STOP #4

BLACK LAYER UPDATE

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There has been a lot of controversy regarding the black layer. One thought suggests that the primary cause of black layer has to do with the occurrence of algae in the soil profile. Another argues that soil compaction, improper topdressing or faulty construction is responsible. Yet another "cause" is blatant mis-management. Finally, anaerobic bacteria and sulfate reduction have been implicated. Where does this leave the golf course superintendent? More than likely it leaves him totally confused and without the answers he desperately needs.

The black layer is physically produced through the reaction of hydrogen sulfide (gas) with soil metals such as iron or copper. Hydrogen sulfide is generated from the sulfate respiration of certain soil bacteria under anaerobic conditions, while the metals naturally occur. Turf loss associated with the black layer results from high concentrations of toxic metabolites (such as hydrogen sulfide) produced during times of anaerobic conditions. Thus, sulfur compounds (from whatever source), metals and anaerobic conditions are necessary prerequisites for black layer formation.

Most sulfur compounds in soil are found in organic debris and are naturally occurring. In some instances sulfur occurs in rain or irrigation water and is also supplementally applied to turf soils in the elemental form. Sulfur derivatives are also commonly found in frequently used turf products such as ferrous sulfate, gypsum (calcium sulfate) and certain fertilizers, fungicides, algicides and micro-nutrient formulations. Thus, there is generally a considerable sulfur input to highly maintained turfgrass.

Soil oxygen, which enters the soil by passive diffusion, is consumed by micro-organisms and plants during respiration. The oxygen is frequently depleted when rates of consumption exceed rates of diffusion. The resulting condition is termed anaerobiosis, which can be attributed to excess water from rain or irrigation, from perched water tables created by uneven topdressing or cultivation practices, from severe soil compaction or from the excessive proliferation of oxygen requiring organisms (algae and microorganisms). Thus, if soils with elevated sulfur concentrations are subjected to anaerobiosis, black layer will occur.

With these thoughts in mind, an experiment was conducted at the Hancock Turfgrass Research Center in East Lansing, Michigan. The experimental design was a randomized complete block having 3 replications. Treatments were factorially arranged and consisted of elemental flowable sulfur applied at rates of 1 or 5 pounds per 1000 square feet, ferrous sulfate applied at rates of 2 or 10 ounces per 1000 square feet and combinations of the two materials. In addition, each set of 3 replications was subjected to differing levels of irrigation: dry (irrigated to prevent wilt), moist (normal irrigation practices) and wet (saturated several times daily).

Results thus far indicate that soils receiving substantial sulfur input, when subjected to anaerobiosis (saturating conditions) do form a black layer. Soils receiving identical sulfur input but not subjected to saturated conditions have not (to date) formed the layer. Check plots (those not receiving sulfur) under saturating conditions also formed the layer. It is, however, well documented that oxidized sulfur (i.e., plant available sulfate) is freely mobile in sandy soils. Thus, the entire area of saturation should be expected to be inundated with supplemental sulfate and develop black layer.