Leaflet AB.

CHEMICAL ANALYSIS OF SOIL,

Its Limitations and Its Utility

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Place of soil analysis misunderstood

Judging from the large number of requests for soil analysis coming to this Station, there is a widespread impression among landowners of the state that chemical analysis is competent to determine the fertilizer requirements and crop adaptations of a soil. Such an impression is quite natural as a result of an understanding of the food requirements of plants, of the knowledge that soils differ greatly in their productive power, and of the fact that commercial fertilizers are valued according to their chemical composition. This common understanding of the value of soil analysis, though correct in principle, is usually wrong in the extent of its application. The chemical analysis of soils is a valuable aid in determining their relative value, to some extent their crop adaptations, and especially in planning rational systems of soil improvement ; that is, systems designed not only for the immediate seasons but with a view to the most efficient management over a period of years. It is a mistake, however, to suppose that a soil analysis will determine just what combination of commercial fertilizers and what amount will give the best returns for the coming year, or just what crop or variety of crop is best adapted to the soil in question. Chemical composition of the soil is not the only important factor which tends to influence the effect of a fertilizer application ; and with wide variation of

other conditions, and especially in connection with the ordinary application of high-priced mixed commercial fertilizers, it often bears no relation to the crop yields. Partly for this reason and partly for others it is not practicable, at least at present, for the Experiment Station to undertake the analysis of soil samples for individual land-owners. The other reasons are as follows :

Station does not analyze miscellaneous samples.

It is a technical matter of some difficulty to secure soil samples that are thoroughly representative of fields in question. By the Station sending out complete directions for such work many farmers would be able to secure good samples ; but at the same time as many more would not succeed in this respect. There would be no way for the Station to tell which were accurate and which not ; and the analysis of samples not entirely representative is worse than a waste of time, for the results may actually be misleading. If this work were undertaken it would be necessary for a representative of the Station to do the sampling.

In the next place the amount of time and expense involved in the analysis of a sample of soil is relatively great. A commercial chemist would probably charge $10 to $25. Should the Station undertake to comply with all requests for soil analysis it would require a larger force

of chemists than it now employs for all lines of chemical investigation.

The Station is engaged in a chemical study of various soil types throughout the state, and certainly more will be accomplished for the farmers in the long run by working in this general way than by spending time on the analysis of miscellaneous samples.

When analysis may be helpful.

An exact knowledge of the composition of the soil is of much importance when viewed in the right way. Soil analysis will determine very accurately the total amount of plant food or other important constituents present in a sample of soil. If any of these constituents occur in such limited quantities that they now or in the near future will affect unfavorably the yield of crops, then obviously the agricultural value of the soil will vary somewhat with its composition, as determined by analysis. It is certain that a great majority of our soils do contain some of these important constituents in such limited amounts.

Plant food must be made available.

The entire stock of plant food in the soil exists in a comparatively insoluble (unavailable) state. If this were not so it would not have remained after many centuries of weathering to which the soil has been exposed, but would have long since leached away. Only a trifling amount

of plant food becomes soluble (available) each year. Any attempt to determine accurately the amount of plant food available for a given season is unsuccessful, for as it is made available it is largely taken up by plants or leached away. Under conditions obtaining in humid regions soils do not contain at any one time more than a mere trace of easily soluble plant food. In any soil the amount of plant food that becomes available during a given season depends upon the intensity of the factors which make it available and upon the total stock of plant food in the soil, somewhat as a man's income depends upon his rate of interest and the amount of capital he has invested. Factors which make plant food available are: Favorable physical condition of the soil as modified by texture, cultivation, drainage, etc.; moisture supply; decaying organic matter; amount of lime carbonate; and many chemical and biological influences, all of which are modified by the above conditions. But it is a well-known fact that even with conditions more than normally favorable for making plant food available, many soils still produce poor or only moderate crops. The total stock of one or more of the plant-food constituents is so low that favorable conditions do not liberate enough for large crop yields. A system of management which is designed to build up such a soil and make it more productive from year to year must provide for supplying these constituents in actually larger amounts than they are reduced by crop-

ping; and the absolute data that is to be obtained by soil analysis is a great help in planning such a rational system. Aside from giving the amount of plant food present, a knowledge of the composition of the soil reveals the supply of lime carbonate and organic matter.

Elements determined in soil analysis.

In order to appreciate what determinations are to be made in a soil analysis the following facts must be held in mind: Ten chemical elements are essential to the growth of all plants. They are carbon, hydrogen, oxygen, nitrogen, phosphorus, potassium, calcium, magnesium, iron and sulphur. Of these ten elements carbon, hydrogen and oxygen are freely furnished by air and water. Iron is supplied in abundance by all soils, and sulphur has never been known to limit crop yields. Potassium, calcium and magnesium are usually found in the soil in large quantities, but under certain conditions are not readily enough available for good yields. Nitrogen and phosphorus are often found in insufficient amounts in the soil and need to be supplied in larger quantities to produce good yields. Besides these plant-food elements, lime carbonate and decaying organic matter are materials necessary to a fertile soil, and very frequently occur in too small amounts.

These facts explain fairly well that in analyzing a soil it is seldom important to determine more than the following constituents: Total phosphorus, carbonates, organic carbon, nitro-

gen, calcium, magnesium and potassium. A qualitative test for acidity by means of litmus paper may also be made. The first two determinations, together with the litmus test, are without doubt the most important of all, and indeed for many soils they may be all that are worth while to make.

Station may aid without analyzing.

Much is already known regarding the fertilizer requirements of the soils of the state, and if one is contemplating sending in a soil sample to be analyzed with a view to determine what treatment his land should have it would be better instead to write the Station fully describing his general conditions and giving the exact location of his farm. He should state the past history of the land, its average unfertilized yield of crops, character of soil and subsoil, and any other points which may have an important bearing. On the basis of such information as this the Station can usually give more reliable advice than from a chemical analysis of any samples of soil which the farmer may send in.

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