CORE CULTIVATION AS A TOOL TO INCORPORATE CRUMB RUBBER INTO HIGH TRAFFICKED TURF

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INTRODUCTION

From research conducted 1990-1992 at Michigan State University, crumb rubber tilled into the soil profile has proven its potential in reducing compaction and decreasing surface hardness. The next question is how to incorporate this product more efficiently into the soil profile, ie. without removing an area from use. As a reminder, the initial experiments had crumb rubber tilled into the soil profile at 3 or 6 inches. To initiate this process, the turf had to be stripped and then resodded or the area reseeded. This process can be timely and expensive, not to mention at least a three month quarantine for **proper** root development. In response to the needs for crumb rubber incorporation with minimum surface disruption, two core cultivation experiments were commenced in Summer 1993. The first site was established at the Michigan State Marching Band practice field(MBpf) and the second, at the Hancock Turfgrass Research Center(HTRC). Our objectives in these studies were to focus on traffic tolerance and crumb rubber particle size. We knew we could control the amount of traffic at the HTRC with the Brinkmam Traffic Simulator(BTS). However, at the MBpf we could not control the amount of traffic or when we could apply the traffic. Therefore, the MBpf was providing a gauge for us to make evaluations when we had no control over this variable versus the timely and extensive traffic applied by the BTS. Additionally, we wanted to evaluate crumb rubber particle size. For core cultivation to be effective as a means for rubber incorporation the rubber must start off at the surface and be able to move at least through the mat layer and hopefully into the soil profile. Therefore, two different particle sizes were being tested: a large 6mm diameter (0.25") size and a blend of smaller particle sizes, 10/20 (2.0"-.05") mesh size. Because of the intense wear applied in both traffic scenarios, it was hoped that the rubber should move down into the soil profile because of the constant pounding received by the surface.

MATERIALS & METHODS

For both experiment areas, a 2x6 randomized complete block design was employed with three replications. Crumb rubber (6mm and 10/20 mesh) was introduced into the turf/soil system via core cultivation at 20% volume for six treatments. They are as follows...

Treatments

1. Cored 5x + topdress + drag
2. Cored 10x + topdress + drag
3. Topdress rubber between 5x Cored
4. Topdress rubber between 10x Cored
5. Strip sod + till rubber 3" + resodded(1991-92 method)
6. Check (Cored 5x; no rubber)

Data collected were impact absorption, shear resistance, soil and surface temperatures, soil moisture, and color and density ratings. For this report only impact absorption and shear resistance will be reported.

At the MBpf, Spartan Grade A Mix (Poa pratensis, Lolium perenne, and Festuca rubra) was seeded at 147 Kg/ha, and fertilized with Scott's 19-26-5 at 49 Kg/ha on 7 July and urea(46-0-0) at 24.5 Kg/ha on 14 July for establishment. Individual plot size was 4.5m x 1.8m. Data collection was taken 21 August, 10 and 24 September, 8 October, and 4 and 18 November. Wear treatment was applied by the Michigan State Band with an average practice being three hours duration for 4-5x a week starting 15 August until 27 November.

At the HTRC, individual plot size was 5.4m x 1.8m. Lolium perenne var. 'Dandy' was seeded at 98 Kg/ha. Fertilization, based on a soil test, was applied before and after installation of the rubber into the soil profile. Before core cultivating, sulfur-coated urea(35-0-0) and ureaformaldehyde(38-0-0) at 24.5 Kg/ha was broadcasted. After installation, urea(46-0-0) at 16.2 Kg/ha was broadcasted in weekly intervals on 28 July, 6 and 12 August and 25-0-25 at 16.2 Kg/ha was broadcasted before traffic treatments commenced. Data collection was taken on 18 August, 17 September, 1, 13 and 25 October, and 15 November. A total of 49 games were simulated over an 82 day period by the BTS starting 26 August through 14 November. On the average, eight passes per week equals the amount of traffic received inside the hashmarks between the 40 yard line of four football games.

Data collection techniques for both studies were consistent except that data for traffic and non-traffic areas were collected for comparison at the HTRC while at the MBpf only Clegg Impact values were collected in the treatment areas. (Note: yardline values were also collected for comparison but are not reported). The impact absorption values were collected by the Clegg Impact Tester(CIT) using a 2.25 kg hammer. The final value recorded was an average of three measurements taken in different areas within the plot. The shear resistance value recorded was an average of three measurements taken with the Eijkelkamp Shearvane; Type 1B. Soil (7.6cm depth) and surface temperatures were recorded with a Barnant 115 Thermocoupler Thermometer. Soil moisture readings were attained by the Gravimetric Method by probing three soil cores (7.6cm depth) for analysis. Color and density ratings were visually observed after installation throughout the growing season.

RESULTS AND DISCUSSION

Marching Band Practice Field Experiment

There was no effect of crumb rubber size on impact absorption at the MBpf except 10 September (Table 1). There was a significant difference among incorporation methods for impact absorption values on 21 Aug., 10 Sept., 24 Sept., and 18 Nov. A trend that should be noted was Treatment 3 (topdressing between the core cultivation process) starting off with a relatively high impact value and becoming the lowest impact value over the season.

There was a significant difference in shear values at the MBpf for crumb rubber sizes (Table 1). Overall, treatments incorporated with 10/20 mesh crumb rubber had lower shear values than treatments with 6mm crumb rubber throughout the study. These differences were significant on 21 August and 4 November. High shearing values for treatments 5 (Rototill rubber and reestablish) and 6 (Core Cultivation only) were expected via previous studies
(Rogers et al., 1993). Treatment 5 already had a contiguous turf community at the beginning of the experiment, but the roots were not well established, and turf plugs were being pulled out of the playing surface. Treatment 6 has high shear values because it does not have a slow stabilization process due to crumb rubber incorporation, but it also has higher Clegg Impact values indicating a higher surface hardness.

Hancock Turfgrass Research Center Experiment

No significance differences were reported for the effect of particle size on impact absorption values(Table 2) on traffic areas at the HTRC. However, impact absorption values were significant for every testing date(except 15 Nov) in regards to incorporation methods. It should be noted the number of football games simulated on each testing date increased throughout the season.

Shear resistance values on the traffic areas regarding particle size had no significance at the HTRC experiment. Every testing date had highly significant shearing values for incorporation methods. Overall, as with the MBpf, treatments 5 and 6 reveal higher values. From the other treatments, treatment 4 (Rubber in between 10x Cored) had higher values throughout the season, but the other treatments were inconsistent.

The difference in the traffic treatments for each experiment is important in the discussion of crumb rubber as a soil amendment. The BTS provides more of the cleated action observed on a football field. The traffic treatment provided on the MBpf illustrates the constant abuse a field can receive. The marching band encompasses at least 100-125 people on the field at once with traffic from sneakers to work boots. Comparison of the two traffic patterns, although extensively different, allows for determination of the flexibility of finding alternative methods for incorporating rubber into the soil profile.

These observations only reconfirm the reasoning for the experiments. Thus, setting up the scenario, when an athlete plants his foot, the potential is high for sod to be torn away from the soil surface and possibly injuring the athlete if the athletic field was not allowed to grow properly. Therefore a three to four month quarantine is highly recommended after turf establishment. Even though measured values illustrated treatments 5 and 6 with optimum values in comparison to other treatments, over the duration of the season, values for the core cultivation treatments also optimized. This trend will be monitored next season, and data collected to solidify crumb rubber as a viable tool for managers to improve the aesthetics and playability of the playing surface.

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REFERENCES

Rogers, J.N., Vanini, J.T. and Pooley, T. 1993, The Effect of Crumb Rubber as a Soil Amendment in a Heavy Traffic Situation. 63rd Annual Michigan Turfgrass Conference Proceedings. Vol 22:9-13.

Table 1. Effects of Crumb Rubber and Core Cultivation on Impact Absorption and Shear Resistance at the Michigan State University Practice Marching Band Field, 1993.

	Impact Absorption values (g)			Shear Resistance values (N/M)		
Particle Size	21 Aug	24 Sep	18 Nov	21 Aug	24 Sep	4 Nov
10/20 mesh	81.9	63.0	63.1	13.5	18.9	15.2
6 mm	82.3	65.1	62.9	11.9	18.1	14.0
Lsd(0.05)	-NS-	-NS-	-NS-	*	-NS-	*
Treatment						
1	80.2	64.3	60.7	11.5	17.4	13.6
2	83.6	64.3	65.3	11.6	17.4	13.3
3	85.8	65.6	59.8	11.8	19.2	13.7
4	89.4	67.9	65.1	11.6	18.4	15.4
5	72.3	58.0	62.2	15.1	19.6	15.0
6	81.6	64.4	65.8	14.7	18.9	16.5
Lsd(0.05)	7.6	4.3	4.3	1.6	-NS-	1.