hold water and the ease with which the soil may be worked.

Soil Fertility Contained in Different Farm Crops Approximate Maximum Amounts Removable Per Acre Annually.

Crop—Yield.	Nitrogen	Phosphorus.	Potassium.	Total Value.
Wheat, grain 50 bushels.	71	12	13	\$11.79
Wheat, straw, 2 1/2 tons.	25	4	45	6.57
Wheat, crop	96	16	58	18.36
Corn, grain, 100 bushels.	100	17	19	16.65
Corn, stalks, 3 tons.	50	6.5	54	10.93
Corn crop	150	23.5	73	27.58
Alfalfa, eight tons	400	36	192	*72.60
Apples, 600 bushels	47	5	37	10.62
Leaves, 4 tons	59	7	47	11.28
Wood growth	6	2	55	1.26
Apple crop	112	14	109	23.76
Fat hogs, 1000 pounds	18	3	1	2.85
Butter, 400 pounds	0.8	0.2	0.1	0.14

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