INCREASED POTASSIUM FERTILIZATIONS FOR ENHANCED TRAFFIC AND DROUGHT RESISTANCE OF PERENNIAL RYEGRASS GROWN ON A SAND ROOT ZONE SPORTS FIELD

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Fertilization of turfgrasses with relatively large amounts of potassium (K) has been associated with resistance to many stress conditions including those imposed by diseases, drought, traffic, and high and low temperatures. Potassium may enhance stress resistance by directly or indirectly causing increased rooting, thickened cell walls with an associated higher cellulose content, and decreased tissue hydration resulting in hardy tissue.

Data from several university studies has supported the above benefits, while data from other studies has shown no benefit. Some of this paradox can be explained by recognizing several factors that may influence the outcome of these studies: soil type (sand, clay, loam, etc.) and starting K soil levels; turfgrass species, including their respective K requirements and uptake capabilities; irrigation amount and potential K leaching, especially in sandy soils, clipping removal and thus the removal of K; N fertility rate, an example being at low N rates, K uptake may be low though there is sufficient soil-available K; and soil chemical and physical properties that influence K uptake, an example being high sodium levels in the water or soil hinder K uptake.

There is little debate about the need for K fertilization of turfgrasses grown on a sand root zone, especially if clippings are removed and the area is irrigated to promote optimum turfgrass quality and function. Potassium fertilization in relatively large amounts on many of the native California soils is debatable. However, many agronomists do stress the need for a balanced nutritional program; one that involves N, P, and K.

Potassium is one of the 16 essential elements required for plant growth, excluding carbon, hydrogen, and oxygen. The K requirement for turfgrasses ranks second only to N. Potassium is not a constituent of plant tissues nor organic compounds, such as carbohydrates, proteins, and lipids. However, K is an essential cofactor involved in carbohydrate synthesis and translocation, protein and amino acid synthesis, and enzyme activity. It is also involved in the control of transpiration, respiration, and uptake of certain nutrients such as N and magnesium. Generally, the requirement for K increases with higher N fertilizer rates, heavy irrigations, and clipping removal.

Soils having sufficient amounts of clay minerals may supply appreciable amounts of plant-available K. However, sandy soils contain much less K than clays and have considerably less ability to retain K against leaching. Potassium is very mobile and can be easily leached from plant tissue and from sandy soils. This situation is further exaggerated when clippings are removed and the site is irrigated heavily. This is a typical situation for athletic fields receiving medium to high levels of management. Sand is a popular root zone medium because it resists soil compaction from heavy traffic and because it facilitates drainage so that rainfall has the least impact on sporting events.

The objective of this study was to determine if increasing the K component of the N/K ratio would increase traffic and drought resistance of perennial ryegrass grown on a sand root zone.
MATERIALS AND METHODS

Cultivar

Manhattan II perennial ryegrass.

Experimental Site

A mature, sand-filled basin model sports field established at the UCR Turfgrass Research Field Laboratory in 1984. The root zone is a well-drained, 16-inch deep, medium textured sand with a subsurface drainage system. The perennial ryegrass was established in spring 1992 by sod.

Experimental Design

Strip-plot design with three replications. K treatments formed main plots (12 x 4.5 feet), while traffic treatments were stripped across main plots forming subplots (6 x 4.5 feet).

Mowing

One time per week with a walk-behind rotary mower; mower setting/actual height - 1 7/8 inches and 1 5/8 inches, respectively; clippings removed.

Irrigation

Irrigated to promote maximum turfgrass quality for the entire plot area; 2.62 inches per week during summer months.

K Treatments

Initiated May 13, 1993. Treatments were applied once every 2 weeks; exception was Multicote which was applied once every 4 months at a rate of 2 lb N/1,000 ft². Note that these treatments were continuous until the drought treatment, which was July 1994.
### Potassium treatments.

<table>
<thead>
<tr>
<th>Fertilizer Source (N-P_{2}O_{5}-K_{2}O)</th>
<th>N/K</th>
<th>Pounds/1,000 ft^2 per month</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>K_{2}O</td>
</tr>
<tr>
<td>Urea 45 - 0 - 0</td>
<td>1/0</td>
<td>0.5</td>
</tr>
<tr>
<td>K-Power 13.75 - 0 - 44.5</td>
<td>1/3</td>
<td>0.5</td>
</tr>
<tr>
<td>Multicote 12 - 0 - 43</td>
<td>1/3</td>
<td>0.5</td>
</tr>
<tr>
<td>K-Power + Urea 19 - 0 - 38</td>
<td>1/2</td>
<td>0.5</td>
</tr>
<tr>
<td>K-Power + Urea 26.4 - 0 - 26.4</td>
<td>1/1</td>
<td>0.5</td>
</tr>
</tbody>
</table>

### Traffic Treatments

Applied with a Brinkman Traffic Simulator (BTS) equipped with football cleats. Two passes with the BTS were equivalent to one football game.

### Traffic treatments.

<table>
<thead>
<tr>
<th>Date</th>
<th>High Traffic</th>
<th>Low Traffic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oct. 4</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Oct. 8</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Oct. 11</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Oct. 15</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Oct. 18</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Oct. 22</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Oct. 25</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Oct. 29</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Nov. 1</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Nov. 5</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Nov. 8</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Nov. 12</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Nov. 15</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Nov. 22</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Nov. 29</td>
<td>4</td>
<td>2</td>
</tr>
</tbody>
</table>

**Total Passes:** 50  
**Game equivalents:** 25
Measurements Following Traffic Treatments

1. Visual rating of wear: 1 to 9; 1 = brown, worn turf, 9 = no wear.

2. Traction strength of sod. Taken with a traction torque apparatus equipped with a 42-kg plate with football cleats.


Drought Treatment

Conducted in July 1994 by withholding irrigation and rating plots visually for drought symptoms (leaf wilting and rolling, and discoloration and eventual firing). Site was rewatered, and recovery from drought was visually rated on a 1 to 9 visual turfgrass quality scale: 1 = brown turf; 9 = best.

Plant Measurements Prior to Drought Treatment

Three plugs (2 3/8 inches diam. x 6 inches deep) were taken from each K treatment - traffic treatment plot in order to determine verdure mass and root mass in the upper 3 inches and root mass in the 3- to 6-inch depth.

RESULTS

Fertility treatments were applied for almost 5 months prior to traffic treatments. These fertility treatments did not significantly affect wear tolerance of perennial ryegrass (Table 1). The K-treatment x traffic-treatment interaction was not significant. This means that K treatments responded relatively the same regardless of traffic treatment level. Therefore, as presented in Table 1, K treatments are the average of both high- and low-traffic treatments. It should be noted that traffic treatments did significantly affect the amount of wear (data not shown). That is, plots receiving the high-traffic treatment were significantly more worn than plots receiving the low-traffic treatment. In summary, higher amounts of K did not significantly increase the wear tolerance of perennial ryegrass. However, upon close inspection of the data in Table 1, there does appear to be a trend for higher traffic tolerance associated with higher amounts of K.

Fertility treatments did not significantly affect sod strength (Table 2). It is also interesting to note that traffic treatments did not significantly affect sod strength (data not shown). One might expect a more worn turf (high-traffic treatment) to have a lower sod strength than a less worn turf (low-traffic treatment).

Note that at the time of this writing, not all data was available. However, a full summary will be presented at the field day.
Table 1. The effect of N/K ratios and simulated traffic on visual wear measurements of perennial ryegrass grown on a sand root zone.

<table>
<thead>
<tr>
<th>Fertility Treatment</th>
<th>N/K</th>
<th>Nov. 23</th>
<th>Nov. 30</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urea</td>
<td>1/0</td>
<td>4.6Y</td>
<td>4.9</td>
</tr>
<tr>
<td>K-Power + Urea</td>
<td>1/1</td>
<td>3.8</td>
<td>4.2</td>
</tr>
<tr>
<td>K-Power + Urea</td>
<td>1/2</td>
<td>5.3</td>
<td>5.6</td>
</tr>
<tr>
<td>K-Power</td>
<td>1/3</td>
<td>5.3</td>
<td>5.5</td>
</tr>
<tr>
<td>Multicote</td>
<td>1/3</td>
<td>4.9</td>
<td>5.0</td>
</tr>
<tr>
<td>LSD P = 0.05</td>
<td></td>
<td>1.3</td>
<td>1.4</td>
</tr>
<tr>
<td>Pr &gt; F</td>
<td></td>
<td>0.12</td>
<td>0.25</td>
</tr>
</tbody>
</table>

\*z Wear rated from 1 to 9: 1 = brown, worn turf; 9 = no wear.

\*y Means are the average of high- and low-traffic treatments.
Table 2. The effect of N/K ratios and simulated traffic on the traction strength of perennial ryegrass grown on a sand root zone.

<table>
<thead>
<tr>
<th>Fertility Treatment</th>
<th>N/K</th>
<th>Traction Torque&lt;sup&gt;z&lt;/sup&gt; (meter kilograms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urea</td>
<td>1/0</td>
<td>4.85&lt;sup&gt;y&lt;/sup&gt;</td>
</tr>
<tr>
<td>K-Power + Urea</td>
<td>1/1</td>
<td>4.57</td>
</tr>
<tr>
<td>K-Power + Urea</td>
<td>1/2</td>
<td>4.67</td>
</tr>
<tr>
<td>K-Power</td>
<td>1/3</td>
<td>4.94</td>
</tr>
<tr>
<td>Multicote</td>
<td>1/3</td>
<td>4.71</td>
</tr>
<tr>
<td>LSD P = 0.05</td>
<td></td>
<td>NS</td>
</tr>
</tbody>
</table>

<sup>z</sup> Traction torque measured with a 42-kg plate with football-type cleats.

<sup>y</sup> Means are the average of high- and low-traffic treatments.