Soil Reaction and Calcium Supply as Factors Influencing the Yield of Potatoes and the Occurrence of Scab

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The soils of Rhode Island are generally acid. Some have become too acid for the best potato yields. Growers hesitate to lime potato soils, however, on account of the possibility of encouraging scab. Many growers attempt to regulate the soil reaction by occasional light applications of limestone so that acidity does not become too great for good yields. To maintain the soil at the desired reaction requires careful planning. Certain areas in a field may produce a scabby crop in spite of the most exact management. Scab may appear on these areas some years but not others. A number of factors besides soil reaction are involved in the occurrence of scab.

Many investigators have studied the effects of soil reaction, calcium supply, liming, and other factors both on the yield of potatoes and the occurrence of scab. The results have not always agreed. Some of the earlier study on this problem was done by Wheeler and co-workers at the Rhode Island Experiment Station. A bulletin issued in 1895 (9) reported results of a 3-year study. It was found that liming acid soils tended to induce scab. It was suggested that calcium could, however, be applied in the form of gypsum (calcium sulfate) without this effect. In a later publication from this station, Rich (4) summarized the results of these early experiments and also reported results on some of the same plots 50 years later. The fertilizer treatments on these plots had remained unchanged throughout this period insofar as nitrogen carriers and lime applications were concerned. In these later experiments it was found that the actual pH of the soil. The publication also reviewed much other work on this problem at various experiment stations. In general, it was found that as the pH of the soil rose to 5.5 or higher, scab occurrence increased.

Schroeder and Albrecht (6) found that excessive amounts of either potassium or calcium brought about decided scabbiness. They concluded that the incidence of potato scab is not directly related to soil acidity. Brown (1) reported results from tests in Connecticut. Adding magnesium sulfate, limestone, or hydrated lime produced no significant effect on either the growth or yield of potatoes. It was recommended, however, that potato growers should have their soils tested and that fields with a pH below 5.0 should be given 600 to 1,000 pounds per acre of dolomitic limestone in order to guard against possible magnesium and calcium deficiencies. Magnesium deficiency has been found on Rhode Island potato soils (2). Smith (7) has reported some reduction in scab on New York soils above pH 7.0, but yields were usually lower. Schaal (5) reported heavy potato scab incidence on Colorado soils with a pH of 7.6 or higher. Applications of sulfur up to 1,000 pounds per acre did not reduce the amount of scab.

Terman et al. (8) in extensive studies in Maine found the development of potato scab closely related to soil pH. The best potato yields were obtained from a pH between 4.55 and 6.00. The soil reaction was adjusted to various pH levels by the use of limestone or sulfur. Sulfur and ammonium sulfate reduced scab. The type of soil was also a factor in the rate of scab increase.

Description of Experiments

Two experiments were conducted at the Rhode Island Station to study the effect of soil reaction and calcium supply on yield and scabbiness of potatoes. The soil reaction was regulated by adding lime or sulfur. The range in reaction was from pH 4.5 to 7.0. Calcium either in limestone or gypsum was also added with the fertilizer for certain treatments. Two series of plots were used; series I from 1937 to 1941 for the first experiment, and series II from 1942 to 1946 for the second. Green Mountain potatoes were used in both experiments.

Bridgehampton very fine sandy loam represents the soil type upon which these experiments were located. It is one of the soils of the outwash plains and is especially important in the potato growing area of Washington County, R. I. It is well-drained, is well-aerated, has an easily-tilled deep-surface soil, and has a medium-high water-holding capacity. The surface soil is smooth, rock-free, and of nearly level relief. Being one of the best soils in Rhode Island, it responds favorably to fertilizers and intensive farming. A typical soil analysis will show approximately the following pounds of available soil nutrients per acre: N, 3,500; P₄O₁₀, 225; K₂O, 375; MgO, 215; CaO, 3,000; MnO, 5. Organic matter will average 3 to 5%.

The first experiment was located on an area where corn had been grown continuously from 1894 until 1933 (3). During the 3-year period, 1934-1936, a uniform grass-legume mixture was grown over the whole area. During the 40-year continuous corn period, the area had been divided into four sections for a comparison of cover crops. Legume cover crops were grown on one section and rye on another; the corn stover was plowed under on a third section and the fourth was left without cover crops. These different treatments resulted in different fertility levels and soil conditions. To overcome the effects of these differences as much as possible, one set of the four replicates of the potato experiment was located on each of these four sections. The effect of these treatments on the yield of potatoes could also be...