CCS Pipeline™

PIPELINE

ANAEROBIC SOIL PROBLEMS AND SOLUTIONS FOR TURF

Problems related to anaerobic conditions can result in reduced growth, poor vigor, and slow recovery from stress, increased disease pressure and poor quality turf grass. This pipeline will attempt to provide basic definitions and solutions for anaerobic soil problems.

Anaerobic is defined as the absence of molecular oxygen. Anaerobic soils quickly become reduced and the nutrients in the soil solution are not plant available. (Refer to: "TPM Nutrient Uptake and Redox Pipeline" for more specific information on this subject.)

Excess rainfall, excess irrigation, soil aggregation problems and associated collapse of soil structure (compaction due to high traffic or microbial mediated collapse of soil aggregates when carbohydrate polymers are degraded) or soil texture problems with too much clay or the presence of large amounts of fine organic materials can all lead to anaerobic conditions.

Ideal soil moisture is close to ½ of the field capacity of a particular soil. Field capacity (field water capacity) is the content of water, on a mass or volume basis, remaining in the soil 2 or 3 days after having been wetted with water and after free drainage (gravity drainage) is negligible. An ideal soil would be composed of approximately ½ solid material including; minerals, sand, silt and clay and organic matter, and ½ open spaces (pore spaces) occupied by equal volumes of water and air (gas).

When a soil is anaerobic the free molecular oxygen content has been reduced to levels below a satisfactory concentration to support normal biological metabolism. Some organisms can exist in anaerobic soils because they have the ability to use combined oxygen taken from molecules like NO_3^{-1} (nitrate ions) and SO_4^{-2} (sulfate ions).

Denitrification occurs in anaerobic soils when organisms reduce nitrate to nitrite and eventually to N_2 leading to nitrogen loss from the soil. When sulfate ions are reduced sulfide ions are produced allowing the formation of metal sulfides that are present and create toxic black layers. These unfavorable processes and others are associated with anaerobic and reduced soil conditions.

When soil is anaerobic root growth, plant productivity and appearance is reduced. If these conditions persist for longer than a few days' roots may die and eventually lead to large dead spots in a turf stand. Disease organisms will attack weakened grass causing further problems.

Steps taken to overcome anaerobic conditions begin with mechanically re-introducing air (oxygen) into the soil. If the soil is completely waterlogged off site drainage may be required. When anaerobic conditions are identified quick measures to oxygenate the soil will reduce the level of damage. The response time should be no more than two to four days after the problem occurs.

Other steps taken to help grass recover from anaerobic conditions include using foliar feeding to provide essential nutrients to grass, using nitrate nitrogen and avoiding ammonia forms until the anaerobic conditions are corrected. Use foliar rates that essentially spoon feed the grass to help in the recovery process. Avoid using acid forming materials when anaerobic conditions are present. Use materials that provide readily available forms of nutrients for grass. Potassium nitrate, calcium nitrate and mono-potassium phosphate materials are good choices for potassium, nitrogen, phosphorus and calcium.

Primary and Secondary nutrients should be applied at these rates for foliar and shallow soil use: N – 5 – 10 lb/ac, P_2O_5 – 2 – 5 lb/ac, K_2O – 2 – 10 lb/ac, Ca* – 5 – 15 lb/ac, Mg – 1 – 4 lb/ac, S – 1 – 4 lb/ac.

Trace minerals should be in chelated or highly available form and used in small dose quantities: Fe – 4 – 8 oz/ac, Mn – 2 – 6 oz/ac, Zn – 1 – 3 oz/ac, Cu – ½ - 1 oz/ac and B* – 2 – 4 oz/20 acres.

The rates above should be repeated in 3 – 5 day feeding cycles and use enough water to get good coverage. Use low salt index materials to avoid injury to sensitive plant tissue.

*** (All calcium foliars should contain Boron, ie. An 8.0% calcium foliar material should contain ~ 0.02% Boron.)**

The recommendations for foliar application above may change based on variety, season and extent of grass injury due to anaerobic conditions. If fungal disease is present, insure that any foliar program used to feed the grass is applied in conjunction with the fungicide and follow all label rates.

Soil and tissue testing should be initiated as soon as possible after identification of anaerobic conditions and a second set should be taken a week after beginning a correction program. If extensive tissue damage occurs these tests should be taken after the grass begins to recover. Necrotic – brown and dead tissue will not provide usable information.

Basic soil and or liquid fertilizer programs used when anaerobic conditions are present should be based on sound agronomic principles including following guidelines of a turfgrass professional. Soil conditioning agents can be used to help remediate anaerobic soils. Gypsum, limestone and other materials may be recommended depending upon the cause of the anaerobic problem. Low rates of fertilizer or fertigation should be used initially and with more frequency. As the grass recovers the rates and timing should follow grass seasonal requirements.

Providing mechanical opening for air penetration and gas exchange from anaerobic soils is the best first step to use. If possible leave the holes or slices open until the excess moisture has drained.

Anaerobic conditions that weaken grass can lead to chemical related problems and/or turf damage if exact label directions for pesticides are not followed. Some labels instruct the applicator to not use the material if the grass is stressed or reduce the rates under stress conditions.

For information on soil and fertility considerations, call Creech Crop Services, LLC.

Buford Creech, CCA at: 941-737-2719 creechcrop@aol.com