PRELIMINARY STUDIES TO DETERMINE EFFECT OF SOUTHERN LEAF BLIGHT ON YIELD OF CORN IN EASTERN ONTARIO

A.T. Bolton [2]

Abstract

Effect on yield of plant age at time of infection with Helminthosporium maydis was determined using the corn (Zea mays) hybrid Warwick SL209 containing Texas male sterile cytoplasm. At Ottawa, corn plants inoculated July 15 developed symptoms within 4 days and exhibited a yield reduction of 50%. Plants inoculated August 1 showed some stunting and yield loss, but the disease was less severe. Plants inoculated August 15 and September 1 exhibited fewer severe symptoms but a statistically significant yield loss. Infection of the lower leaves of the corn plants did not affect yield but infection of the upper leaves including the ear caused considerable yield loss. The results of these preliminary experiements suggest that, in eastern Ontario, natural infection of corn susceptible to H. maydis occurs too late in the season to cause yield losses of more than 10%.

Résumé

On a determine l'effet sur le rendement du stade de croissance au moment de l'infection par Helminthosporium maydis, en utilisant le mais hybride Warwick SL209 portant la stérilité cytoplasmique male Texas. A Ottawa, les plants de mais inoculés le 15 juillet ont manifest8 des symptômes en moins de 4 jours et ont accuse une reduction de rendement de 50%. Les plants inoculés de ler août ont manifesté une certaine atrophie et une perte de rendement, mais à un moindre degré. Sur les plants inoculés de 15 août et le ler septembre les symptômes graves étaient moins nombreux mais la baisse de rendement a été statistiquement significative. L'infection des feuilles supérieures, n'a pas influé sur le rendement, mais celle des feuilles supérieures, y compris l'épi, a provoqué une baisse de rendement considerable. Les résultats de ces experiences préliminaires portent à croire que dans l'est de l'Ontario, l'infection naturelle du mais susceptible à H. maydis se produit trop tard dans la saison pour causer des baisses de rendement de plus de 10%.

Southern leaf blight was found on corn (Zea mays L.) in eastern Ontario in 1970. Although the disease caused serious losses in areas of the United States as well as in a few fields in southwestern Ontario, the damage caused in eastern Ontario was negligible *(2)*.

The pathogen Helminthosporium maydis Nisikado [stat. perf. Cochliobolus heterostroph s (Drechs.) D ε] race T overwintered in eastern nt r n the winter 1970–71 but did not appear on corn plants in the area until September. As a result, losses were only slight in spite of the fact that in many fields lesions covered a high percentage of leaf area of most plants (1).

In 1972, field experiments were carried out at Ottawa to determine if an epidemic could be initiated earlier in the season and to assess the effect on yield of early infection. A study also was made of the effect on yield of inoculation of different plant parts.

Materials and methods

To determine the effect on yield of plant age at time of infection with H. maydis, the Zea mays L. hybrid Warwick SL209 containing

[1] Contribution No. 401. Research Station Agriculture Canada, Ottawa, Ontario.

[2] Present address: Ornamental Research Service, Research Branch, Agriculture Canada, Ottawa, Ontario KIA 0C6.

Texas male sterile cytoplasm was used. Each plot consisted of three 8-plant rows with plants 30 cm apart in rows 1 m apart. Eight plots of each of the five treatments were located 4 m apart in all directions. Plants in the center row of each plot were inoculated with H. maydis 7, 9, 11, and 13 weeks after planting beginning with the first inoculation July 15. H. maydis isolated from corn near Ottawa in September 1971 was used in the inoculations.

To determine the effect on yield of the amount of foliage infected, eight additional plots per treatment were laid out as described above, and plants were inoculated 11 weeks after seeding, as follows: 1) the first five leaves from the base of the plant; 2) the first six leaves, including the first ear; 3) the first eight leaves and ears; 4) the entire plant.

TO prepare large quantieies of inoculum, the fungus was grown at 22–25 C on autoclaved corn kernels in 2-liter erlenmeyer flasks containing 800 g corn and 300 ml distilled water. Six to 8 days after seeding with conidia of H. maydis the infested kernels were removed from the flask and spread out on paper towels to dry. The dried infected corn was stored in paper bags until required. To prepare inoculum, the kernels were placed in large plastic bags along with sufficient sterile water to maintain humidity at 100%, spread out to a depth of about 2 cm, and placed under fluorescent lights (about 500 ft-c) for 8–9 days. At that time the surface of the kernels was covered with spores. To make the spore suspension, water was added and the mixture strained through several layers of cheesecloth. A suspension of 10,000 to 12,000 spores per ml was applied to the corn foliage at the rate of 1 liter to eight plants. Inoculations were made during the late evening to avoid rapid drying of the leaves. During the following 10 days the plants were moistened at half-hour intervals during the day using mist nozzles.

All plots were harvested October 3, and the weights of cobs and foliage were recorded.

Results

Corn plants inoculated July 15 at the 7-week stage developed symptoms within 4 days. Plants inoculated after July 15 required a longer time to produce disease symptoms. At harvest, however, symptoms were quite severe on all but those plants inoculated September 1. The latter exhibited extensive lesions in the ear area, especially on the husks. By harvest a few spores had spread to the check plots, but only a few lesions were present on the upper leaves of these plants.

Approximately 50% of the plants inoculated at the 7-week stage were stunted. Many of the stunted plants produced cobs that were less than one-half normal size while non-stunted plants appeared to produce normal cobs. A few plants inoculated August 1 were stunted, but no definite stunting occurred in plants inoculated later. However, the August 15 and September 1 infections caused some loss of vigor and plants were shorter than the uninoculated checks.

Table 1. Effect on grain yield and total (fodder) yield of plant age at time of inoculation with southern leaf blight[1]

Age at inoculation[2]	Total yield[3] (kg/ha)	Grain yield (kg/ha)
Check	33,047 a[4]	10,180 a
13 weeks	28,500 b	9,180 b
11 weeks	26,414 c	8,600 b
9 weeks	24,023 d	7,740 c
7 weeks	17,180 e	5,380 d

[1] Average of eight plots.

[2] Calculated from germination.

[3] Weight of foliage plus cobs.

[4] Values followed by the same letter are not statistically different at the 5% level according to Duncan's multiple range test.

Although there was considerable variation within plots receiving the same treatment, differences in yield between treatments were significant at the 5% level using Duncan's multiple range test (Table 1). Plants

Table 2. Effect on grain yield and total (fodder) yield of area of plant affected with southern leaf blight[1]

Area inoculated[2]	Total yield[1] (kg/ha)	Grain yield (kg/ha)
Check	23,671 a[5]	9,960 a
5 leaves	20,531 ab	9,760 a
6 leaves[3]	18,234 b	8,920 b
8 leaves[3]	18,140 b	7,820 c
All leaves[3]	16, 594 b	7,500 c

[1] Average of eight plots.

[2] Calculated upward from the lowest true leaf.

[3] Including ear.

[4] Weight of foliage plus cobs.

[5] Values followed by the same letter are not statistically different at the 5% level according to Duncan's multiple range test.

inoculated July 15 yielded approximately 50% as much grain and foliage as uninoculated plants.

Plants with the lower five leaves inoculated at the 11-week stage did not show a significant reduction in yield. However, if the infected area included an ear and ear leaf, a significant yield loss resulted (Table 2). Increasing the infected area to include the 8 lower leaves or the entire plant caused a reduction in grain but not in foliage production.

Discussion

Gates et al. (2) reported that a yield loss of about 10% resulted from removal of the two leaves below the ear leaf 2-3 weeks after mid-silk and that removal of all the leaves below the ear leaf resulted in a loss of 15%. They also reported that removal of the ear leaf and all the leaves above it resulted in a yield reduction of 45%.

In the investigations reported in this paper, the first inoculation was made 3 weeks before the mid-silk stage and by the time those plants were past mid-silk most leaves were about 60% necrotic. It is, therefore, reasonable to conclude that yield was reduced about 50% due to destruction of green leaf tissue. Later infections produced less necrotic tissue and yields were correspondingly greater.

Experiments under artificial conditions in the greenhouse have shown (unpublished results) that corn plants reach a very susceptible stage between the sixth and seventh week after germination and that they very rapidly develop resistance to infection after the seventh week. This would explain the fact that the plants inoculated July 15 (at the 7-week stage) were variable in their reaction to inoculation. If all plants in this group had been stunted, the yield loss might have reached 90%.

In the Ottawa area, H. maydis that had overwintered on corn debris such as stalks, stored cobs, and leaf material produced viable spores from late May to the end of June (1). If weather conditions were conducive to infection at that time, an epidemic could result. However, during that period temperatures are usually low and rainfall is generally light. Conditions in eastern Ontario are more conducive to development of southern leaf blight in August and September but by then corn has passed the susceptible stage and losses of more than 10% are not likely to occur. Late infection, although causing considerable necrosis, does not appear to bring about serious losses.

Literature cited

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