CONTROL FACTORS OF LEAF SPOT AND THEIR AFFECT ON SYMPTOMS

By Clinton F. Hodges, Professor of Horticulture and Plant Pathology, Department of Horticulture, Iowa State University

Turfgrass pathologists have endeavored to characterize symptoms of turfgrass diseases so that turf managers can diagnose specific diseases and their casual pathogens in the field. Such efforts have served the turf manager reasonably well for the more common diseases. However, increasing knowledge of environmental and cultural factors on disease symptoms continues to provide examples of variation in disease development and symptoms. Variations in disease development and symptom expression induced by environmental and cultural factors can be the cause of considerable consternation. This is becoming evident among species of the genus *Helminthosporium* and especially for *H. sorokinianum Drechslera sorokiniana)*. In time, however, understanding the various effects of environment and cultural aspects on disease expression by *H. sorokinianum* may be used to the turf manager's advantage. The purpose of this presentation is to summarize our knowledge of factors that can modify the symptomatology of leaf spot (*H. sorokinianum*) on Kentucky bluegrass.

Cultivar resistance and time

The use of fungicides is the primary means by which turfgrass diseases are controlled. Resistant cultivars and appropriate cultural practices also contribute to the control of some diseases.

The multitude of Kentucky bluegrass cultivars released in recent years has increased the hope among turfmen that resistance to various diseases will be improved. Resistance to diseases of Kentucky bluegrass induced by species of *Helminthosporium* leaf spot, however, must be approached with caution. Of 30 cultivars grown from seed (and vegetative parts) at the Iowa State University Horticulture Research Station, only five cultivars (Adelphi, Merion, Olymprisp, Rugby, and S. Dakota Cert.) had less than 30% of their leaves infected by *H. sorokinianum* in the spring of their fourth year of growth.

Most cultivars show increasing levels of leaf spot damage with each successive year's growth. In this regard, observations of S. Dakota Certified in subsequent years placed it among cultivars most susceptible to leaf spot.

It seems that the longer any cultivar is grown, the greater the incidence of leaf spot. The pathogen *H. sorokinianum* is a very aggressive parasite that attacks numerous species of grasses ranging from cereals to turfgrasses. The pathogen lives on dead tissue of the lesion it produces on the leaf and may produce a phytotoxin that is responsible for killing leaf tissue. It is very difficult to achieve high levels of resistance in cultivars against pathogens of this type. Under such circumstances, any cultivar that shows less than 30% of its leaves to be infected by *H. sorokinianum* after 4 to 5 years growth may be representative of higher levels of resistance to this pathogen.

Natural selection and observant turf specialists developed the earliest resistant varieties of Kentucky bluegrass for all turf managers.

Leaf age and symptoms

The leaf spot symptoms of *H. sorokinianum* are generally described as starting with small, circular, dark brown to purplish black spots that gradually enlarge and develop tan or brown centers. These lesions also may be surrounded by a zone of chlorotic tissue. This symptomatology is most common on the youngest leaves of the shoot in spring and fall, but such symptoms are greatly modified by progressively older leaves on the shoot.

Kentucky bluegrasses generally maintain 3 to 4 leaves per shoot; the two youngest leaves most commonly show typical leaf spot symptoms, while the two oldest leaves often have enlarged spots accompanied by chlorotic streaking on leaves. Occassionally, a single small leaf spot at the leaf blade base, or at the cut ends of older leaves, can result in the entire leaf turning yellow. Such symptoms on older leaves can be confusing in field diagnosis, particularly if younger leaves show few typical leaf spots. Variations of this type in symptom development have, on occasion, lead pathologists to believe that perhaps different species of *Helminthosporium* were involved. It is known, however, that *H. sorokinianum* can produce a wide range of leaf symptoms that develop in response to physiological age of the infected leaf.

It is becoming increasingly clear that leaf age must be considered in all evaluations of *H. sorokinianum* symptoms. Severity of symptoms produced by this pathogen increase on each older leaf.

Environment and symptoms

Development of *H. sorokinianum* leaf spot on Kentucky bluegrass is markedly influenced by environmental factors. Recent research has es-

tablished that lesion development is influenced by photoperiod and light quality. Individual lesions increase in size on leaves as day length becomes shorter; and, as day length increases lesions become smaller. Under shorter day length, brown to purplish black portions of lesion increases in size as does yellowing that surrounds lesions and complete yellowing of infected leaves is accelerated. Day length also interacts with leaf age; as day length shortens, symptoms become more acute on each older infected leaf.

These observations suggest that leaf spot symptoms should be less severe in spring with increasing day length and more severe in fall with decreasing day length. This is, in fact, a common observation for *H. sorokinianum* on Kentucky bluegrass.

Quality of light reaching infected leaves also can influence appearance of leaf spot symptoms. Infected leaves exposed to increased levels of far-red light have larger lesions and more general yellowing than infected leaves exposed to normal levels of far-red light. As light passes through upper, younger leaves of a plant the proportion of far-red reaching older, lower leaves increases. This phenomenon may, in part, explain why older infected leaves tend to become completely yellow in the fall and early winter. During this time of year shorter daylength and the far-red light reaching leaves will tend to increase the rate at which they age and at the same time increase disease severity on infected leaves.

Effects of temperature and water (rainfall or irrigation) on *H. sorokinianum* leaf spot development are difficult to separate. Leaf spot is most active during the cool periods of spring and fall. As temperature (possibly combined with wind velocity) increases and rainfall decreases in summer months, number and size of leaf spots decreases. However, our field studies have shown that if the summer is relatively wet, or if irrigation is provided, leaf spot may occur on 13 to 60% of leaves throughout summer months depending on susceptibility of the cultivar. Midsummer leaf spot seems to be more closely regulated by moisture than by temperature.

Cultural practices and symptoms

Nitrogen fertilization often increases the severity of *H. sorokinianum* leaf spot on Kentucky bluegrass. When nitrogen stimulates leaf spot it is usually reflected by an increase in size of lesion and by some general yellowing of infected leaves.

Studies recently completed in our laboratory indicate that nitrogen and leaf age interact to influence leaf spot severity (i.e. the youngest leaves of nitrogen fertilized plants may have less disease than those of nonfertilized plants, but disease is increased on the oldest leaves by nitrogen fertilization). This suggests that the subject of nitrogen fertilization and leaf spot severity is related to the physiological age of leaves and that influence of nitrogen on disease may be modified by leaf age.

Herbicides represent another cultural tool that shows some potential for influencing severity of *H. sorokinianum* leaf spot on Kentucky bluegrass. Such commonly used herbicides as 2,4-D, MCPP,

---

Nitrogen and leaf age interact to influence leaf spot severity. Some herbicides enhance development of leaf spot as well.

---

and dicamba may enhance leaf spot development. Like other environmental and cultural factors that enhance leaf spot, leaf age is directly involved in the interaction. Increase in diseased tissue on youngest leaves is minimal and severity of disease increases on each older leaf. In some instances, one small lesion on an older leaf of a plant exposed to MCPP or dicamba can result in a rapid straw-colored blighting of the entire leaf. It is believed that auxin-like herbicides (2,4-D, MCPP, dicamba) may increase the rate of aging in older leaves and predispose them to more severe disease.

Seasonal appearance of leaf spot

It is now known that leaf age, environment, and cultural factors can influence severity and appearance of *H. sorokinianum* leaf spot symptoms. On the basis of these observations, it is of interest to speculate on how these various factors might influence leaf spot during the various seasons of the year. The following outline is a speculative summation of how leaf age, environment, and culture practices might interact with leaf spot.

Spring

A. Appearance of Symptoms

1. Leaf spots small in early spring.
2. Leaf spots larger with some leaf yellowing in mid-spring.
3. Leaf spots smaller by late spring to early summer unless irrigation is provided.

B. Factors involved

1. The rapid flush of leaves in the early spring results in a very youthful shoot which inhibits leaf spot development. By mid-spring normal senescence of leaves on individual shoots has increased and such leaves show the larger lesions and the more severe yellowing symptoms.
2. By late spring increasing day length and reduced moisture levels (assuming irrigation is not provided) results in fewer leaf infection and less severe infections.
3. Applications of nitrogen or herbicides (auxin types) between mid-spring and early summer could increase severity of leaf spot. However, it is also possible that

Continues on page 62

Management *from page 59*

Fungicide disease control basically involves products that are (1) lethal to the fungus, or (2) inhibit fungal germination, growth or multiplication. Some fungicides are "broad spectrum", inhibiting a wide range of pathogens and other are "narrow spectrum", having a specific activity for only a few fungi.

Helminthosporium leaf spot fungicides prevent infection by the fungus rather than cure the disease. Thus effective fungicide control occurs only on plant parts to which fungicides are applied and only for the period fungicides remain on the plant. Contact fungicides must be applied at regular intervals to maintain protection on turfgrass leaf surface. Since control is achieved by a protective coat of fungitoxic chemical on the plant surface the fungicide must be applied uniformly. New, unprotected shoot growth is constantly being formed within the turf stand. These limitations must be recognized whenever you use fungicides to manage plant diseases. Certainly fungicides do help in a turf leaf spot management program but they will not replace a poor leaf spot management program or substitute for no leaf spot program at all.

In summary, of the general disease management methods, three are suitable for *Helminthosporium* leaf spot management consideration. These are resistant lines, sanitation and protection, while exclusion and eradication have limited value. The guts of a leaf spot management program is proper cultural management. Turf managers where *Helminthosporium* leaf spot is a threat should consider the effects of modified mowing, watering, and fertilizing practices. Further, they should consider de-thatching and if needed, modifying the turf environment. Lastly, apply fungicides as needed. If the results of these efforts are unsatisfactory, renovate by over seeding with resistant cultivars or reestablish completely including necessary soil and site preparations. **WTT**

Factors *from page 53*

early spring application nitrogen and auxin-like herbicides might temporarily retard leaf spot symptoms by promoting youthfulness in rapidly growing leaves.

Summer

A. Appearance of Symptoms.

1. Minimal appearance of small leaf spots under a normal, relatively dry summer environment.
2. Moderate to heavy leaf spot symptoms during wet summers or with irrigation.

B. Factors Involved.

1. Increasing day length and temperature, and reduced levels of moisture would normally reduce invections and decrease disease development on individual leaves. These factors would keep leaf spots relatively small.
2. Excessive rainfall or irrigation during summer will compensate for higher temperatures and increase infections. Applications of nitrogen and herbicides under these circumstances would further enhance disease severity. Some preliminary evidence suggests that high temperature stress combined with nitrogen and (or) herbicides may greatly enhance leaf spot symptoms on irrigated turf during the summer months.

Fall

A. Appearance of Symptoms.

1. Early fall number and size of leaf spots increases.
2. Late fall to early winter leaf spot symptoms become severe, including yellowing and blighting of entire leaves. Turf may appear to have a yellow undercover.

B. Factors involved.

1. Increasing moisture, shorter day lengths, and lower temperatures increase number of infections and enhance senescence of leaves. Enhanced senescence predisposes leaves to more severe disease development.
2. By late fall and early winter decreasing day length becomes a primary factor in enhancing leaf aging, and older infected leaves respond by blighting.
3. Nitrogen applied in late summer or early fall may have some delaying effect on senescence and for a period slow yellowing of older infected leaves.
4. Late summer to early fall applications of herbicides may enhance yellowing of older infected leaves by increasing the rate at which the leaf reaches senescence.

Winter

A. Appearance of Symptoms.

1. No leaf spot symptoms on dormant grasses. Winter may be the most important season for fungal colonization of dead tissues.
2. Grasses remaining green under snow cover and especially unfrozen soil will continue to show leaf spotting, yellowing, and blighting typical of late fall.

B. Factors Involved.

1. Provided adequate moisture is available, mycelium will grow slowly down to 36 degree F. Such growth could be important to colonization of dead tissue and an increase in spore production the following spring.
2. The potential availability of nitrogen, especially slow release forms, during winter months could provide an important nutrient source for pathogens and aid colonization of dead tissue.
3. Kentucky bluegrass will often remain green under snow cover, especially if the ground is unfrozen, and if nitrogen fertilizer is applied in the late fall. Under such circumstance leaf spotting and yellowing will persist as long as temperatures are 36 degrees F. or above.