A Comparison of Two Soil-Test Methods as Correlated with Wheat and Cotton Response to Fertilizers

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A BIOLOGICAL soil-test method, utilizing the fungi Cunninghamella blakesleeana (5) and Aspergillus niger (4) in the determination of "available" phosphorus and potassium, respectively, has been used at the Tennessee Agricultural Experiment Station since 1936. More recently, a chemical extraction method, using sodium perchlorate in N/10 perchloric acid as suggested by Bray (1), has been employed. The chemical method is now being used in a state soil-testing laboratory, and the data from it form the basis for making fertilizer recommendations to Tennessee farmers.

A comparison of the two methods, as correlated with crop response to fertilization in the field, presents an interesting and worthwhile study.

PROCEDURE AND METHODS

FIELD TECHNIC

The field trials reported in this paper were located on private farms and were conducted in cooperation with the Tennessee Valley Authority. They were located in the three major geographic areas of the state, namely, east Tennessee (Knox County), middle Tennessee (Bedford County), and west Tennessee (Madison and Carroll counties). The trials, conducted over a period of 8 years (1940-47), include 29 tests on wheat and 31 tests on cotton on 17 different soil series. The trials were set up as a phosphate comparison study, but they also permit a study of the influence of potash. Because of the nature of the experiments, only fields not recently fertilized were selected. Therefore, the soil tests have value in indicating to some extent the natural fertility level of the various soil series. The number of fertilizer treatments varied from 12 to 16 and the area occupied by the trials from 1/40 to 1/80 acre in size. For yield determinations, the entire plot was harvested in the case of wheat and the two center rows of a four-row plot in the case of cotton.

Most of the trials in Bedford County contained only one plot of each treatment. An exception was the unfertilized check, which was replicated four times. The basic rates of fertilizer application used in the soil-test comparisons were 16-32-25 and 32-64-50 (N, P₂O₅, K₂O), acre basis. Also, in Bedford County, the wheat trials were divided into limed and unlimed sub-plots. Yields as presented are averages of these two rates under both limed and unlimed conditions. This was considered a justifiable procedure since the responses at the two rates of fertilizer application were of the same order and their combination increases the reliability of the averages. Moreover, while liming was generally beneficial, the yields of wheat were only slightly greater than those obtained on the unlimed soil. The trials in Knox, Madison, and Carroll counties contained four replications of each treatment in a modified Latin square or a 3 x 3 balanced lattice design. In these trials the basic rate of application was 32-40-50. Two methods of fertilization were used, viz., broadcast for wheat and in-the-row for P and K by reference to calibration curves arrived at by "available K" will be used throughout this paper.

PRESENTATION OF DATA

The detailed data for the wheat and cotton with respect to phosphorus are presented in Tables 1 and 2. The fields are grouped by county types and the phosphorus determinations, yield increases attributable to phosphate, and where these yield increases are statistically significant, they are so indicated. Because of the large number of replications in the Bedford County trials, comparisons of statistical significance could not be made.

The pH determinations shown in these tables represent the lowest and the highest values of the four check plots and apply to the unlimed, those cases where lime was applied to one plot.