EFFECTS OF INTENSE, SHORT-TERM TRAFFIC ON SOIL PHYSICAL PROPERTIES AND TURFGRASS GROWTH

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Effects of Intense, Short-term Traffic on Soil Physical Properties and Turfgrass Growth

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ABSTRACT

Most turfgrass areas are subjected to some degree of traffic resulting in wear and compaction placing stress on the plant. Along with physical abrasion caused by wear, traffic causes compaction which presses soil particles together altering soil physical parameters. With a constant force, the degree of compaction is a function of soil water content. Maximum compaction occurs at some time after the large soil pores start to drain.

Five treatments were applied to a 2.5 year old tall fescue (Festuca arundinacea Schreb. 'Kentucky 31') stand on a Chase silty clay loam. A one-time compaction treatment of 35 passes with a water filled, smooth, power roller exerting 1.0 kg/cm^2 static pressure, was applied to a soil with four soil moisture levels. Soil moisture treatments were established by irrigating the area until water was standing and then applying the compaction treatment 0, 4, 24, and 72 hours after the standing water condition, respectively. The fifth treatment was a non-compacted check. The effects of treatments on soil physical factors and plant growth were monitored. The study took place from 3 May to 11 July 1979.

Of the compacted treatments, bulk density was 1.41 g/cm^3 for the 24-hour treatment and 1.31 g/cm^3 for both the 0-hour treatment and the check. Aeration porosity at -0.1 bar matric potential was reduced by 20% for the soil compacted at saturation compared to the check. After

6 weeks, differences in moisture retention were not evident.

Two and six weeks after treatment date, visual ratings were reduced in all compacted plots. The 4 weeks between ratings had high temperatures and no rain. A correlation coefficient of 0.82 occured between visual quality and aeration porosity at -0.1 bar matric potential. No differences at alpha = .10 were found between treatments for verdure and shoot density. Four weeks after treatment, root weights at the 0-10 cm level were reduced by 61% in the saturated treatment compared to the uncompacted check.

Total nonstructural carbohydrates (TNC) levels 4 weeks after compaction, were higher than the check for the 0, 4, and 24-hour treatments indicating a slower growth rate. All treatments showed a steady increase in TNC except for the 24-hour treatment which showed a 35% decrease in TNC level 7 weeks after compaction. By 9 weeks after compaction, all treatments exhibited similar TNC levels.

Additional index words: Tall fescue, soil moisture content, compaction, grass.

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Most turfgrass areas are subjected to some degree of traffic which is a stress on the turfgrass plant. Even routine maintenance practices. such as mowing, impose traffic stresses. Recreational turfs are often subjected to heavy traffic when environmental and soil conditions are unfavorable. As a result, the turf stand may deteriorate.

The two major traffic related problems are wear and soil compaction. Wear is the injurious effects of concentrated traffic on a turf due to physical abrasion and tearing (1). Compaction is the pressing together of soil particles into a more dense soil mass (1,7). Soil compaction influences air, water, and soil strength factors. These paramenters in turn affect growth and persistance of the turf.

With a constant applied force, there is an optimum moisture content at which soil compacts to the greatest extent (4). Due to the imcompressability of water, in a saturated soil maximum compaction will occur at some point after the larger pores start to drain and fill with air. At that time, water will act as a lubricant allowing soil particles to pack closer together (7).

Due to the stresses imposed on the turfgrass plant from compaction, it is important for the turfgrass manager to restrict traffic on excessively wet turfs. Knowledge of the resultant effects on the turfgrass plant may provide the turfgrass manager with a better basis for controlling use of a turf area when unfavorable soil conditions are present.

The objective of this study was to observe the effects of intense, short-term traffic on soil physical properties and turfgrass growth.

MATERIALS AND METHODS

To observe the effects of heavy traffic on an established turf at different soil moisture levels, five treatments were applied to a 2.5 year old tall fescue (Festuca arundinacea Schreb., 'Kentucky 31') stand. The soil was a Chase silty clay loam of the fine, montmorillonitic, mesic Aquic Arguidolls at the Kansas State Univeristy Turf Research Plots in Manhattan, Kansas. The study took place from 3 May to 11 July 1979. Each plot measured 2.44 X 1.13 m and was seperated by .61 m alleys. Experimental design was completely randomized with three replications for each treatment.

All compaction treatments were initiated on 3 May. Four of the treatments were compacted at: 0 (saturation); 4 (partially saturated); 24 (field capacity); and 72 (below field capacity) hours after irrigating the total area to a standing water condition. The fifth treatment received