Growth and Cold Tolerance of Tifgreen Bermudagrass

by F.A. POKORNY
University of Georgia, Athens, Georgia

Introduction

Soil compaction and freezing temperatures are major factors contributing to the loss of turfgrass. Cultural practices such as increased fertilization rates, increased irrigation rates, soil amendments and mechanical aerification techniques have been used to overcome soil compaction. Presently mechanical aerification is the standard practice of correcting soil compaction, because removal of numerous soil cores is less costly and time consuming than complete renovation of a given area.

Loss of established turfgrass has been attributed to adverse winter conditions, such as excessive rains, poor drainage, and ice sheet formation, toxic accumulations in the soil of methane and carbon dioxide, dessication, and heavy infestations of low temperature fungi.

Since little information was found relating to the effects of soil compaction on winter injury of turfgrass, this study was undertaken.

Vegetative Development

Sprigs of Tifgreen bermudagrass were established in 6—inch metal cans in the three soil mixtures shown in Figure 1. A duplication of the three soil mixes was covered with a 3—inch layer of pine bark in an attempt to absorb compaction forces. Four months after planting, pressures of 0, 20, 40, 60, and 80 pounds per square inch (psi) were applied three times weekly for nine months.

During establishment, fertilization was based on general management practices using a 6-12-12 analysis fertilizer at the rate of 25 pounds per 1,000 square feet. Thereafter, one pound actual N, 0.11 pound P and 0.42 pound K were applied monthly. Soil pH was maintained at 5.5 — 6.0 with domestic limestone.

Grasses were cut to a height of one inch for a period of eight weeks after planting and thereafter was lowered to approximately 1/2 to 1/4 inch.

Approximately one inch of water was applied per week. Moisture levels were increased to approximately field capacity prior to the application of compaction pressures.

Temperature in the unshaded greenhouse was maintained at 60°F at night and 70—80°F on sunny days when possible. During periods of naturally high temperatures, the greenhouse was air-cooled using the pad and fan system.

Top Growth

Top growth was increased by amending the soil with 25 and 50 cent milled pine bark, respectively. A faster rate of growth, greater density, and leaf turgidity were characteristic of turf grown in the bark amended soils. Top growth was also greater in the non-cushioned media than in soils covered over with a 3-inch layer of pine bark (Figure 2). Cushioned soils

Figure 1. Distribution of particle separated for the three soil mixtures and the milled pine bark used as the soil amendment and the three-inch milled pine bark cushion layer.

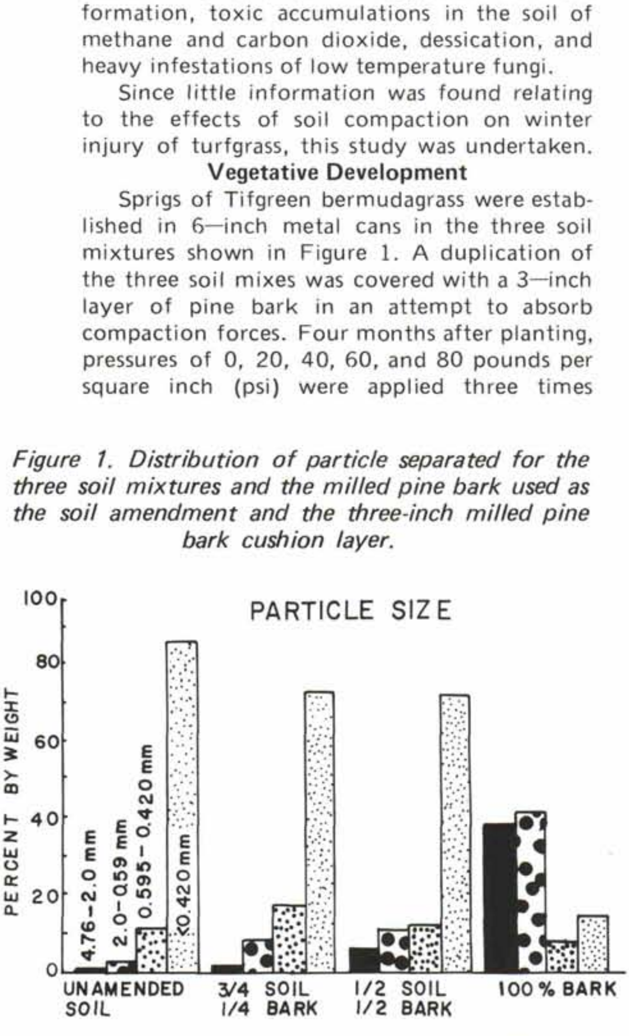
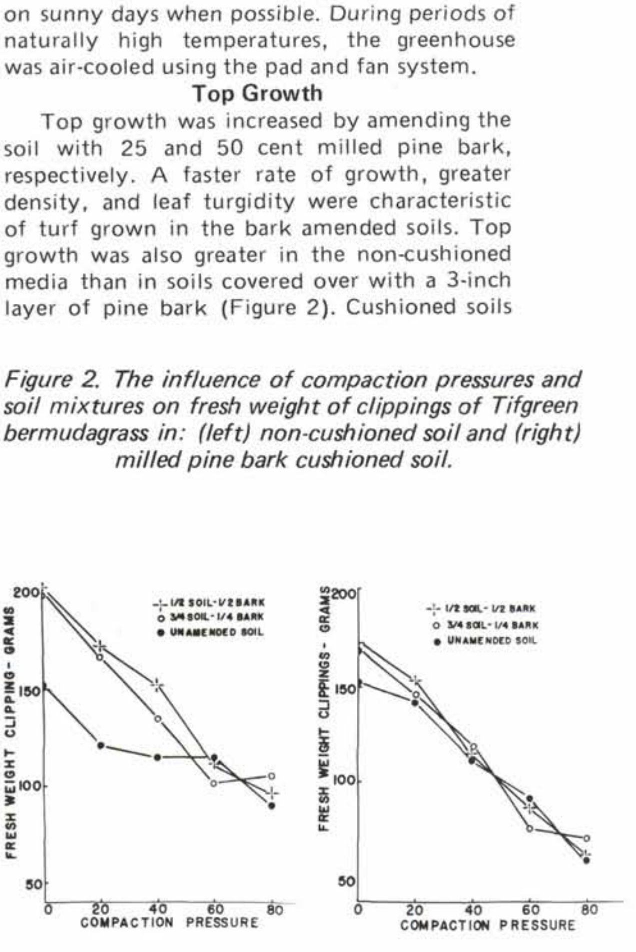


Figure 2. The influence of compaction pressures and soil mixtures on fresh weight of clippings of Tifgreen bermudagrass in: (left) non-cushioned soil and (right) milled pine bark cushioned soil.



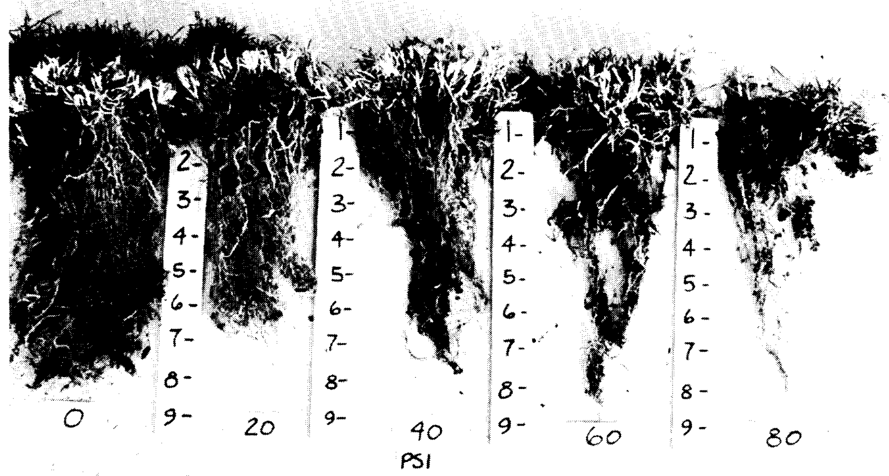


Figure 3. Root development of Tifgreen bermudagrass in a soil medium of 3/4 field soil — ¼ milled pine bark as influenced by soil compaction.

one month after the initiation of compaction treatments were highly resilient and had a high air content. Contraction and expansion of this zone was visually evident but constant compaction resulted in a gradual decline in resiliency. These soils became less productive than the non-cushioned soils. At pressures of 40, 60, and 80 psi, standing surface water, in excess of 1/8 inch was observed for periods of 24 to 48 hours after irrigation.

A 3—inch bark cushion layer also offset the value of incorporating pine bark into the soil as a physical conditioning agent (Figure 2).

Top growth decreased as compaction pressures were increased (Figure 2). Five months after compaction treatment was started, dieback was evident in the turf grown within the high compaction range (60 to 80 psi). Damage to crown tissue appeared to increase as soil compaction increased.

Root Development

Root development was enhanced by amending the field soil with 25 per cent and 50 per cent (by volume) pine bark, respectively. The root systems in the 50 per cent pine bark — 50 per cent soil mixture were active and had a high percentage of root hairs per linear inch of root. As compaction pressures were increased, root development (Figure 3) decreased. Root development was better in the non-cushioned soil than in soils cushioned by a 3—inch layer of pine bark. Roots produced in the cushioned soils, especially when compaction pressures were high, possessed few root hairs and exhibited much root breakage not found in the non-cushioned soil mixtures. In combination with anaerobic conditions caused by water retention in the cushion layer and with root breakage, high root decomposition rates were prevalent. This probably accounted for the rancid odor of these soils.

Soluble Salt Accumulation

Soluble salts were determined in the upper and the lower 2—inch soil profiles 13 months after soil compaction treatments were started. In the surface profile, salt concentration increased as compaction pressures increased from 0 to 80 psi. Soluble salt content changed very little in the lower soil profile. Addition of a 3—inch cushion layer of pine bark also resulted in a substantial increase in soluble salts in the upper 2—inch profile. This increase may be partially accounted for by the high cation exchange capacity of the pine bark and partially by the layering effect between the pine bark cushion layer and the soil mixture. Such layering apparently resulted in a restriction of water movement through the medium.

Excessive salt accumulations are apt to occur on highly compacted turfgrass soils and may become serious where a layering effect exists between the soil and the other organic or inorganic soil amendments. Serious burning of crown and leaf tissue and limited root activity can be expected unless soil compaction is alleviated and percolation rates improved so that leaching of excessive salts will occur. The use of milled pine bark as a soil amendment increased the soluble salt content of the base soil, and where no layering effect was present, the salt levels were within the limits established for satisfactory plant growth. However, when a layer of pine bark was used to absorb compaction pressures, soluble salt accumulations considered inhibitory for normal plant growth developed .

Recovery From Low Temperature Exposure

Fertilization practices were discontinued one month prior to initiation of cold treatments. All turf was transferred from the 60°F greenhouse into a 50°F holding area for a dormancy inducing period. Air temperature was gradually lowered and maintained at 40 to 45°F for a period of three weeks. Light intensity was reduced to 1,500 — 2,500 foot candles.

Containers of turf were then moved from the holding area into a thermostatically controlled cold chamber. Air temperatures within the chamber were depressed at the rate of 10°F per hour to 25°F and thereafter at a rate of 2°F per hour until the minimum of 15°F was obtained. The latter temperature was maintained for a period of five hours. A warming cycle followed the reverse of this procedure. The entire low temperature treatment was carried out in a 24-hour period. After freezing, all grasses were moved to the holding area, allowed to warm to room temperature, and then were transferred into a 60°F greenhouse for a recovery period of one to three weeks. Grasses were evaluated daily for recovery.

Recovery of bermudagrass after exposure to artificial freezing temperatures was found to be greatest in soils amended with 50 per cent pine bark, 25 per cent pine bark, and unamended soils in descending order. Differences in turf injury and recovery rates between cushioned and noncushioned soils were of no significance. Regeneration potential decreased as compaction pressures were increased. It may also be pointed out that low temperature treatments were not sufficiently low to have had a detrimental effect upon the root systems of the grasses. At no time were soil temperatures less than 35.7°F. It appears, therefore, that grasses recovered best in soils which permitted adequate soil aeration, gaseous exchange, water infiltration rates, and suitable resiliency or resistance to soil compaction. Soil receiving the least amount of applied pressure recovered more readily than did soils which received pressures of 40 to 80 psi. The former soils promoted a more extensive root system which was better able to support the regeneration of aerial plant parts. Where root systems were greatly limited in their growth and development, little support could be supplied toward development of new leaf area. Conversely, those grasses receiving pressures of 0 to 20 psi were endowed with an extensive leaf area, and therefore were better able to carry on a balanced activity which would consist of photosynthesis, respiration, transpiration and food storage, food utilization, and other metabolic processes.

Super Sam by Paprocki