RECYCLED RUBBER AS A SOIL AMENDMENT

M. Ventola, J. A. Rea and J. N. Rogers, III
Department of Crop and Soil Sciences
Michigan State University, East Lansing, MI

The advent of longer lasting, more durable tires has left our society with a disposal problem. 234 million tires were discarded in the United States last year alone, and landfills are refusing to accept this non-biodegradable product because it is a fire hazard and tends to frost heave in the soil.

Thanks to a funding commitment by the Michigan Turfgrass Foundation, six experiments were initiated at four different locations in 1991 to investigate the feasibility of incorporating crumb rubber (0.6 cm diameter pellets of used tire rubber) into the soil to improve the physical properties of athletic fields and other high traffic areas (Table 1.) What follows is a summary of the goals, problems, and preliminary results of each of these locations.

CROPS AND SOIL SCIENCE GREENHOUSE-M.S.U.

Lolium perenne was planted into three soils (sand, loam, and a compacted fine sand) at four different rates of crumb rubber, (0,10,20, and 40% rubber by volume) in the winter of 1990. The pots were six-inch diameter. The 10% and 20% rubber treatments showed an increased clipping yield compared to the check and 40% treatments. This fall, moisture was withheld from the samples, and the number of days to permanent wilt of the turfgrass was measured (Figure 1).

In the loam topsoil, all rubber amended treatments increased the drought tolerance of the plants dramatically. In the sand treatment, a larger rate of rubber was needed to see an increase in drought tolerance. The compacted sand never really developed roots, therefore the addition of crumb rubber had no effect on wilt prevention. This study suggests that rubber soil amendments increase moisture retention by increasing the ratio of macro- to micropores in the soil.

MICHIGAN STATE UNIVERSITY FOOTBALL PRACTICE FIELD

On May 9, 1991, a 160 foot by 60 foot section between the 10 and 30 yardlines of the Duffy Daugherty Football Building practice field was stripped of its sod, and three replications of plots 5 feet wide and 160 feet long of 0, 10, 20, and 30% crumb rubber were randomized and incorporated to a three inch depth. The area was seeded with *Lolium perenne* (5.25 lbs per 1000 ft^2) and established until August, when varsity football practices began.

A request made by Dr. Rogers to Coach Perles to increase play on the test area resulted in what is estimated as the traffic equaling four-six games/day for the last ten days of August. This proved too much traffic for an immature turf. This eliminated any effects that turfgrass cover would play in improving playability. In addition, this intense wear prevented any validation of the effects of crumb rubber on increasing turfgrass wear tolerance. Still, a less compacted, softer soil was evident where 20% rubber percent treatments had been incorporated. The orientation of the plots should allow for some human testing and perception studies to be performed in the future as the study will be reseeded in the spring of 1992.

HANCOCK TURFGRASS RESEARCH CENTER MICHIGAN STATE UNIVERSITY

Three sets of plots were installed at the Hancock Turfgrass Research Center on May 20, 1991. A factorial array of five treatments (0,10, 20, 30 and 40% rubber by volume), incorporated at two depths (three and six inches) with three replications used for each experiment. Crumb rubber was measured using a known volume container and laid out on the plots, as was a volume of topsoil in an attempt to keep the plot area level for wear treatments by the Brinkman Traffic Simulator. The entire area was tilled to a three inch depth, then specific plots (20 ft by 5 ft) were tilled to a six inch depth.

Experiment one was seeded with *Lolium perenne* var 'Dandy' (5.25 lbs per 1000 ft^2) and established until September, when wear treatments were applied. Figures 2-4 show a summary of the temperature data taken on four different dates. In the warmer months the lower rates of rubber decreased the temperature, while in the cooler months these same rates increased the temperature. This temperature stabilizing effect could be a beneficial tool for turf managers in transition zone climates. Figure 5 shows that the peak deceleration (measure of field hardness, higher values meaning a harder surface) average for all the worn plots was lowest at the 20% crumb rubber volume.

Experiments two and three were sodded with two year old *Poa pratensis* supplied by Halmich's Sod Farm. Experiment three was used in a sod rooting experiment and experiment two was used for football field traffic simulation. Both of these experiments suggest that layered sod roots more quickly into an amended soil plot than into a check plot not amended with rubber. A more extensive investigation of this effect is planned for 1992.

M.S.U. ICE CREAM STORE STUDENT PATH

This study was an attempt to find a less costly method of incorporating crumb rubber into a low maintenance, high traffic area analogous to a high school practice field. Five treatments were used on plots that were 10 feet by 10 feet. Two treatments were core cultivated (0.5 inch hollow tine) six times and the cores removed. Sixty pounds of rubber was raked into one treatment. Two other treatments were Verti-grooved (a machine that removes three 0.5 inch wide, 3 inch deep slices of soil) six times. One of these treatments was also incorporated with 60 pounds of crumb rubber per plot. The final treatment was leaf-raked like all the others and left as a check.

Figure 6 shows the peak deceleration values for all treatments over the season. The variability in the Impact Values (Gmax) of the check is due to the soil moisture content of the plots. It is interesting to note that at low soil moisture content and high Gmax, the rubber treated plots are much softer than the check, but as the moisture content increases over the season, that magnitude of the difference is minimized.

OFF-SITE RESEARCH

Two experiments were established in the Detroit area in 1991. Golf Course Superintendent Ed Hock and the members of Grosse Ile Golf and Country Club were kind enough to remove a section of cart path in order to investigate the feasibility of crumb rubber amended soil under golf cart traffic. The clay soil of this site should answer some questions regarding effects of crumb rubber on fine textured soils in the next few years.

Dr. Vargas and the Detroit Landscape group also installed 5,500 pounds of rubber at Cass Park to investigate disease and compaction in another low maintenance, high traffic area.

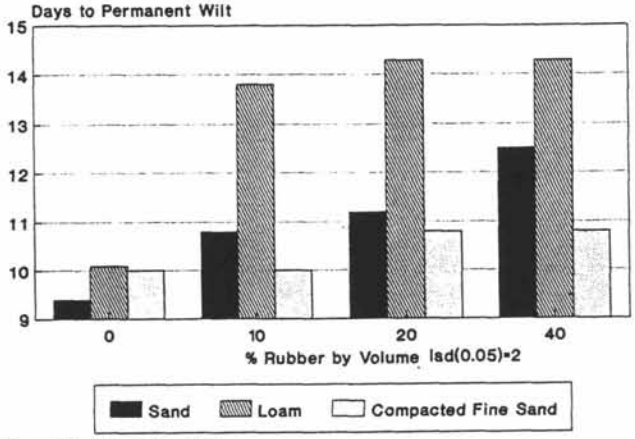
CONCLUSION

Although we are excited about our initial results, we remain cautiously optimistic as to the product as a soil amendment for the turfgrass industry. Data from the first season of the project are promising, and we are confident that the data from upcoming years will answer many questions on this particular soil amendment. A specific volume of rubber 10-20 percent seems evident, however the question of installation is still a major point. The whole group is very happy the installation phase is complete, as information was gained in the process of covering ourselves with a fine rubber mist that sticks in your pores and mouth even after weeks of showers. The first full season of growth for the plots (1992) should prove to be much more enjoyable. Much gratitude is owed to everyone involved, especially the Michigan Turfgrass Foundation for funding the project.

Table 1. 1991 crumb rubber amendment research.
Michigan State University - 1991.

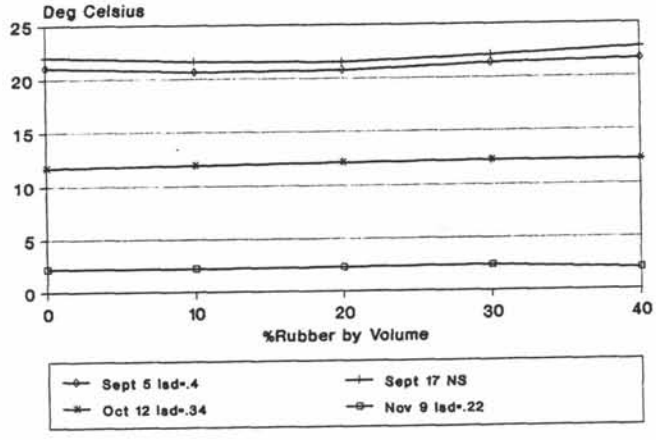
LOCATION	CRUMB RUBBER (lbs)
Greenhouse	200
Hancock Turf Research Center- P. ryegrass K. bluegrass	 6,750 11,250
MSU practice football field	10,800
MSU student path	480
Cass Park, Detroit	5,500
Grosse Ile G & CC	6,000
Total	40,980

Figure 1. The effect of three crumb rubber amended soils on drought tolerance of perennial ryegrass.



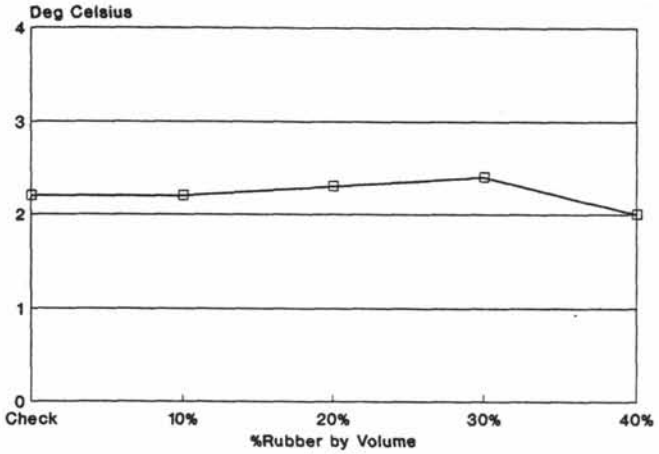
Michigan State University--1991.

Figure 2. The effect of crumb rubber amended soil on high, medium, and low soil temperatures in perennial ryegrass turf.



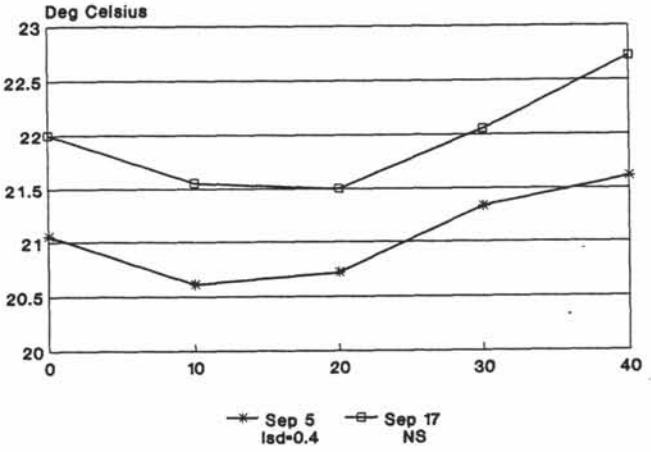
Michigan State University--1991.

Figure 3. The effect of crumb rubber amended soils on low soil temperatures on perennial ryegrass turf--Nov. 9, 1991.



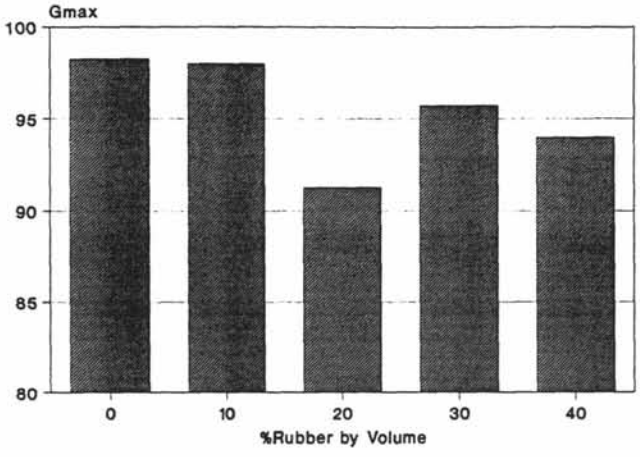
Michigan State University--1991.

Figure 4. The effect of crumb rubber amended soils on high soil temperature in perennial ryegrass turf for two dates.



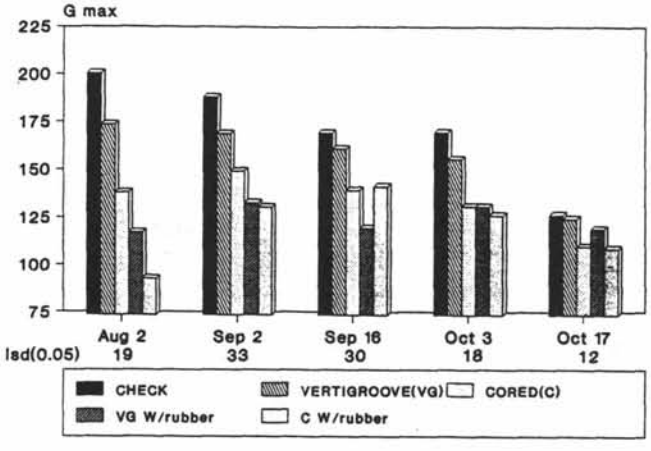
Michigan State University--1991.

Figure 5. Effect of crumb rubber amended soils on peak deceleration of perennial ryegrass turf averaged over four dates in 1991.



Michigan State University--1991.

Figure 6. The effect of crumb rubber, top dressing, and cultivation techniques on impact absorption in a high traffic area.



Michigan State University 1991.