THE EFFECTS OF VARIOUS PHOSPHORUS AND POTASSIUM FERTILIZER APPLICATIONS ON THE INCIDENCE AND SEVERITY OF HELMINTHOSPORIUM LEAF BLIGHT OF SWEET CORN

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Introduction.—Sweet corn has not always been a major crop in Florida. Small amounts have been grown and used locally but it was not until the 1946-47 season that it was included in the Annual Fruit and Vegetable Report. During that season 6,000 acres were reported as the state total. Each year since then the acreage has been increasing until the 1949-50 report lists 29,000 acres. This expanding acreage of the crop has been accompanied by an increasing number of production problems. One of the most important of these problems from a plant pathological point of view is leaf blight caused by the fungus Helminthosporium turcicum Pass. This disease causes the most severe loss in the Everglades in the early planted fall crop and the late spring plantings. Large plantings have been totally destroyed by this fungus in southern Florida when the temperature and free moisture have been relatively high.

Many growers and research workers had made the observations that a difference in both incidence and severity of the disease seemed to be correlated with fertility levels of various commercial plantings. Packing house figures seemed to support these observations. However, no controlled data were available to support these contentions. In the spring of 1950 Dr. W. T. Forsee and Mr. E. A. Wolf had two fertility experiments on sweet corn in the field at the Everglades Experiment Station. Helminthosporium leaf blight had become general throughout these plantings and was increasing late in the season. These replicated experiments made it possible to obtain controlled data on the affects of various phosphorus and potassium fertilizer levels on the incidence and severity of the disease.

Plot Design.—Two sets of plots were available for indexing. The first was located on thoroughly decomposed Everglades peaty muck and the second on virgin Everglades peaty muck. For this presentation these are designated experiments one and two, respectively. Three levels of phosphorus and three levels of potassium, each with a zero check, were applied in each experiment. Thus there were sixteen possible treatments replicated five times in randomized blocks on both soil types. The variety planted was Golden Security and where possible only inside rows were used for indexing.

Indexing Methods.—Two separate factors, incidence and severity of the disease, were being investigated. Consequently a single indexing method using intensity grades like the one described by Ullstrup et al. would not serve to tell if the suspected difference was due to varying severity or a larger number of infections. Two different indices were used for determining incidence and severity. The Incidence Index was a direct lesion count on ten leaves taken from each plot. The total number of lesions on these ten leaves was used as the Incidence Index for that plot. The second index used to determine severity was called the Dead Tissue Index and was obtained by using the distal twelve inches of the same leaves used for the Incidence Index. This portion of the leaf was used to facilitate examination and estimation. Five individuals independently viewed each of the ten leaf tips from each plot and estimated the percent of leaf tissue destroyed to the nearest 20 percent. (That is, there were six classifications from 0 to 5, each representing an increment of twenty percent destruction.) The estimates of each judging individual for the ten leaves from each plot were averaged. Then the five individuals' averages were averaged again for the Dead Tissue Index of each plot. The fourth leaf down from the tassel was used in both indices because

1—Florida State Marketing Bureau Annual Fruit and Vegetable Report 1949-50 season. 106 pp. Florida State Marketing Bureau, 505 West Adams Street, P. O. Box 779, Jacksonville 1, Florida.

there were enough lesions for comparison but not excessive tissue destruction to complicate unduly an evaluation of the percent leaf area destroyed.

Results.—The data obtained from the Incidence Indices and the Dead Tissue Indices were subjected to an analysis of variance. Results of these analyses are given in Tables 1 and 2.

In experiment one the soil had a high level of residual potassium and low level of residual phosphorus. The application of additional potassium had no influence on either incidence or severity of the disease (see Table 1). There were significant differences in both indices at the various phosphorus levels as follows: The differences between the Dead Tissue Indices of levels 2 or 3 and the 0 level are highly significant, while the differences between level 2 or 3 and level 1 are significant only at the 5 percent level (see Table 1). Differences between the Incidence Indices of phosphorus level 2 or 3 and the 0 level are highly significant, but there are no significant differences between levels 1, 2, and 3 (see Table 1).

The soil of experiment two had a reversal of residual levels of the two elements. Phosphorus was high and no significant differences in either index can be seen at any of the levels of application (see Table 2). Residual potassium was low and significant differences do exist in both indices at the various levels of this element. The differences between levels 1, 2, or 3 and the 0 level of the Dead Tissue Index are all highly significant, but no significant differences exist between levels 1, 2, and 3 (see Table 2). A trend is indicated, however, when one compares the Incidence Indices of the potassium levels to the Dead Tissue Indices. The differences between the Incidence Indices of levels 1, 2, or 3 and the 0 level are all highly significant, and a significant difference, at the 5 percent level, exists between levels 1 and 2. A highly significant difference is noted between levels 1 and 3.

Discussion.—The plants of experiment one conducted on thoroughly decomposed Everglades peaty muck were uniform in size, whereas those of experiment two conducted on virgin Everglades peaty muck were variable. This variation was directly attributable to the amount of potassium available to the plants. The blocks at the 0 level (those receiving no potassium) were badly stunted and the foliage was scorched from a lack of this element. Infection in both experiments was general and occurred rather early, but a progressive development of the disease was checked by lack of free moisture and relatively low temperatures until a short time before harvest. At the time of indexing (concurrent with harvesting) the disease was perceptibly active in the plots.

Intra-field spread of the disease seemed to be at different rates in the two experiments. This was reasonable, since the experiments were in different locations, were planted at
different dates, and had different residual levels as noted. This is further supported by the general differences apparent in the Incidence Indices, though the size differential did exist between the plants in the two experiments.

The large differences between the indices of the 0 level of potassium and levels 1, 2, and 3 in experiment two can be misleading, since the factor of obvious potassium starvation enters into the figures at the 0 level. The large amounts of dead tissue in these plots caused by a lack of potassium made an accurate determination of the individual lesions difficult. This made the Incidence Index low, because only definite lesions were counted. The Dead Tissue Index was also raised, since it was impossible to determine accurately which portion of the total dead tissue was due to the action of the fungus and which was due to lack of this element and the index was therefore based on total dead tissue.

A simple inspection correlation of these data with the yield data of the experiments was not analyzed. However, trends can be seen. Experiment one had no significant differences in yield from potassium application and no significant differences can be found in either disease index for this element. Significant differences noted in increasing yields to the second level of phosphorus are reflected in the increasing Incidence Index of this element. This is the reverse of what would be logically expected. Yield differences in experiment two at the various phosphorus levels were not significant and no significant differences exist in either disease index of this element. Potassium did have a profound influence on yield and highly significant differences exist in increased yield between levels 1, 2, and 3 when compared to that of the 0 level. These differences exist also in both the Dead Tissue Index and the Incidence Index of this element in experiment two as both indices decrease as potassium applications increase. Yields for correlation were obtained from Forsee and Wolf.

Summary.—Under the conditions of this experiment on well decomposed Everglades peaty muck with high residual potassium the use of more phosphorus fertilizer, over that necessary for good plant growth, increased the damage caused by H. turcicum to sweet corn, according to the indexing methods used. Increasing potassium fertilization had no affect on either incidence or severity of the disease. The use of phosphorus fertilizers over what is necessary for good plant growth on virgin Everglades peaty muck with high residual phosphorus had no influence on the incidence or severity of the disease.

Conclusions.—Whether the use of fertilizers to assist in controlling Helminthosporium leaf blight of sweet corn is economically feasible or not cannot be accurately determined from these experiments, since the factor of differential plant growth, directly influenced by fertilization, had a strong differential effect on both indexing methods used. The time of infection and subsequent tissue destruction by lesion enlargement, as affected by climatic factors, also influenced the severity of the disease. Therefore, while the Incidence Index will indicate trends, a more accurate index of the influence of the disease will probably be found in a type of index involving a calculation of the proportionate total area killed by the disease.

The Dead Tissue Index used in these experiments was this type of index, but modification of the method used as follows should greatly increase its accuracy: The total leaf area of a representative number of plants from each plot should be ascertained. Then the percent of this total area destroyed by the disease should be determined by actual measure. Several of these indices should be made throughout the growing period as the development of the disease warrants. These data should allow one to determine the effect of various fertilizer elements on the disease at various stages of growth and the over-all effects at the end of the season. It should be helpful also in determining the effectiveness of spray programs, nutritional sprays, etc., as it is believed to be a more accurate method of determining such effects.

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