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 SuperSoil, 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 SuperSoil, 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 then 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-SuperSoil Treatment
2	SuperSoil Treatment @ 2%

Table 2- Summary ANOVA, mean differences between the Day 1, Day 40, and Day 70 for each treatment in grams/cm³.

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

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

SD - Significant difference at 0.05 probability level
NSD – No significant difference

Statistical Analysis:

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

SuperSoil 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-SuperSoil Treatment
2	SuperSoil 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	SD	SD
Treatment 2	NSD	NSD
Treatment		
Non-SuperSoil	0.0859	0.3613
SuperSoil @ 2%	0.0716	0.8115

% Change	Day 1 to 40
Non-SuperSoil	320.60%
SuperSoil @ 2%	1033.64%

SD - Significant difference at 0.05 probability level
NSD – No significant difference

Statistical Analysis:

Non-SuperSoil 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, $t(4.2) = -2.92$, $p = 0.041$

SuperSoil 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 SuperSoil 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.'