Control of Corn Leaf Diseases

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Leaf diseases of corn in Iowa in 1990 were probably the most severe since the 1970 epidemic of Southern corn leaf blight. The leaf diseases resulted in an "early maturing" of the corn in many fields which was attributed erroneously to a late season heat stress in many popular reports. These leaf diseases combined with heavy corn borer infestations in some areas contributed greatly to the smaller kernels, poor kernel fill, and lower yields than expected. The leaf diseases will be discussed individually.

The most common leaf disease in 1990 was common rust, caused by the fungus *Puccinia sorghi*. This obligately parasitic fungus supposedly does not survive the winters in Iowa and the spores of the organism must be blown in from the Southern states where it parasitizes green corn during the winter. Lesions were observed by early June and frequently by mid-June. The cool wet weather during the summer was ideal for development of rust. Normally common rust development is inhibited greatly by the hot summer temperatures and the disease does not increase greatly until the cooler nights of late August and September. This year the cool evenings with dew formation nearly every night allowed the rust epidemic to develop in mid summer. Sweet corns and some inbred lines of dent corn are very susceptible to rust. Most dent hybrids are somewhat resistant to rust, especially until mid-August, and this usually suppresses disease development greatly. In 1990, however, common rust development on dent hybrids was the heaviest I've seen in 22 years at ISU. Southern rust, which is caused by *Puccinia polysora*, was not prevalent although it is normally found about one out of every four years. Southern rust is associated with hot, humid weather with dew or rain most nights.

Northern leaf blight was the most severe in 1990 that it has been during my tenure at Iowa State University. This disease, which is characterized by elongated, lens shaped lesions about 2 to 6 inches long, was present over the entire state, but most severe in the central to western portions of the state and south of US 30. Many fields lost most of their green foliage by the first week of September. This disease is caused by the fungus *Exserohilum (Helminthosporium) turcicum*, which exists as several races. The more common races are race 1, which is effectively controlled by the single Htl gene, and race 2, which defeats the
Ht1 gene. Because race 2 of E. turcicum became widely distributed throughout the corn belt during the last 10 years, most of the newer hybrids are being released without the Ht1 gene. The race that dominated in 1990 was race 1, because some fields among the severely diseased would be green and any Northern leaf blight lesions were of the small, chlorotic, non-sporulating resistant type ascribed to Ht1. The seed companies confirmed that these hybrids carried the Ht1 gene. Ten years ago most of the hybrids had the Ht1 gene and race 2 became the predominant race. It is interesting that as the Ht1 gene has been phased out, race 1 returns as the predominant race.

In Southeastern Iowa, the mild winter allowed the corn flea beetle to overwinter, and this insect is the overwintering source of the bacterium Erwinia stewartii, which is the causal agent for Stewart's wilt of corn. The bacteria survive the winter in the body of the insect and are transmitted to the plants by the same insect. Survival of the corn flea beetle will occur when the average temperatures for December, January, and February total 90 degrees or more. Although the bacteria become systemic in the vascular system of many corn varieties, the leaf lesions are the most obvious symptoms of the disease. The disease was being misdiagnosed as Northern leaf blight in many instances. In my research plots on the Southeast Iowa Experiment Station near Crawfordsville about 350 exotic and old open pollinated varieties in a disease nursery had natural infections with E. stewartii that were severe enough to preclude the assessment of gray leaf spot in many of the entries. Many of the seed production fields and some hybrid varieties were heavily diseased south and east of Oskaloosa. The pathogen eventually spread into other regions of the state with dispersal of the corn flea beetle, but the severity was light and sometimes overlooked because of other leaf diseases.

Northern leaf spot appeared early over much of the state and became a severe problem in a few hybrids and in many of the seed production fields, especially in Eastern Iowa. The lesions were typical of those produced by race 2 of the fungal pathogen, Bipolaris zeicola (Helminthsporium carbonum). In 1989 and again in 1990, Northern leaf spot was a problem in some seed production fields north of Interstate 80 from Eastern Iowa, through Wisconsin, Illinois, Indiana, and Michigan according to several seed company representatives. The disease apparently is most severe on materials of B73 heritage, moderately severe on Mo17 types, and lightest on Oh43 derivatives, according to James Dodd of Professional Seed Research. This host selectivity is one of several reasons to support designating this apparently new pathogen as race 4 of B. zeicola. This new pathogen is one that must be followed closely because of the large number of hybrids that are derived from B73 and Mo17 types and because it has become a serious problem for seed producers.
The remaining two leaf diseases of any importance in Iowa are gray leaf spot (Cercospora zeae-maydis) and eyespot (Kabatiella zeae). Both pathogens are fungi and are associated with conservation tillage and continuous corn management practices. The drought conditions of 1988 and 1989 inhibited the development of these two diseases and therefore the amount of overwintering inoculum was very low. The weather in 1990 was ideal for disease development in terms of moisture, but the diseases didn't get started because of low initial inoculum. There were some fields with a significant amount of eyespot and gray leaf spot by the end of the season, and these will be important sources of inoculum for 1991.

**Leaf Disease Control**

The principles of disease control are avoidance, exclusion, eradication, resistance, protection, and therapy. These principles are implemented through various practices and management techniques. Some of these are appropriate for controlling leaf diseases of corn and some have little application with these diseases.

**Avoidance**

Selection of fields for corn production that have low levels of inoculum is important for avoidance of the pathogen. Corn fields that had high levels of foliar diseases in 1990 may best be avoided for corn production in 1991, except if the main problem in 1990 was rust. The rust pathogen will not survive in the plant debris, therefore the plant debris will not be a source for rust inoculum in 1991. Crop rotation is a good practice to employ with the other pathogens, because the inoculum from the prior season is avoided. This is especially true with large fields. The use of strip intercropping is not a satisfactory rotation scheme, because the debris from the prior corn crop is adjacent to the next years crop repeatedly throughout the field. Strip intercropping is an inadequate rotation scheme for control of leaf pathogens that survive in plant debris. A long cold winter will kill the corn flea beetle, thereby eliminating the Stewarts wilt bacterium, and the farmers will avoid this disease early in the growing season in 1991.

**Exclusion**

Seed certification and seed treatments are procedures to exclude seed borne and seed transmitted pathogens from the fields. The Stewarts wilt bacterium and Bipolaris zeicola are the only leaf pathogens that are seed transmitted to the next crop. Growers are at the mercy of the seed producers, because seed health certification is not required with corn seed produced for domestic use. Nearly all seed is treated with a fungicide and this will control the surface borne fungal pathogens.
Eradication

The eradication of fungal leaf pathogens is practiced by management techniques that destroy the overwintering inoculum of the pathogen. This can be achieved by several procedures. The debris from the prior crop that carries the pathogen can be buried by plowing, removed from the field by cutting the corn for silage or fodder, or employing crop rotation practices which allow for other microorganisms to digest and rot the debris before corn is replanted into the field. Theoretically tillage practices performed soon after harvest of corn would expose the pathogens in the leaves and stalks to the soil microflora longer than tillage practices done in the spring and should hasten the demise of the pathogens.

Resistance

Resistance is a primary means for control of many leaf pathogens. Corn hybrids and inbreds differ in their responses to all of the leaf pathogens mentioned above. Because there are numerous hybrids available to every grower, the grower must rely on the seed producer and seed sales representatives to inform the growers of the relative disease resistance of the hybrids for sale. The Ht1 gene for resistance to race 1 of the Northern leaf blight pathogen has not been incorporated into most of the inbreds used to produce the newer hybrid introductions. Although race 1 was the dominant race of *E. turcicum* present in Iowa in 1990, race 2 of the pathogen exists in Iowa and could return to be the dominant race if extensive use of Ht1 resistance were to reoccur. Most seed companies are breeding for broad based resistances to all of the diseases. Everyone should take notice of the disease severity in the hybrids in the demonstration plots that the seed companies plant in the neighborhood, but compare only among the varieties in that planting. The inoculum potential, disease pressure, and management will likely be different at each planting site, therefore it is unwise to compare disease severities between sites. Comparisons should not be made between an early maturing hybrid and a late hybrid. An early hybrid may avoid a late season epidemic and thereby look more resistant than a later hybrid. Resistance to leaf diseases is often lost as the plant nears senescence; thus an early hybrid may look very susceptible at the same time that a later hybrid appears green and less diseased, when in fact both varieties are equal in resistance.

Protection

Protection from fungal leaf pathogens is commonly achieved by using foliar fungicides. Tenn-Cop 5E (Reg. TM of Tennessee Chemical Company), which is the copper salts of fatty and rosin acids, is the only fungicide registered for use on field corn; there are no feeding restrictions. Bravo (Reg. TM of Fermenta
ASC Corp.), which has the common name chlorothalonil, is registered for use on seed corn, but the residue cannot be fed to livestock. In 1990, seed corn producers in some states (not Iowa) were granted limited FIFRA Section 18 specific exemptions to apply propaconazole [Tilt (Reg. TM of Ciba-Geigy Corp.)] to seed corn and more than 80,000 acres were treated. These special exemptions have been rescinded by EPA and evidently will not be reissued in 1991. The efficacy of the three materials will be discussed in the conference workshop.

The effectiveness of fungicide applications is influenced by characteristics of the fungicide formulation, the life cycle of the pathogen causing the disease, and the weather. Both of the registered compounds are non-systemic fungicides and act only as external protectants on the leaf surface. They must be applied before the fungus penetrates into the leaf and the fungicide must possess the tenacity to remain on the leaf surface and be effective against future inoculations of spores of the fungus. The fungicide is subject to erosion by elements of the weather, therefore the fungicide may need to be reapplied at seven to 14 day intervals. Leaf tissues emerging from the plant whorl after application will not be protected. The fungus spore after being deposited on the leaf surface, must germinate and penetrate the leaf surface. Germination and penetration may require from six hours to five or more days, depending upon the pathogen invading. After penetration into the leaf, the fungus parasitizes the leaf and this activity may go unnoticed for three to 20 or more days until a visible lesion appears. This period between penetration and lesion development is known as a latent infection or the latent period of infection and is fairly constant for a pathogen. The latent period of infection for Northern leaf spot is three-five days, for rust and eyespot is about ten days, for Northern leaf blight is about 14 days, and for gray leaf spot is 14-24 days. The fungicides will have no effect during the latent period of infection, therefore the application of a fungicide may initially appear ineffective, because the latent infections will continue to develop lesions and the fungicide will be effective only in the prevention of new penetrations and infections. Fungicides must be applied early in the epidemic to have a significant effect on disease development; once the leaves have some noticeable disease, there will be numerous latent infections and the fungicide application may be essentially useless. The effect of timing of fungicide applications will be discussed in the workshop. The cost of fungicides and applications would probably preclude the use of fungicides on field corn, but can be cost effective for seed corn and sweet corn production.

**Therapy**

There are no curative treatments for leaf diseases of corn. Dry weather with no dews is the best condition to arrest disease
development. This condition usually is not the best for corn production.

Summary

The 1990 season was ideal for the development of several leaf diseases of corn and these contributed to lower than expected yields. The most common disease was rust, but the most devastating in large areas of the state was Northern leaf blight. Northern leaf spot appeared universally, but was especially severe in seed production fields over Eastern Iowa. Stewarts wilt was very heavy in Southeast Iowa where it affected many seed production fields and was severe on some hybrids.

The much heavier than normal leaf disease severity in 1990 will result in a high inoculum potential for 1991 for Northern leaf blight, Northern leaf spot, gray leaf spot, and eyespot. If the winter is mild again, the inoculum potential for Stewarts wilt will be high in 1991. Good management practices and careful selection of hybrids could be very important for control of leaf diseases of corn in 1991, particularly if rainfall and temperatures favor another epidemic.