FEATURE ARTICLE

Why Putting Greens Appear Red or Purple in Winter and Spring

Peter H. Dernoeden

The first frosty nights in autumn bring about some pronounced physiological changes in plants. In creeping bentgrass (*Agrostis stolonifera*), especially on lower-cut putting greens, the leaves may develop a reddish-brown, purple, or blue-gray color. The discoloration may be uniform, but frequently the various shades of purple, red, or blue appear in circular patches. These patches constitute different clones within the bentgrass polystand. The colors are most prevalent on older greens, especially those seeded to Seaside or "South German" bentgrasses. These varieties were genetically variable and as a result not all plants emerging from seed were true to type. Hence, individual plants would grow and the more aggressive types would dominate to produce circular patches. These patches are not unlike the circular areas of blighted turf associated with some diseases. The purplish discoloration often is misdiagnosed as red leaf spot (*Drechslera erythrospila*) by some golf course superintendents. *Helminthosporium* diseases that cause leaf spot and melting-out are not commonplace on creeping bentgrass, but leaf lesioning can cause a reddish-brown discoloration and subsequent severe thinning in Kentucky bluegrass (*Poa pratensis*) and perennial ryegrass (*Lolium perenne*) turfs. The purpling from frost often is prominent in Penncross greens. Since Penncross has three parents, at least three different types of color patches or clones can appear on greens. Similar color changes can appear in older stands of Pennlinks, Southshore, Providence, and all of the newer seeded bentgrass cultivars. Some cultivars, such as Crenshaw, may display a more uniform, purplish color in winter. The same purple color also can occur in annual bluegrass (*Poa annua*), but seems to be more commonly associated with the perennial types rather than the annual types.

Why do putting green grasses turn red, blue, or purple? The cool to cold temperatures trigger the color responses. During mid to late October, many regions experience relatively warm days (65 to 75°F; 17 to 24°C), but cool nights (32 to 55°F; 0 to 13°C). The sunny, bright, and warm days stimulate plants to produce large amounts of sugars (through photosynthesis) in leaf blades and sheaths. At night, the sugars must be translocated out of the leaves to crowns for storage or use in other physiological processes. When nights are very cool or frosty the sugars are not completely moved out of the leaves and they accumulate. There are many types of sugars. Glucose is a common plant sugar and sometimes glucose molecules are chemically bound with anthocyanins. Anthocyanins are pigments and their function in plants is unclear. They provide the red, purple, and blue colors in flowers. Anthocyanins are always present in leaves, but normally are masked by the presence of chlorophyll. They are expressed in the foliage of trees during cool and bright weather to provide the spectacular colors in autumn leaves. Hence, bentgrasses may experience a similar accumulation of sugar, and therefore anthocyanins, following the first cool or frosty night of fall. Frost injury may denature the green chlorophyll, thereby exposing the anthocyanin pigment. These colors may intensify and persist throughout winter months and slowly disappear in mid-spring after the turf begins active growth.

A similar phenomenon can occur on bentgrass greens, tees, and fairways in the spring. This usually coincides with unseasonably warm temperatures in late winter or early spring, which stimulates a premature green-up of bentgrass and annual bluegrass. Should night temperatures plummet into the low 20s°F (–7°C), or if there are several nights of frost following a premature green-up, the bentgrass and annual bluegrass again may develop a reddish-brown, brick-red, or dark-purple color. This condition is aggravated by topdressing, brushing, core cultivation, foot traffic (especially around the hole, and in entrances and exit areas), and other grooming practices performed at the time cold temperatures recur following an early green-up. Use of plant growth regulators, and dry and windy weather further contribute to the reddening or purpling of creeping bentgrass. *Helminthosporium*-like lesions may develop on these leaves, but it should be noted that water-soaked leaf lesions can develop in response to many different kinds of injury mechanisms. Therefore, the lesions observed on red or purple leaves during cold periods most likely are caused by mechanical injury associated with grooming, topdressing, or mowing greens too early in the morning following a frosty night. The bentgrass will recover rapidly with the advent of consistently warmer weather (i.e., days >70°F; 21°C and night >45°F; 7°C). An application of about 0.1 to 0.2 lb N/1000 ft^2 (5 to 10 kg N/ha) from a water-soluble nitrogen source will speed recovery as daily temperatures rise.

Continued on page 6

...Putting Greens...

Continued from page 4

Despite the aforementioned explanation, many persist in believing that the reddish color of greens must be disease. After all, textbook photos or red leaf spot disease on greens depict symptoms almost identical to frost injury. To explain this better it may be helpful to review the *Helminthosporium* diseases and their incitants. Many of the fungi that cause leaf spotting and melting-out diseases of turfgrasses once belonged in the taxonomic genus *Helminthosporium.* Today, these fungi are more appropriately referred to as species of *Drechslera* or *Bipolaris.* Because these diseases have been known for decades as *Helminthosporium* leaf spot and melting-out, most people do not recognize names other than *"Helminthosporium."* Thus, *Helminthosporium* often is used as a generic name for all the *Drechslera* and *Bipolaris* species that can cause leaf spot or melting-out diseases. *Drechslera erythrospila* is the causal agent of red leaf spot. Most turfgrass pathologists (Couch, 1995; Smiley et al., 1992; Smith et al., 1989; and Vargas, 1994) agree that red leaf spot is a warm weather disease that develops in late spring or early summer. In Kentucky, Vincelli and Doney (1995) reported that colonial, brown top and dryland bentgrasses were very susceptible to red leaf spot, but all 15 cultivars of creeping bentgrass evaluated in their trial showed high levels of resistance to *D. erythrospila.* There are other *Drechslera* species known to be associated with bentgrasses; they include *D. catenaria* and *D. gigantea. D. catenaria* is the most likely species to attack bentgrass in the spring, especially Toronto creeping bentgrass. Since our diagnostic lab opened in 1980, none of the aforementioned *Drechslera* spp. have been associated with creeping bentgrass in Maryland. In mid-May of 1997, however, we did find *D. dictyoides* producing prodigious numbers of spores on senescent or dead leaves of Penncross creeping bentgrass from a new tee. The sodded Penncross turf also was heavily infected with yellow tuft disease. In this case, *D. dictyoides* likely was acting as an opportunistic saprophyte, because there were no lesions on green leaves and spores were only found on dying or dead leaves. We also find red leaf spot (*D. erythrospila*) in late May and June on colonial bentgrass.

Most reports of *Helminthosporium* diseases in *Agrostis* species have involved colonial bentgrass, redtop or vegetatively propagated creeping bentgrass (e.g., Toronto). Hence, the relative rarity of *Helminthosporium* diseases in creeping bentgrasses today may be due in part to better resistance in Penncross and the many newer cultivars released in recent years. Furthermore, the widespread usage of broad spectrum fungicides applied from late autumn to spring for controlling winter diseases on greens (e.g., snow molds) also may help explain why leaf spotting and melting-out diseases are uncommon in the spring on creeping bentgrass.

During the summer *Bipolaris sorokiniana* can attach bentgrass, but the melting-out phase is uncommon in creeping bentgrass. Colonial bentgrass, however, may exhibit melting-out in the summer, particularly when treated routinely with sterol-inhibitor (DMI) or benzimidazole fungicides. Again, this is probably due to the routine use of the aforementioned fungicides for combating summer diseases. Regardless, it is not unusual to find a few zonate lesions (i.e., circular to oblong, brownish-purple lesions with or without a tan spot in the center) produced in response to *B. sorokiniana* spore penetration on bentgrass leaves during summer stress periods.

Some golf course superintendents have reported seeing a positive response from a broad spectrum fungicide applied in the spring to red, frost-injured greens. This would be more convincing if an untreated strip were left for comparative purposes! Assuming, however, that a positive response occurs, it may be due to the chemical impacting populations of "weak," secondary pathogens or the activity of saprophytes. During cool weather, these organisms may be enhancing leaf senescence at a time when plants are not actively producing new leaves and tillers for replacement of either frost-damaged or naturally senescing leaf tissue.

A somewhat similar blackening or purpling of leaves also may be elicited by the following: iron applications, low soil phosphorus levels, ammonium sulfate application, high application rate of fungicides classified as sterol inhibitors, some plant growth regulators, and arsenic toxicity. These responses are well known and can occur at any time of the year.

Literature Cited

Couch, H.B. 1995. *Diseases of Turfgrasses.* Krieger Publishing Co. Malabar, FL.

Smiley, R.W., P.H. Dernoeden, and B.B. Clarke. 1992. *Compendium of Turfgrass Diseases.* APS Press. St. Paul, MN.

Smith, J.D., N. Jackson, and A.R. Woolhouse. 1989. *Fungal Diseases of Amenity Turf Grasses.* E.&F.N. Spon. London and New York.

Vargas, J.M. 1994. *Management of Turfgrass Diseases.* Lewis Publishers, Boca Raton, FL.

Vincelli, P. and J.C. Doney. 1995. Reaction of bentgrasses to *Drechslera* leaf blight. *Biological and Cultural Tests.* 10:36.