Correlation of Yield and Quality of Alfalfa and Clover Hay with Levels of Available Phosphorus and Potassium

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Before intelligent recommendations can be made regarding applications of fertilizer for certain crops, an understanding is needed of the relation that normally exists between the yields of these crops and the levels of available phosphorus and potassium in the soils on which they were grown. It was for the purpose of obtaining more information on this relation that experiments were started in 1942–43 on Spencer and Antigo silt loams in northwestern Wisconsin. Because of frequent failure and low yields of alfalfa and clover in this area, special attention was given to the relation that these levels bear to yield and survival of these legumes.

The Spencer and closely related soils comprise nearly 3,000,000 acres in central and northwestern Wisconsin. They were formed under mixed pine and hardwood forests on granitic glacial drift overlain by several inches of loess, believed to be of local origin. The Antigo soil comprises about 150,000 acres in this area and in northeastern Wisconsin. It was formed under a similar forest vegetation on glacial outwash plains, and also overlain by several inches of loess. As a result of podzolization, these soils are naturally quite acid (below pH 5.5), and after several years of cropping, usually contain only 15 to 25 pounds of available phosphorus (soluble in 0.002N H₂SO₄) and 80 to 100 pounds of exchangeable potassium per acre. The cropped soils usually contain 2 to 3% organic matter and have a base exchange capacity of 6 to 12 m.e. per 100 grams.

Establishing Desired Fertility Levels

In these experiments different levels of available phosphorus and potassium were established, as indicated in Table 1, by applying superphosphate and muriate of potash in addition to 3 tons of finely ground limestone per acre. To establish the levels of phosphorus in treatments 5 to 8, 9 to 12, and 13 to 16, inclusive, 350, 700, and 1,630 pounds per acre, respectively, of 45% superphosphate were applied; the 150, 200, and 300 pound levels of potassium took 300, 600, and 1,200 pounds, respectively, of 50% muriate of potash. In all except treatment No. 17, one-half the lime and fertilizer were applied before plowing and disced in and one-half after plowing and also disced in. On going into corn, all plots received manure, plowed under, in proportion to the total yield of dry matter produced, 1 ton of moist manure being applied for each ton of dry matter produced during the rotation. A rotation of corn, oats, and 2 years of hay (alfalfa-clover-timothy) was followed.

Beginning in 1945, corn in all except treatment No. 1 was fertilized in the hill with 150 pounds of 3–12–12 per acre. Also, beginning in 1945, superphosphate and/or muriate of potash were applied broadcast and disced in before seeding.