Soil testing and soil analysis have advanced tremendously in the past ten years. This advance has not been restricted to some particular phase, but rather has included all lines of the subject. First, our knowledge regarding the forms and conditions in which the nutrient elements exist in soils, especially as regards availability, has advanced greatly in recent years. This knowledge is fundamental to the development of methods of extraction which will differentiate between the readily and difficultly available forms of nutrient elements. Second, methods of determining these elements after they have been extracted from the soil have been improved far beyond our fondest expectations of ten years ago. And lastly, the farmer, the gardener, and the general public are accepting soil testing, not as something which is mysterious, but rather as something to be expected in a modern world of radios, automobiles, and aeroplanes.

Forms of Nutrient Basic Elements in Soils

Perhaps the greatest advance which has been made in recent years relative to the forms of nutrient elements in soils is the general recognition that the exchangeable bases which are held in both the organic and inorganic exchange compounds constitute the great reservoir of readily available nutrient bases of soils. Calcium, magnesium, and potassium are held tenaciously enough in this form to prevent undue losses by leaching but are still available to plants through exchange reaction with the hydrogen of carbonic and other acids. Ferrous iron and manganous manganese probably at times exist in exchangeable form in which case they should be readily available to plants. There is good reason to believe that the readily available copper, zinc, and cobalt also exist for the most part in the exchangeable form. Even nitrogen when in the form of the base-ammonium is held in the exchange compounds like any other base. All of the bases mentioned when in the exchangeable form may be brought into solution by the plant through the excretion of carbonic acid.

In addition to the exchangeable forms of calcium and potassium, and all of the bases mentioned with the exception of ammonium, in soils, sometimes in large quantities in the various primary and secondary silicates. In these forms, however, the bases have less availability, usually no greater in the case of potassium and the other more important than is sufficient to produce a ten to fifteen per cent normal crop. Since the exchangeable bases can be extracted from a soil by a salt solution or a weak acid without seriously attacking the bases in other silicates, it becomes rather simple to remove the exchangeable bases from a soil for determination as to amount.

A few words should be said about the bases returned to soils in crop residues and manure. The potassium in these materials is practically all water soluble and as a result a large portion soon finds its way back into the exchange compounds. Through biological activity, the other bases are also liberated and likewise find their way back. By the use of a soil with a salt solution or a weak acid will remove practically all of the plant and much of the other bases from these materials and thus correctly measure them being readily available.

Forms of Nutrient Acidic Elements in Soils

Turning now to the acidic nutrient elements, it is found that phosphorus, nitrogen, sulfur, and iodine need to be considered. With the exception of the ammonium form of nitrogen, these elements form acids and do not exist in exchangeable form like the exchangeable bases.