NITROGEN AND POTASSIUM FERTILITY OF A SAND BASED ROOTZONE ATHLETIC TURF,

T.M. Krick, J.N. Rogers III, J.R. Crum, and J.J. Plachta
Department of Crop and Soil Sciences
Michigan State University
East Lansing, MI

INTRODUCTION

Nitrogen and potassium are essential nutrients for turf plant survival. Some of the major turfgrass effects attributed to nitrogen include: shoot growth, shoot density, color, disease proneness, heat and cold tolerance, and drought hardiness, wear tolerance and disease proneness (Beard, 1988). Potassium regulates turf plant water relations, heat/cold/frost resistance, wear tolerance and rooting. It is important to understand the intricate balance and interrelation of the entire plant growth process (Freeborg & Daniel 1985). Many newly constructed athletic fields are making use of sand based rootzones. Sand based fields allow for adequate drainage and maximize rooting. Stability may also be improved depending on the sand size and shape. Due to their low cation exchange capacity, sands do not hold nutrients readily, particularly nitrogen and potassium. A study was begun 1993 at the Hancock Turfgrass Research Center (HTRC) on the campus of Michigan State University in which nitrogen and potassium fertilizers were applied to a turf stand existing on a sand based athletic field. The object of the study was to determine the effects of nitrogen and potassium rates and ratios on color, quality and overall stability (measured via shear vane) of a sand based athletic field.

MATERIALS & METHODS

The study was conducted on a two year old seeded blend of perennial ryegrass (*Lolium perenne*) beginning September 1993. The blend, known by its tradename *Renovator Pro*, is comprised of three cultivars; 'Dandy', 'Delray', and 'Target'. The experiment was a one factor completely randomized design with six fertilizer treatments. Three products were used to make the treatments; Andersons' Nutralene (40-0-0), Greens and Tees Fert. (25-0-25), and Andersons soluble potash (0-0-60). The three fertilizers were combined in such a manner to allow for the following treatments shown in Table 1.

Fertilizer treatments were applied monthly with the first application occurring 5 May 1994 and the final on 6 October for a total of six applications. Wear treatments were applied using the Brinkman Traffic Simulator beginning 2 September. At an average of 14 cleats per square foot per roller, the simulator makes 56 cleat dents per square foot, the equivalent of one football game within the Zone of Traffic Concentration (ZOTC), in two passes (Cockerham and Brinkman, 1989). Traffic simulation was conducted through 9 November at which time approximately 42 games had been simulated. Data collected included color, density, quality, shear-vane measures, clipping yields, and tissue analysis.

RESULTS/DISCUSSION

Color:

Color ratings were conducted in Fall due to the simulation of wear and correlation of typical athletic field use periods (i.e. football/soccer seasons). Color differences were significant amongst the fertilizer treatments for those dates provided and throughout the Fall, (see Table 2). Turfgrass color responses followed the nitrogen applied. Comparisons between different potassium levels at similar N levels showed little difference in turfgrass color.

Quality:

Quality ratings were conducted monthly throughout the study. The treatment receiving the highest amount of N (9 lbs/M) also received the highest quality ratings throughout the study. Quality ratings are presented in Table 3. Weekly quality ratings at the time traffic simulation began, however only monthly ratings are provided since they reflect the overall Fall trend. Higher quality ratings were associated with high N treatments. Quality ratings were based on both color and density. Nitrogen is critical to turfgrass color which explains the higher quality ratings that were given to those treatments receiving higher amounts of N.

Table 1. Nitrogen and potassium study fertilizer treatments applied monthly, May-November 1994, Hancock Turfgrass Research Center, Michigan State University.

Treatment	lbs./1000 ft^2/year lbs. N	lbs. K
1	3	0
2	3	3
3	3	6
4	6	6
5	6	9
6	9	3

Potassium, as mentioned earlier, is important to wear tolerance. Wear tolerance is a function of turf density, which K provides for. The importance of K fertility became apparent later in the season as differences in quality ratings were observed.

Density:

Density ratings were conducted in the Fall and significant differences were noted amongst the treatments (Table 4). K had little effect in low N situations. It is thought that N may have been limiting for these treatments since only three pounds had been applied. It was noted that when K is held steady and N is increased higher densities were obtained.

Shear Measures:

Traction was measured with a field shear-vane apparatus, type 1B, Eijkelkamp, the Netherlands (van Wijk, 1980). Means of three measurements per plot were recorded are in given Newton-meters (Nm). No significant shear differences were observed between fertilizer treatments on trafficked areas for all dates when measured as seen in Table 5. Perennial ryegrass has a bunch-type growth habit and a minimal thatch layer. The combination of growth habit and low thatch likely explains the low shears recorded.

Tissue Analysis:

Plant tissue analysis was conducted monthly for the months of June, July, and August. Nutrients which exhibited significant differences across fertilizer treatments are given in Table 6. Significant differences in potassium levels were noted in June but not in July and August. A possible explanation for this is that the turf plant is growing at slower rates in the months of July and August. Plant uptake in these months is lower than spring and fall periods. Other nutrients that exhibited differences included Molybdenum, Copper, and Calcium.

CONCLUSIONS

The importance of nitrogen and potassium to the turf plants livelihood cannot be overemphasized. The addition of these elements to turfgrass systems under trafficked conditions grown in sand based rootzones is imperative due to inherent low retention of nutrients in the soil system. Fertilizer treatments having higher amounts of nitrogen and potassium had significantly higher color ratings compared to lower levels but no significant differences were noted relative to stability as measured through the shear vane apparatus. Quality and densities were also enhanced for those treatments containing more nitrogen and potassium. None of the treatments proved were in terms of shear vane measures (rotational force). The treatment receiving the highest amount of N (9 lbs/M) obtained the highest quality ratings yet did not provide high shear measures. Shear vane measures continued to drop for all treatments through the course of the study as traffic increased.

This was similar to observations made in 1993 and is likely a function of the perennial ryegrass bunch-type growth habit. Also, due to its growth habit, ryegrass has very little to no thatch and poor recuperative ability. For the three months that tissue analysis was conducted only the month of June indicated a significant difference amongst treatments for potassium concentrations. This indicates that soil potassium reserves were at adequate levels so as to prevent any significant differences from being observed amongst fertilizer treatments. This study provided information for the extensive body of turf professionals who work with sand based systems. Depending on soil conditions, the magnitude of nutrient output can substantially influence fertilizer requirements. Nitrogen and potassium are readily leached in sandy soils (Turgeon, 1991), and for this reason these nutrients should be monitored either by tissue or soil testing. They must also be applied more frequently and at environmentally appropriate levels.

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Table 2. The effect of nitrogen and potassium fertility in sand based rootzones on perennial ryegrass color under trafficked conditions[1], Hancock Turfgrass Research Center, Michigan State University, 1994.

	9 Sept.	30 Sept.	21 Oct.	9 Nov.
Treatment				
Total N/M/K/M				
3/0	5.5	6.0	5.1	4.8
3/3	5.9	5.4	4.9	4.5
3/6	5.5	5.1	4.3	4.3
6/6	7.6	6.9	7.0	5.8
6/9	7.3	6.9	6.8	6.1
9/3	7.6	8.3	8.3	8.4
LSD at 0.05 level	0.6	0.9	0.6	0.9
Games simulated	4	18	34	42

[1]Color scale 1-9; 1=brown, 9=dark green and 5 acceptable.

Table 3. The effect of nitrogen and potassium fertility in sand based rootzones on perennial ryegrass quality under trafficked conditions[1], Hancock Turfgrass Research Center, Michigan State University, 1994.

Month	May	June	July	Aug.	Sept.	Oct.	Nov.
Treatment							
Total N/M/K/M							
3/0	4.3	4.9	5.8	7.4	5.3	4.4	3.9
3/3	4.5	5.5	5.9	7.0	5.3	5.1	4.9
3/6	4.6	5.3	6.1	7.1	5.0	4.8	4.4
6/6	5.8	7.1	7.1	7.8	6.6	6.5	5.9
6/9	5.8	7.0	7.1	7.8	6.5	6.4	6.3
9/3	7.4	8.5	8.1	8.4	7.9	6.9	6.6
LSD at 0.05 level	1.1	1.2	0.7	1.1	1.0	1.3	1.0
Games simulated ---	---	---	---	10	34	42	

[1]Quality rating 1-9; 1=bare ground, 9=ideal turf and 5 acceptable.

Table 4. The effect of nitrogen and potassium fertility in sand based rootzones on perennial ryegrass density under trafficked conditions, Hancock Turfgrass Research Center, Michigan State University, 1994.

	9 Sept.	30 Sept.	21 Oct.	9 Nov.
Treatment		%		
Total N/M/K/M				
3/0	83	54	46	34
3/3	87	56	54	36
3/6	85	46	54	33
6/6	92	71	78	58
6/9	92	69	80	62
9/3	97	85	88	74
LSD at 0.05 level	5	12	13	13
Games simulated	4	18	34	42

Table 5. The effect of nitrogen and potassium fertility in sand based rootzones on perennial ryegrass shear measures under trafficked conditions, Hancock Turfgrass Research Center, Michigan State University, 1994.

	9 Sept.	30 Sept.	21 Oct.	9 Nov.
Treatment		Nm		
Total N/M/K/M				
3/0	13.4	14.8	14.1	11.1
3/3	12.8	14.9	14.3	13.0
3/6	12.9	14.7	12.9	12.9
6/6	13.6	12.8	13.5	12.8
6/9	13.5	13.4	13.2	12.0
9/3	13.2	13.8	12.7	9.9
LSD at 0.05 level	NS	NS	NS	NS
Games simulated	4	18	34	4

Table 6: The effect of nitrogen and potassium fertility in sand based rootzones on perennial ryegrass tissue analysis, Hancock Turfgrass Research Center, Michigan State University, 1994.

Month	June				July			August			
Nutrient	B	Mn	Mo	K	Cu	Ca	Mo	Zn	Fe	Cu	Ca
						ppm					
Total N/M/K/M											
3/0	6.9	49.4	5.7	22281	13.1	6646	5.8	33.8	121	15.0	4815
3/3	5.3	45.4	5.2	23516	13.9	5692	5.1	34.3	100	16.5	4738
3/6	8.2	49.1	5.4	24042	14.5	5724	5.3	35.2	98	16.9	4427
6/6	5.4	33.6	4.7	24525	14.6	4981	4.4	44.6	101	18.6	4058
6/9	4.8	27.1	4.3	25128	14.2	4801	4.3	44.9	97	18.1	3760
9/3	4.9	28.6	5.3	27843	10.4	4241	4.3	36.4	133	14.1	5122
LSD at 0.05 level	2.3	17.6	0.8	2464	0.9	1019	0.9	4.2	23	1.6	582

*Significant at 0.05 alpha level.