THE EFFECTIVE USE OF POTASH FERTILIZERS DURING THE WAR

ERNEST E. DeTurk

Stimulated by the near-disastrous shortage of potash fertilizers during World War I, the potash industry in the United States entered upon a program of exploration, scientific research and development so effective that the United States had become practically independent of foreign supplies even before the outbreak of the present war (Fig. 1). Indeed, if it were not for the apparent necessity of exporting potash fertilizers to allied nations, it is probable that American sources and refining facilities could meet all demands for use in the United States for its duration.

The war has already produced many problems in relation to fitting fertilizer use to crop needs and available supplies, and potassium problems are not the least among them. Fortunately, the principles of soil management and fertilizer use as evolved in the past are sufficiently sound that necessary changes, though difficult, are less drastic than the complete conversions that many nonagricultural industries have been forced to make. With regard to potash, an adequate treatment of the wartime problems requires a review of potash usage and its scientific basis, the changes necessitated by present conditions, and also a projection of the problem into the postwar period, to approach permanent agricultural production at the higher yield levels which will certainly be a future necessity. In general, what is good for the long range program is good for the present, with the exception that an extra effort must now be made to secure greater output of farm products at once. This can be done either by bringing new acres under the plow, which requires more machinery and man power, or by improving the production per acre, with little increase of either. We are still paying the penalty for the first plan as practiced 25 years ago, and we have the opportunity now of profiting by the second if put into operation at once.

The most effective use of potash now and in the future must depend on an understanding of the chemical status of native soil potassium as well as of that applied as fertilizer, considering at the same time the potassium needs of the crops grown.

THE CHEMISTRY OF SOIL POTASSIUM

This phase of the subject will be considered with reference to the gray-brown podzolic and associated humid prairie soils. Following this will be discussed in order the soils to the west, south, and north, i.e., the pedocals of the Great Plains with lateritic tendencies, and the podzols. Finally the soils of the Rocky Mountain region and the Pacific coast states will be considered.

POTASSIUM POTENTIALITY OF GRAY-BROWN AND HUMID PRAIRIE SOILS

As particularly exemplified in this region, the account of the potassium supplying ability of soil for crops and its durability is essentially a story of colloid chemistry. This ability, which is the result of potassium fertility, is dependent primarily on more or less flexible equilibrium among the forms of potassium in the colloidal clay. The clay minerals chiefly concerned consist of an isomorphous series with montmorillonite or beidellite predominantly in the finer sizes below 0.1 micron, while illite (12) characterizes the coarser clay from 0.1 to 1 or 2 microns. The latter closely resembles muscovite, which may even be considered the end member of the series. Potassium occupies a graded series of positions in these minerals resulting in a gradient in relative ease of removal.

At the more flexible end of the series is replaceable K, which is momentarily and reversibly convertible to the water-soluble K ion, the equilibrium depending chiefly on K concentration in relation to that of replaceable cations. This flexible relationship has been expressed mathematically by Jenny (14) as a matter of probability affected by the freedom of oscillation of the different cations around the colloidal surface. It has been shown that the degree of exchange of a cation in this system is essentially a function of its hydration number.