Testing Data Packet

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Contents

Effect of SoilTech on the Release of Sodium and Total Salts

Report by Dr. Bob Ames, AMS Staff Scientist
Ref L07-32, May, 2007

SoilTech, is a clear liquid consisting of 11 polymers used for improving soil structure by reducing sodium.

Experimental Design:

Sodium extraction testing: Soil was collected from an irrigated peanut field in west Texas that was experiencing salinity problems (see analysis below). The soil was air-dried, screened through a 2 mm mesh screen, and stored in 30-gallon plastic trash cans.

Soil Nutrient Content (ppm)

NO_3–N	P1[1]	P2	K	Ca	Mg	Na
13	59	68	174	485	217	139
ok	very high	very high	low	very high	very high	very high

[1]P1 and P2 are Bray 1 and Bray 2 phosphorous extraction methods. P1 is readily available P (weak acid extraction). P2 is less available P (strong acid extraction).

One hundred (100) g of air-dry field soil was placed into plastic 100 ml. sterile containers. Seven (7.0) ml. of sterile deionized water was applied to moisten the soil. Then 10.0 ml of sterile deionized water containing 0.75 ml of SoilTech was applied to the soil surface. The total volume (17.0 ml) of solution brought the soil moisture content to 70% of maximum field capacity. The soil test units were maintained at 70% field capacity for 30 days with the addition of sterile deionized water applied as needed based on weight determinations. There were five replications. After 30 days, the soil was air dried and thoroughly mixed prior to electrical conductivity (EC) determinations patterned after recommendations by Rhoades (1996) and sodium (Na) extraction based on Helmke and Sparks (1996). From each replication, two 25 g air-dry soil subsamples were removed; one 25 g sample for each EC and Na measurement.

EC was determined by placing 25 g of air dry soil in a 125 ml Erlenmeyer flask; adding 100 ml of sterile deionized water; shaking for 30 minutes on a rotary shaker at 250 rpm; allowing the solution to settle for 30 minutes; then gravity filtering the solution through a Whatman #2V filter paper. The clear extract solution (25 degree C) received 2 drops of a 0.1% sodium hexametaphosphate solution prior to EC measurement. EC measurements were made using a Hach CO150 Conductivity Meter and reported as µS/cm.

Sodium determinations were made using a 25 g subsample from the original 100 g of each replication. As with the EC measurements, there were 5 replications per treatment. The 25 g soil sample was placed in a 125 ml Erlenmeyer flask; 100 ml of a neutral 1.0 M ammonium acetate solution was added; then the mixture was shaken on a rotary shaker for 30 minutes at 250 rpm; allowed to settle for 60 minutes with the flask at a slight incline; then filtered through a Whatman #40 filter paper under vacuum. Fifty ml. of the clear solution from each replication was adjusted to a pH of 9.0 using 0.8 g of a Hach Ionic Strength Adjustor powder (magnesium sulfate and Tris (hydroxymethyl) – aminomethane). Na concentrations were determined while stirring using a Hack, Model 51925 Platinum Series Combination Sodium (ion specific) Electrode, and Hack EC10 pH Meter. Readings were recorded when the meter drift stabilized at < 1 mV/minute. Sodium concentrations in the extract solution were based on a standard curve (mV vs. mg/L Na) prepared from known Na standards and reported as mg Na/L. For both EC and Na measurements, the replicated data were evaluated for statistical significance using a one-way ANOVA. Significant ($P < 0.05$), differences between treatment means were separated using Studentized Range tables and calculated LSD values.

Results:

Soil salinity testing: The ability to extract sodium from the soil was greatly increased in the treatments containing SoilTech.

Table 3. Sodium extraction and electrical conductivity of extracts from soil treated with SoilTech, as compared to the untreated control.

Treatment	**Sodium in soil extracts (mg Na/L)**	**Electrical conductivity of soil extracts (µS / cm)**
SoilTech	175.0 a	515.2 c
Control	85.6 c	436.6 d
$LSD_{.05}$	8.8	36.6
$LSD_{.01}$	10.8	45.0

Table values are a mean of 5 replications per treatment. Values not sharing the same letter are significantly different.

Conclusions:

SoilTech has a highly significant effect on the extraction of sodium and total salts from the soil compared to the untreated control.

References:

Rhodes, J.D. 1996. Salinity: Electrical Conductivity and Total Dissolved Solids. In: Methods of Soil Analysis, Part 3, Chemical Methods. Soil Science Society of America, Inc., Madison, WI USA pp 417-435/

Heimke, P.A. and D.L. Sparks. 1996. Lithium, Sodium, Potassium, Rubidium and Cesium. In: Methods of Soil Analysis, Part 3, Chemical Methods. Soil Science Society of America, Inc., Madison , WI USA . pp 551-574.

Test Results From
International Sports Turf Research Center Inc.

The following data is the result of a field test performed in 2005 at Belmar Golf Club in Norman, Oklahoma to determine the effects of SoilTech liquid, organic aeration on heavy red clay found on the golf course.

Brett Proctor, Golf Course superintendent at Belmar, had used SoilTech on some heavily compacted gumbo clay soil at his previous golf course in 2004. He saw positive results in turf quality and soil compaction. As the new superintendent at Belmar, Brett decided to apply SoilTech to his red clay fairways, since he had seen good results with it previously. In June, 2005, before applying SoilTech, a 2" diameter core was taken 4" deep in an area on the #10 fairway. He sent that core sample to the International Sports Turf Research Center in Olathe, KS. ISTRC is an independent and well-respected soil physical properties lab that does work on thousands of golf courses around the world.

90 days after the application of SoilTech (in September, 2005,) another core sample was taken from within 3 feet of the previous sample. That core was also sent to ISTRC so the results could be compared to the sample taken prior to application of SoilTech. Following is a summary of the results.

Test Results Summary:

Bulk Density

Untreated - 1.64 g/cc

Treated - 1.34 g/cc

Infiltration Rate

Untreated - 0.02 inches per hour

Treated - 0.12 inches per hour

Total Porosity

Untreated - 35.01%

Treated - 47.26%

Capillary Pores

Untreated - 30.08%

Treated - 39.84%

Non-Capillary Pores

Untreated - 4.93

Treated - 7.42%

Root Mass

Untreated - 1/4"

Treated - 1/2"

40 cm Water Holding capacity

Untreated - 18.34%

Treated - 29.82%

Note: The product tested was Turf2Max; it is the same product as SoilTech. Turf2Max is a retail product sold in less than 5 gallon quantities.

ISTRC REPORT AND CORE PHOTS

The following are the original test report and core photos. The first photos are from core #1, which was untreated, and the second set of photos is from core #2, which was treated with SoilTech. The color change in core #2 is from SoilTech changing the soil structure and increasing the water and air penetration.

I.S.T.R.C. Form: Physical Evaluation

I.S.T.R.C.

Page: 1

"International Sports Turf Research Center, Inc."

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Olathe, Kansas 66061-3651

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Fax: 913-829-4013

The I.S.T.R.C. System™

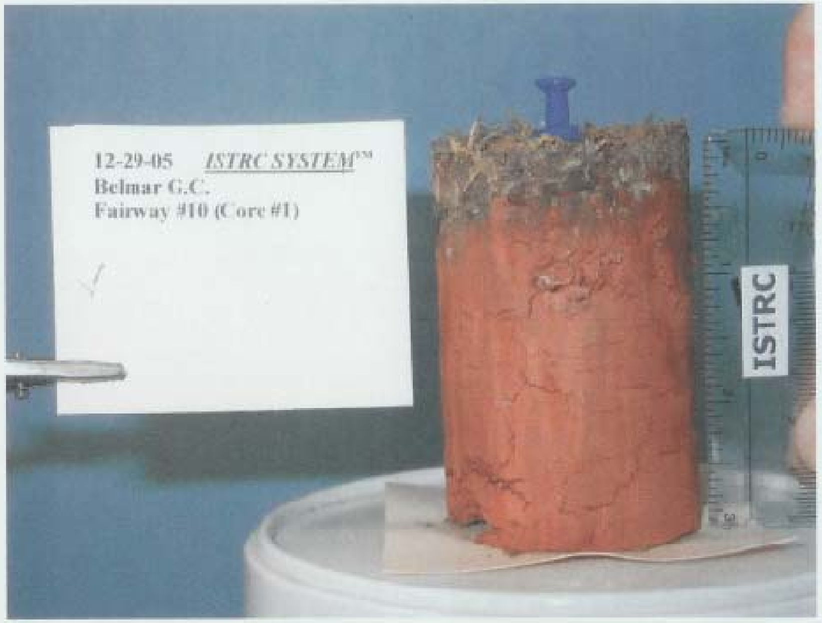
Company: BELMAR GOLF CLUB
Name: Mr. David Nowland
Address: 1025 E. Indian Hills Rd.
City, ST, Zip Norman, OK 73071

Account No. 4050111
Date Jan 6, 06
Facility Belmar G.C.
ISTRC Rep. Mr. David Nowland

Physical Evaluation

ISTRC SYSTEM™ Core Analysis

LAB ID NO.	SAMPLE NAME	Infiltration Rate in/hr	40 cm Water Holding %	Bulk Density g/cc	Solids %	Porosity: Total Porosity %	Capillary [Water Pores] %	Non-Capillary [Air Pores] %
05120022-F10	Fairway #10, Core #1	0.02	18.34	1.64	64.99	35.01	30.08	4.93
	Organic [ISTRC Walkley/Black] .25 to 1 in.	4.98%				Root Mass: 1/4"		
	Organic [ISTRC Walkley/Black] 1 to 2 in.	2.09%				Feeders: 3 1/2" sparse		
	Organic [ISTRC Walkley/Black] 2 to 3 in.	1.59%						
	Organic [ISTRC Walkley/Black] 3 to 4 in.	1.63%						
05120022-F10	Fairway #10, Core #2	0.12	29.82	1.34	52.74	47.26	39.84	7.42
	Organic [ISTRC Walkley/Black] .25 to 1 in.	5.35%				Root Mass: 1/2"		
	Organic [ISTRC Walkley/Black] 1 to 2 in.	2.65%				Feeders: 4" sparse		
	Organic [ISTRC Walkley/Black] 2 to 3 in.	2.25%						
	Organic [ISTRC Walkley/Black] 3 to 4 in.	2.30%						
	Organic [ISTRC Walkley/Black] .25 to 1 in.					Root Mass:		
	Organic [ISTRC Walkley/Black] 1 to 2 in.					Feeders:		
	Organic [ISTRC Walkley/Black] 2 to 3 in.							
	Organic [ISTRC Walkley/Black] 3 to 4 in.							
	Organic [ISTRC Walkley/Black] .25 to 1 in.					Root Mass:		
	Organic [ISTRC Walkley/Black] 1 to 2 in.					Feeders:		
	Organic [ISTRC Walkley/Black] 2 to 3 in.							
	Organic [ISTRC Walkley/Black] 3 to 4 in.							
	USGA Sample Range [Root Zone Mix]	6 to 12	10 to 20	1.4 to 1.7	45 to 65	35 to 55	15 to 25	15 to 30


12-29-05 ISTRC SYSTEM™
Belmar G.C.
Fairway #10 (Core #1)
ISTRC


12-29-05 ISTRC SYSTEM™
Belmar G.C.
Fairway #10 (Core #1)
ISTRC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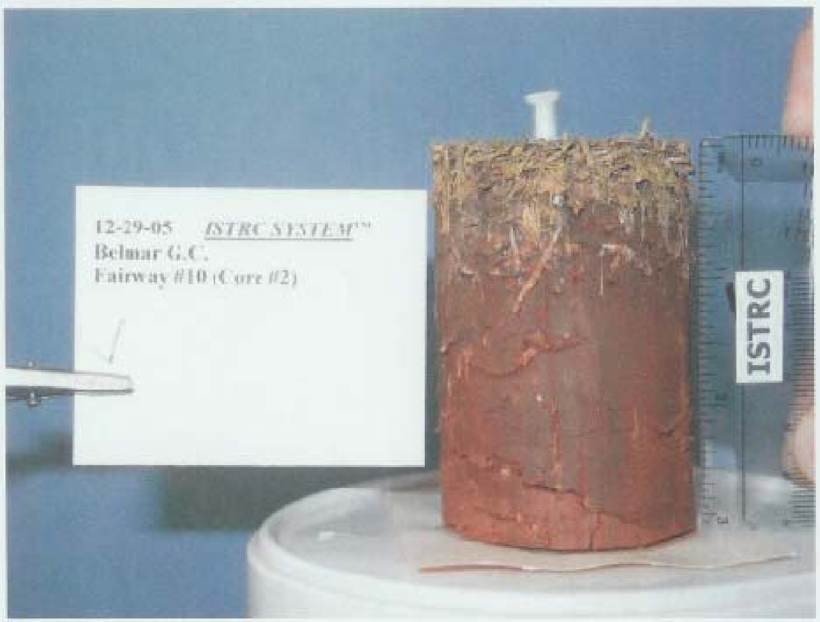
12-29-05 ISTRC SYSTEM™
Belmar G.C.
Fairway #10 (Core #1)
ISTRC


12-29-05 ISTRC SYSTEM™
Belmar G.C.
Fairway #10 (Core #2)
ISTRC

12-29-05 ISTRC SYSTEM™
Belmar G.C.
Fairway #10 (Core #2)
ISTRC

12-29-05 ISTRC SYSTEM™
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12-29-05 ISTRC SYSTEM™
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Evaluating the Influence of a Liquid Polymer (SoilTech) On Soil Aggregation

D.D. Minner Ph.D Iowa State University and S.K. Lee

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 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. SoilTech 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 SoilTech liquid organic polymer solution. The Iowa-Soil required 100g of soil treated with 89 ml of SoilTech® and QuickDry® required 70g of porous clay material treated with 76.5 ml of SoilTech 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. On 16 Mar 2004 at the end of the study period, 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 SoilTech 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 SoilTech treatment. Results of the preliminary findings were to serve as the basis for further study.

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% SoilTech (MWD 1.09 and 0.93, respectively) compared with the untreated control (MWD 0.62). Increasing SoilTech rate from 2% to 4% did not influence aggregate MWD. Without grass SoilTech had no influence on aggregate MWD.

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

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

Table 2. Summary ANOVA, aggregate size distribution, and aggregate mean weight diameter for SoilTech (SS) 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.**	**mm.**
1. Iowa soil, 0% ST + grass	24.2	5.9	42.4	10.0	14.9	30.1	0.62
2. Iowa soil, 2% ST + grass	48.0	8.7	27.0	5.6	8.5	56.8	1.09
3. Iowa soil, 4% ST + grass	38.1	12.0	29.9	7.3	10.9	45.3	0.95
4. QuickDry®, 0% ST + grass	2.4	9.1	39.3	19.5	27.2	11.6	0.17
5. QuickDry®, 2% ST + grass	1.6	6.7	39.7	17.8	31.5	8.4	0.14
6. QuickDry®, 4% ST + grass	1.3	9.7	42.5	24.4	21.3	11.1	0.16
7. Iowa soil, 0% ST	34.8	14.3	32.0	6.1	10.6	49.2	0.89
8. Iowa soil, 2% ST	35.9	9.3	35.3	7.7	10.0	45.2	0.87
9. Iowa soil, 4% ST	47.1	9.8	24.9	6.5	9.2	57.0	1.08
10. QuickDry®, 0% ST	1.8	4.4	45.1	16.0	29.6	6.2	0.13
11. QuickDry®, 2% ST	6.7	10.6	38.9	17.6	24.2	17.4	0.24
12. QuickDry®, 4% ST	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.

References

Brady, N.C, and R.R. Weil. 2002. The nature and properties of soils. 13th ed. Pearson Education, INC., NJ.
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.
SAS Institute. 1999. The SAS system for windows, Version 8. SAS Institute Inc., Cary, NC.

Effect of Amendments on Soil Infiltration and Bulk Density

Jeff Rule

Red Earth Laboratory

7-10-07

Introduction

High soil bulk density and low water infiltration rates can introduce problems in turf and landscape management. The combination of the two may lead to low subsurface oxygen levels, decreased microbial activity, and eventually a decline in plant health. This study is designed to show the effects chemical aeration has on the soil's bulk density and infiltration rate in the study area. The product was applied to the sample area alongside controls in a study grid. The product to be applied was SoilTech, The percent change in the density and infiltration of each treatment type will then be compared to determine probable effects the products have on the soil.

Materials and Methods

A resident lot was chosen for the study site that met initial soil properties pertinent to the study. The criteria for the site were soil texture of high clay content, elevated bulk density, and a low infiltration rate. A 14 foot by 20 foot study area was measured off consisting of five rows two feet wide and seven columns two feet wide with one foot in between, to serve as a buffer and reduce leaching interferences. The resulting grid consist of 35 two foot by two foot sample areas with a one foot buffer between each. All sample areas were then divided into nine sub samples eight inches by eight inches. To designate the sub samples each were labeled 1-9, rows labeled 1-5, and each column A-G. For example, sub sample 2B3 would be in the second row, column B, sub sample 3. On day 1 the initial infiltration rate was measured for sub samples 1, 2, and 3 in all sample areas following USDA guidelines. Then cores were then taken from sub samples 1, 2, and 3 for bulk density test using USDA methodology. Each sample area in a column was treated with the recommended rate of SoilTech, and left as a control. The same tests were conducted on day 40 following the applications using sub samples 4, 5, and 6 and again on day 70 using sub samples 7, 8, and 9.

Results and Discussion

The area in study comprised of a clay type soil texture with 8% sand, 15% silt, and 77% clay by volume. Initial bulk densities show a range of 1.27-1.46 g/cc and infiltration rates of 0.0152-0.7 mm/min. The average infiltration rates of the three sub samples were used to represent their respective sample area. The percent change of day 40(avg. of 4, 5, and 6) from the initial value (avg. of 1, 2, and 3) was then calculated for each of the 35 sample areas. The percent change of identical treatment types were then averaged to give a final result. The same procedures were done using the bulk densities. Data for infiltration rates were not recorded at the 70 day interval. During a 4 week period leading up to day 70 the area received more than 20 inches of rainfall. This left the study area and the residential site saturated. It was found out during the study the site had drainage problems which resulted in infiltration rate interference. The data were analyzed using the ANOVA method of the 'TexaSoft, WINKS SDA Software, 6th Edition, Cedar Texas, 2007.

Bulk Density Testing Results:

Table 1- Treatment for the bulk density test

Treatment #	Treatment list
1	Non-SoilTech Treatment
2	SoilTech Treatment @ 2%

Table 2- Summary ANOVA mean differences between the Day 1, Day 40, and Day 70 for each treatment in grams/cm^3.

Source	Day 1	Day 40	Day 70
Treatment 1	NSD	NSD	NSD
Treatment 2	SD	SD	SD
Treatment			
Non-SoilTech	1.3676	1.3564	1.4276
SoilTech @ 2%	1.3758	1.2817	1.3158

% Change	Day 1 to 40	Day 1 to 70
Non-SoilTech	-.8%	4%
SoilTech @ 2%	-7%	-4%

SD - Significant difference at 0.05 probability level

NSD – No significant difference

Statistical Analysis:

Non-SoilTech Treatment Data Analysis Summary:

A one-way Analysis of Variance was performed to test the hypothesis that the average mean value across categories of GROUP were equal. In the presence of significance for the omnibus ANOVA test, a Newman-Keuls multiple comparison test is used to perform pairwise comparisons. Statistics were performed using WINKS SDA Software (Texasoft, Cedar Hill, TX.) Statistical decisions were made at $p=0.05$ unless otherwise stated.

The average values across categories of GROUP were not found to be different

$F(2, 42)=.23$, $p = 0.79$.

SoilTech Treatment Data Analysis Summary:

A one-way Analysis of Variance was performed to test the hypothesis that the average mean value across categories of GROUP were equal. In the presence of significance for the omnibus ANOVA test, a Newman-Keuls multiple comparison test is used to perform pairwise comparisons. Statistics were performed using WINKS SDA Software (Texasoft, Cedar Hill, TX.) Statistical decisions were made at $p=0.05$ unless otherwise stated.

The average values across categories of GROUP were found to be different

$F(2, 42)=10.68$, $p <.001$.

A Newman-Keuls multiple comparison procedure was performed at the alpha=0.05 significance level to determine specific pairwise differences.

Water Infiltration Results:

Table 1- Treatment for the water infiltration test

Treatment #	Treatment list
1	Non-SoilTech Treatment
2	SoilTech Treatment @ 2%

Table 2- Summary ANOVA mean differences between the Day 1, and Day 40 for each treatment, in inch./hr.

Source	Day 1	Day 40
Treatment 1	NSD	NSD
Treatment 2	SD	SD
Treatment		
Non-SoilTech	0.0859	0.3613
SoilTech @ 2%	0.0716	0.8115
% Change		**Day 1 to 40**
Non-SoilTech		320.60%
SoilTech @ 2%		1033.64%

SD - Significant difference at 0.05 probability level

NSD – No significant difference

Statistical Analysis:

Non-SoilTech Treatment Data Analysis Summary:

A preliminary test for equality of variance indicates that the variances of the two groups are significantly different. Therefore a two-sample t-test was performed that does not assume equal variances.

The means of the two groups were significantly different.

Using the unequal variances t-test, $t(4.2) = -2.92$, $p = 0.041$

SoilTech Treatment Data Analysis Summary:

A preliminary test for equality of variance indicates that the variances of the two groups are significantly different. Therefore a two-sample t-test was performed that does not assume equal variances.

The means of the two groups were significantly different. Using the unequal variances t-test, $t(4.1) = -3.18$, $p = 0.032$

Statistics were performed using WINKS SDA Software (Texasoft, Cedar Hill, TX.)

Conclusion:

The application of the individual product did show significant changes at day 40 from their initial result, regarding both the bulk density and infiltration rates, as compared to the control. The SoilTech had considerable changes when compared to the control. This study did indicate a reduction in bulk density and an increase in infiltration rate with the products applied separately and as a mixture into day 40. The results also indicate a reduction in the product activity going into day 70 following the application. This is shown by a decrease in the percent change avg. in each of the treatment types.

References

'TexaSoft, WINKS SDA Software, 6th Edition, Cedar Hill, Texas, 2007.'

Investigating Increases in Clay Soil Aggregate Stability Using SoilTech

What Are Soil Aggregates?

Soil aggregates are oil particles that bind together into clumps. When they bind together, pore spaces increase and because without proper pore space air and water penetration is greatly reduced.

What is Aggregate Stability?

Aggregate stability refers to the ability of soil aggregates to resist dispersion when outside forces (usually associated with water) are applied.

Question:

Does SoilTech cause individual clay soil particles to aggregate and remain stable against flowing water?

Purpose:

This test determins whether the addition of SoilTech to clay soil will cause or improve soi particle aggregation. Soil scientists agree that a soil with good aggregate stability improves soil aeration, water percolation, and infiltration over time. Increased stable soil aggregates will also reduce bulk density and aid in the soil water-holding capacity over time as well. Also, formation and preservation of aggregates will allow organic matter to be preserved in the soil.

Materials and Methods:

The effect of SoilTech on the ability to aggregate clay soil particles was determined by the following procedures.

Four batches of 120 grams of Chandler clay soil were pulverized to pass through a 0.25mm sieve and 30mL of water was added with varying amounts of SoilTech (0%, 2%, 5%, and 10%) added to different batches. The soil was well mixed and pressed through a 4mm sieve. After drying for 2 days in a warm room at low humidity, air at 50°C was blown on the soil for 10mins to complete the drying. 40gm samples were placed on the top sieve of a set of three, 0.84mm, 0.42mm, and 0.25mm arranged in decreasing size. The sieves were raised and lowered in distilled water through a distance of 1.5cm at the rate of 30 cycles per minute for three minutes. At the end of that time the sieves were raised, allowed to drain, the soil was then dried at 80°C, and weighed. This procedure was repeated two times. This process was replicated three times, producing three samples for each level of SoilTech added. The results are reported as the percent of soil aggregates larger than 0.25mm.

Test Results:

The Percent of Soil Aggregates Larger Than 0.25mm in Chandler Clay Soils

	% SoilTech Used	% Aggregates Larger Than 0.25mm			Average
		Sample #1	Sample #2	Sample #3	
Batch #1	0%	0%	0%	0%	0%
Batch #2	1%	19%	16%	22%	19%
Batch #3	2%	67%	58%	64%	63%
Batch #4	5%	88%	77%	70%	78%
Batch #5	10%	91%	93%	74%	86%

Conclusion:

The largest % increase occurs between 1% and 2%. Application rates beyond 2% improve the aggregate structure of the soil, but could become a cost factor. The test supports the product claim that SoilTech not only improves the structure of clay soil by increasing aggregate size, but also shows that those aggregates are stable.

Effects of SoilTech on Soil Strength

Question:

Does one standard application of SoilTech reduce soil compaction on a wide scale, enough to justify a large lawn care company (over 23,000 customers) to apply as a standard application each year for every customer?

Purpose:

This test will help determine if it is feasible for a large lawn lawn care company to apply SoilTech to every customer's lawn, over a wide range of soil conditions.

Test Sites:

Two hundred twenty two (222) test sites were selected at random from the customer list.

Control:

One standard application of SoilTech was applied at the label rate on each of the test sites. Two measurements for soil compaction were taken, one at the time of application and the other 8 weeks after application. Each site was marked and recorded.

Application:

On July 16, 2002 each site was treated with the standard application of SoilTech. The standard rate is 4oz SoilTech diluted 60:1 per 1000 square feet.

Tests Performed:

On July 16, 2002, before the application of SoilTech, a soil compaction test was performed on each site. Two measurements were taken at each site, the first one at the 3" depth and the second at the 6" depth. The method used was a soil compaction gauge that measures penetration resistance in pounds per square inch.

On September 16, 2002 a second soil compaction test was performed on each site at the 3" depth and at the 6" depth.

Summary of Test Results:

- Two hundred twenty-two tests were performed at both the 3" and 6" depth.
- Average soil compaction at the 3" depth was 187 pounds per square inch before application.
- Average soil compaction at the 3" depth was 107 pounds per square inch 8 weeks after application.
- Average soil compaction reduction was 80 pounds per square inch.
- Average reduction in soil compaction was 43%.
- Average soil compaction at the 6" depth was 239 pounds per square inch before application.
- Average soil compaction at the 6" depth was 170 pounds per square inch 8 weeks after application.
- Average soil compaction reduction was 68 pounds per square inch.
- Average reduction in soil compaction was 29%.

Test Results:

3" Soil Depth

Penetration Resistance in p.s.i.	Number of Tests	Average Decrease in p.s.i.	Average Decrease
1-50	13	2	4%
51-100	42	19	23%
101-150	59	58	34%
151-200	29	90	46%
201-250	23	116	47%
251-300	56	177	59%

6" Soil Depth

Penetration Resistance in p.s.i.	Number of Tests	Average Decrease in p.s.i.	Average Decrease
1-50	1	0	0%
51-100	21	14	15%
101-150	31	34	24%
151-200	27	56	28%
201-250	31	67	28%
251-300	111	112	38%

Interpretation:

The data suggests that the more compacted the soil is, the more effective SoilTech is in reducing compaction. At both the 3" and 6" depth, these tests demonstrate a direct relationship between severity of compaction and the result after treatment.

The soil compaction tests prove the effectiveness of SoilTech on a wide range of soil conditions. The high number of repetitions and using two depths substantiate the usefulness of SoilTech on a broad scale.

Conclusion:

The application of SoilTech on a wide range of soil conditions has substantially reduced soil compaction enough to justify a large lawn care company in Oklahoma to apply the product on every customer each year as a routine application.

This test supports the claim that SoilTech reduces soil compaction.

Soil Conditioner’s Effects on Soil Respiration Rate

Introduction:

This test was performed to investigate whether the addition of SoilTech to various soils can support the claim "aerates soil". Many users claim that SoilTech improves lawn drainage and makes zoysia grass and bermuda grass care easy.

It is widely accepted that soils with poor structure break down to a mud as the amount of water is increased thereby reducing the amount of oxygen available to the plant roots. Air components such as oxygen and nitrogen diffuse through the soil profile. When water is added much less air diffuses through the thick water films.

Question:

Does SoilTech increase the soil respiration rate of treated soils versus non-treated soils?

Purpose:

Soil respiration (aeration) is directly affected by the amount of moisture contained within the soil. Soils will reach a point of saturation, which is the level when aeration or the diffusion of air ceases. At this point plant growth is affected and can be detrimental if the soil remains saturated for a period of time. This test explores the potential of soils that have been treated with SoilTech, to increase the amount of moisture contained before reaching saturation, and increasing aeration at lower moisture levels.

Materials and Methods:

Soil respiration rate is measured by the production of carbon dioxide ($CO2$) as an indicator of aerobic microorganism activity, live roots, and soil organisms. Soil respiration is essential for the establishment and maintenance of a healthy plant community therefore is considered a positive indicator of soil quality.

The accessibility of oxygen to live plant roots in soil in the various amounts of water is measured by the technique of Webley, Quastel et al., described in detail in the J. Agr. Sci. 37, 257 , (1947). Yeast was substituted for the plant roots and the oxygen uptake by the yeast is measured by a manometric method. The carbon dioxide evolved (respiration) in the metabolic process is absorbed by potassium hydroxide in a center well so that the change in gas volume is caused by the utilization of oxygen by the yeast and the soil microorganisms.

Ten replications of each soil type at four soil moisture % levels were performed to achieve an average result. Three selected topsoils were air-dried, pulverized, and screened to pass a one mm sieve. Each topsoil was then equally divided into ten 100 gm portions. (30 portions total-10 of each topsoil type). Then five 100 gm portions of each of the three topsoils were treated with 40 ml of water. Then the remaining topsoil samples (five of each soil type) were treated with a water solution containing 2.5% SoilTech. Each of the wet soil samples were then broken up, and allowed to air dry. Then each sample was broken up further to pass a 4 mm sieve. Crumbs 4mm or less were collected for each sample. These crumbs were then used in each flask for the evaluation of soil respiration.

Test Results:

Respiration Rate and Soil Moisture %

Soil Types	% SoilTech	Soil Moisture %			
		25%	**37.5%**	**50%**	**62.5%**
OK Chandler Clay	None	77	43	16	0
	2.5	110	97	52	12
Bixby Sandy Loam	None	112	91	51	6
	2.5	134	120	68	22
Black Gumbo (KS)	None	89	50	23	0
	2.5	102	76	39	8

Interpretation:

The respiration rate measured by the Warburg apparatus should be as high as possible in the presence of the maximum soil moisture levels. All soils become saturated if enough water is added thereby preventing access of air. In this condition, the respiration rate of the soil cannot be measured therefore the result shown in the above chart is "0". As the soil moisture % increases the respiration rate decreases until the soil becomes saturated and further growth of the yeast stops.

Conclusion:

Soils with good aggregate stability retain their porous crumb structure in the presence of large amounts of water. The yeast suspension in water is spread over a large surface and oxygen can diffuse through relatively thin films of water. This increases oxygen uptake by the yeast, thereby increasing the soil respiration rate. Soils with poor structure break down to a mud as the amount of water are increased and much less oxygen diffuses through these thick water films. Thus the oxygen uptake by yeast in this type of soil is much lower.

SoilTech in all three soils demonstrated an increase in the respiration rate at all tested soil moisture levels. This supports the claim that SoilTech "aerates soil".

Determining Changes of Soil Water Evaporation Rates Using SoilTech

Question:

Does a standard application of SoilTech reduce the rate of soil water evaporation?

Purpose:

Water conservation is an important factor when scheduling irrigation for lawns, sports complexes, gardens, and flowerbeds. Actual users of SoilTech consistently report significant reduction in water usage within 60 days of application. Reports range from 33-67% reduction.

Materials and Methods:

Oklahoma Chandler Clay and Bixby Sandy Loam were treated with just water and also with water and SoilTech. The moisture content of each sample was adjusted to 25%, and 2 kilograms of soil were placed in two-liter beakers. These beakers were kept in a greenhouse and were weighed everyday to document the rate of water evaporation from each sample. Ten replications of each test were performed to achieve an average result.

Test Results:

Soil Water Evaporation in a 15-Day Period - Oklahoma Chandler Clay

Treatment	% SoilTech	% Water Evaporation	% Water Evaporation Improvement
Untreated	None	43.6	----
Treated	2.0	25.8	59.2%

Soil Water Evaporation in a 15-Day Period - Bixby Sandy Loam

Treatment	% SoilTech	% Water Evaporation	% Water Evaporation Improvement
Untreated	0	57.8	----
Treated	2	35.2	61.9

 

Untreated/Treated With SoilTech

The soil particle size is substantially larger on the right sample, which indicates increased pore space. The treated sample (right) has retained 22% moisture, whereas the untreated (left) sample retained 7% moisture.

Conclusion:

This test supports a significant reduction of water evaporation in both Oklahoma Chandler Clay and Bixby Sandy Loam. SoilTech aids in conditioning clay soils with a no-till soil preparation method that helps reduce water evaporation. This study supports the claim that SoilTech contributes to water conservation in clay and sandy soils. Commercial and individual users of SoilTech consistently reported being able to water less and still maintain turf color and growth. Arrowhead Sports Complex in Broken Arrow Oklahoma realized a 67% reduction in water evaporation within 60 days of SoilTech application.