Effect of soil moisture content and various traffic intensities on the performance of Kentucky bluegrass.

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Objectives

To determine the effect that different traffic schedules have on Kentucky bluegrass (*Poa pratensis*) performance. Specifically, we were interested in determining if the same amount of traffic caused more injury if it was applied all-at-once (one day per week) or spread out over time (a little each day).

And also, to study the interaction between traffic intensity and soil moisture for Kentucky bluegrass.

Methods

Two independent trials were conducted at the Horticulture Research Farm in Ames, Iowa during summer and fall of 2001 and 2002. Six different traffic regimes were applied to Kentucky Bluegrass (Table 1 and 2) with a GA-SWC Traffic simulator (Carrow et al., 2001). The experimental design was a randomized complete block with 7 treatments and 3 replications. Each small plot was 2 ft x 12 ft. Traffic simulation started on August 1 and ended on November 7 in 2001 and from July 29 to November 1 in 2002.

Table 1. Traffic schedule followed on Kentucky bluegrass during summer and fall 2001.

Number of passes/week	Number of passes per day				
	Monday	Tuesday	Wednesday	Thursday	Friday
5 dispersed	1	1	1	1	1
10 dispersed	2	2	2	2	2
15 dispersed	3	3	3	3	3
5 concentrated	0	0	0	0	5
10 concentrated	0	0	0	0	10
15 concentrated	0	0	0	0	15
Control	0	0	0	0	0

Based on the observations of the first year, a second split level (soil moisture) was added in 2002. The split factor was achieved by splitting the area to be trafficked in 2 sections and by adding water to one section 20 minutes before traffic initiated (wet). The other section received water after traffic was finished (dry). The total amount of water applied was equal for both sections.

Table 2. Traffic schedule followed on Kentucky bluegrass during summer and fall 2002.

Number of passes/week	Number of passes per day				
	Monday	Tuesday	Wednesday	Thursday	Friday
6 dispersed	2	0	2	0	2
12 dispersed	4	0	4	0	4
18 dispersed	6	0	6	0	6
6 concentrated	0	0	0	0	6
12 concentrated	0	0	0	0	12
18 concentrated	0	0	0	0	18
Control	0	0	0	0	0

During 2001, rain sometimes made it too wet to operate the traffic simulator and it was impossible to strictly keep the traffic application schedule. Traffic that was not applied as scheduled was transferred to the next available day. In 2002, the entire study area was tarped during rain events to further control moisture during traffic. Percent turf cover was visually rated during the traffic period.

Results

Traffic intensity and periodicity influenced the performance of Kentucky bluegrass (Table 3). In both 2001 and 2002, the lowest turf cover was observed at the highest traffic intensity (15 passes/ week) applied on a dispersed scheduled (Table 3 and 4).

Table 3. Turf coverage of Kentucky bluegrass observed under various traffic scenarios during fall 2001.

Intensity pass/wk	Periodicity	Under traffic						Recovery	
		7-Aug	28-Aug	11-Sep	24-Sep	8-Oct	21-Nov	20-Jun	7-Aug
		Turf cover (%)							
0	~	100	100	100	100	100	100	100	100
5	c	100	98	96	97	95	95	100	100
5	d	100	93	93	95	96	92	97	99
10	c	95	93	88	77	85	85	96	96
10	d	92	73	73	75	83	63	85	93
15	c	88	63	62	50	50	55	78	80
15	d	87	57	52	63	57	35	67	80

c= all traffic concentrated one day of the week; d= traffic dispersed over the week

It seems that dispersing the traffic over the week does not allow the grass to recover before the following traffic event. This interaction only seems to be important at high traffic levels. Low traffic intensities do not show important differences between concentrated or dispersed traffic.

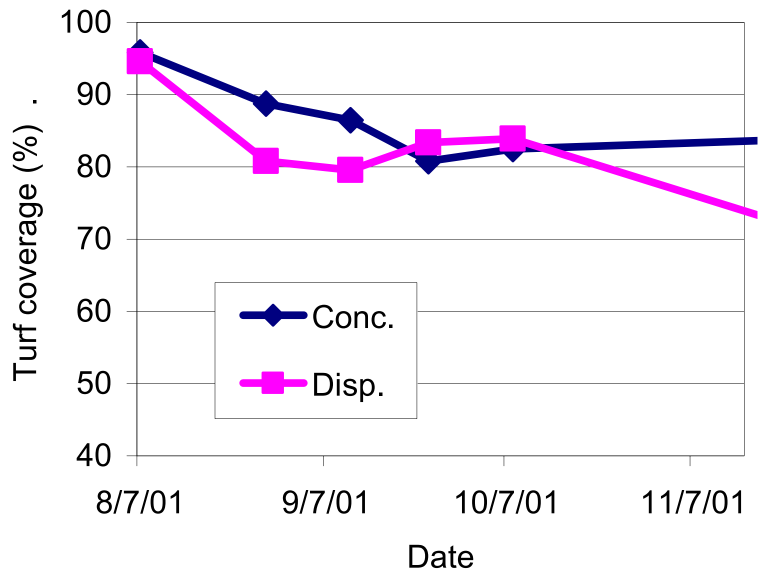
Table 4. Turf coverage of Kentucky bluegrass observed under various traffic scenarios during fall 2002.

Passes/wk	Periodicity	Condition	Under traffic			
			7-Aug	10-Sep	28-Oct	12-Nov
			Turf cover (%)			
0	~	dry	100.0	100.0	100.0	100.0
0	~	wet	100.0	100.0	100.0	100.0
6	c	dry	99.3	97.7	95.0	98.3
6	c	wet	99.0	96.7	93.3	97.7
12	c	dry	96.3	93.7	90.0	88.3
12	c	wet	95.7	91.0	81.7	86.7
18	c	dry	83.3	78.3	75.0	45.7
18	c	wet	83.3	73.3	50.0	20.0
6	d	dry	100.0	98.7	95.0	98.7
6	d	wet	100.0	98.0	95.0	98.0
12	d	dry	95.3	94.0	91.7	83.0
12	d	wet	97.3	93.7	86.7	55.0
18	d	dry	91.7	88.3	81.7	30.7
18	d	wet	88.3	76.7	50.0	5.7

c= all traffic concentrated one day of the week; d= traffic dispersed over the week.

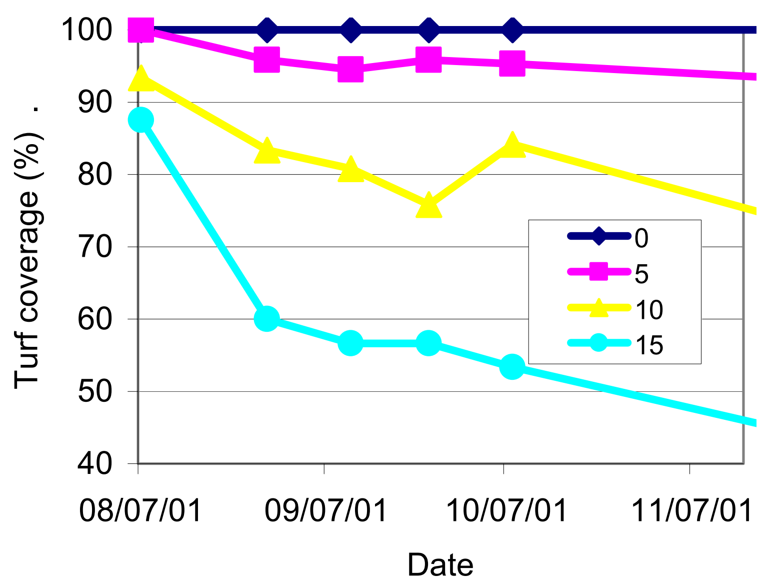
Data of 2001 was averaged over traffic intensities to observe differences due to traffic periodicity (Figure 1). During the first month of treatment, dispersed traffic caused more turf injury than concentrated traffic; later in the fall there was no difference. As indicated in the methods, rain caused irregularities in the traffic schedule that may have influenced the results. For example, if it rained on Wednesday evening then the 15 passes treatment would have received 15 passes on Friday all under wet conditions. However, the 15 passes dispersed treatment would have received 5 passes on Monday and 5 passes on Wednesday under dry conditions with only 5 passes on Friday under wet conditions. Turf trafficked under wetter conditions was expected to be injured more. Therefore, in the example above, greater turf injury associated with concentrated traffic may have actually been influenced by the wet conditions. The converse was true if it rained on Sunday. A Sunday rain resulted in wetter traffic conditions for the Monday and Wednesday dispersed traffic. By Friday, the plot area had dried out and the Friday concentrated traffic would be applied under drier conditions. In 2002, the study area was tarped to prevent rain from entering the study area and irrigation was controlled to provide wet and dry treatments.

Figure 1. Kentucky bluegrass turf cover based on traffic periodicity during fall 2001.



Results were also averaged over periodicity to show differences only due to traffic intensity (Figure 2). By the end of the traffic period, the highest traffic intensity reduced turf cover to less than half of the total area. Also, it was noted that there were larger relative differences between 10 and 15 passes per week than from 5 to 10. The same was observed when comparing changes from 0 to 5 and from 5 to 10 passes weekly. This indicates that the decrease in turf cover may follow an exponential curve instead of a simple accumulative trend. Turf may be able to tolerate or even recover rapidly form lower levels of traffic; however, traffic beyond a threshold level degrades recovery potential because crowns and rhizomes are destroyed when soil is exposed. From a practical standpoint, it is important that those who schedule athletic events understand and stay below the threshold traffic limit for a given field or suffer irreversible traffic injury.

Figure 2. Turf coverage of Kentucky bluegrass observed as result of traffic intensity (0,5,10,15 passes/wk with traffic simulator) during fall 2001.



For 2002, data was averaged over soil moisture and periodicity to show results affected to intensity (Figure 3). Results of the second trial were very similar to the first year. Large visible differences were observed between treatments 12 and 18. Also, the larger decrease of turf cover seems to occur towards the end of fall, after the middle of October.

Figure 3. Turf coverage of Kentucky bluegrass observed as result of traffic intensity (number of passes with the simulator) during fall 2002.

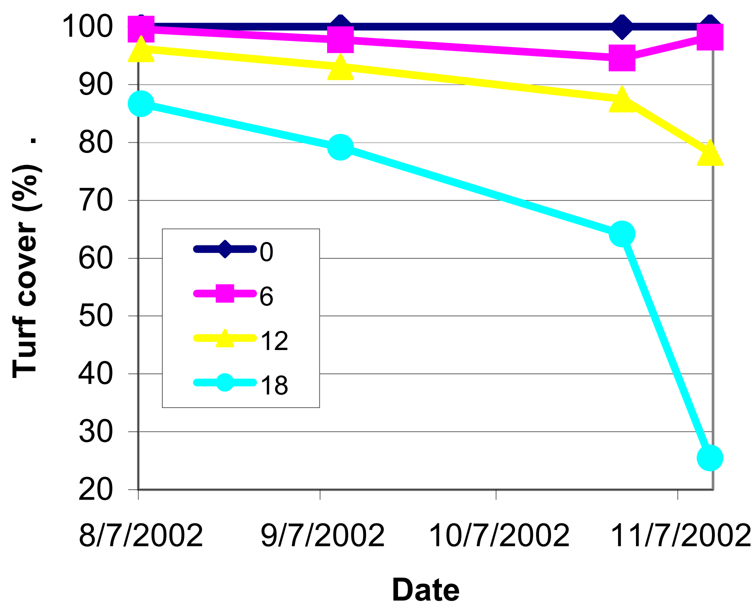


Figure 4. Turf coverage of Kentucky bluegrass as result of traffic periodicity during fall 2002.

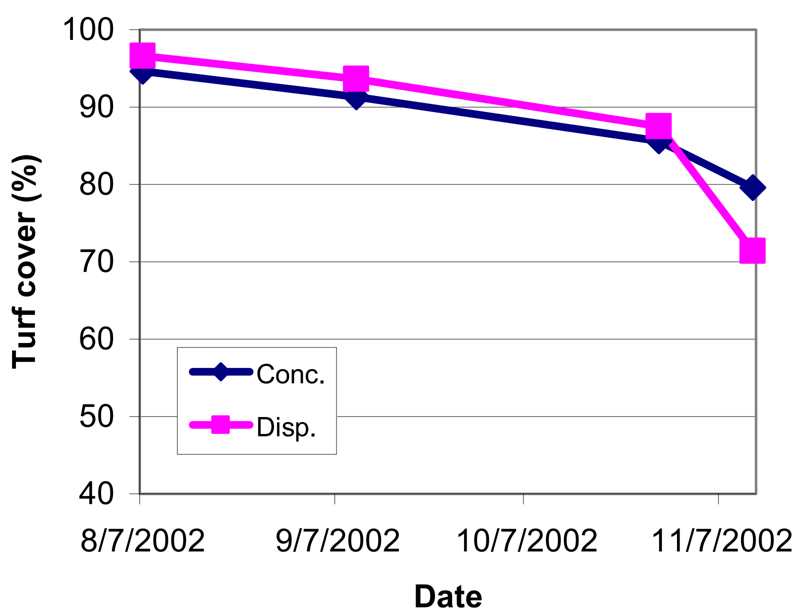
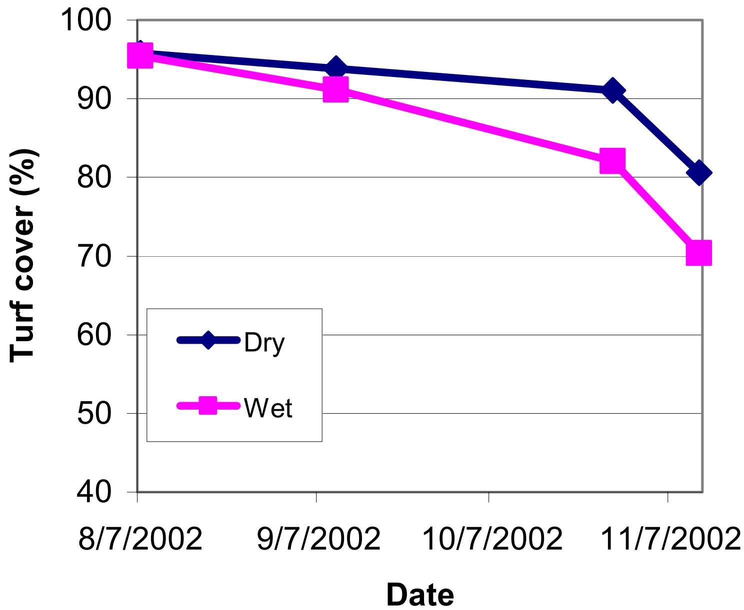


Figure 4 shows the effect of traffic periodicity; data was averaged over traffic intensity and soil conditions. Figure 5 shows the results due to soil moisture only. No clear differences were observed in terms of periodicity when all information has been averaged. However, isolated cases, especially at high intensities, indicated a disadvantage of dispersing traffic over time.

Figure 5. Turf coverage of Kentucky bluegrass as affected by soil moisture conditions during fall 2002.



Soil moisture differences affected turf cover. Even at low rates of traffic, wet soil conditions showed the greater turf injury and less turf cover. Differences were even greater at higher traffic intensities.

Conclusions

Turf cover decreased with increasing traffic.

Wet conditions caused more turf injury and less turf cover relative to dry conditions.

Concentrated traffic (all in one day) followed by a recovery period (6 days) had less turf injury and more turf cover than the same amount of traffic applied as dispersed (traffic every other day).

From a practical stand point it is important that those who schedule athletic events understand and stay below the threshold traffic limit for a given field or suffer irreversible traffic injury.

Literature cited

Carrow, R.N. , R.R. Duncan, J.E. Worley and R.C. Shearman. 2001 Turfgrass traffic (soil compaction plus wear) simulator response of Paspalum vaginatum and Cynodon spp. P. 253-258. *In* K .Carey (ed.) Int. Turf Soc. Research J. vol. 9.