A STUDY OF TECHNIQUES FOR PREDICTING THE POTASSIUM AND BORON REQUIREMENTS OF ALFALFA: I. THE INFLUENCE OF MURIATE OF POTASH AND BORAX ON YIELD, DEFICIENCY SYMPTOMS, AND POTASSIUM CONTENT OF PLANT AND SOIL

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During the past five years potassium and boron deficiency symptoms have been observed with apparent increasing frequency on alfalfa stands in New York. In 1942 and 1943 series of field experiments were established in order to determine to what extent alfalfa hay yields could be increased by potassium and borax additions, and to determine on what basis future predictions could be made as to whether or not a given field of alfalfa would respond to these elements. The object of this paper is to present the results obtained from these experiments.

EXPERIMENTAL PROCEDURES

The experimental areas were selected by driving along the roads in certain counties where alfalfa was grown, and when a young stand of alfalfa was observed, permission was requested from the owner to lay out an experiment. The 77 experimental plots established in the fall of 1942 were largely located in areas that were known to be deficient in potassium, while the remainder of the plots, which were established in the fall of 1943, were selected more or less at random without particular regard to the probability of a response to potassium. The plots were located in about 16 different counties and covered the central and northern sections of the state, but no experiments were established in the southeastern and southwestern sections. In all cases the phosphorus and lime requirements of the soil had been satisfied, in part at least, by the farmer.

All experimental plots were 1/100 acre in size, being 10 feet wide and 43.5 feet long. One plot received potassium only, the second received potassium and boron, and the third received boron only. The surrounding area served as a check plot. The potassium additions consisted of muriate of potash applied at the rate of 500 pounds an acre, while the boron additions consisted of commercial borax applied at the rate of 40 pounds per acre in the plots established in 1942, but the amount was decreased to 25 pounds on the plots established in 1943. All materials were applied as a top dressing in the fall.

Yields were estimated on the first and second cuttings in July and August of each year by cutting three separate square yard areas from each plot, and weighing the green hay in the field. The actual dry-matter yields were calculated by assuming a 25% dry-matter content of the material.

Potassium deficiency symptoms were estimated by selecting at random 50 alfalfa plants from the hay cut from each plot. The plants that showed any potassium- or boron-deficiency symptoms were counted and expressed as a percentage of the total. This same sample of plants was saved, carried to the laboratory, dried at 70° C, and ground for chemical analysis.

The potassium content of those samples secured in the first cutting of 1944 was determined by the method of Wilcox (5), while that of the remainder was determined by the rapid tissue test as described by Boynton and Peech (1).

Soil samples were collected at four different periods throughout the three-year period. Complete rapid soil tests were run on these samples to determine the exchangeable potassium content of the soil as determined by the ammonium acetate procedure. All data are presented separately for two-cuttings for each of the three years during the tests were conducted.

It is obvious from these data that the yield of alfalfa hay was significantly increased by the addition of muriate of potash to the soil. The actual increase for any year (two cuttings) varied from 2,115 pounds an acre.

The yield data for the boron plots indicate that significant yield increases were caused by the application of 40 or 25 pounds of borax per acre. The relationships in connection with the boron plots are presented in the second paper of this series by Peech and Gustafson (2).

The potassium content of the alfalfa and the exchangeable potassium content of the soil were markedly increased by the fertilizer treatment.

In the first year of the experiment all of the potassium-treated plots produced alfalfa free of potassium-deficiency symptoms, but certain of the check plots always exhibited deficiency symptoms in some of the plants. After the first year, the potassium-treated alfalfa on the most deficient soils still show mild potassium deficiency symptoms, indicating that 500 pounds of muriate of potash did not prevent the appearance of deficiency symptoms in one cropping year. The significance of this fact will be discussed more fully later.

Some of the detailed relationships which have been presented in a general way in Table 1 will now be considered.

RELATIONSHIP BETWEEN POTASSIUM CONTENT OF ALFALFA PLANT AND YIELD RESPONSE OF ALFALFA HAY

Fig. 1 shows the relationship between the potassium content of the alfalfa on the check plots and the percentage increase in yield of the alfalfa hay over that of the check plots.