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The CORN BLIGHT PROBLEM -- 1970 and 1971

by

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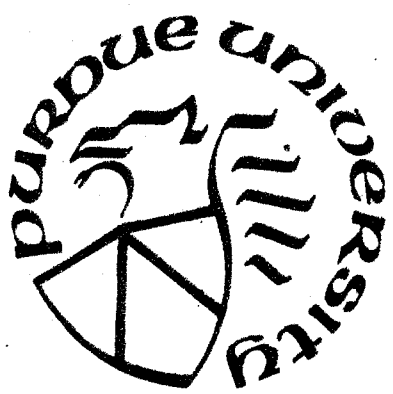

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INTRODUCTION

Southern corn leaf blight is caused by the fungus Helminthosporium maydis. The disease has been known for many years and is widespread in tropical areas of the world wherever corn is grown. Until 1969, southern corn leaf blight (SCLB) was considered a minor disease in the United States, since it seldom caused severe leaf damage or loss in yield. At about this time, a new race of H. maydis (race T) adapted itself to Texas male-sterile (TMS) cytoplasm corn. The origin of the new Race T is not known. The unusual susceptibility of TMS cytoplasm corn was first recognized in scattered fields in Illinois, Indiana, and Iowa in 1969.

Since the early 1960's, male-sterile cytoplasm has been widely used by seed corn companies to lower the cost of producing seed by the elimination of hand-detasseling. An estimated 85 to 90 percent of the corn grown in 1970 contained Texas male-sterile cytoplasm. When Texas male-sterile cytoplasm was incorporated into hybrids it was not known that susceptibility to southern corn leaf blight was bared in this type of cytoplasm.

THE 1970 CORN BLIGHT EPIPHYTOTIC

Three very important factors were responsible for the onset and development of the corn blight epiphytotic in 1970. These three factors, necessary for the development of any plant disease, are: (1) a susceptible host (in this case Texas male-sterile cytoplasm corn), (2) a virulent pathogen (in this case a new pathogenic race of the fungus Helminthosporium maydis), and (3) a favorable environment for the pathogen (in many diseases caused by fungi, of which SCLB is one, warm, damp weather is ideal). The absence of any one of these three factors would have prevented the widespread development of SCLB in 1970.

Race T of H. maydis unexpectedly spread very rapidly during 1970, from late February to June, in Florida, Georgia, Alabama, Mississippi,

and other southeastern states. Tremendous numbers of spores, carried by moisture-laden northerly winds, infected corn in Kentucky, Tennessee, and eastern Missouri; later, Illinois, eastern Iowa, Indiana, Ohio, and other parts of the Corn Belt were infected. By late August, the disease was found as far north as Minnesota, Michigan, and Ontario, Canada. The rapid and widespread development of SCLB in 1970 is shown in Figure 1. Widespread drought in the western Corn Belt restricted blight development there.

Reduction in 1970 corn yields nationally from SCLB is difficult to estimate. However, corn leaf blight, combined with severe drought conditions in some areas, is estimated to have reduced 1970 corn production about 700 million bushels from the original forecast total of 4.8 billion bushels. The forecast average yield per acre on July 1, 1970 was 83.1 bushels; in December it was estimated the harvested yield was only 71.7 bushels per acre -- a reduction of 15 percent (Figure 2). In some states the average yield loss was greater and in many individual farm fields the crop was nearly a total loss.

SYMPTOMS OF SOUTHERN CORN LEAF BLIGHT

Symptoms of SCLB are characterized by tan or light-brown spots or lesions that usually appear first on the lower leaves. Under suitable conditions wind or splashing rain carries spores to upper leaves producing secondary infections. Lesions are oblong to spindle-shaped, ranging up to about 1/2 to 1 inch in length and 1/4 to 1/2 inch in width. On very susceptible plants the lesions increase rapidly in number. The lesions may merge, severely blighting and killing the leaves. A scale showing the six stages of blight severity which can be identified on the ground is shown in Figure 3.

The lesions on the stalk, leaf sheath, and ear husks may enlarge rapidly, to as much as 6 inches in length. The penetration of the silk end of the ear or the shucks takes 7 to 14 days in damp weather, and may lead to a moldy or charcoal-like rot of the kernels and cob. The grain is destroyed. With severe leaf-killing, stalk rot by H. maydis and other fungi is increased. As a result there is much lodging where blight is severe.

DEVELOPMENT OF BLIGHT IN 1971

The pattern of blight development in the Corn Belt test area during 1971 is shown in Figures 4 to 9. The maps are based on biweekly field observations made in Corn Blight Watch Experiment segments and flight lines. These observations were the most comprehensive and quantitative of any of the several operational efforts carried out to follow blight

development. The data shown are average blight severity levels with appropriate weighting for the number of acres of each blight class present in each flight line.

Considering all cytoplasm types the average blight severity was less than 1.5 through July 30 (Figure 4). Although prior to this, blight had been reported present in several hundred counties in the Corn Belt. In T-cytoplasm fields mild levels of infection were developing in Missouri, southern Illinois, and southern and west-central Indiana (Figure 5).

Two weeks later there had been a further increase in the prevalence and severity of blight infection with some areas of severe infection present in Illinois and Indiana (Figures 6 and 7). By the last week of August blight infection had become more widespread with at least mild levels present in much of the eastern Corn Belt area (Figure 8). Figure 9 shows the areas in Illinois and Indiana where blight was most severe in T-cytoplasm fields. Although there was some increase in the severity of leaf infection in September, most of the crop was nearly mature and further infection would have little or no effect on yields.

DISCUSSION

The prevalence and severity of only a few crop diseases can be accurately forecast months in advance of their onset. At the present time, SCLB is not one of these. No one could predict with certainty what the extent and severity of SCLB would be in 1971. The 1971 season with its threat of serious damage from SCLB is past and the factors which accounted for blight development can be examined.

First, except in the deep South, growers planted 5 to 20 percent more resistant, normal cytoplasm seed than had originally been expected (Figure 10).

The distribution of the resistant seed played a significant part in the pattern of blight development in 1971. A relatively larger portion of the resistant seed was planted in areas hard hit by blight in 1970, i.e. Illinois, Indiana, eastern Iowa, and Missouri. Those areas which escaped serious blight damage in 1970 planted a larger portion of susceptible, Texas male-sterile cytoplasm seed (Figure 11). As shown in Figures 4 to 9 the most severely-infected areas of the Corn Belt in 1971 were those where there was very little T-cytoplasm seed planted. In addition, the greatest acreages of corn occurred in those areas which had relatively little blight (Figure 12).

Weather, however, was the single most important factor in determining the severity of SCLB in 1971. A warm, dry spring enabled farmers to

plant early (Figure 13). This, combined with favorable growing conditions in May and June, got the crop off to a fast start. In many areas the crop was nearly mature before blight infection reached significant levels.

Cool, dry weather from mid-July to mid-August significantly reduced the build-up of blight which might have otherwise been expected (Figure 14). In many areas across a large portion of the Corn Belt region, blight lesions were present on the lower leaves throughout July and August, but the cool temperatures held development of the disease in check. Below normal temperatures during this period were at the same time very favorable for ear development and high yields.

The number of acres in each blight severity class in the Corn Belt test area from August 23-27 is shown in Figure 15. Less than 20 percent of the acreage had moderate or severe infection levels and only about 5 percent of the acreage was severely infected.

Although the 1971 growing season produced the highest yields on record (Figure 16), it should be noted that about 55 percent of the acreage in the Corn Belt had slight or mild levels of infection. Had the season's weather been warmer and more humid, blight development would have been greater.

CONCLUDING REMARKS

In 1970 an epiphytotic of Southern Corn Leaf Blight caused an approximate 15 percent loss to the nation's corn crop. The disease is characterized by small brown lesions appearing on the leaves of corn plants. With favorable weather conditions the lesions increase in size and number and may completely kill susceptible plants in 10 to 14 days. Plants with Texas male-sterile cytoplasm are most susceptible to the new race of SCLB which was present in 1970 and again in 1971.

The extent and severity of infection of SCLB in 1971 was determined by three factors. First, susceptibility of the crop -- a slightly-larger portion of the crop was planted to resistant hybrids than had originally been expected. Second, the presence of the pathogen -- the disease fungus overwintered in the Corn Belt and was present earlier than in 1970. Third, the favorability of the environment for the growth and reproduction of spores -- the cooler and less humid than normal weather in the Corn Belt was relatively unfavorable for blight development. This last factor is the major reason that the disease, although widespread, was not nearly as severe as in 1970.

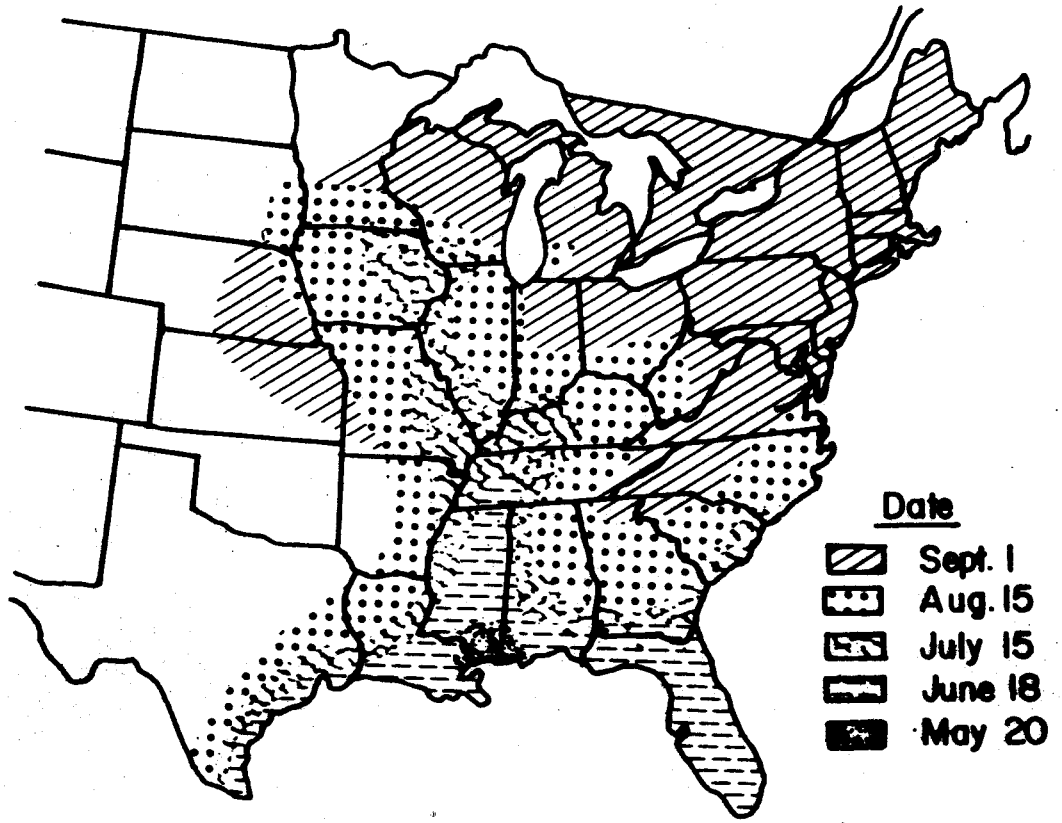

Figure 1. In 1970 southern corn leaf blight rapidly spread from the southern states to the Corn Belt.

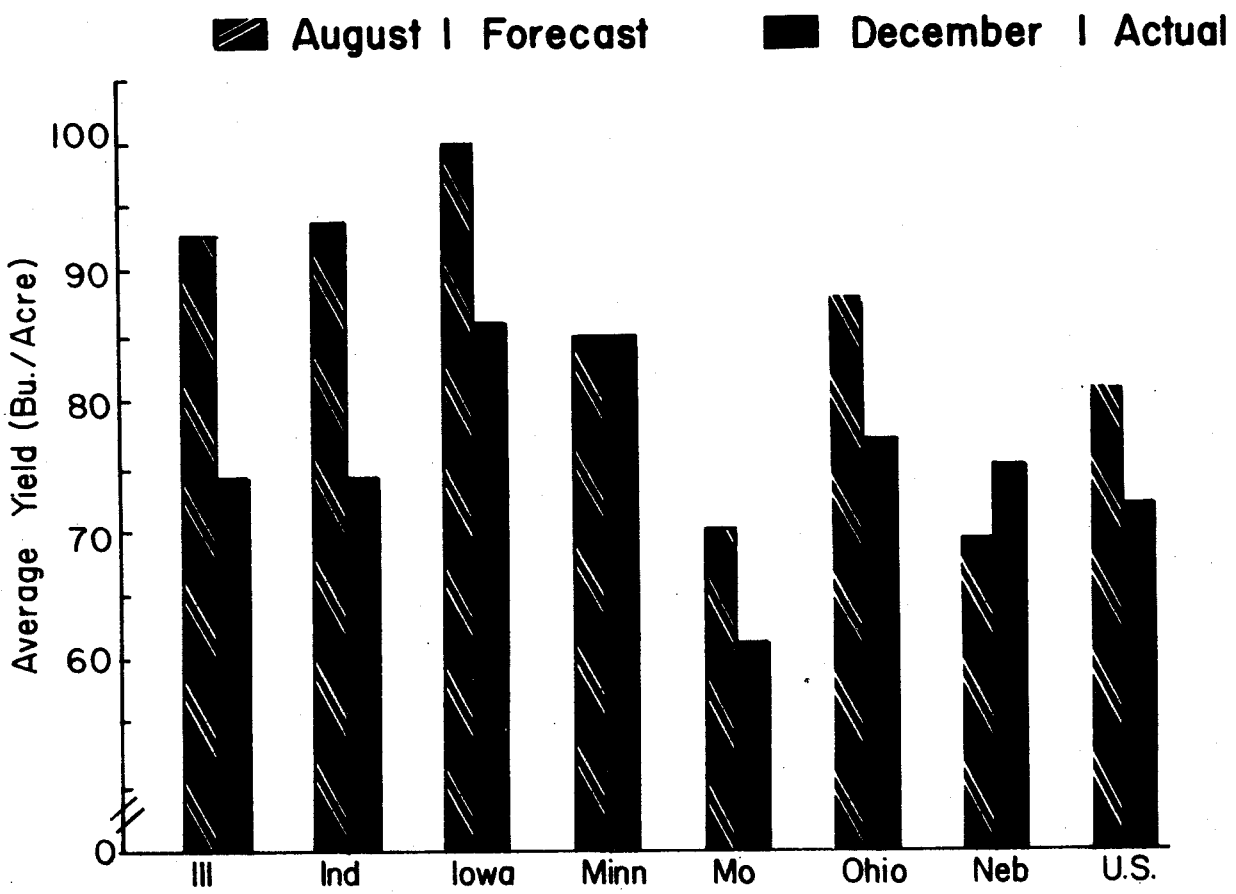

Figure 2. Yields were reduced an average of 15 percent by southern corn leaf blight in 1970. Total losses from blight were estimated to be one billion dollars.

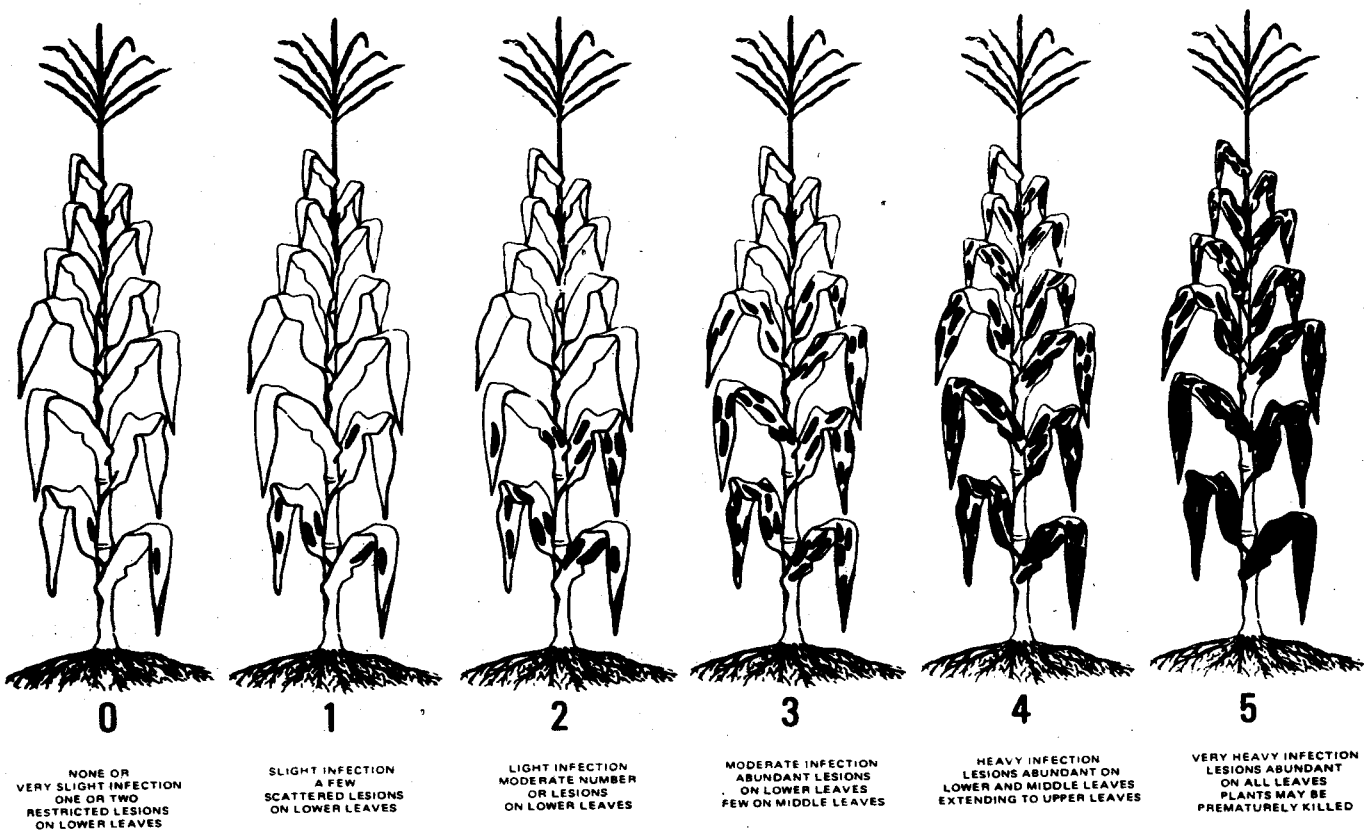

Figure 3. Scale showing the six stages of blight severity which can be identified on the ground.

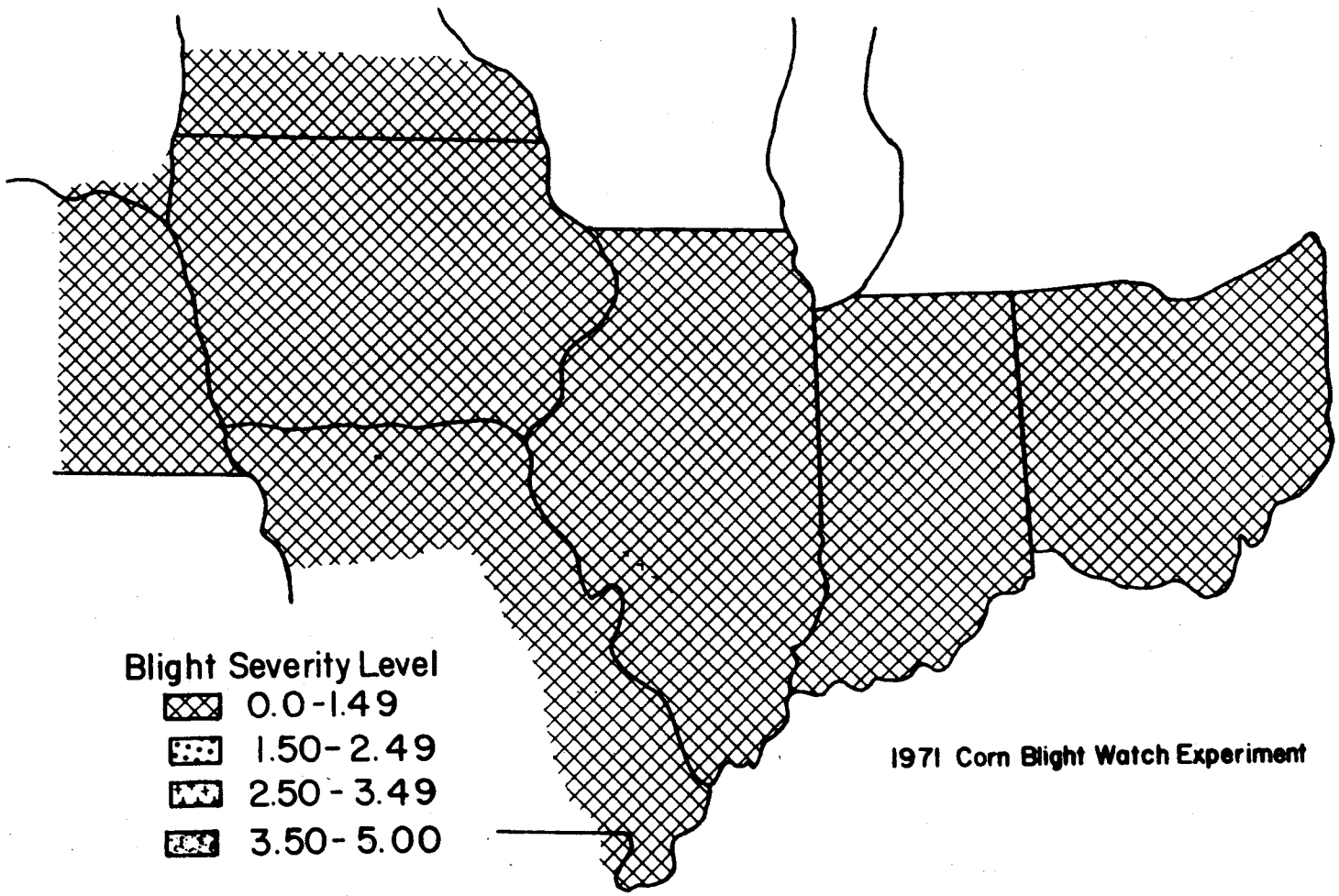

Figure 4. Average blight severity of all cytoplasm types, July 26 - 30, 1971.

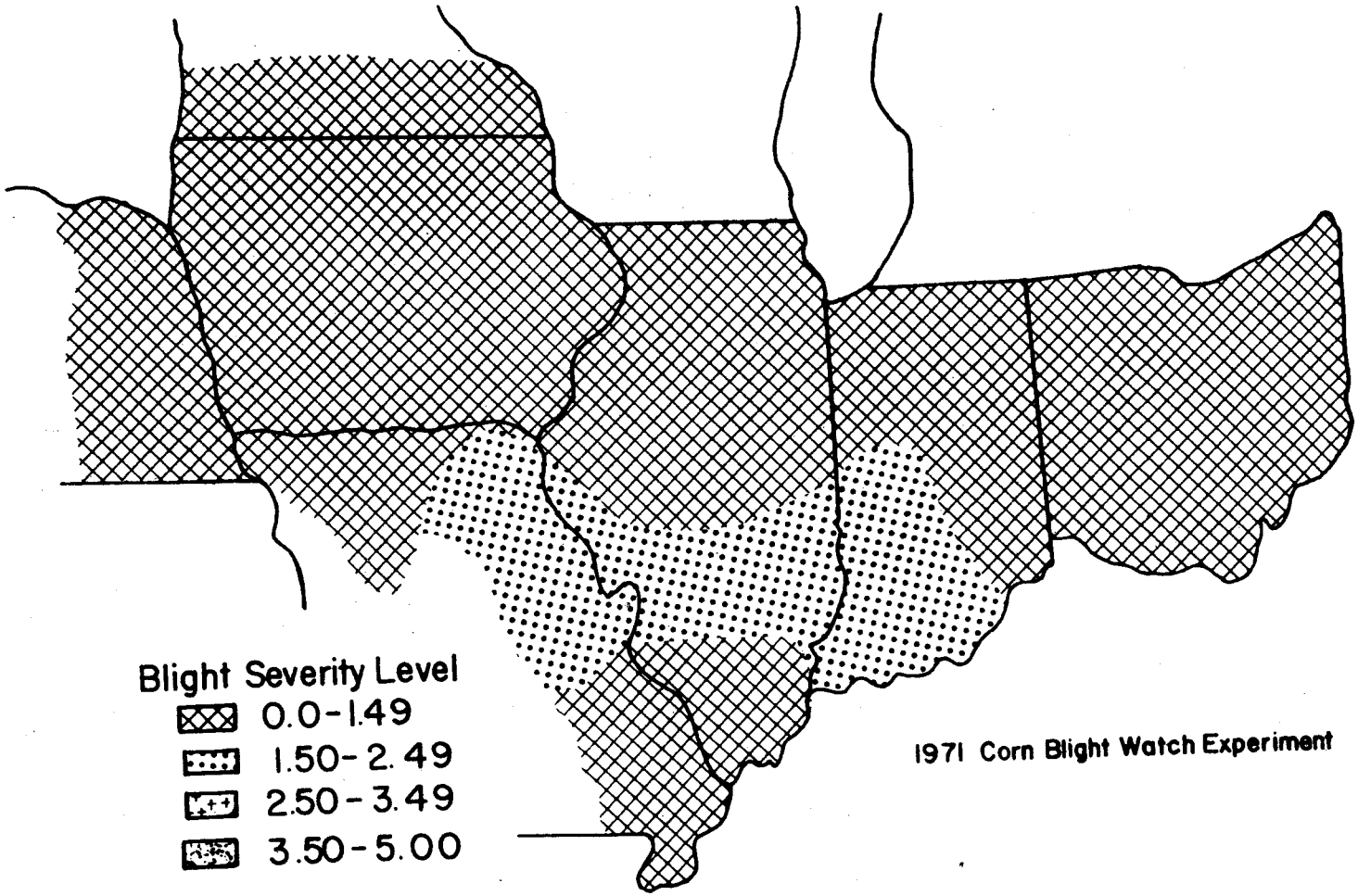

Figure 6. Average blight severity of all cytoplasm types, August 9 - 13, 1971.

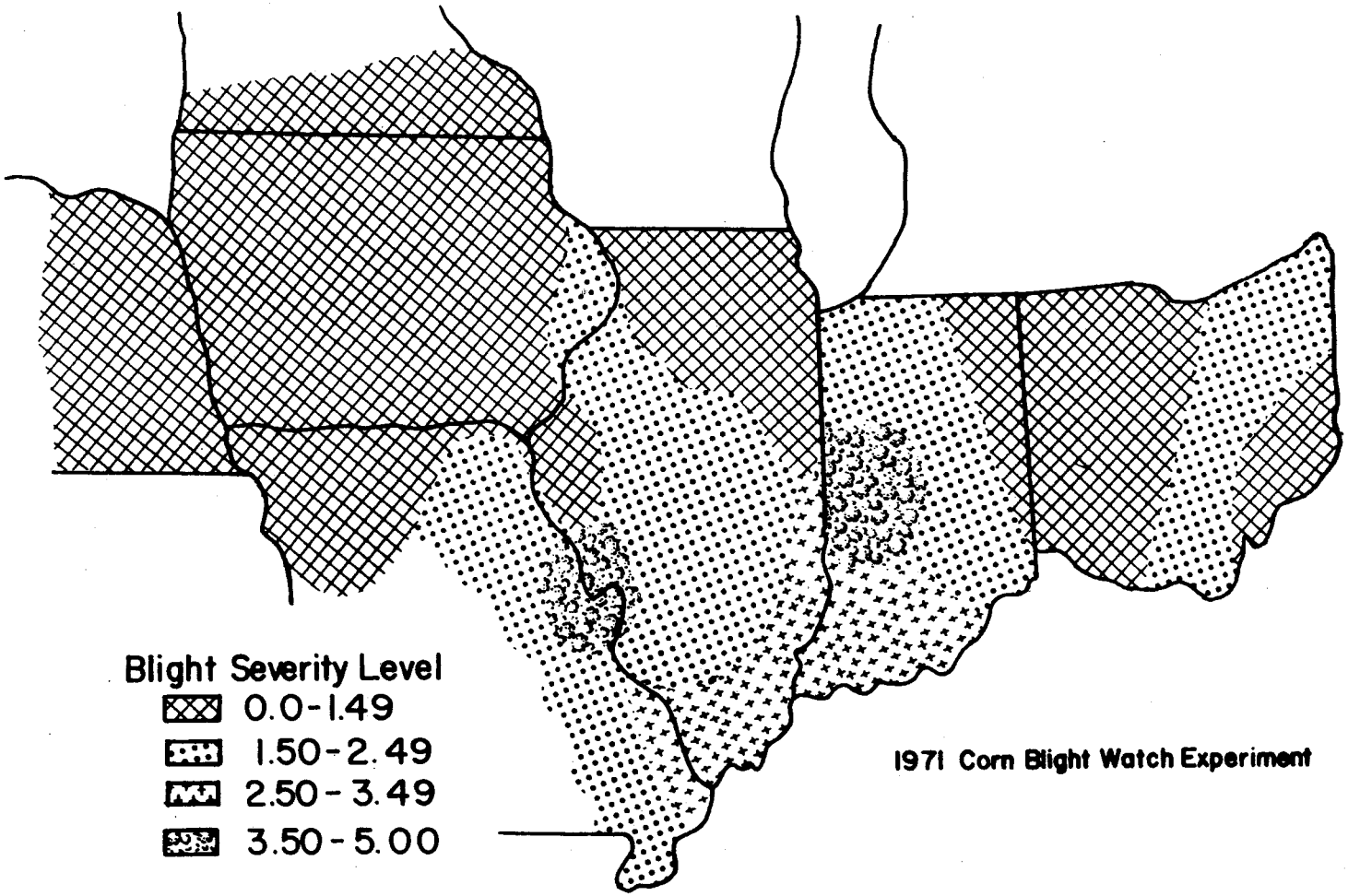

Figure 7. Blight severity of Texas male sterile cytoplasm corn, August 9 - 13, 1971.

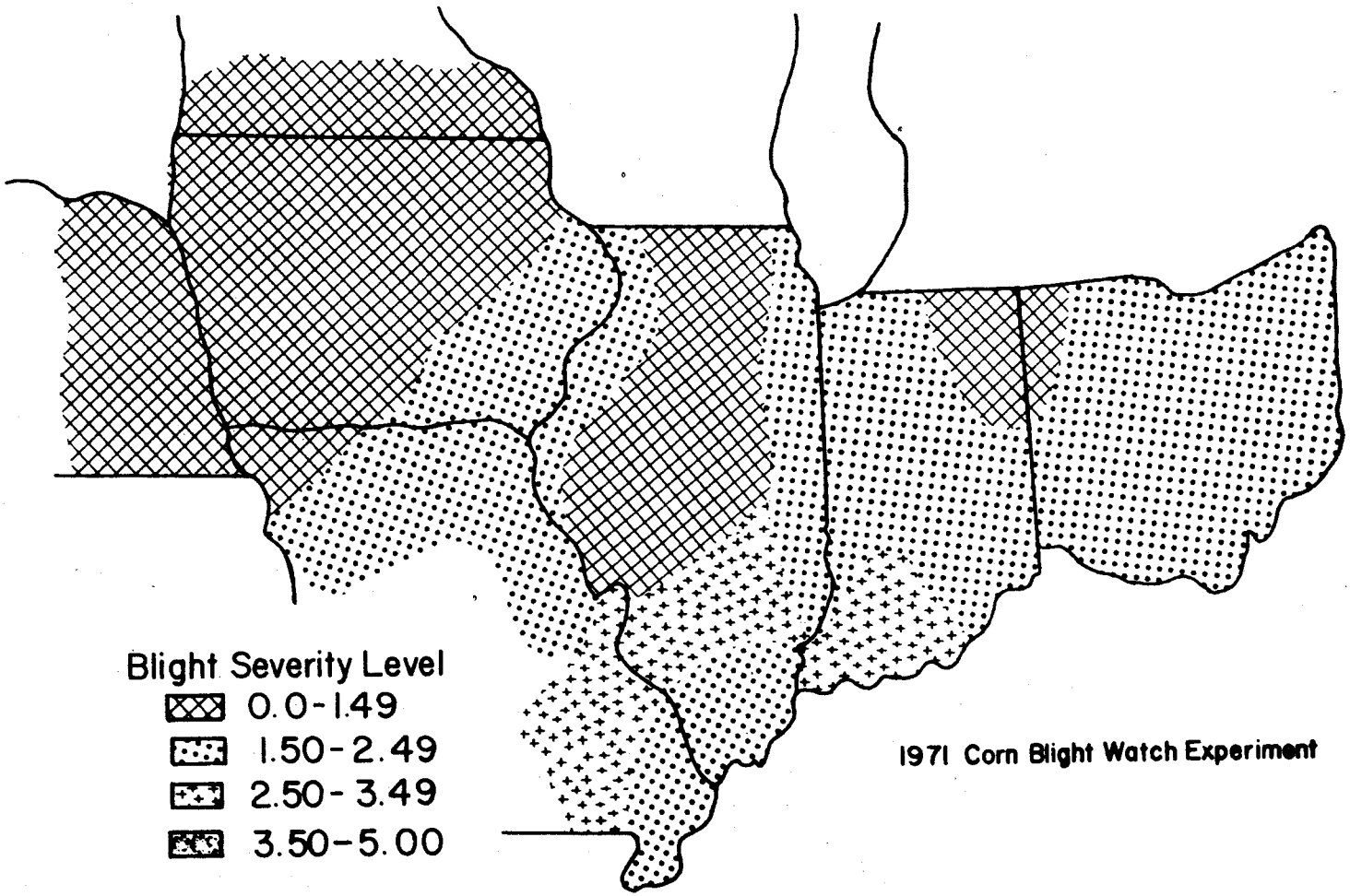

Figure 8. Average blight severity of all cytoplasm types, August 23 - 27, 1971.

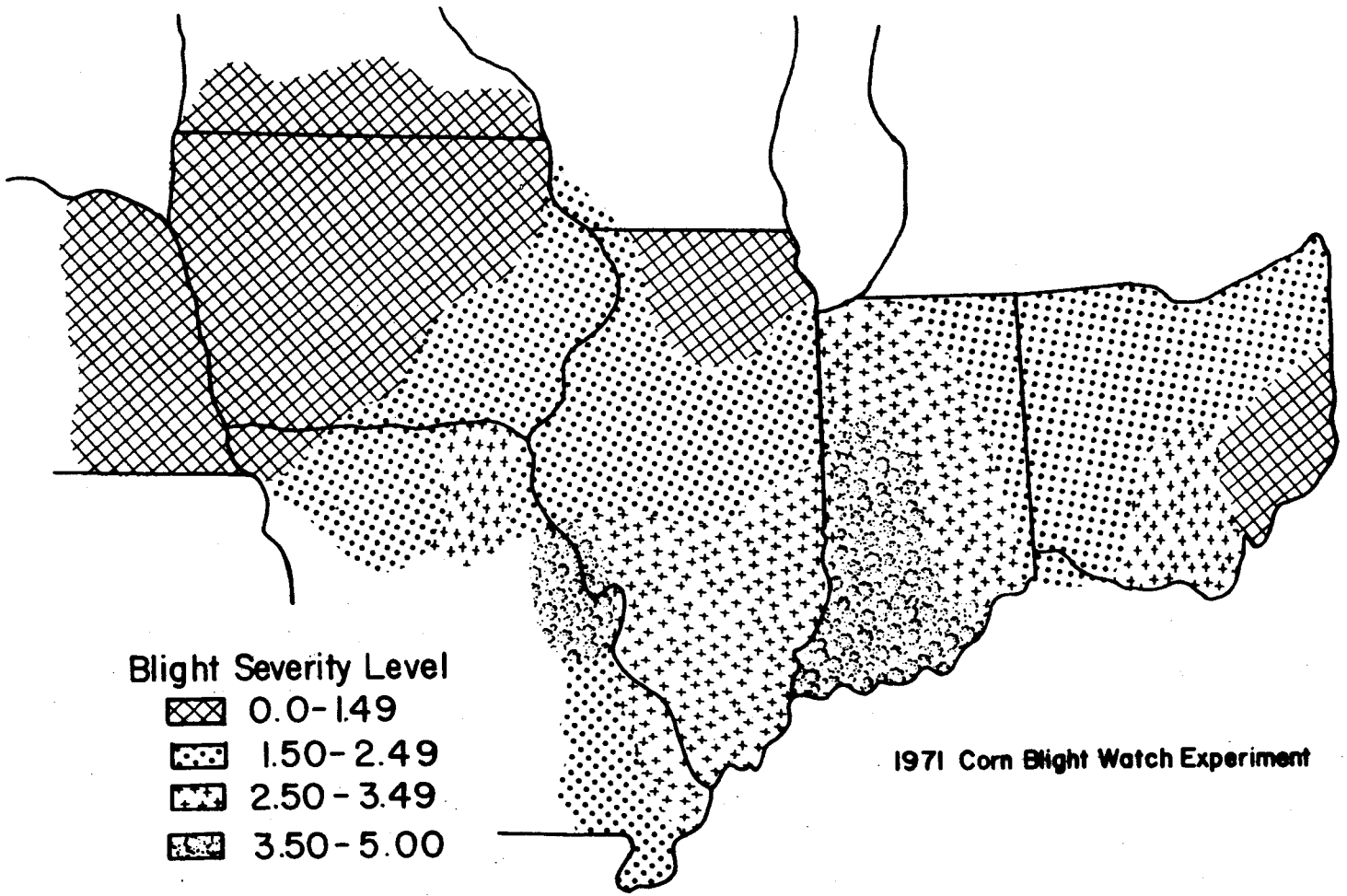

Figure 9. Blight severity of Texas male sterile cytoplasm corn, August 23 - 27, 1971.

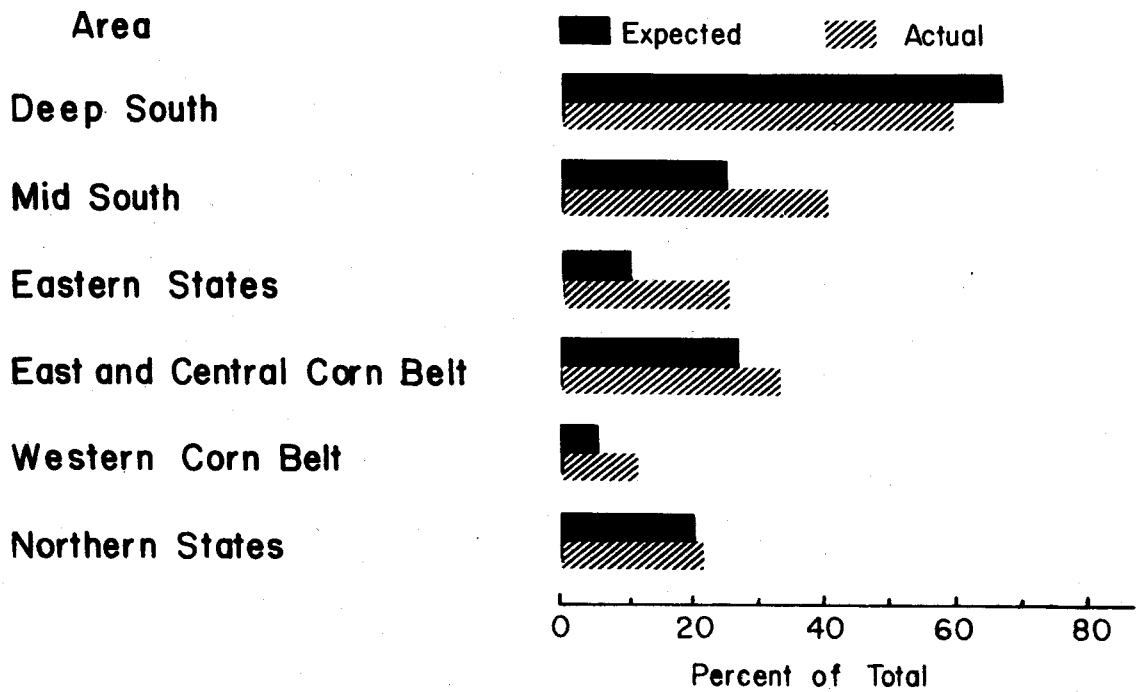

Figure 10. Comparison by geographic area of expected and actual proportion of normal cytoplasm seed planted in 1971.

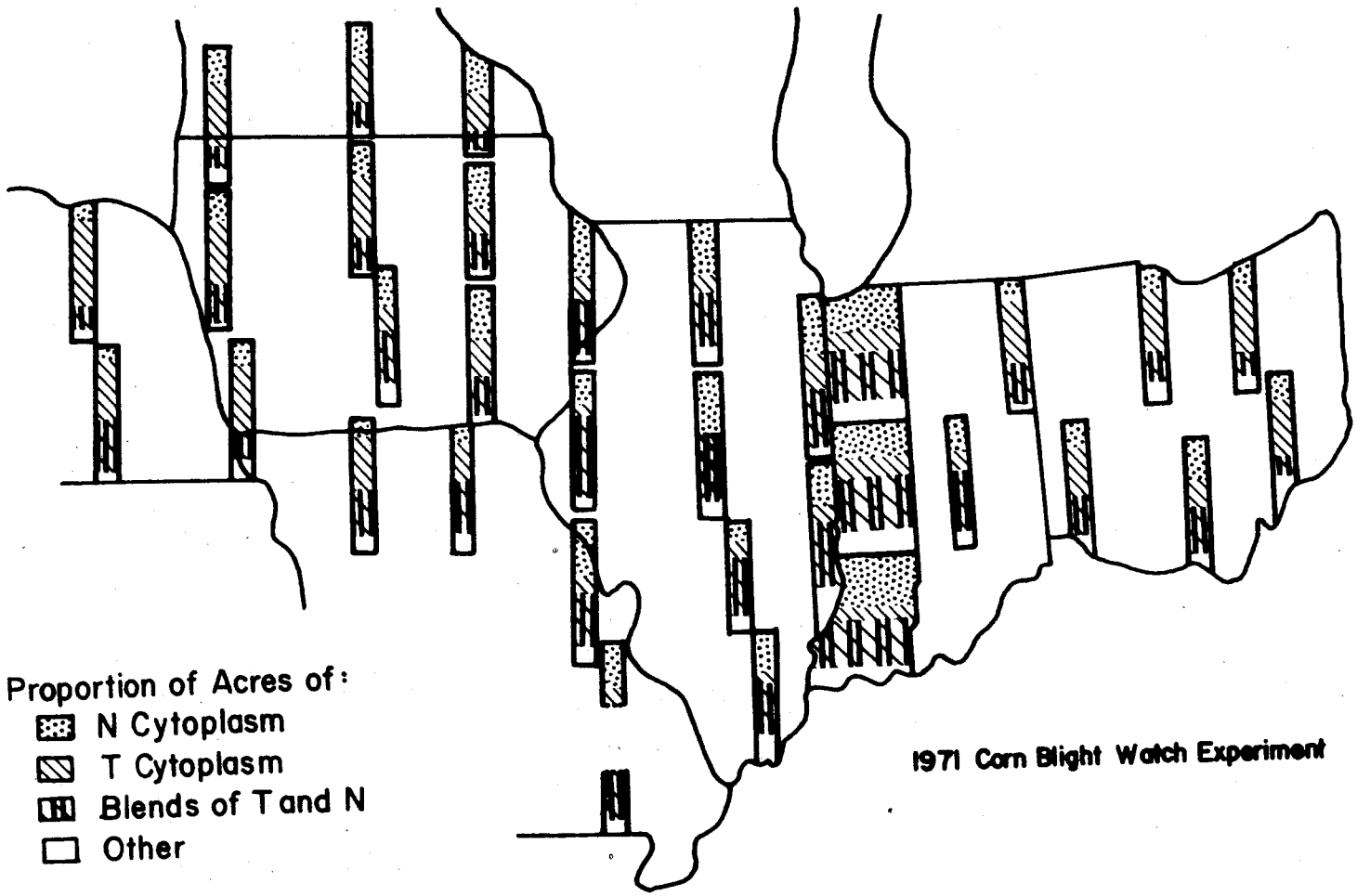

Figure 11. Distribution of corn cytoplasm types by geographic area in the Corn Belt in 1971. The highest proportions of resistant types were planted in the eastern Corn Belt.

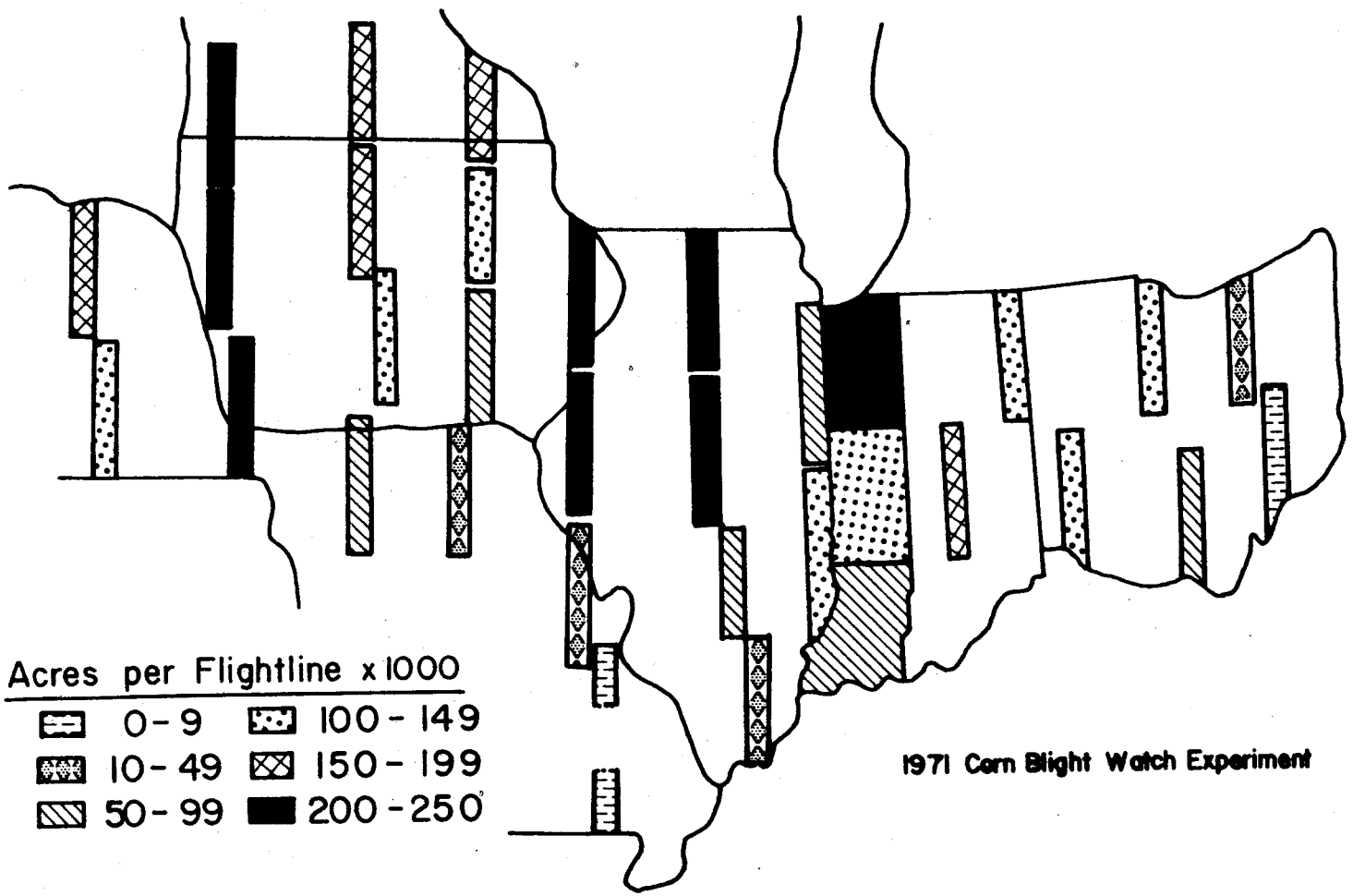

Figure 12. Density of corn acres in the experiment test area.

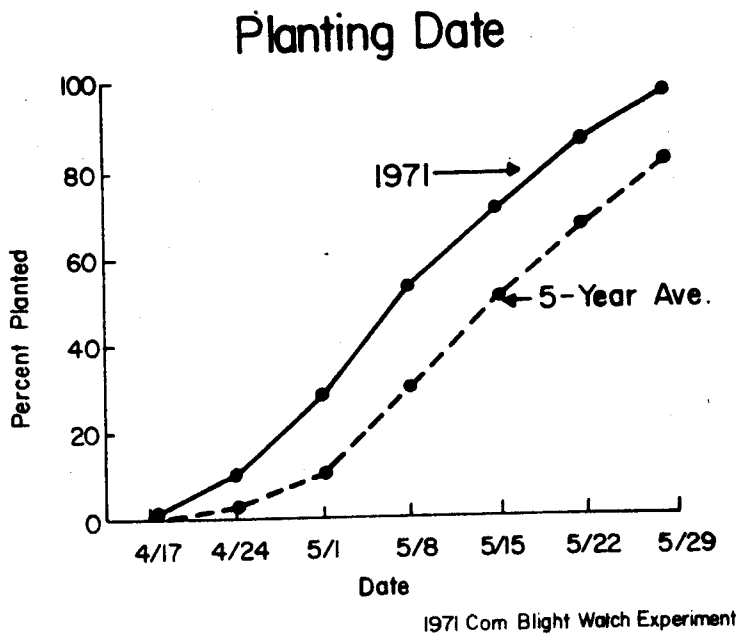

Figure 13. Favorable spring weather enabled farmers to plant the 1971 corn crop 10 days to two weeks earlier than normal.

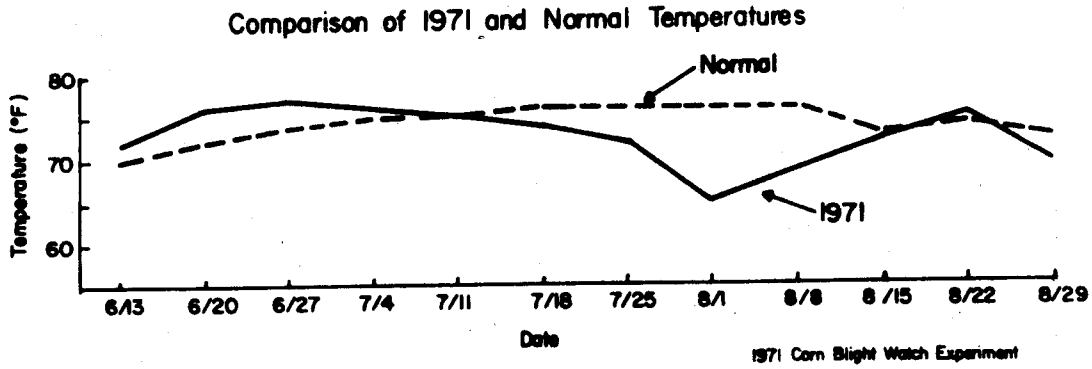

Figure 14. Above-normal temperatures in June and early July were nearly ideal for corn growth. Below-normal temperatures from mid-July to mid-August greatly retarded further blight development and were favorable for high corn yields.

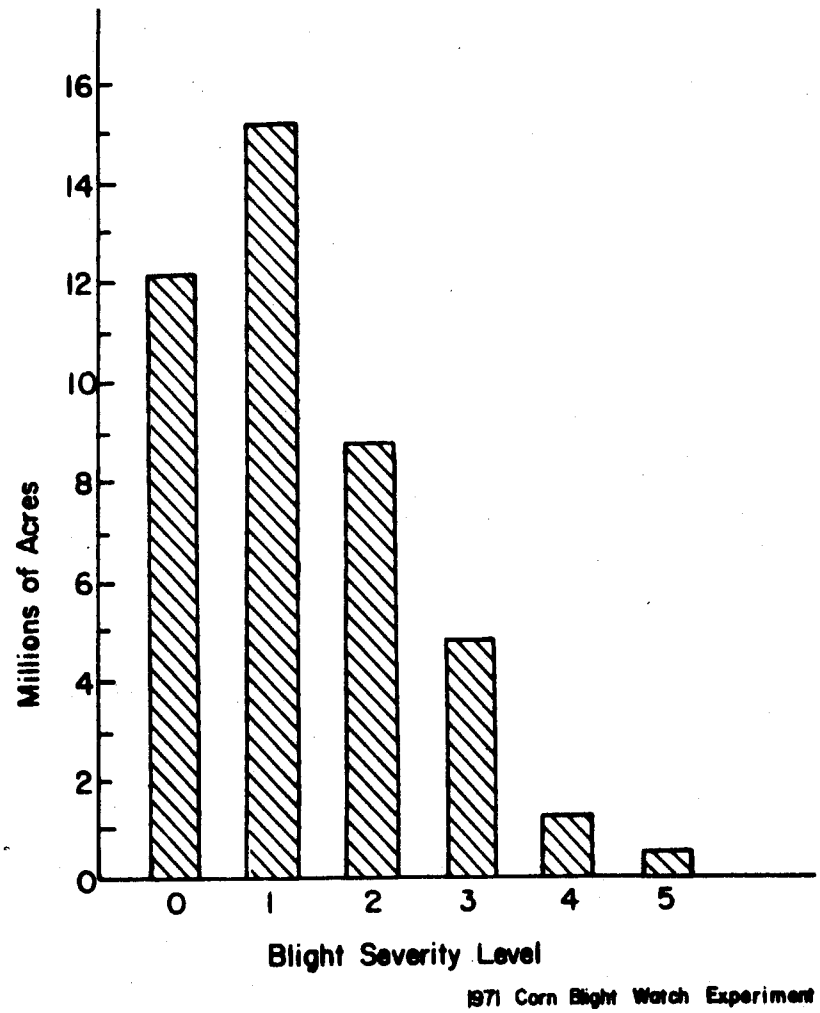

Figure 15. Number of acres in each blight severity class in the Corn Belt, August 23 - 27. At this time the crop was nearing maturity and further blight development would have little effect on yields.

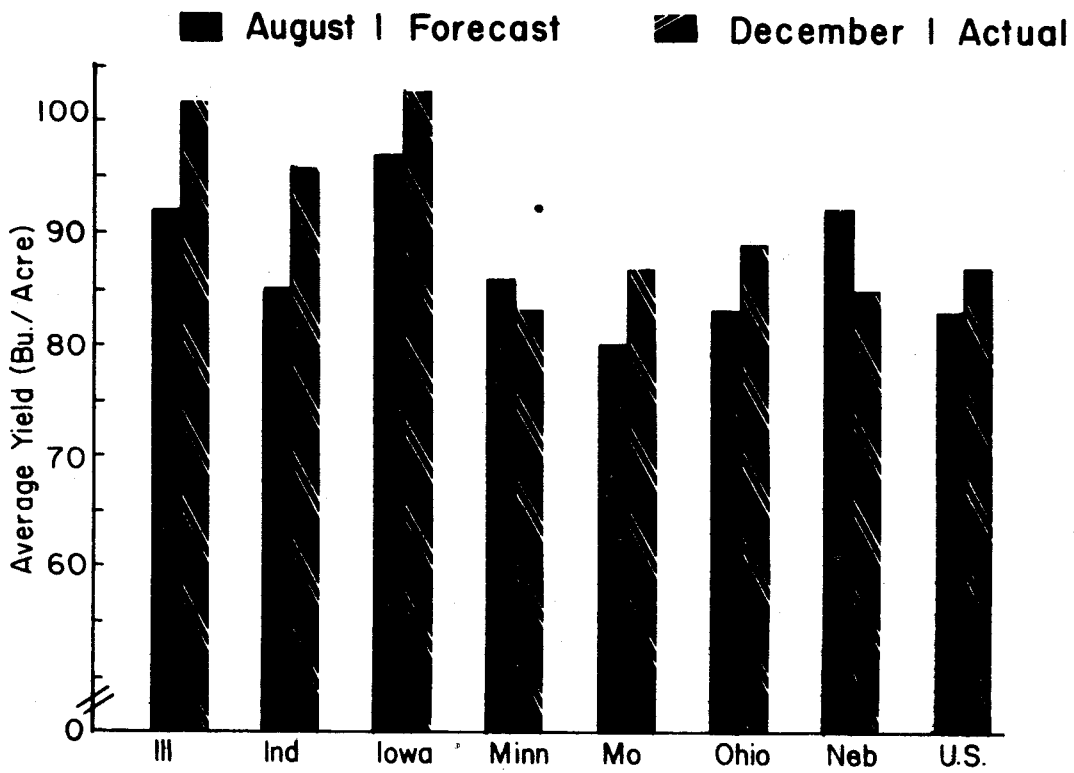

Figure 16. With favorable weather for corn and restricted blight development, record high corn yields were produced in 1971.