



This live oak between the 3rd and 4th hole on the Y&CC of Stuart was used for screening errant shots. What kind of price tag do you put on this loss? Photo by Craig Weyandt.

directors. This memo explained how much rain we had received, how many trees were down, and the basic plan of attack for dealing with the problem. So communication was good but next time I will take more pictures.

When it was all over, the course had been closed for nine days after the hurricane and there are a few less trees but the overseeding came up great, and overall we feel lucky that things were not worse.

Flooding Usually Worse Than Wind for Golf Courses

BY JAMES B BEARD, PH.D.

The hurricane season in the Atlantic Ocean has brought major flooding problems to eastern North America. The high winds associated with hurricanes typically result in the downing and uprooting of trees.

This may result in the need for extensive debris removal from turf areas where tree limbs and various materials torn from buildings and other constructed facilities are strewn.

This wood, metal, and similar debris should be removed as soon as possible in order to avoid interference with mowing operations and potential turf injury by light exclusion.

Soil Deposition

The dimension of hurricanes that can create the most injury to turfgrasses is the very intense rainfall and resultant flooding of turf areas. Recent intense rains on the east coast of the United States ranged from 10 inches (25 cm) to as high as 25 inches (63.5 cm) in less than one day.

The lateral water flow from slopes onto lower areas of the floodwaters results in the deposition of soil, including clay, silt, and salt. Salt deposited on the grass leaves should be washed off as soon as possible to prevent physiological desiccation and death of the turfgrass plants.

The deposition of clay and/or silt creates a fine-textured layer that is prone to compaction and can become relatively impermeable to downward soil water infiltration for years to come. Thus the removal of this soil deposition as soon as possible is very important, especially from high-sand root zones on putting

greens and tees. The thin layer of soil remaining after mechanical removal of thicker layers should be washed off to the extent possible using water that is pressurized and directed through large-volume hoses.

Submersion Injury

Flooding that persists for an extended period of time can cause the death of certain turfgrasses. Complete submersion under water can result in soil oxygen depletion within a matter of hours. This may result in death of the root hairs and subsequent yellowing of the turfgrass plants due to a nitrogen or iron deficiency.

Ultimately, death of the turfgrass plant may occur by one of several mechanisms, including (a) a build-up of certain toxic compounds, such as ferrous and sulfide ions formed by reduction of anaerobic soil conditions, (b) the accumulation of toxic organic compounds, such as methane or carbon dioxide produced by the decomposition of soil organic matter, and (c) the accumulation of toxic by-products within the plant tissue under anaerobic conditions.

The relative degree of injury to turf-

grass from submergence varies depending on the (a) turfgrass species, (b) submergence duration, (c) submergence depth, (d) water temperature, and (e) light intensity.

Submersion at high water temperatures of 86°F (30°C) can result in death of the fine leaf fescues (*Festuca spp*) in one day, whereas creeping bentgrasses (*Agrostis stolonifera*) may survive more than 60 days submergence at low water temperatures of 50°F (10°C).

Accordingly, it is important to use submersion-tolerant turfgrass species on sites that are subject to frequent flooding.

The extent of injury from submergence increases with increases in the depth of water coverage. Grasses with leaves extending above the water surface are able to survive much longer than if totally submerged. Also, grasses under stagnant or standing water are more likely to be killed than when under flowing water.

However, one of the most important factors in the degree of injury that occurs during flooding is the actual water temperature. The extent of death increases dramatically as the water temperature increases from 50°F (10°C) to 80°F (27°C).

Thus, submersion early in the year at cooler water temperatures is less likely to cause turfgrass injury than submersion later in the summer when water temperatures are high, and especially when also exposed to cloud-free, full-radiant sunlight levels.

Injury Assessment

Once the debris is collected and any soil deposition removed as completely as possible, the next step is to assess the extent of damage to the turfgrass, which may appear as a totally brown canopy. Individual plants of the desired turfgrass species from numerous locations under flooding should be lifted out and examined carefully.

Cut a horizontal cross section through the grass crowns and the nodes on lateral stems to determine if they are white, firm, and healthy, or brown, mushy, and dead. This will be an indicator of the

amount of turfgrass recovery that can be anticipated.

Numerous multiple samplings are critical to get a representative assessment. Then the decision must be made whether replanting of critical turf areas will be required to repair the damage. Removal of any dead turf plant material and thatch from the surface is important to avoid a future organic layer problem.

If soil deposition has occurred, fairly intense core cultivation will aid in disrupting the clay or silt layer that has developed. The usual establishment procedures can then be followed.

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Editor's Note: Dr. Beard's article is presented as a cautionary warning of the unseen and possible long term effects from the flooding associated with this very active tropical season. Rainfall amounts exceeding 40 inches have been recorded during the 1999 hurricane season from July to October. Many portions of peninsular Florida experienced effects from Hurricanes Floyd, Harvey and Irene. Golfers and owners should be prepared for tentative turf conditions until enough time and good weather can help heal the turf damage. Weakened bermudagrass now covered with overseeding may still be weak in the spring during transition.

Golf Not the Only Agribusiness to Feel Irene's Wrath

Early damage estimates are in, and Hurricane Irene packed an estimated \$400 million punch, devastating South Florida's fall crops.

Florida Commissioner of Agriculture Bob Crawford has requested the governor's assistance in seeking an agri-

culture disaster declaration from USDA Secretary Dan Glickman.

Preliminary reports indicate that Dade County alone may have suffered losses of more than \$230 million in vegetable, tropical fruit and nursery crops.

In Palm Beach, Broward, Martin, St. Lucie and Indian River counties, preliminary surveys put losses at an estimated \$170 million.

Hurricane Irene dumped 15-20 inches of rain and had winds in excess of 80 mph when it tore across South Florida in mid-October.

Surveys are ongoing in Monroe, Collier, Hendry, Glades, Okeechobee, Osceola and Brevard counties.

Commissioner Crawford estimated that over 650,000 acres under production had been impacted by the storm. Crop losses ranging as high as 85 percent on more than 30,000 acres of tropical fruits and winter vegetables in a six-county area have been reported. In Dade County vegetable losses are estimated between 95-98 percent.

Nursery stock losses in the impacted area amount to an estimated \$215 million. In the Indian River citrus growing area, early loss estimates range from 15-20 percent on 225,000 acres.

"South Florida farmers supply the nation with more than 50 percent of its winter vegetables," Crawford wrote to Governor Bush. "It is imperative that all efforts be made to assist the hard-hit farmers in re-establishing this important production as quickly as possible."

Commissioner Crawford is asking for a declaration of an agricultural disaster for the six hard-hit and contiguous counties to authorize all financial assistance available under federal programs.

Editor's note: I share this information about our brothers and sisters in agriculture not to minimize the recovery time, effort and damage to the hundreds of golf courses in South Florida, but to reiterate Craig Weyandt's sentiments, "It could have been worse!"

Credit: Florida Fertilizer and Agrichemical Association's November 1999 newsletter