집중적 답압 피해에서의 잔디회복을 위한 강제 흡·호기 순환식 설비의 효과

주영규 · 손진수 · 김인철 · 심규열[1] · D.D. Minner[2]

연세대학교 생물자원공학과, [1]한국잔디연구소, [2]Dept. of Horticulture, Iowa State University

Effects of a Forced Air-Flow (Soil-Air™) System for Recovery of Turfgrass after Intensive Traffic Injury

Y. K. Joo · J. S. Son · I. C. Kim · K. Y. Shim[1] · D. D. Minner[2]

Dept. of Biological Resources & Tech., Yonsei University, Korea

[1]Korean Turfgrass Research Institute, Korea

[2]Dept. of Horticulture, Iowa State University

INTRODUCTION

Korea and Japan will host the World Cup Soccer Game in 2002. Ten stadiums have been built and more than 30 soccer grounds for practice have been renovated in Korea. Sport fields in both countries have problems on cool-season turfgrass growth and quality by summer decline during humid and warm climate especially followed by intensive uses. We measured the effects of Soil-Air™ system, which is designed to optimize root-zone soil gas and moisture levels to promote the growth and maintenance turfgrass. This system has been designed to connect to USGA style drainage system with vacuum or compression functions. This experiment was carried out to verify the effects of the system on soil gas exchange (aerifying), drain, and temperature control ability in turfgrass root-zone. The effects of the system on turfgrass recovery were also detected after intensive uses with heavy traffic treatments.

MATERIALS AND METHODS

Experiment plot was established in 1998 with 1/10 of actual size ($960m^2$) of soccer field to meet the particle size distribution and construction of the USGA specifications (USGA Green Section Staff. 1998). The plot was divided into a Soil-Air^{TM} operated and non-operated check plot. Four turfgrass species (Kentucky bluegrass 85%+Perennial ryegrass 15%, KBG 15%+PR 85%, 'Zenith' *Zoysia, Zoysia japonica*) were sodded from nursery, which had the same soil properties as the research plot. The traffic treatments, which were simulated to actual soccer game, were applied five different levels (check, 1 or 2 games in every day, and 1 or 2 games in 2.5 days) for 20 days during July to August of 1999. The traffic roller had clits with the same material and distance of soccer shoe. The effects of the Soil-Air^{TM} on soil moisture content, soil temperature (10 cm depth in ground), gas exchange (O_2, CO_2), surface resilience, and turf recovery (root mass weight, turf quality) were measured during and the end of the experiment.

RESULTS AND CONCLUSIONS

The application of the Forced Air-Flow (Soil-Air^{TM}) system showed significant effects on recovery of turfgrass after intensive traffic injury during humid and warm summer climate of 1999 in Korea. The summary of the research findings were as followings:

- Increased traffic resulted in the accumulation of CO_2 in the root zone dramatically, which may have caused stress to the grass root system (Gill and Miller, 1956; Tan, 1994) (Table 1).

Table 1. Soil gas content after 2 hrs of Soil-Air^{TM} operation. (14:00 August 5, 1999)

Treatment		GAS (%)											
		O_2					LSD	CO_2					LSD
		Control	1game/2.5day	2game/2.5day	1game/1day	2game/1day		Control	1game/2.5day	2game/2.5day	1game/1day	2game/1day	
SOIL AIR	KBG	20.90a A	20.90a A	20.90a A	20.90a A	20.90a A	NS	0.00c A	0.00c A	0.00c A	0.00c A	0.00c A	NS
	ZENITH	20.90a A	20.90a A	20.90a A	20.90a A	20.90a A	NS	0.01c A	0.00c A	0.04c A	0.00b A	0.00c A	NS
NO SOIL AIR	KBG	19.93b A	18.87a A	18.30b B	18.23b B	16.23c B	1.58	0.77b C	1.23b B	1.47b B	1.81a B	3.01a A	0.98
	ZENITH	18.27c A	14.57b A	13.07c A	17.60b A	18.53b A	NS	1.47a A	2.29a A	2.73a A	1.27a A	1.31b A	NS
LSD		0.43	4.00	2.55	1.52	0.46		0.36	1.04	0.73	0.78	0.39	

Capital letters and small letters mean LSD grouping for column and row, respectively.

- Within 1 or 2 hours of operation of the system, root zone soil gas (CO_2, O_2) levels returned to natural atmospheric levels completely (Table 1).
- Soil CO_2 levels began to decrease within the first 10 min of operation of the system. The levels were reduced from 1.3 to 0.06% after 30 min, and natural atmospheric levels within 1 hr. When the system was turned off, CO_2 levels increased to 0.36% and 0.7% after 5 and 20 hr, respectively (Fig. 1).
- The system operation during heavy precipitation (40 mm/hr for 3 hr) resulted in significant decrease root zone moisture content levels.
- The application of the system did not affect the resilience of turf surface after traffic treatments. Higher traffic treatment resulted in lower surface resilience especially in Zoysiagrass plots.

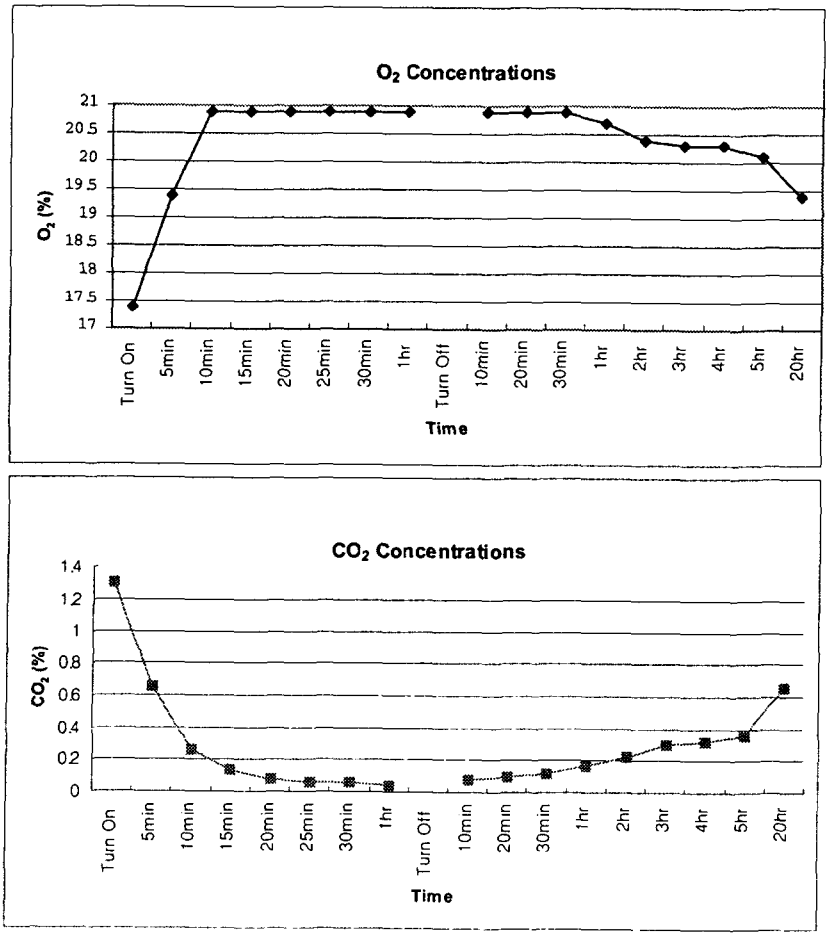

Fig. 1. Effect Soil-Air^{TM} operation on changes of O_2 and CO_2 concentration in turf root zone (10 cm in depth).

Table 2. Effect of turfgrass recovery on root weight with or without Soil-Air™ operation. (Measured at September 2, 1999)

Treatment		Root dry wt. (g) / 86.6 cm^2 × depth 20 cm					LSD
		Control	2.5d*1game	2.5d*2game	1d*1game	1d*2game	
SOIL-AIR	KBG	7.56a A	6.21a B	4.95a C	4.23a C	4.08a C	1.88
	ZENITH	2.69c A	3.62b A	3.03b A	3.47a A	3.29a A	NS
NO SOIL-AIR	KBG	4.39b A	5.10ab A	4.47ab A	3.68a A	3.86a A	NS
	ZENITH	3.27c A	2.98b A	3.50ab A	3.62a A	3.06a A	NS
LSD		1.09	2.28	NS	NS	NS	

Data were collected at 4 weeks later after 20 days of traffic treatment.

- Operation of the system had a significant beneficial impact on turf recovery by increased root dry wt and improved turf quality, as compared with the non-operated check plots (Table 2).
- The system did not have a significant impact on surface or root zone temperatures when operated in the vacuum mode for 2 hr during a period of high humidity and high ambient temperature. More research is required including operation of the Soil-Air™ system in both the vacuum and pressure modes at various times during the day and night.

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