A SYSTEM STUDY FOR SPORTS FIELDS: THE OTHER 295 DAYS

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"I've worked grounds maintenance for 15 years. It is rewarding, frustrating, and at times I've wondered why I've worked at it for so long. But on Friday night when the lights are on, the field is green, the lines are brilliantly white and straight, and the teams take the field, then you know why."

A Michigan Sports Field Manager

Introduction

Turfgrass research has been driven largely by the golf course industry for the last 50 years. Golf course research has revealed turfgrass principles and cultural practices as the common denominators in the turfgrass industry, including sports fields. However, it is at this juncture, they separate rapidly. When I was putting my thoughts together for this talk, I came across this quote. In what I have been pursuing (my Ph. D.), and answering the question from Dr. Rogers (What do you do in 70 days to get a sports field ready?), it made me realize that evaluating cultural practices in the scope of sports field management had to be judged on its own merits.

Typically, the task of a sports field manager is to build turfgrass density and health during the summer periods (a 70-day window or the "off-season") and then try to maintain conditions throughout the playing season (a 295-day window which includes the fall, a dormant winter and the spring seasons). The opportunity to rotate high traffic areas in golf is quite straight forward as compared to moving the 20 yard line of a football field in the middle of a season. Plus, golf is not played in cold, inclement weather (except for the hearty) while this is the norm for the sports turf in Michigan. The environmental factors make a significant difference in the ability of the turfgrass to recover from the damage in the cold weather. Foremost, the players running, turning, and grinding their feet into the turfgrass is unique to sports turf and a necessary parameter to consider.

Therefore, the effect of cultural practices can be different during sub-optimal conditions then during optimal conditions. Decision makers and sports field managers that have the information and techniques from sports turfgrass research will have a better understanding of the inputs needed and provide safer and more playable sports fields. In turn, this will provide source of community and civic pride because they have a game plan.

The objective of this research was to evaluate many factors all within one experiment for management of sports fields and to provide a "game plan" that can be followed which is a) cost-effective and b) provides the best surface for playing sports in Michigan at the grade and high school level.

Materials and Methods

In 2003, this study was conducted at the Hancock Turfgrass Research Center (HTRC) on the campus of Michigan State University in East Lansing, MI. Six management factors at two levels were implemented; grass mixtures, fertility, irrigation, re-seeding, core cultivation and crumb rubber (Table 1).

Table 1. Individual treatment factors for the study.

Factors	Low	High
A) Grass Mixtures	50% Per. ryegrass / 50% Ken. bluegrass 4 lbs. / 1000ft^2	50% Common Bermuda / 50% Supina 2 lbs. / 1000ft^2
B) Fertility	"Lean out" 2.0 lbs N/1000 ft^2/ year	"Pump up" 4.0 lbs N/1000 ft^2/year
C) Irrigation	None	Yes - 50% ET
D) Reseeding	None	Yes - 50% reduced rate
E) Core Cultivation	None	Yes - 2x/year
F) Crumb Rubber	None	Yes - 0.5"

N = Nitrogen, ET = evapotranspiration

The experiment was a fractional factorial design with six management systems or "game plans" within the plot area replicated three times (Table 2).

Table 2. Treatment descriptions, factors and systems for study.

	Systems					
Factors	1 (Control)	2	3	4	5	6
Grass Mixture	PR/KB	PR/KB	PR/KB	CB/S	CB/S	CB/S
Fertility	2# N/M/YR	4# N/M/YR	2# N/M/YR	2# N/M/YR	4# N/M/YR	2# N/M/YR
Irrigation	--	50% ET	50% ET	--	50% ET	--
Reseeding	2#/M - 2x/YR	2#/M - 2x/YR	--	1#/M - 2x/YR	--	--
Core Cultiv.	--	2x/YR	2x/YR	--	2x/YR	2x/YR
Crumb Rubber	--	--	0.5"	--	0.5"	0.5"

PR = perennial ryegrass, KB = Kentucky bluegrass, CB = Common bermudagrass, S = supina bluegrass, # = pounds, N = Nitrogen, M = 1000ft^2, ET = evapotranspiration

The soil profile was a Capac loam containing 61% sand, 23% silt and 16% clay (Fine-loamy, mixed mesic Aeric Ochraqualfs), and treatment areas measured 8.5 ft x 10 ft.

On 19 May, a Koro Field Topmaker (Pols International BV, The Netherlands) was used to remove the existing turfgrass stand. Once the plot was cleaned from the debris and re-graded, a Toro greens aerifier (Minneapolis, MN), with 0.5" tines was used to core cultivate the plot to ensure there was no hard pan formed from the blades of the Koro machine. On 23 May, the soil profile was sterilized with Basamid™ at 8 lbs. /1000ft^2.

On 3 June, re-entry was allowed and the surface of the soil was scratched up with hand rakes before seeding began. The mixtures were seeded to their appropriate treatments, and a starter fertilizer (13-25-12) was applied at 1 lb. P/1000ft^2. Germination blankets (A.M. Leonard, Piqua, OH) were placed over the top of the plot and removed 16 June.

The re-establishment phase took place from 3 June to 10 Aug 2003. On 3 June, irrigation was applied daily. From 26 June to 8 July, a Honda rotary mower (Alpharetta, GA) was used to minimize rutting of the surface. On 9 July an eXmark® mower (eXmark® Corporation, Beatrice, NE) was used for the duration of the experiment and no matter the mower, the turf was mowed twice per week at a mowing height of 2 inches. Clippings were returned at all times except from 20 April to 5 May 2004 in order to control *Poa supina* seedheads being spread throughout the plot. Lesco® 18-3-18 fertilizer, at 0.5 lbs. N/1000ft^2, was applied throughout the study.

Evapotranspiration rates were determined by the weather station at the Hancock Turfgrass Research Center, on the campus of Michigan State University in East Lansing, MI. The rate was divided in half and the appropriate water amounts were applied with a hose and a predetermined nozzle setting. The appropriate plots did not go more than five days without water.

On 15 November 2003 and 3 June 2004, appropriate treatments were re-seeded at 50% the original seeding rate, and core cultivated but did not necessarily receive both factors. Seed was sprinkled across the whole plot and dragged in. A Toro Greens Aerfiier (Minneapolis, MN), using 0.5" tines, was used, and cores were dragged back in. The appropriate plots were core cultivated once in fall 2003 and twice in spring 2004.

Crumb rubber (¼" particle size) was applied on 14 July and 27 July 2003 in ¼" applications for a total of 0.5" topdressed to the appropriate plots. At each application, 53 lbs. was sprinkled evenly across the surface and raked in four directions to spread as even as possible. Throughout the re-establishment process, there were no alterations in the original irrigation scheduling. With some crumb rubber at the surface, no "burning out" was noticed at any time.

A traffic regime was initiated on 11 August to 24 October 2003, 31 March to 28 May 2004 and 16 August to 11 November 2004. At total of 338 passes were applied with the Brinkman Traffic Simulator (BTS) with 112 passes completed by 24 October 2003, 192 passes completed by 28 May 2004 and 146 passes completed by 11 November 2004. The BTS was pulled using a John Deere 5200 tractor (Moline, IL) and weighed approximately 1260 lbs. (with water). Two passes simulated the traffic received between the 40 yard lines and inside the hashmarks for one National Football League game (Cockerham, 1989). On 14 September 2004 and for the duration of the experiment, traffic alternated direction every other day and changed on a 90° due to bumps in the surface.

Turfgrass cover ratings, plant counts, soil moisture, shear resistance and surface hardness values were measured and taken in the traffic areas. Cover ratings were estimated visually. Plant counts were obtained using a soil probe with 1.25 inches in diameter. Three counts were recorded for each plot. Time Domain Reflectometry (TDR) values were measured with a Trime FM gauge and FM3 probe with 2 inch rods (Mesa Systems Co. Medfield, MA). One TDR measurement was recorded throughout the treatment area. Shear resistance values were measured by the Eijkelkamp shear vane Type 1B (Eijkelkamp Agrisearch Equipment BV, The Netherlands). Three measurements were recorded throughout the treatment area and were measured in Nm. The Clegg Impact Soil Tester (CIT) (Lafayette Instrument Co., Lafayette, IN) was used to measure peak deceleration (G_{max}) values. A 5 lb. hammer was dropped in three random locations per plot from a height of 18 inches.

Data were analyzed using Statistical Analysis System (SAS) for ANOVA. Treatment means were separated using Fisher's Protected LSD values, and calculated when the *F* ratio was significant at the 0.05 level.

Results and Discussion

Peak deceleration values are listed in Table 3. All data were significant except on 11 November 2003. Highest values were observed on 11 September 2003 and 16 April and 6 September 2004. A consistent pattern emerges with Systems 3 and 5 being significantly lower, and Systems 1 and 4 being significantly the higher versus the other treatments throughout the study. Even on 21 November 2004, after 100 more passes have been applied by the BTS, this pattern remains the same except for System 1 being significantly higher versus the other treatments.

Table 3. Effects of management systems on peak deceleration values.

System	2003			2004					
	G_{max}								
	5-Aug	11-Sep	11-Nov	29-Mar	16-Apr	28-May	9-Aug	6-Sep	21-Nov
1	77 ab	218 a	84	57 ab	146 a	81 a	165 a	139 a	94 a
2	89 a	144 b	81	44 b	148 a	67 b	125 b	116 b	84 b
3	53 b	101 c	71	48 b	108 b	72 b	95 b	96 c	72 c
4	75 ab	204 a	81	61 a	138 a	81 a	159 ab	131 a	87 ab
5	66 b	96 c	77	49 b	100 b	65 b	114 b	95 c	71 c
6	61 b	128 b	81	50 b	112 b	73 ab	118 b	106 bc	77 bc
No. of Passes	0	56	112	0	24	80	0	46	146
Accum. Passes	0	56	112	112	136	192	192	238	338

Shear resistance values are listed in Table 4. All data were significant except on 11 November 2003 and 29 March and 16 April 2004. On 5 August 2003, before traffic was applied, Systems 3, 5 and 6 are significantly lower versus the other treatments, and this is due to some of the crumb rubber being at the surface and had not settled to the soil/turfgrass interface. As the traffic progresses, Systems 2, 3 and 5 emerge as the stronger surfaces on 21 November 2004. However, System 2 was erratic and slowly decreased as the season progressed in 2004, and Systems 3 and 5 were most consistent throughout the experiment with System 5 being significantly higher versus the other treatments. All three systems did have supplemental irrigation and core cultivation applied however there were differences in fertility, reseeding and crumb rubber. Systems 1 and 4 were significantly lower versus the other treatments at the end of the experiment.

Table 4. Effects of management systems on shear resistance values.

System	2003			2004					
	Nm								
	5-Aug	11-Sep	11-Nov	29-Mar	16-Apr	28-May	9-Aug	6-Sep	21-Nov
1	18 a	13 b	19	17	7	20 b	19 ab	12 b	0 c
2	20 a	20 a	18	15	2	23 a	22 a	22 a	14 ab
3	13 b	11 bc	17	15	8	15 c	12 c	12 b	12 ab
4	22 a	13 bc	19	18	2	16 c	19 ab	11 b	0 c
5	13 b	9 c	13	14	7	19 b	17 b	18 a	17 a
6	12 b	6 d	13	14	2	15 c	12 c	11 b	8 b
No. of Passes	0	56	112	0	24	80	0	46	146
Accum. Passes	0	56	112	112	136	192	192	238	338

Conclusions

Although data analysis is still on-going, general conclusions have surfaced:

System 3 and 5 performed the best in terms of surface hardness, shearing resistance and turfgrass cover (data not shown). Higher inputs were used for both systems, compared to the other systems, however, a different mixture and fertility rates were implemented.

Systems 1 and 4 performed the worst in terms of surface hardnes, shearing resistance and turfgrass cover (data not shown) regardless of species mixture. Lower inputs were used for both systems, compared to the other systems.

Topdressing crumb rubber provides a more consistent and stable surface regardless if the playing surface is too hard or too dry. This is an important concept for administrators to evaluate especially with minimal inputs and the safety of the children using these sports fields.

This report is not done! Future reports will also take into consideration the costs of each system and a 5-year game plan to implement them. Decision makers and sports field managers will have a game plan that can be followed that will get results both in the short term (a 70-day management plan)and the long term (295 day management plan). Michigan sports fields will improve!