UNIVERSITY OF GEORGIA

Development of Cultivation Programs on Turfgrass to Reduce Water Use and Improve Turf Quality

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Poor soil physical conditions interfere with turfgrass management by limiting water movement, reducing soil aeration, and decreasing root and shoot growth. Compaction of the soil surface and excessively fine-textured (i.e., high in clay and silt content) soil profiles are two of the most common soil problems found on golf courses. Cultivation is an important method of alleviating these problems; however, comparative research studies to evaluate different techniques have not been conducted.

Five cultivation techniques were compared for their effectiveness in improving soil physical properties and growth of common bermudagrass (*Cynodon dactylon*). The site was a Cecil clay loam, typical of the Piedmont region of the southeast. A non-compacted control and compacted control were included and all cultivation techniques were evaluated under compacted conditions. Severe compaction was applied with a smooth power roller in April, May and July, 1989, and in March and July, 1990. The cultivation treatments were hollow tine core aeration (3 inches depth of penetration), Verti-drain (12 inches), Verti-slicer (4.5 inches), Aera-vator (3 inches), and Hydro-Jet (6 to 8 inches). Cultivation treatments were applied during May and July in 1989 and during April and August in 1990.

Soil Physical Properties. Within the surface 3 inches, only hollow tine core aeration significantly reduced soil bulk density and increased total porosity relative to the compacted control. Soil strength, a measure of soil hardness, was determined in March, May and August, 1990. The Verti-drain reduced soil strength by 23% to a depth of 8 inches in March and May, and 27% in August at the 4 inches depth. The Aera-vator treatment resulted in a 27% decline in soil strength in the May period to a depth of 2 inches. Hydraulic conductivity, a measure of water infiltration, increased 7.5 fold in May 1990 after Verti-drain treatment and 4.5 fold in August 1990 after Aera-vator application. Oxygen diffusion measurements were made at four periods in 1989 and 1990. No cultivation treatment improved oxygen diffusion compared to the compacted control.

Root and Water Relations. Root weights and root length density data were obtained during June and September in 1989, and July and September in 1990. Only the 1989 data are available. No root responses to treatments were observed in June 1989. On the September 1989 sample date, root weights in the 12 to 24 inches zone were decreased by Aera-vator and Verti-slice procedures, while root length densities increased 79% by Verti-drain treatment in the 12 to 24 inches zone relative to the compacted control. Water extraction data obtained during eight periods throughout

1989 and 1990 revealed higher water extraction than the compacted control on two dates for the Verti-slicer and one date for all other cultivation methods.

Shoot Growth. Turfgrass quality declined for one to two weeks after cultivation for all procedures except the Hydro-Jet in 1989. Some loss of shoot density occurred in August 1989 after Verti-slicer and hollow tine core aeration. In May, 1990 improved visual quality and shoot density were apparent for Verti-drain and hollow tine core aeration plots. Also, Aera-vator application increased visual quality. Higher visual quality versus the compacted control was observed in June and October for the Verti-drain and Hydro-Jet treatments, respectively. At one week after cultivation in early August, some decline in shoot density occurred in the Aera-vator, Verti-slicer, and hollow tine coring plots.

Summary.

(a) Verti-drain reduced soil strength to a depth of 8 inches and improved infiltration. These effects on soil physical properties enhanced deep rooting in late summer.

(b) Aera-vator reduced soil strength in the 2 to 4 inches soil zone on one date and enhanced infiltration. These improvements in the physical properties of the surface few inches did not result in better rooting since deep root growth in late summer was less than the control.

(c) Hollow tine core aeration improved soil surface conditions as shown by low bulk density and higher aeration porosity; however, rooting was not affected.

(d) Verti-slicer and Hydro-Jet treatments did not influence measured soil physical properties or rooting.

(e) Improved soil water extraction during dry-down periods was observed one out of eight times for all procedures (2 out of 8 for the Verti-slicer).

(f) All methods except the Hydro-Jet caused some decline in visual quality and/or shoot density within a week of treatment on at least one occasion. The Verti-slicer and hollow tine core aeration exhibited this trend most often (i.e., 4 out of 5 treatments).

(g) All cultivation procedures resulted in some improvement in visual quality and/or shoot density during some period of the study, except the Verti-slicer treatment.

Future Direction. The results from this study and a previous one (funded by the USGA to evaluate 5 other procedures) will be used to formulate several cultivation programs. Cultivation programs will include two to three different procedures applied at appropriate times of the year. New procedures may also be included. This phase will be conducted in 1991 and 1992.