Symposium on Chemical Reactions and Movement of Fertilizers in Soil

INTRODUCTION

Fertilizers are applied to soil for the single purpose of increasing the productivity of the land. Evaluation of fertilizers through agronomic studies has been the standard practice for many years. The more effective materials for promoting plant growth are termed good fertilizers, and, if economics warrant, these better products become commercially available materials.

Present-day fertilizers are effective in promoting plant growth, and improvements in the technology have made them available in adequate supply and at moderate cost. However, increasing the efficiency of utilization remains a major problem.

Efforts to determine the fate of applied fertilizer show that part is consumed by the plant, part is lost in drainage water, and another part remains in the soil.

A great deal of evidence is available to show that fertilizer remaining in the soil for a prolonged period becomes less readily available to plants than freshly introduced fertilizer. An accurate determination of the proportion remaining in the soil is extremely difficult because of the complexity of the soil itself, and because of changes occurring in the chemical composition of the fertilizer due to soil-fertilizer chemical reactions. It has been reported that plants often utilize less than 50% of the fertilizer applied, thus making a study of such utilization an important area of research.

It was the purpose of this symposium to assemble current information on fertilizer-soil reactions. We were fortunate to obtain leaders in this area of research to present papers on the chemical reactions and movement of nitrogen, phosphorus, and potassium salts in soil. It is hoped that the published papers will create the additional interest to intensify effort in the work.

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The Behavior of Water-Soluble Phosphate in Soils

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When water-soluble phosphate fertilizers are applied to the soil, they immediately enter into reactions whose products dominate the environment in their immediate vicinity and may support phosphate ion concentrations as high as 1000 times that in the unaffected soil. This local effect may persist for several months, with slow reversion of the initial products to less soluble ones. The distribution of the fertilizer phosphate in the soil depends upon the amounts of reactive iron, aluminum, and calcium in the soil, the moisture characteristics of the soil (which control the rate of dissolution of the fertilizer), and the reactivity of the solution derived from the fertilizer. Knowledge of the composition of the solution makes possible a prediction of the amounts of phosphate precipitated as the different compounds, and this type of information may lead to a rational basis for the selection of fertilizers to suit particular combinations of soil and crop.

To maintain or upgrade the fertility of their soils, farmers of the United States use annually some 3 million tons of nitrogen, 1 million tons of phosphorus, and 2 million tons of potassium. Technical problems in the production of the many forms of fertilizer that supply these nutrients have been the object of intensive research by fertilizer manufacturers.

Agronomists have done extensive research for many years to determine the conditions for the most economical production of a particular crop in a particular location. Choice of a particular fertilizer is but one of the factors involved in this agronomic research; physical and chemical conditions in the soil, plant variety, water supply, temperature, day length, and disease all contribute to make the crop-soil relationship one of the most complex sets of interacting variables known to science. Despite the complexity of the problem, however, a successful agriculture requires the maintenance of a satisfactory chemical environment for the growing crop.

An understanding of exactly how this environment is maintained, of exactly what happens when a fertilizer is placed in the soil, has far-reaching economic and biological significance. Without this understanding, technological knowledge of fertilizer production bears only a remote relation to agronomic knowledge. Over the past 15 years, TVA, which is active in both fertilizer and agronomic research, has pursued studies in the interconnecting area *(10)*, and