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Effect of Aeration and Compaction on Some Characters Of a Turf Grass Mixture Under Sulamani City Conditions

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Abstract

This experiment was carried out in Perramagron area in the Northwestern part of Sulaimani city, at the Ornamental Plant Nursery , (Lebanon Mountain Company) for cultivation and landscape (35° 32' N, 45° 21' E, and 730m altitude), for the period 15th May 2012 to 1st September 2012to study the effect of aeration, without aeration, compaction and without compaction on same characters of turf grass mixture. The Factorial Experiment (2*2) was laid out by using the Complete Randomized Block Design (CRBD), Each treatment combination was replicated four times with plot (1×4) m^2. Obtained results show that: aeration significantly caused increased in plant density, root depth, active root, and Soil infiltration when compared with non-aeration. But compaction 70 kg treatment decreased plant density, root depth, active root, and soil infiltration when compared with non-compaction. In contrast, the bulk density was increased significantly because of this treatment. The interaction between aeration and without compaction give the highest average of Plant density 640 plants/m^2, root depth 53.00 cm root, active root 18 cm, highest level of Soil infiltration 1.08cm. While the highest Bulk density 1.95gm/$cm^3$was recording in the treatment that aeration and compaction.

Introduction

Lawns are area of aesthetic and recreational land planted with grasses *[1]*. The Lawns as any herbal plant can survive when it is cuts at an altitude of low appropriate component and covers green above the soil surface *[2]*. A healthy lawn provides play area adds oxygen to our air filters pollutant from air runoff water, cools the environment; and provide soil erosion *[3]*. Green spaces covered 70-80% of the area of the most of the land in the public and private gardens, parks, roads, squares or sports stadiums, also absorption the sound and reduces the noise *[4;5]*. Growing media are the substrates in which a plant will grow. They provide the nutrition's; air spaces for good respiration; and retain sufficient available water to enable plant growth. At a basic level, soil compaction happens when something collapses the air pockets in between the components in the soil. A common reason for soil compaction is pressure from foot traffic or heavy machinery, creating a persistent subsoil compaction, Furthermore, a soil that is clay heavy will compact more easily than other soils. It significantly reduces the amount of large pore spaces. Furthermore, low soil oxygen levels caused by soil

compaction are the primary factors limiting plant growth in landscape soils *[6;7]* . It is common to see soil compaction in ground that is walked on frequently, near sidewalks or near roadsides, is a primary cause of an unhealthy lawn due to retards in root growth by altering soil physical properties, including aeration porosity, bulk density, soil strength, and pore size distribution. Furthermore, Materechera *et al*. (1992) *[8]* and Cook *et al*. (1996) *[9]* evaluated the effects of compaction on root growth of three species, including perennial ryegrass (*Lolium perenne*L.) and reported that both root and shoot dry mass and total root length decreased as mechanical impedance increased. Also for Kentucky bluegrass (*Poa pratensis* L.), perennial ryegrass, and tall fescue (*Festuca arundinacea* Schreb.), the root-limiting bulk density was 1.34 g cm−3.A similar study by O'Neil and Carrow (1982) *[10]* found the root-limiting bulk density for Kentucky bluegrass to be greater than 1.38 g cm−3.

At the same time Lawn problems improved by aerating include thatch, poor drainage, heavy traffic**,** walking, playing and compaction, then aeration loosens compacted soil and breaks up thatch. It allows water and other nutrients to seep into the soil, encouraging new root growth and establishing a stronger, deeper root, healthier turf. Another benefit of aeration is the increasing the activity of soil microorganisms that decompose thatch helping prevent fertilizer and pesticide run-off from overly compacted areas.

Lawn aeration involves the removal of small soil plugs or cores out of the lawn. Although hand aerators are available, most aeration is done mechanically with a machine having hollow tines or spoons mounted on a disk or drum. Known as a core aerator, it extracts 1/2 to 3/4 inch diameter cores of soil and deposits them on your lawn. Aeration holes are typically 1-6 inches deep and 2-6 inches apart. Other types of aerators push solid spikes or tines into the soil without removing a plug (spiking). These are not as effective because they can contribute to compaction. Core aeration is a recommended lawn care practice on compacted, heavily used turf and to control thatch buildup *[11].*

The objectives of this study were to determine the effect of a compacted and aeration soil on some characters for turf grass mixture under Sulamani city conditions .

Materials and Methods

This experiment was carried out in Perramagron area in the Northwestern part of Sulaimani city, at the Ornamental Nursery Plants, (Lebanon Mountain Company) for cultivation and landscape (35° 32' N, 45° 21' E, and 730m altitude), for the period 15th May 2012 to 15th November 2012. It was used lawn mixtures of six seeds grass (cold season grasses) obtained from the same company consisting of *Lolium pernne* Green fair 5%, *Lolium pernne* Keystone 5*%, Festuca arundinacea* Stariett 35%, *Festuca arundinacea* Olimpic gold 35%, *Poa pratensis* Panduro 10%, *Poa pratensis* Miracle 10. An area of about 30 m^2 lawns of two years age, (4 × 1)m plot for each treatment combination was allocation four replication, so the experiment consist of(2 × 2= 4) treatments combinations. The soils of experimental field are analyzed to obtain some physical properties table (1).

The process of compaction treatment was carried out by walking person 70 kg weight for 3 minutes on each time and for each week *[12].* The period was 3 months starting 15th May 2012 to 15th August 2012.

The aeration treatment was laid out in 1st September 2012 by special device designed for this purpose model Ryan Lawn air V plus aerator, Figure 1 (it's an excellent time to aerate for cool-season grasses such as bluegrass, ryegrass and fescues grow most actively in the fall *[13],* this device take pieces out (core) of the flat, lengths 10 - 12 cm and 1.9 cm diameters, Figure 2 *[11].* The aeration treatment was performed in the block that was compaction.

Table-1: Some physical properties of the soil.

Clay	***Silt***	***Sand***	***Textural name***	***Bulk density***	***Available water%***	***O.M.C***
577.82	*378.38*	*43.80*	*salty clay*	*1.2*	*11.43*	*25.27*

Data measurements began from the first day, until the end of the experiment (15th November 2012), including the following experimental data :

- *Plant Density (plant/m²):* Plant density calculate by making square from metal silk it area 225cm², then randomly throw on the flat to calculate plant number that located in that area of 225cm² *[14]* .
- *Active Root (cm):* It was collected in 50 % for the plant root, which effective collects and roots that absorb a large part of the food in that region.
- *Root Depth (cm):* Calculated by the Measuring the depth of the tape root.
- *Soil infiltration (cm):* The speed of water pass in the soil on the way of (Double – ring infiltration field test). Is a measure of the rate of the soil ability to absorb rainfall or water irrigation *[15].*
- *Bulk Density (gm/cm³):* Soil density was calculated by a known cylinder volume terms were incorporated in the soil for a distance of 15cm and then cast out the soil and then took the weight by density equation and found soil density *[16].*

Data were analysis by use SPSS program and the means are test by use Duncan multiple rang test at 5% level *[17].*

Results and Discussion

1-*Effect of Aeration on Plant Density, Active roots, root depth, Bulk density and soil infiltration:* The data in table 2 showed that the effect of aeration on plant density was significant and it reached 520 plant/m² compared to without aeration 28.50 plant/cm². In addition, the active root increased significantly to 14.50 cm as a result to aeration treatment when compared to without aeration 12.50 cm. Similarly, the root depth increased to 37.50 cm when compared to without aeration, which record 25.00 cm. Although the bulk density was statically insignificant as a result to these treatments, the soil infiltration reach the highest signification value 0.65 cm obtained by aeration compared without aeration 0.43 cm.

Table- 2: Effect of aeration on plant density plant/m², active roots (cm), root depth (cm), Bulk density (gm/cm³) and soil infiltration (cm).

Treatment	*Plant density*	*Active root*	*Root depth*	*Bulk density*	*Soil infiltration*
Without aeration	*456b*	*12.50b*	*25.00b*	*1.81a*	*0.43b*
Aeration	*520a*	*14.50a*	*37.50a*	*1.81a*	*0.65a*

Means with same letter for each characters are not significantly different at 5% level based on Duncan's Multiple Rang Test.

These result agree Liang *et al.*(1996) *[18]* on the Maize (*Zea mays*) The number of main root and secondary lateral roots from segments of primary adventitious roots increased dramatically when soil water content decreased and oxygen increase in the soil, also agree with (Sayed *et al,* 2012) *[19]* on turf thus promoting good root development. This is confirmed by an improved amount of plant density, fresh and dry roots, and a net root elongation. As well bulk density lose porous soils and those rich in organic matter have lower bulk density, may be refer to the Aeration treatment which increase the soil oxygen exchange therefore increase soil aerated and increase the roots depth, active roots and plant density, also the water infiltrate can be improved as the air tunnels increased, also the soil aerated removed the thatch layer that reduce the root deep in the soil and soil aerated then help the root to absorb water from the soil *[15].*

2- *Effect of Compaction on Plant Density, Active roots, root depth, Bulk density and soil infiltration*: The data in table 3 clarified that the compactions with 70 kg decrease significantly the plant density 26 plant/cm² comparable with without compaction that give 560 plant/ m². In addition, the active root decreased significantly to 11.50 cm as a result to the upper treatment when compared with the without compaction 15.50 cm. also the root depth and soil infiltration decreased to 23cm, 0.32cm respectively as a result to the same factor, while the non compaction give the highest values 39.00 cm and 0.76 cm for the two treatment respectively. In the other hand bulk density increased significantly 1.87 gm/c³ as a result to compaction the lawn plant with 70 kg when compared with non compaction 1.74gm/cm³.

Table-3: Effect of compaction on plant density (plant/m^2), active roots (cm), root depth (cm), Bulk density (gm/cm^3) and soil infiltration (cm).

Treatment	Plant density	Active roots	Root depth	Bulk density	Soil infiltration
Compaction	416 b	11.50 b	23.00 b	1.87 a	0.32 B
Without compaction	560 a	15.50 a	39.00 a	1.74 b	0.76 A

Means with same letter for each characters are not significantly different at 5% level based on Duncan's Multiple Rang Test.

This results agree with Shierlaw and Alston (1984) *[20]* and WBTV(2010) *[21]* may be related to the Low soil oxygen which caused by soil compaction so limiting plant growth. Primarily soil compaction, contribute in 80% of the plant disorders in the landscape setting. In addition, the compacted of clayey soils lead to a shallow rooting system with reduced plant growth, lower vigor, and lower stress tolerance. Aeration enhances infiltration of rainfall or irrigation because of the air spaces between soil particles that help the water to infiltrate down easily, with pressure leading to break the soil.

3- *Effect of interaction between aeration and compaction on Plant Density , Active roots , root depth , Bulk density and soil infiltration:* The interaction between aeration and compaction showed significantly effects on all characters in table 4 and the less values for plant density, root depth, active root, and soil filtration respectively reach 400 plant/m^2, 22.00 cm. 11.00 cm. 0.25 cm for the plants that compaction and aeration compared with the highest value 640 plant/m^2, 53.00 cm, 18.00 cm, 1.06 respectively that obtained in the lawn grasses that non compacted and aeration, except bulk density that give the opposed result . These result agree with Crush and Thom (2011) *[22]* that Soil compaction restricts root penetration resulting in poor anchorage and susceptibility of plants to uprooting during grazing in addition access to moisture and soil nutrients in reduced which decreases the fitness of sward under stress condition. As well agree with Ungerand and Kasper (1994) *[23]* not all parts of a root system are equally exposed to compaction under field conditions.

Table-4: Effect of interaction between compaction and aeration on plant density (plant/cm^2), active roots, root depth, Bulk density (gm/cm^3) and soil infiltration (cm).

Compaction	Aeration	Plant density	Root depth(cm)	Active root(cm)	Bulk density	Soil infiltration
Compaction	**Aeration**	400c	22.00c	11.00b	1.95a	0.25b
	without aeration	432bc	24.00bc	12.00b	1.80b	0.40b
without compaction	**Aeration**	640a	53.00a	18.00a	1.67c	1.06a
	without aeration	480b	26.00b	13.00b	1.82b	0.47b

Means with same letter for each characters are not significantly different at 5% level based on Duncan's Multiple Rang Test.

Hence, because of compensatory growth by unimpeded parts of the system, only the distribution and not the total length of roots may be altered. The most important reason to aerate lawn is to reduce soil compaction. The ability of grass to absorb water and nutrients was directly related to the depth and strength of the root system. Thatch can prevent water and nutrient materials from penetrating beyond the ground surface and this leads to the roots of grass only growing close to the surface. This makes the turf susceptible to damage and can cause grass to thin and dry out over time. Core aeration reduces thatch accumulation, minimizes its buildup and modifies its makeup by incorporating new soil into the thatch *[24].*

Depending on results of the study conclude the following : We conclude that using Aeration caused significantly increased in Plant density, root depth, active root, and Soil infiltration when compared with non-aeration. But compaction with 70 kg decreased Plant density, root depth, active root, and Soil infiltration when compared with non-compaction. In contrast, the bulk density was increased significantly.

Based on the results and conclusions of the study, we recommend to aerating lawn yards that are exposed to heavy traffic**,** walking, playing and compaction by using special machines that extract pieces (core).

Figure 1 : Ryan Lawnaire V plus aerator

Figure 2 : Plugs shape (core) from aeration

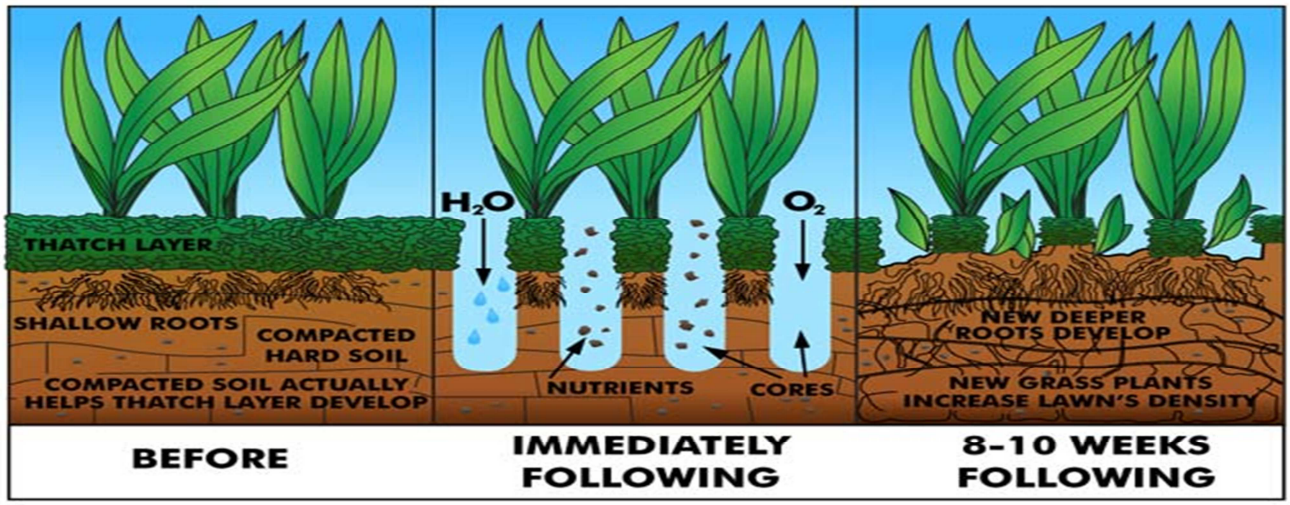

Figure- 3 : Aeration effects on soil and lawn grasses (Source : *[21]*)

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