Evaluating the Influence of a Liquid Organic Polymer (Turf2Max®) on Soil Aggregation and Growth of Perennial Ryegrass

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Introduction

A soil aggregate is defined as many soil particles held in a single mass or cluster, such as a clod, crumb, block, or prism (Brady and Weil, 2002). Pore space created by binding these particles together improves retention and exchange of air and water. Stability of soil aggregate refers to the ability of soil aggregates to resist disruption when outside forces are applied. Products that increase soil aggregation would benefit turfgrass growth on compacted soils with poor soil aeration. This study was initiated to determine if a liquid organic polymer mixture, Turf2Max®, has any influence on turfgrass quality or soil aggregation.

Materials and Methods

The study was conducted from December 22, 2003 to March 16, 2004 (76 day growing period) in the research greenhouse at the Iowa State University Horticulture Department, Ames, IA. Turf2Max® was applied to two soils. Local Iowa topsoil (Nicollet, fine-loamy, mixed, mesic Aquic Hapludoll) with 4.0% organic matter was screened and dried. Commercial baseball infield clay, QuickDry®, was used as the second soil. Material for both soils was processed through a hammer mill and soil that passed a 149 micron sieve was used in the green house study. Soil was placed in 2.5 by 2.5 inch plastic pots and treated with Turf2Max® liquid organic polymer solution. The Iowa-Soil required 100g of soil treated with 89 ml of Turf2Max®® and QuickDry® required 70g of porous clay material treated with 76.5 ml of Turf2Max® solution to fill each pot (Fig 1). Two conditions, with grass and without grass, were made to measure stability of soil aggregate. An additional set of treatment pots with grass were used for destructive sampling during root weight measurement. Pots were seeded with 'Catalina' Perennial ryegrass (*Lolium perenne* L.) at 7 lbs/1000 sqft on December 22, 2003. Fertilizer was applied 30 days after planting to supply 1.0 lb of N, P, and K/1000 sqft. One inch of water per week was applied to promote growth during the study.

Turfgrass color, quality, and density were visually estimated according to National Turfgrass Evaluation Program guidelines (http://www.ntep.org/pdf/ratings.pdf). Turf color was evaluated on a visual scale of 1-9 where, 1= completely straw brown, 6 = lowest acceptable color, and 9 = dark green. Turf quality was rated on a scale of 1-9 where, 1 = poorest, 6 = lowest acceptable quality, and 9 = best. Turf density was rated on a scale of 1-9 where 9 = maximum density. Turfgrass density is a visual estimate of living plants or tillers per unit area. Plant height was measured 46 days after seeding (DAS). Beginning 46 DAS, turf was mowed weekly at 5 cm and clippings were collected. On 16 Mar 2004, at the end of the study period, turfgrass was clipped at the soil level and combined with the weekly mowing samples to produce a total dry weight shoot yield for the 76 day growing period. The harvested grass foliage was oven-dried at 67ºC for 24 h and weighed. At the end of the study, root dry weight was determined by washing and oven-drying samples at 67ºC for 24 h. Because it was impossible to completely separate the roots from the soil, oven dried roots were ashed at 490 ºC for 8 h in a muffle furnace and then weighed to determine total organic matter. Aggregate stability was measure according to a modified method by Cambardella and Elliott (1993).

The experimental design was a randomized complete block with three replications and 12 treatments (Table 1). There were 3 rates of Turf2Max® liquid organic polymer (0, 2, and 4%), 2 soil sources (Iowa-soil and QuickDry® soil) and 2 grass conditions conditions (with and without grass) for a total of 12 treatments. The data were analyzed using PROC ANOVA of the SAS software, Version 8 of the SAS System for Windows (SAS Institute, 1999). Means were separated ($\alpha = 0.05$) by Fischer's protected LSD.

Results

The greenhouse study was initiated as a preliminary study to determine if there was any beneficial response from Turf2Max® treatment. Results of the preliminary findings were to serve as the basis for further study. There were no visible differences in turfgrass establishment or growth during the 76 day study period. Turfgrass density, color, quality, height, shoot growth, and root growth of the non-treated control was not significantly different from the Turf2Max® treated turfgrass during the 76 day study (Table 3 and Figs 24 and 25).

The aggregate particle size distribution and the aggregate mean weight diameter (MWD) are presented in Table 2. Mean weight diameter of soil aggregates is an indication of the stable fraction of the aggregates in the soil system. A higher mean weight diameter value indicates more stable aggregates. Treatment effects were significant for mean weight diameter. The Iowa-soil with grass had more stable aggregates when treated with 2% and 4% Turf2Max® (MWD 1.09 and 0.93, respectively) compared with the untreated control (MWD 0.62). Increasing Turf2Max® rate from 2% to 4% did not influence aggregate MWD. Without grass Turf2Max® had no influence on aggregate MWD.

This study represents only a single greenhouse screening for the Turf2Max® product and it therefore is not conclusive. The aggregate stability study needs to be repeated in the greenhouse and then substantiated under field conditions before any claims can be made about this product. Our preliminary observations indicated that under the conditions of a 76 day greenhouse study: 1) There was no visual improvement in turfgrass color, quality, or growth by using Turf2Max®. 2) It is possible that aggregate stability increases with use of Turf2Max®, and 3) more research is needed to substantiate these preliminary observations.

Table 1. Treatments showing 3 levels of Turf2Max®, 2 soil types, and 2 levels of grass cover.

Treatment #	Treatment list
1	Iowa soil and 0% Turf2Max® with grass
2	Iowa soil and 2% Turf2Max® with grass
3	Iowa soil and 4% Turf2Max® with grass
4	QuickDry® and 0% Turf2Max® with grass
5	QuickDry® and 2% Turf2Max® with grass
6	QuickDry® and 4% Turf2Max® with grass
7	Iowa soil and 0% Turf2Max® without grass
8	Iowa soil and 2% Turf2Max® without grass
9	Iowa soil and 4% Turf2Max® without grass
10	QuickDry® and 0% Turf2Max® without grass
11	QuickDry® and 2% Turf2Max® without grass
12	QuickDry® and 4% Turf2Max® without grass

Table 2. Summary ANOVA, aggregate size distribution, and aggregate mean weight diameter for Turf2Max® (T2M) treatments evaluated in a green house study conducted 22 Dec 2003 to 16 Mar 2004.

		Aggregate Particle Size Distribution						
		2mm	**250um**	**90um**	**53um**	**<53um**	**Macro aggregate**	**MWD†**
Source								
	Treatment	**	NS	NS	**	**	**	**
	Block	*	NS	NS	*	*	*	*
Treatment			%					— mm —
1	Iowa soil, 0% T2M + grass	24.2	5.9	42.4	10.0	14.9	30.1	0.62
2	Iowa soil, 2% T2M + grass	48.0	8.7	27.0	5.6	8.5	56.8	1.09
3	Iowa soil, 4% T2M + grass	38.1	12.0	29.9	7.3	10.9	45.3	0.95
4	QuickDry®, 0% T2M + grass	2.4	9.1	39.3	19.5	27.2	11.6	0.17
5	QuickDry®, 2% T2M + grass	1.6	6.7	39.7	17.8	31.5	8.4	0.14
6	QuickDry®, 4% T2M + grass	1.3	9.7	42.5	24.4	21.3	11.1	0.16
7	Iowa soil, 0% T2M	34.8	14.3	32.0	6.1	10.6	49.2	0.89
8	Iowa soil, 2% T2M	35.9	9.3	35.3	7.7	10.0	45.2	0.87
9	Iowa soil, 4% T2M	47.1	9.8	24.9	6.5	9.2	57.0	1.08
10	QuickDry®, 0% T2M	1.8	4.4	45.1	16.0	29.6	6.2	0.13
11	QuickDry®, 2% T2M	6.7	10.6	38.9	17.6	24.2	17.4	0.24
12	QuickDry®, 4% T2M	9.0	10.8	34.4	18.6	23.2	19.9	0.27
	$LSD_{0.05}$	19.3	NS	NS	6.5	9.7	17.9	0.32

* Significant at 0.05 probability level.
** Significant at 0.01 probability level.
† Mean weight diameter.

Table 3. Summary ANOVA, turfgrass height, total shoot dry weight, and root dry weight for Turf2Max® (T2M) treatments evaluated in a green house study conducted 22 Dec 2003 to 16 Mar 2004.

		Turfgrass density		Turfgrass color		Turfgrass quality		Turfgrass height	Total shoot dry weight	Root dry weight
		46 DAS†	76 DAS	46 DAS	76 DAS	46 DAS	76 DAS	46 DAS	76 DAS	76 DAS
Source										
Treatment		**	NS	**	NS	**	NS	*	NS	**
Block		NS	NS	NS	NS	NS	NS	NS	NS	NS
Treatment								— mm —	— mg —	– mg –
1	**Iowa soil, 0% T2M + grass**	7	8	7	8	7	8	90	722	485
2	**Iowa soil, 2% T2M + grass**	7	8	7	8	7	8	77	718	486
3	**Iowa soil, 4% T2M + grass**	7	8	7	8	7	8	90	817	593
4	**QuickDry®, 0% T2M + grass**	6	8	6	8	6	8	57	853	1006
5	**QuickDry®, 2% T2M + grass**	6	8	6	8	6	8	57	808	0910
6	**QuickDry®, 4% T2M + grass**	6	8	6	8	6	8	57	831	1163
	$LSD_{0.05}$		**NS**		**NS**		**NS**	**18**	**105**	**2499**

* Significant at 0.05 probability level.
** Significant at 0.01 probability level.
† Days after seeding.
NS Not significant.

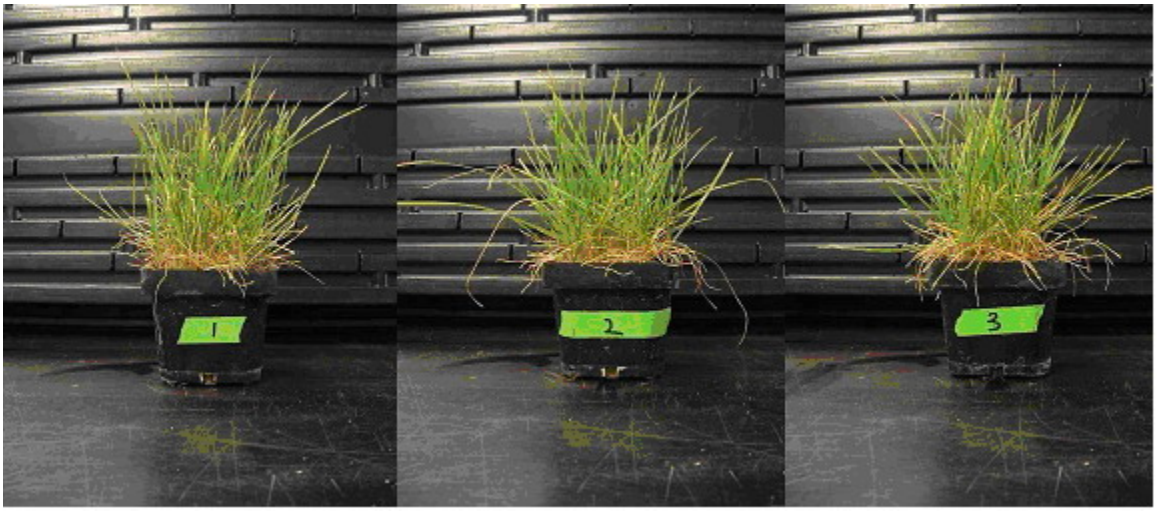

Figure 24. Visual aspect of treatment plots before aggregate determination. Treatments showing Iowa-soil plus grass treated with Turf2Max® at 0%(left), 2% (center) and 4% (right).

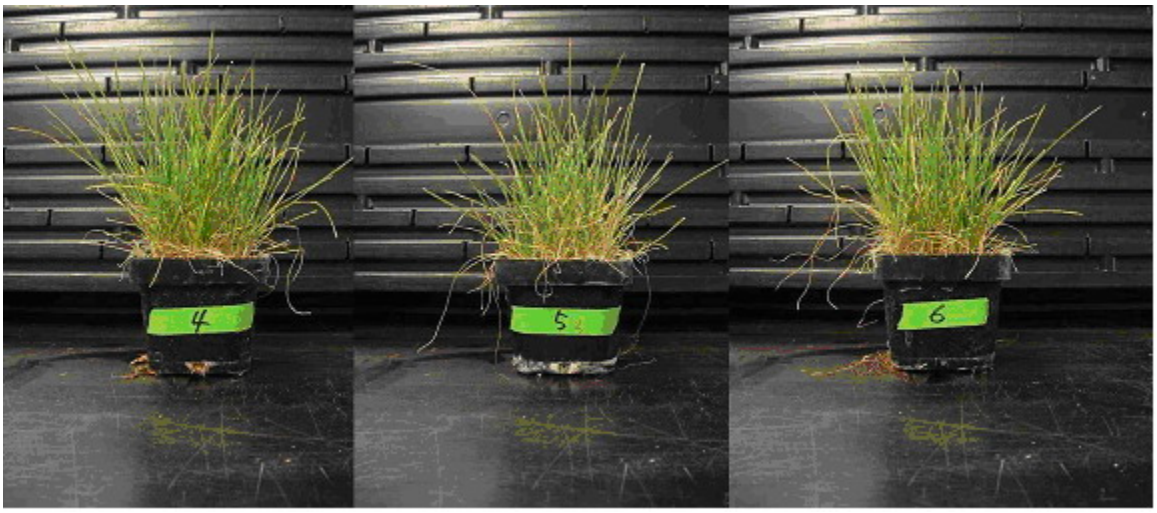

Figure 25. Visual aspect of treatment plots before aggregate determination. Treatments showing Quickdry porous clay plus grass treated with Turf2Max® at 0%(left), 2% (center) and 4% (right).

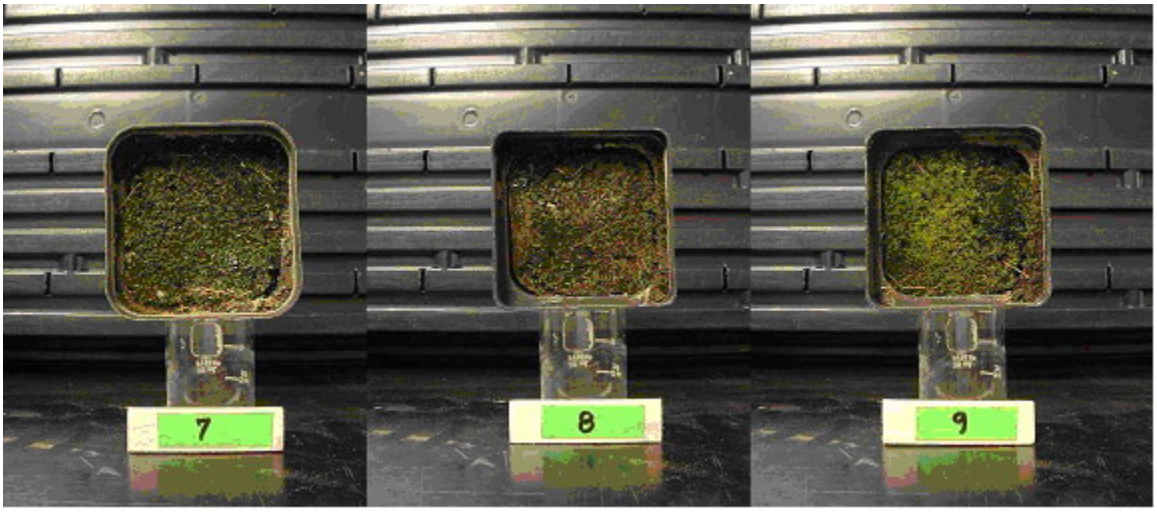

Figure 26. Visual aspect of treatment plots before aggregate determination. Iowa soil without grass at 0, 2 and 4% Turf2Max®.

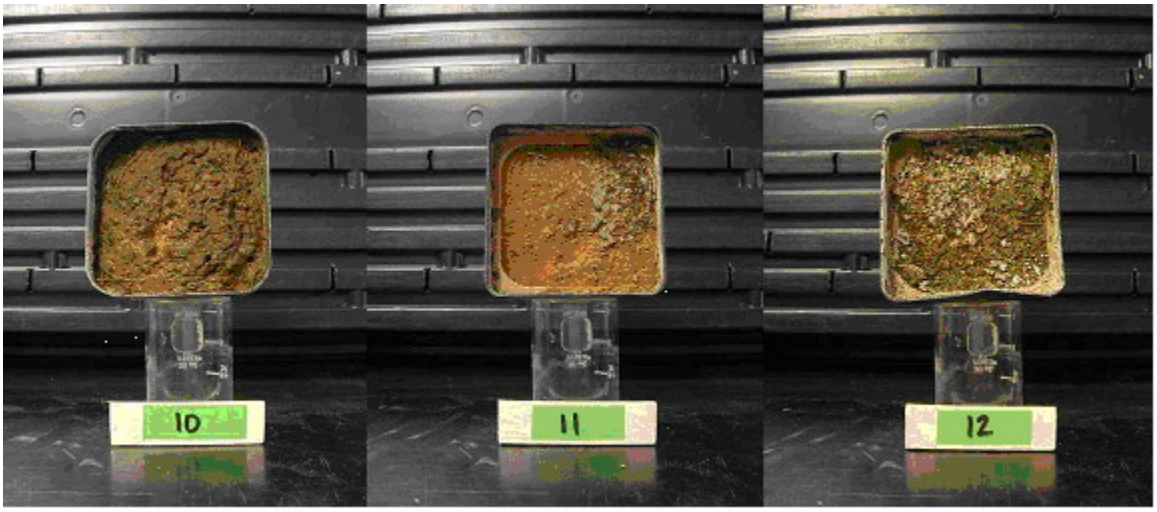

Figure 27. Visual aspect of treatment plots before aggregate determination. Quickdry without grass at 0, 2 and 4% Turf2Max®.

Figure 28. Root and tissue samples collected at the end of the greenhouse study on 16 Mar 2004. Pictured samples have been oven dried.

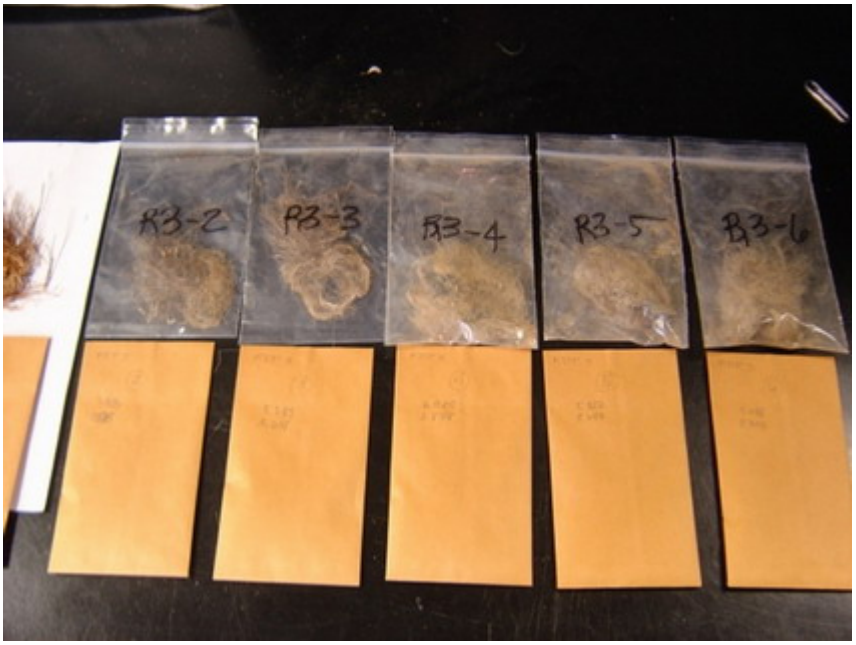

Figure 29. Root samples after washing and drying and before determining ash content in muffle furnace.

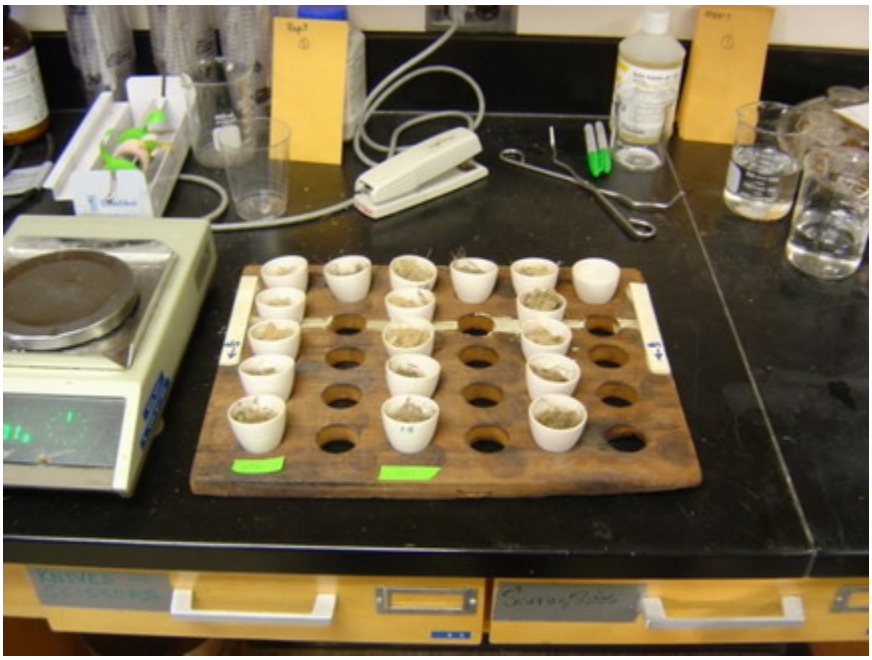

Figure 30. Weighing ash from root samples after muffle furnace treatment.

References

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Cambardella, C. A. and Elliott, E. T. 1993. Carbon and nitrogen distribution in aggregates from cultivated and native grassland soils. Soil Sci. Soc. Am. J. 57:1071-1076.
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