SOUTHERN LEAF BLIGHT OF CORN IN ONTARIO IN 1970

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Abstract

Southern leaf blight of corn (*Zea mays*) caused by *Helminthosporium maydis* became widespread in 1970 through weather conditions that were exceptionally favorable for the development and rapid spread of a new race of the pathogen. Most of the corn grown in the U.S.A. and in Ontario contained the Texas (T) male-sterile cytoplasmic factor and was therefore susceptible to the new race.

Most fields that were examined in Essex, Kent, and Lambton Counties contained diseased plants. The disease occurred as far north as Bruce and Grey Counties, and as far east as Northumberland and Prince Edward Counties and in the Ottawa area. In most of the fields that were examined in Essex, Kent, and Lambton the disease was confined to the lower leaves. In most fields yield loss from blight was assessed at less than 1%; only in occasional fields would assessed losses have exceeded about 5%. Seed crops were often blighted, resulting in a proportion of diseased kernels.

Because of the extensive use in seed production in 1970 of lines which contain Texas (T) male-sterile cytoplasm, 70 - 75% of the 1971 Canadian crop will be susceptible to the disease.

Introduction

Southern leaf blight of corn (*Zea mays* L.), caused by *Helminthosporium maydis* Nisikado & Miyake (*Bipolaris maydis* (Nisikado) Shoem. stat *perf.* *Cochliobolus heterostrophus* Drechs.), has until recently occurred mainly in the southern areas of the United States, extending occasionally into southern parts of the corn belt (12). In 1969 many seed crops and some grain crops in Illinois and Iowa (3, 5, 8) were damaged by a race of *H. maydis* that was distinguished by its virulence on corn genotypes containing the Texas (T) cytoplasmic factor for male sterility and by its avirulence on corresponding genotypes with normal cytoplasm (5, 8). Hooker et al. (5) and Smith et al. (9) concluded that a new 'biotype' of *H. maydis* had become established in the USA, because in earlier years local races of the fungus had not differentiated between the two cytoplasmic types, and cultures collected in 1963 did not do so in 1969.

In recent years, corn genotypes with Texas (T) male-sterile cytoplasm have been widely used to save the cost of labor for detasselling female parents in corn seed production. About 80% of the corn grown in 1970 in the United States and in Ontario contained this cytoplasmic factor. With unusual weather and with most of the acreage planted with susceptible corn, the new race of *H. maydis* was widespread in the U.S. corn belt in 1970, and extended into parts of Ontario. This report summarizes its occurrence in 1970 and its possible implications for corn production in Ontario.

Occurrence of the disease

The disease was first identified in Ontario in mid-August, at which time samples were received from Essex, Lambton, and Oxford counties. A cooperative survey of the disease was made by staff of the Research Station, Harrow, the Ontario Department of Agriculture and Food, and the University of Guelph.

In Essex and Kent counties between Aug. 25 and 28, the disease was found in 69 of 80 randomly selected fields (Table 1). In 57 fields the disease was essentially confined to leaves at or below ear level and its prevalence was sufficiently light (less than about 50 spots per leaf) as to cause very little loss (Table 1, classes 1 and 2). In 11 fields in Essex Co. and one in Kent CO., all within 5 miles of Lake Erie, leaves located at and below ear level were blighted to the extent of 1/4 to 1/2 of the leaf area (Table 1, class 3); spots were also present on the upper leaves, but in only 3 fields was the damage to these leaves extensive. Estimates of probable yield losses at these

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Table 1. Assessment of southern leaf blight of corn in southern and eastern Ontario in 1970

County	Date	No. of fields examined	Disease class† 0	1	2	3
Essex	late August	50	6	9	24	11
Kent	late August	30	5	8	1	6
Elgin	late August	9	2	3	4	0
Lambton	late August & late September	14	3	5	6	0
Middlesex	late August	12	3	7	2	0
Perth	late August	4				
Oxford	late August	4				
Waterloo	late August	2				
Wellington	late August	14	Identified on diseased corn leaves but not assessed.			
Lincoln	late August	8				
Wentworth	late August	3				
Bruce	early September	2				
Grey	early September	2				
Ontario	early September	3				
Durham	early September	5				
Prince Edward	mid-September	2				
Carleton	mid-September to mid-October	Up to 20% infected plants in 7 out of 17 fields examined.				
Russell						
Grenville						
Dundas						

† Where 0 = disease not detected;
1 = disease incidence very light;
2 = less than about 50 spots per leaf at ear level and below; estimated yield loss <1%;
3 = spots damaging 1/4 to 1/2 of leaf area at and below ear level, light spotting above. Estimated yield loss 5 to 8%; in 3 cases with heavy spotting of upper leaves, about 15%.

levels of disease incidence are discussed below. Even in fields where there were many leaf spots, only a small proportion (<1%) of the ears became infected, generally through the tips.

The disease was widespread in Lambton, Middlesex, and Elgin counties, but no cases of appreciable loss were encountered. In Lambton Co. on September 23 the disease had spread to the tops of many infected plants, although its incidence was still light. Southern leaf blight was identified on diseased corn leaves collected in many other areas of southern Ontario (Table 1). By mid-September the disease had spread as far north as Bruce and Grey counties and as far east as Northumberland and Prince Edward counties.

Between September 15 and October 15, 17 corn fields were examined in the Ottawa valley in the counties of Carleton, Russell, Grenville, and Dundas. Symptoms of southern leaf blight were observed in 7 fields, and *H. maydis* was isolated in each case. In one field several ears were rotted at the tips and *H. maydis* was isolated from the blackened areas of the husks. The seeds under the severely affected husks were discolored, but isolations from these failed to yield the southern leaf blight fungus.

In Lambton Co. and in counties to the east, spots on leaf specimens were commonly found to be those of yellow leaf blight, caused by *Phyllosticta* sp., indicating that this disease was also widespread in Ontario in 1970. Symptoms of eyespot, caused by *Kabatiella* sp., appeared on some specimens from Middlesex, Waterloo, Wellington, Ontario, and Durham counties.

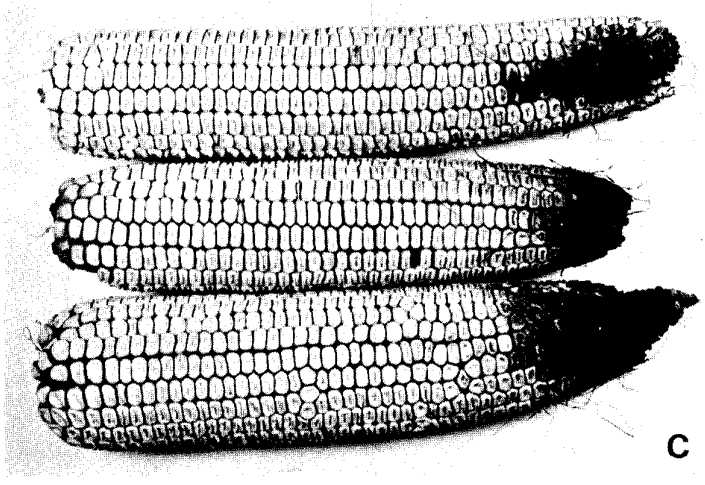

Figure 1. Symptoms of southern leaf blight of corn. A. Infected field crop, showing lesions on leaves, sheaths and ears. B. Lesions on leaf. C. Ears with black mycelial weft between tip kernels.

Symptoms and fungal characteristics

Leaf spots caused by H. maydis are fawn colored, sometimes with a grayish tinge and a dark border, and range in size up to about 2-3 cm x 0.4–0.8 cm (Figure 1A,B). Usually the spots are not distinguishable from those of yellow leaf blight (4, 10) unless the causal fungus can be identified on them. Leaf spot symptoms on the upper leaves are more likely to be those of southern leaf blight, which may affect upper, middle, and lower leaves, than of yellow leaf blight, which in Ontario tends to affect only the lower and middle leaves, especially before mid–August. Northern leaf blight lesions caused by Helminthosporium turcicum Pass. are usually much larger (about 5–10 cm x 0.5-1.5 cm) and are of a more regular, elliptical shape than are those of southern leaf blight.

On the leaf sheaths and husks, small dark brown spots develop and expand into fawn-colored lesions surrounded by brown or purple areas: lesions on the husks tend to be more rounded than those on leaf sheaths (Fig. 1A). The fungus may penetrate the husk layers and sometimes reaches the ear. Ear invasion may also take place through the tip of the ear: this can be recognized in the field by blackening of the tips of the husks, which tend to remain tightly closed. .The mycelium progresses between the kernels and may mass into a dark grey or black weft between the tip kernels (Fig. 1C). Conidia are scarce in the region of the black weft, but can more readily be found on the husk tips and between the kernels further down the ear.

The range in size of conidia formed on the leaves or husks from 4 fields was 43 - 116μ x 11 - 16μ, with 3 - 10 septa (Fig. 2). Most were 58 - 93 x 12.8 - 16.0μ, with 5 - 9 septa; and the average measurements of 41 conidia were 75 x 14.2μ, with 6.3 septa. These averages axe somewhat smaller than those given by others (listed in 1, 6), which are about 90 x 15 with 8 septa, but they are similar to those found by Burton (1) for H. maydis on ears of sweet corn from Florida. Most spores were boomerang–shaped, both sides of the spore being well curved. With Helminthosporium carbonum Ullstrup one side of the spore is usually more or less straight (11). Conidia of H. turcicum average 105 x 20μ; and the hilum of an H. turcicum conidium is raised on a small–prominence, whereas that of an H. maydis conidium is continuous with the rounded end of the spore (12).

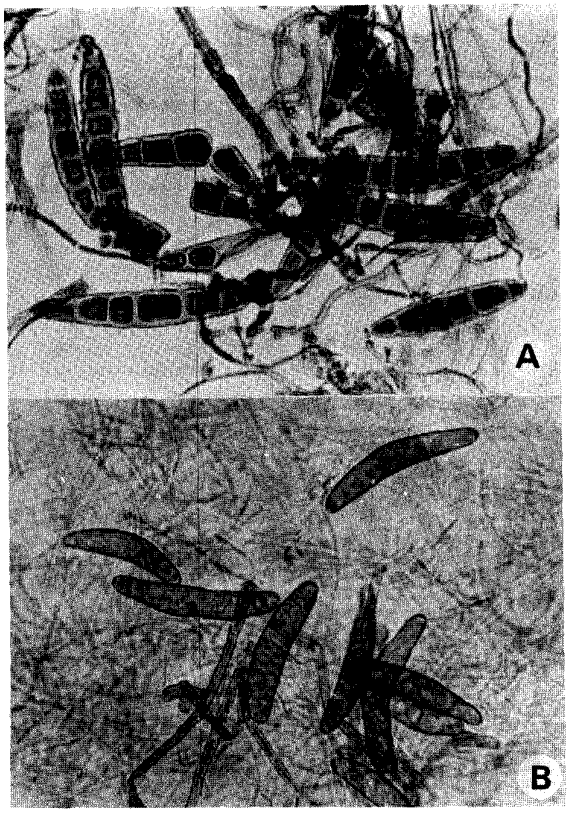

Figure 2. Conidia of Helminthosporium maydis, x310.
A. From field leaves.
B. From culture on potato-dextrose agar.

Yield loss

Through leaf damage.––Experiments at Harrow (unpublished) indicate that about 10% of yield is lost if the two leaves below the ear leaf are removed at 2 to 3 weeks after mid–silk; and that the additional removal of all the leaves below these reduces yield by a further 5%. Removal of the ear leaf and all leaves above it at 2 to 3 weeks after mid–silk lowers yield by about 45%.

The blight became established in southern Ontario about 1 month after mid–silk, and after this time the leaves below the ear would normally make only a minor contribution to yield. In the great majority of fields in the area, leaf spots involved only a very small proportion of the area of these leaves, and thus their effect on yield would be well under 1%.

In the fields where about 1/4 to 1/2 of the area of the leaves at or below ear level was affected, yield losses of the order of 5 - 8% would be expected. In the three fields where, in addition to severe damage at and below ear level, about 10% of the overall area of the upper leaves was also diseased, the loss is estimated at about 15%.

In general, blight caused very minor loss in Essex and Kent counties in 1970 compared with the losses from severe late drought.

Through ear infection.––In several seed production fields the leaves of inbred lines containing the Texas (T) cytoplasmic factor

were severely blighted by the end of August. In a few of the fields, the fungus had invaded the apical one-third of a large proportion of the ears, but did not progress much further as the ears dried. Some seed crops were discarded, while in others much seed was lost in removing infected ears and diseased kernels. The damage to the ears in the seed fields was much greater than was seen in fields of heavily blighted grain corn.

Epidemiology

The simultaneous appearance of blight in several southern Ontario counties during August indicates that the disease may have been initiated after spore deposition from widespread spore showers blown in from the south in late July and early August. The Canadian Weather Review (2) describes, as an outstanding feature of the weather for July, a sustained flow of moist and warm tropical air during the last week of the month, bringing humid and wet weather and unusually warm nights to much of Ontario. Such conditions probably favored the establishment and development of blight. At Guelph in late August, leaves that were not visibly affected initially were observed to develop average-sized lesions in about 4-8 days in the field.

Development of the disease was retarded in much of southwestern Ontario during late August and September when dry weather prevailed. However, the disease became increasingly severe, especially on the upper leaves, in some of the fields located within a few miles of Lake Erie, where periods of high humidity were far more prolonged than futher inland.

Where comparisons were possible, only those hybrid and inbred corn lines with Texas male-sterile cytoplasm became heavily lesioned. Their counterparts with normal cytoplasm showed a few relatively small lesions. The presence of fertility restorer genes in genotypes with male sterile cytoplasm did not reduce their greater susceptibility to the blight as noted also by Scheifele et al. (8).

Discussion

The conclusion seems inescapable that the outbreak of the southern leaf blight in Ontario was caused by the newly recognized race of H. maydis that is virulent on corn carrying the Texas (T) male-sterile cytoplasm. A return to the use of seed containing normal cytoplasm will greatly restrict the development of the race of H. maydis that was prevalent in 1970. By 1972, most seed corn will carry normal cytoplasm, and some may contain male-sterile cytoplasm of types other than the Texas (T) type. However, because of the extensive use in seed production in 1970 of lines containing Texas (T) male-sterile cytoplasm, 70 - 75% of the 1971 Canadian crop will be susceptible to the disease. At a joint meeting of the Ontario Corn Committee and the Seed Corn Dealers' Association in September 1970, the seed corn companies voluntarily agreed to label all seed corn sold in Ontario in 1971, specifying the method used in its production and thus indicating its reaction to the race of H. maydis prevalent in 1970.

Because susceptible corn will be planted widely in Ontario in 1971, any serious and widespread outbreak of the blight will depend upon establishment of infection and weather conditions favorable to blight development. Temperatures close to the fungal optimum (85F[29.4C]) (1) and prolonged humid and wet periods occur frequently in southern Ontario in June and July, and would favor early and rapid disease development if the fungus is established at that time. Early infections from overwintered sources of inoculum may be highly significant in initiating a blight outbreak and increasing the extent of the damage caused. Complete ploughing under of corn crop residues is indicated. Seed transmission of the fungus even by a very small proportion of seed would also be important in view of the very rapid spread of the disease once established. Late-season infections produced from inoculum blown in from the south would probably result in relatively little disease, as was experienced in 1970.

Enhanced susceptibility both to southern leaf blight (5,8,9) and to yellow leaf blight (7) is associated with Texas (T) male-sterile cytoplasm. The rapid spread of a relatively new race of a pathogen previously of localized importance, and the much increased incidence of a formerly very minor pathogen, emphasize the risk involved in using plants of similar biological types over wide areas.

NQMENCLATOR

The scientific names currently used for the three diseases of corn referred to in this article are as follows:

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Acknowledgments

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