SOIL CONDITIONS UNDER WHICH ALFALFA RESPONDED TO BORON

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Recognition of the importance of the minor elements in plant nutrition has become widespread in recent years. In general, it appears that this marked trend has been due to two major causes: 1. Intensification of research projects which involve soil and, or plant relationships. 2. The tendency toward continuous planting of one or a few heavily and artificially fertilized crops on soils which originally had small amounts of colloidal materials. Many examples, on which these statements are based, will occur to most agronomists and space will not be taken here to enumerate them.

Although most of the responses of plants to minor elements had been found in artificial cultures or under unusual soil conditions in the field, the Storrs Agricultural Experiment Station began in 1926 exploring the possible needs for minor elements of alfalfa (*Medicago sativa*) grown on the experimental plots. The soil, there, is classified as Charlton fine sandy loam, a glacial till type characterized by the presence of a rather impervious hard pan about 30 inches below the surface and by being one of the best soils in Connecticut for corn, hay, and pasture. Three tons of alfalfa hay and 60 bushels of corn are common yields on the experimental area.

It is not known how long this experimental land has been under cultivation, but judging from the facts that it is located near a main highway in a township where the first settlement by white men was in 1692, and that the first church in the immediate locality of Storrs was erected in 1737, it seems quite probable the tract has been tilled for at least 200 years. Its experimental history dates to 1910 and the particular plots with which this paper is concerned to 1914.

From 1914 to 1934, two 5-year rotations were located on the area. During that period a total of 100 tons of manure was applied uniformly to both rotations, but the P and K treatments were varied. Also, one rotation was limed heavier than the other, a total of 9 and 7.5 tons per acre, respectively, being applied between 1914 and 1920. The reactions in 1936 of the soil to a depth of 30 inches are given in Table 1.

In 1935, alfalfa was drilled on both areas without other minor elements were added to a generous limestone, superphosphate, and potash treatment. In the former rotations plots were subdivided and various fertilizers, including boron and several other elements, were applied on the surface. Responses were obtained from any of those minor element treatments. In 1938, the fields were fertilizers disked in on quadruplicated plots and the entire area reseeded to Grimm alfalfa.

From May to mid-August the season of 1939 was very dry, the total precipitation for May, June, and July being only 60% of the 50-year average. At the end of July the second crop of alfalfa on some plots began to manifest an unusual appearance. The top leaves were turning yellow, finally becoming deep, creamy yellow and, on some plants, orange. The buds withered and turned brown. The failure of the top leaves and buds to develop the entire plant a dwarfed or squatty appearance.

It was soon evident that the alfalfa on those plots which had received borax at 20 pounds (0.26 pounds of B) per acre the previous August appeared to be behaving normally in spite of the droughty conditions. Estimations of the stands, height, and prevalence of yellow-topped plants were made and the yield matter determined. These data are given in Table 3 and are summarized in Table 3.

From a study of those tables it is clear that the prevalence of "yellows" was reduced to very small percentages by boron, either alone or with other minor elements, Cu, Mn, and Zn. In none of the treatments which included borax were over 5% of the plants affected with the trouble. On the other hand, where the boron was lacking, the prevalence of "yellows" was over 5% on all treatments which included boron. The yield matter on the boron-containing plots was significantly higher than on the other plots.

The tendency to-...