Rubber Tire Particles as a Topdressing Amendment for Intensely Trafficked Grass - 1996 Data

Jeffrey J. Salmond and David D. Minner

The U.S. discards about 250 million tires a year. The rubber tire recycling industry produces several grades, sizes, and shapes of processed rubber. All recycled rubber is not the same. Suitable materials for athletic field use must be free of all metal fibers and slivers, and must be of a size that is compatible with hollow coring and can easily filter into the turf canopy. Some rubber particles may contain nylon strands from "cord reinforced tires". It is doubtful that the nylon will limit plant growth, however the effect of the nylon on water retention and plant growth is not known. To ensure a consistent rubber product only a trace of nylon should be present.

There are two distinct sources for rubber at this time. One is crumb rubber that comes from chipping whole tires, and the other is rubber buffings that come from the retread industry when tire treads are ground before recapping. Processing and distribution of crumb rubber is more advanced at this time and commercial rubber materials are available in the 1/4-inch and 2-mm (.08 in) size. The "coarse crumb" and "medium crumb" materials used in this study are from the tire chipping and screening process (Table 1). There has been very little effort in commercially producing screened rubber buffings for turf use. Consequently, this product is usually given away for the price of shipping. "Buffings" are shreds of rubber that are ground directly from the intact tire before it is recapped with a new tread. Buffings have no metal or nylon cord since only the rubber tread is recycled. The particles range in size from 2 inches to 0.25 mm (about the size of medium sand). Smaller particles are rounded but many are shreds that have a length to width aspect ratio of approximately 7:1. Two buffing products have been screened for use in this study (Table 1).

A study was initiated in May, 1995 at the Iowa State University Horticulture Research Station, north of Ames, Iowa to evaluate various sizes of "crumb" and "buffing" rubber for use as a topdressing material on high-traffic grass areas. The purpose of this study was to determine the maximum amount of rubber that can be applied without causing reduced grass performance. On 6 May 1995 a mature stand of 'Midnight' Kentucky bluegrass, growing on a Nicolett (fine-loamy, mixed, mesic Aquic Hapludoll) soil, was mowed at a 1/2-inch height to remove most of the grass blades and then solid tine cored on 3-inch centers with 1/2-inch tines. A 3/4-inch or larger hollow-tine would provide better incorporation of the crumb and buffings rubber. All topdressing materials were hand spread and raked into the plots that consisted of grass stubble and core holes. The sand topdressing and the non-treated control plots also received the same preparation of mowing and coring.

The study was arranged in a randomized complete block design with three replications. Individual plots were 4 ft by 6 ft. The plots were topdressed with nine treatments and a control (Table 2). Each of the rubber treatments were topdressed to a particular depth of 0.38 and 0.75 inches. A proposed higher rate, 1.0 inch, could not be reached at the initiation of the study.

Traffic simulation was performed with a Brouwer machine having two rollers. Each roller consisted of having 1/2" football cleats surrounding it. Traffic was done on one-foot centers across the plots. Compaction treatments were performed for a short time in June with a Brouwer smooth roller filled with water to a weight of 900 pounds. Traffic and compaction treatments were performed on Monday, Wednesday, and Friday during the traffic period. Traffic started in April and ended in June, to simulate spring athletic activity. The turfgrass was allowed to recover during a no-traffic period in the summer. Traffic continued in September and October to simulate fall sports.

Ratings were taken on the basis of five parameters. Turf quality, density and color were visually rated on a 10 to 1 scale: 6 = lowest acceptable value for a specific parameter, 10 = the best appearance and 1 = the least desirable appearance (Table 2). Traffic tolerance was assessed by visually estimating percent turf cover and quality. Turf quality is often the simultaneous perception of turf color, texture, and density. Turf color ranged from 10 = dark green to 1 = yellow or brown. Turf texture was not considered as a component of turf quality in this study. Turf density and retention of a

vegetative mat or thatch were given more consideration when rating turf quality on treatments receiving traffic in this study. Turf density was a visual estimate of plants per unit area.

Percent living turfgrass cover and percent of soil, sand, or rubber topdressing showing were evaluated for the area of plot (Table 3). Percent living turfgrass cover is probably the most important parameter in terms of evaluating the detrimental effects of traffic on athletic turf. Following traffic treatments, turf begins to decline and the underlying materials, bare soil, sand, or rubber, become visible. The percent cover values estimate how much grass, bare soil, sand, or rubber is visible on the surface. Treatments with a high percentage of turf cover and low percentage of sand or rubber topdressing showing are more desirable.

Surface hardness was evaluated during the traffic and recovery periods (Table 4). The g-max was recorded using 0.5 kg and 2.25 kg drop hammers. The values were stored with the BrÅel and Kjër 2515 Vibration Analyzer and later relayed to a compatible computer. Higher g-max values indicate a harder, less resilient surface.

The Statistical Analysis System version 6.06 (SAS Institute, 1989) and Analysis of Variance (ANOVA) were used to analyze the data. Least Significant Difference (LSD) means comparisons were made to test between treatment effects on visual quality, density, color, percent turf cover, and percent topdressing showing (Tables 2 and 3). LSD means comparisons were also made to test between treatments effects on surface hardness (g-max) (Table 4).

One of the interesting effects from rubber occurred on frozen ground (Table 4). During the winter period, sand treatments show a higher g-max with 0.5 and 2.25 kg hammers. Frozen conditions on 22 January 1997 caused a harder surface for the control compared to rubber topdressed turf (high rates of coarse crumb, medium buffing, and coarse buffing and low rates of medium crumb or buffing using the 0.5 kg hammer). With the 2.25 kg hammer, the sand and soil control was significantly harder compared to the high rates of coarse crumb and coarse buffing. Preliminary results display that the higher rate of rubber, 0.75 inches, provides the best overall effects as compared to the lower rates of rubber, sand and the soil control.

Table 1. Particle size analysis for sand, crumb rubber, and buffings rubber used as topdressing.

Size	Sieve Mesh	Diameter mm	Sand	Coarse Crumb	Medium Crumb	Medium Buffing	Course Buffing
Gravel	1/4 in	6.3	0.0	0.0	0.0	0.0	0.0
Fine Gravel	10	2.0	0.4	85.0	23.7	4.5	13.9
Very Coarse	18	1.0	1.5	13.4	56.6	50.6	79.9
Coarse	35	0.5	17.2	0.5	9.1	35.1	6.1
Medium	60	0.25	55.7	0.4	7.1	7.7	0.1
Fine	100	0.15	19.1	0.1	2.4	1.6	0.0
Very Fine	<100	<0.15	4.2	0.1	1.0	0.3	0.1

Table 2. Turf quality[1], density[2], and color[3] evaluated on 'Midnight' Kentucky bluegrass after periods of traffic and recovery.

	Treatment	Rate	After spring traffic			After summer recovery			After fall traffic		
			June 21, 1996			August 14, 1996			November 8, 1996		
		(in)	quality	density	color	quality	density	color	quality	density	color
1.	Coarse crumb	0.38	6.0	5.3	6.3	4.7	5.0	5.7	3.7	3.0	6.0
2.	Coarse crumb	0.75	6.7	6.3	7.3	6.7	6.0	6.3	5.0	5.0	7.3
3.	Medium crumb	0.38	5.7	5.7	6.7	5.7	5.0	5.7	4.3	3.3	6.7
4.	Medium crumb	0.75	7.7	6.7	7.0	6.7	6.3	6.3	6.3	6.3	6.7
5.	Medium buffing	0.38	7.0	7.0	6.3	6.7	6.3	6.7	6.0	6.0	7.0
6.	Medium buffing	0.75	8.0	7.0	7.7	8.3	7.7	7.7	8.0	7.7	7.7
7.	Coarse buffing	0.38	6.0	6.0	6.7	5.7	5.7	7.0	4.7	4.7	7.3
8.	Coarse buffing	0.75	7.7	6.7	7.3	8.0	7.3	7.7	6.3	6.7	7.3
9.	Sand	0.75	7.0	7.0	7.0	7.3	7.0	6.7	6.0	6.0	7.7
10.	Control	--	5.7	5.3	6.3	4.0	3.3	6.3	3.7	3.0	6.3
	$LSD_{(0.05)}$		1.0	NS	NS	2.3	1.8	1.7	2.5	2.6	NS

[1]Grass quality was rated on a 10 to 1 scale: 6 = lowest acceptable quality, 10 = best quality.
[2]Grass density was rated on a 10 to 1 scale: 6 = lowest acceptable density, 10 = highest density.
[3]Grass color was rated on a 10 to 1 scale: 10 = dark green, 6 = lowest acceptable color, 1 = yellow or brown.
NS = not significantly different at the 0.05 level.

Table 3. Percent turf cover[1] and percent soil, sand, or rubber topdressing showing[2] evaluated on 'Midnight' Kentucky bluegrass after periods of traffic and recovery .

	Treatment	Rate	After spring traffic		After summer recovery		After fall traffic	
			June 21, 1996		August 14, 1996		November 8, 1996	
		(in)	turf cover	topdress	turf cover	topdress	turf cover	topdress
1.	Coarse crumb	0.38	70.0	15.0	60.0	7.3	51.7	43.3
2.	Coarse crumb	0.75	81.7	36.7	80.0	10.0	66.7	35.0
3.	Medium crumb	0.38	70.0	5.0	70.0	4.0	65.0	20.7
4.	Medium crumb	0.75	81.7	11.7	88.3	6.7	86.7	8.3
5.	Medium buffing	0.38	78.3	4.0	88.0	1.7	86.7	5.7
6.	Medium buffing	0.75	88.3	6.0	97.7	2.3	91.7	5.7
7.	Coarse buffing	0.38	71.7	11.7	75.0	5.0	75.0	20.0
8.	Coarse buffing	0.75	83.3	25.3	93.0	6.7	86.7	15.0
9.	Sand	0.75	80.0	5.0	93.0	1.7	80.0	15.0
10.	Control	--	56.7	0	48.3	0	51.7	0
	$LSD_{(0.05)}$		12.3	15.6	21.5	NS	27.0	21.0

[1]Percent turfgrass cover of plot area.
[2]Percent of plot area showing soil, sand, or rubber topdressing.
NS = not significantly different at the 0.05 level.