# SOME PROBLEMS IN TEACHING SOIL FERTILITY.

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The teaching of soil fertility in Southern Illinois is not an easy problem. Located as we are, principally on the Lower Illinois Glaciation, the soil is naturally acid and deficient in organic matter. The principal soil type is that of gray silt loam on tight clay. Because the soil is of this type, acid and deficient in organic matter, many problems related to the physical properties of the soil and the essentials of fertility arise. Therefore the problem of the teacher is two fold,—that of illustrating the principles of fertility by way of the limiting plant food elements, and the conditioning and keeping the soil in the very best of physical tilth for the growing of the respective farm crops.

While the soils of this area are very deficient in the relative amounts of plant foods as compared with other areas or glaciations, yet when these essentials are supplied a very marked response is noted. Three essentials as we note them are needed:

1st. Limestone to sweeten and to floculate or granulate the very fine soil particle for the better circulation of air and the absorption of water. The lime or calcium may not be considered as absolutely essential to the cerial crops, but very essential to the growing of all legumes. Here is found its greatest value.

2d. The nitrogen supply is very deficient in our surface soils, and its cheapest carrier is that of organic matter which further serves to assist in the partial granulation of the fine soil particle for the better circulation of air and water, and to act as a sponge to hold the moisture. Deep plowing, where limestone and organic matter are worked into the soil, breaks into and serves to deepen the very tight subsoil, and to increase the feeding areas of the roots. Without this granulation and deepening of the surface, the fine colloidal condition of the soil serves as a water shed in times of hard rains, and is the cause of much washing and leaching.

3d. The phosphorus supply in our soils is very deficient. The subsurface and the subsoil contain much more than the surface. Our shallow and medium rooting plants are very much limited in yield in some sections because of this phosphorus deficiency. By the addition of lime deep rooting plants such as the legumes may be grown. Sweet clover seems to be the best deep rooting legume for this section. It will grow on soils very deficient in organic matter, where only two to three tons of limestone have been applied. When the legume is plowed under the much needed organic matter is supplied, and being a legume some forty pounds of nitrogen or more per ton of legume has been added to the soil, and which the legume has taken from the air. In this way the very high priced element, nitrogen, which we find in complete commercial fertilizers, may be secured in the most economic and simple way. Again, because of this very deep rooting legume, permeating the subsoil some two to five feet, and sometimes deeper, much phosphorus is brought from the deeper areas of the subsurface and the subsoil where the roots of the more shallow feeding crops can not permeate. It is in this way that the surface soil is practically maintained in its phosphorus supply. It has been found by experiments that by the use of this deep rooting legume that the addition of raw rock phosphate to supply the element phosphorus could be delayed for several years. But when the phosphorus supply gets low enough as indicated by the crop growth, the element in its most economic form, that of raw rock, should be applied with some form of organic matter and turned under. Here again the complete commercial form may not be used because of its almost prohibitive price.

Here the essentials of a permanent soil fertility are to be illustrated. Limestone, nitrogen through organic matter by the growth of legumes, and phosphorus in the form of raw rock phosphate, all of which in their cheapest possible forms. Data serve to prove that where these three are added on the Lower Illinois glaciation that the yield of our common farm crops are practically doubled.

The teacher of soils must clearly demonstrate these principles through the business methods of farming. The farmer knows well the principle of paying back what he borrows, but he has not and is not playing fair with his soil. It is impossible to have a greater crop yield than our limiting food element for that respective crop. In past years these elements have not been replaced in such proportions as they have been removed. Business principles tell us that if we are to continue our crop yields even at the present time we must return to the soil these limiting elements. An increasing crop yield means a better balancing of the elements of plant foods. Chemical analysis alone is not sufficient to reveal the limiting elements, for both the available and the non-available foods for plants are shown. At times chemical analysis shows a sufficient quantity of the limiting element present. In such cases a better physical condition of the soil is necessary that the tightly secured foods may become available for crops.

To show this availability, and also the results of a better physical condition of the soil, cultural methods should be used. It may be impossible for some teachers to have regular field plots, but suitable containers of any kind may be used, such as flower pots, jars, buckets, etc. Such containers should be of uniform size. Perhaps the most satisfactory container is a cylinder, made from galvanizing, 18 inches high and about 28¾ inches in diameter. This cylinder may be placed in the ground, leaving about two to three inches above the surface. The surface of this cylinder will be near one-ten thousandth of an acre. The same soil type may be used, or the dirt removed to the depth of the cylinder and entirely new soil from another type or section be added, and the same results obtained, provided the subsoil conditions are the same. As many of the cylinders may be used as the teacher's project justifies. Ten will be ample to illustrate the principles of a permanent fertility with limestone, nitrogen and legumes, and raw rock phosphate. Many physical properties of the soil, crop rotations, legume inoculation, and many other facts may be shown. This may be done the same as in actual field operations.

Relative application of the limiting factors may be made, results observed and accounted for, just the same as in field practices. The teacher's laboratory lies in and around such a project. Without such a demonstration much of our teaching is labeled as theory. The use of such a method will solve many of our problems in the business and scientific practices of farming.