Nitrogen Fertilization of Oats and Its Relation to Other Crops In the Rotation

Nitrogen is usually the most deficient plant food nutrient in Corn Belt soils \(^1\). This condition arises from nitrogen losses through erosion, leaching, and cropping. The cropping systems as generally practiced in the Corn Belt results in serious depletion of the available nitrogen supply, since corn, a heavy nitrogen user, is the principal crop and occupies large acreages in relation to other crops. Legumes, particularly alfalfa and clovers, occupy relatively small acreages. In Iowa, for example, a total of 26,084,000 acres were in cropland in 1945. Of this acreage, 43.2% was in corn, 21.6% in oats, 12.1% in hay, 7.2% in soybeans, 12.1% in rotation pasture, and 3.8% in miscellaneous crops such as winter wheat, flax, and barley. Corn is grown almost as intensively in other Corn Belt states \(^4\).

Corn, being the principal cash crop, is most favored in the farm nitrogen program. It is grown immediately following the turning under of a legume sod and receives a large percentage of the available supply of barnyard manure. When one or more corn crops have depleted this supply of "homegrown nitrogen", a legume or legume-grass seeding is made with small grain as a nurse crop largely as a means of replenishing the soil nitrogen so that more corn may be grown. In this system, the small grain is grown at the place in the rotation where the available nitrogen supply is at its lowest. In Iowa, yields of the oat nurse crop are low, caused partly from nitrogen deficiency.

The low yields of oats have caused farmers to value this crop primarily because of its role as a nurse crop. However, with the development of disease- and lodging-resistant oat varieties which are capable of high crop yields and of responding effectively to high fertility levels, it is possible that oats may become a more profitable crop in the Corn Belt rotations. This is indicated by the relatively high yields of oats that have been obtained in Iowa during the recent years with the use of fertilizers \(^3\).

During the past three years, extensive investigations have been in progress in Iowa to determine the feasibility of increasing the yield of oats and other small grain crops through the use of nitrogen fertilizers. This paper reports data from the oat studies from the standpoint of (a) the importance of nitrogen fertilizer in increasing the yield of the oat crop, (b) the effect of previous cropping upon the response of oats to nitrogen, (c) the influence of phosphorus and potassium applications upon the efficiency of the response from nitrogen fertilizer, (d) the effect of nitrogen upon the yield and lodging of the new varieties known as the Clinton variety, (e) the effect of rate of nitrogen application upon the efficiency of its utilization, and (f) the effect of nitrogen fertilization of the nurse crop upon the succeeding hay crop.

EXPERIMENTAL

Fifty-two replicated field experiments were conducted to determine the effect of nitrogen fertilizer upon the yield of oats, and the effect of previous cropping upon the response of the succeeding hay crop. The experiments were located on farms where the farmer was following soil management practices typical to his area. Records were kept on all fields on the preceding 5 years.

In order to evaluate the relative need of nitrogen compared with the need of phosphorus and potassium, and to determine the influence of each of the fertilizer materials upon the others, 44 of the experiments were laid out in a factorial design. Three replications were used in each experiment. Seven of the 44 experiments were conducted with nitrogen fertilizer applied at the rate of 20 pounds per acre of nitrogen, 40 pounds of K\(_2\)O, alone and in all possible combinations of two factors, nitrogen and potassium, singly and together. Fifteen were conducted in 1946, using 20 and 40 pounds of nitrogen, 40 and 120 pounds of P\(_2\)O\(_5\), and 20 and 60 pounds of K\(_2\)O. Ammonium phosphate, and muriate of potash were sources of materials. All fertilizer was applied broadcast and disked into the soil before the oats were sown and the legumes were planted. Oat yields were determined at all locations and legume hay yields at the following year at 13 locations. These were Tama, Boone, Control, and Marion. Legumes used in the experiments, where hay yields were obtained, were red clover, alfalfa, and mixtures of the two.

In order to determine the effect of nitrogen fertilizer upon the yield of the new, stiff-strawed Bond-hybrid oats, a factorial design was used. Sixty-one factorial experiments conducted in 1944 and 1945 has been previously reported \(^3\). A randomized block design of four replications was used in each experiment. A basic application of 300 pounds of K\(_2\)O and nitrogen fertilizer was made to all plots. Ammonium phosphate was the source of nitrogen. All fertilizer was applied as described above.

A preliminary nitrogen rate study was conducted in which 20 and 40 pounds per acre of nitrogen were applied.

RESULTS AND DISCUSSION

A complete summary of the oat yield data from the NPK factorial experiments conducted in 1945 has been previously reported \(^3\). The effect of nitrogen fertilizer upon the yield of the Clinton variety is given in Table 1. Data showing the effect of nitrogen upon the yield of the Clinton variety are given in Table 2. The effect of nitrogen upon the yield of the following hay crop is given in Table 3.

**NEED AND IMPORTANCE OF NITROGEN FERTILIZER**