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# Evaluation of Effect of Organic Fertilizer's Treatments and Soil Compaction on the Qualitative Traits of Sport Lawn in Different Seasons

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**Abstract:** Natural structure of lawn brings about the sensitivity of it to climate conditions and imposed destructive forces during its use. In this study, the effect of several types of organic fertilizers including leaf mold (LM), rice husk (RH), livestock manure, spent mushroom compost (SMC), a mixture of LM, RH and livestock manure (mixture 1), a mixture of LM, RH and SMC (mixture 2) with the ratio of 1:1:1 and control (no fertilizer) along with several levels of compaction including roller weighted of 36, 56 and 76 kilograms were studied on the change qualitative traits of sport lawn in different seasons. An experiment was conducted at the strip plot design in three replications, in research farm of Gorgan University of Agricultural Sciences and Natural Resources during 2008-2009. According to the results, the chlorophyll rate in the fall was higher than winter and spring. With the comparison of the cover rate, density and height, it was observed that in different seasons, the highest and lowest rate of these attributes was related to spring and summer respectively.

**Keywords:** Appearance quality; Chlorophyll; Media; Roller; Traffic.

## 1. Introduction

Traffic is sources of abiotic stress that can impose two distinct forms of injury on lawn including lawn wear and soil compaction. Lawn wear can include tissue tearing, tissue bruising and tissue removal from horizontal forces. Physical injuries to the shoots result in chlorophyll degradation and subsequent reduction in photosynthesis. Secondary effects include increased susceptibility to insect or fungal attack at the sites of injury or increase weed pressure due to loss of lawn density. Soil compaction as the second type of traffic damage is initially expressed at the root system level. Roots suffer from reduced growth and viability in response to low soil $O_2$ and increase soil strength. The overall effect of these injuries is inhibition of lawn growth, loss of density, and premature senescence of shoot or root tissue (Vanini *et al*., 2007; Trenholm *et al*., 2000; Bidoki *et al*., 2002). The amount of traffic stress injury depends on the lawn growth stage and species, environmental conditions, soil type and bed preparation, intensity, and type of traffic, amount of soil moisture etc. Long way to reducing this type of stress, is an evaluation of breeding cultivars that have improved wear tolerance characteristics. But, direct and shorter way in doing this is using special management in planting and maintenance of lawn. Fertilization programs influence the ability of lawn to withstand the different damages. Excess nitrogen fertilization will reduce wear tolerance. This occurs because the nitrogen causes rapid growth of the grass, which results in lush, succulent tissue that is susceptible to mechanical injuries. Proper nitrogen fertilization, however, will improve wear tolerance in two ways. First, it will promote greater shoot density (number of shoots per unit area) of the grass, thereby providing more shoot tissue to absorb the injury. Secondly, it will allow for faster regrowth following the injury and will promote new lateral growth to help the grass cover any bare ground resulting from the injury (Kohlmeier and Eggens, 1983). Potassium fertilization also strongly influences lawn's tolerance to many stresses, including

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wear injury (Trenholm, 2000). In an experiment, Trenholm *et al*., (2001) were evaluated the effect of different rates of potassium on wear tolerance of three hybrid *Cynodon dactylon* cultivars and seven ecotypes of *Seashore paspalum*. They found that potassium, with increase cell turgidity, shoot density and reduction in tissue succulence and total cell wall, provided shoot tissue with greater mechanical strength to withstand the pressures and abrasions resulting from wear injury. As it is mentioned, the severity and duration of traffic influence the ability of recovery after stress usage. In most conducted researches on turfgrass wear tolerance, two levels of traffic stress (concentrated and dispersed) are used. In concentrated traffic, the rate of desired stress is applied all-at-once, while in dispersed stress the same amount of traffic is applied repeatedly (Minner and Valverde, 2002). Traffic tolerance of species *Festuca*, *Lolium perenne*, *L. multiflorum*, *Poa pratensis*, *Agrostis palustris* and *A. capillaris*, was evaluated by Minner and Valverde, (2003) in spring and fall seasons. Each species received two levels of traffic stress. Traffic stress was applied with a **GA-SWC**[1] traffic simulator (Carrow *et al*., 2001). In spring experiment, turf cover in *Festuca* sp. and *L. perenne* and in fall experiment, turf cover in *L. perenne* was significantly more than other species. Overall, recovery seemed to be slightly better in plots with concentrated traffic. In this study, the effects of seven types of different organic fertilizer at three levels of soil compaction were evaluated on the qualitative factors of sport lawn in Gorgan conditions in different seasons.

## 2. Materials and Methods

The research was conducted in two stages of field and laboratory, at research farm and laboratories of agronomic sciences faculty in Gorgan University of Agricultural Sciences and Natural Resources during 2008-2009. The experimental design was a strip plot with three replications. Lawn used was sports lawn, seed mixture of *Lolium perenne* cultivar "Rival" (55 percent), *Poa pratensis* cultivar "Geronimo" (35 percent), *Festuca rubra* cultivar "Rubra" (5 percent) and cultivar "Apache" (5 percent). Organic fertilizers which were mixed to the topsoil surface included leaf mold (LM), rice husk (RH), livestock manure, spent mushroom compost (SMC), a mixture of LM, RH and livestock manure (mixture 1), a mixture of LM, RH and SMC (mixture 2) with the ratio of 1:1:1 and control (no fertilizer). In addition, three compaction treatments contained roller weighted of 36, 56 and 76 kilograms. The area of project land was $350m^2$. After plowing, leveling and implementation scheme, the land was divided into 63 experimental units with dimensions of $2 \times 2m^2$ and the distance between the experimental units was considered one meter. Then organic fertilizers applied to the soil surface in a 3cm layer and incorporated with shovel to a depth of 10 to 15cm by the worker. Three compaction treatments were applied with a roller which its weight could be changed by adding or removing water to its tank. After planting seeds with the amount of $45gm/ m^2$, other lawn maintenance operation was conducted regularly and similarly in all plots. Samples were taken in mid seasons and leaf chlorophyll content as lawn color index was determined, using 80 % acetone (Arghavani *et al*., 2006). At the end of each month visual evaluation of turf quality, based on cover rate, turf color and density (rate of tillering) were performed on a rating scale that ranged from 1 to 9 with 9 being most desirable. In the end, their average was considered for each season (Adavi *et al.*, 2005). Height of lawn randomly was measured with a ruler in three points per every plot from the lawn crown till the end of last leaf, almost before every mowing and their average was considered (Adavi *et al*., 2005). At mid different seasons samples of every plot were taken using a mower that its cutter blade set at 5cm above ground. The dry matter rate of different treatments was determined after drying fresh samples at $70^0$C for 48 hours (Adavi *et al*., 2005). Statistical analysis was performed with SAS software. Significant differences between means were determined by LSD test at the 5 percent level (Soltani, 2007).

## 3. Result and Discussion

### 3.1 Chlorophyll

The lawn is mentally very important so that its light green color causes human's mind to be psychologically relaxed and has many positive effects on human social behaviors. Chlorophyll content is an index to compare the degree of greenery on the lawn. The result of chlorophyll measured in summer due to changing the centrifuge type was contrary to reality. Hence the result of this season wasn't mentioned. With the comparison of the total mean of chlorophyll content in fall, winter and spring, the highest chlorophyll rate was observed in fall (Fig. 1).

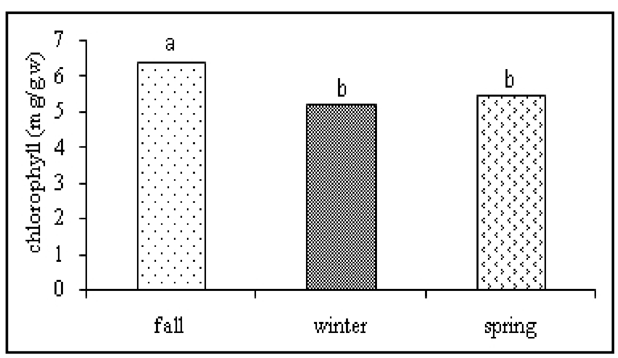


**Fig. 1. Comparison of the chlorophyll content in fall, winter and spring.**

[1] -Georgia soil compaction wear

The rate of temperature has an important effect on the color quality of a lawn. Hence due to unsuitable temperature in winter, color quality in this season was less than fall and spring. Considering the role of nitrogen in the synthesis of chlorophyll molecules (Hapkins, 1999; Meyer, 1973) and the effect of potassium in the photosynthesis and carbohydrate production (Hapkins, 1999; Ghorbanli and Babalar, 2003), the observation of the highest rate of nitrogen and potassium of plant in the fall (Fig. 2; Fig. 3) could be another reason for increased chlorophyll content in this season.

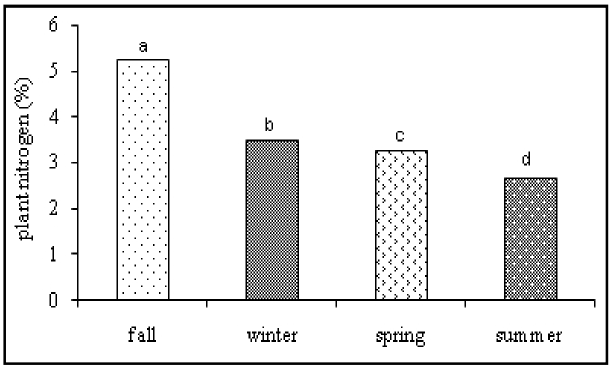


**Fig. 2. Comparison of the nitrogen content of plant in different seasons.**

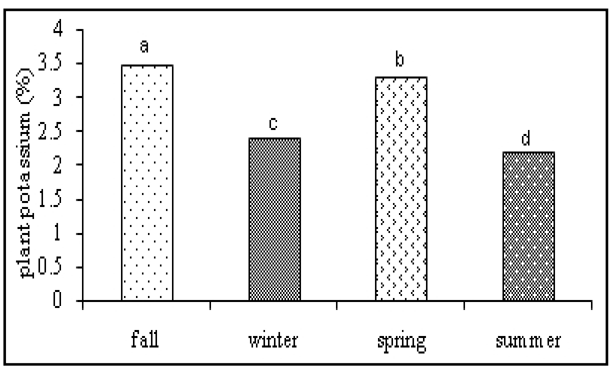


**Fig. 3. Comparison of the potassium content of plant in different seasons.**

### 3.2 Cover rate, Density and Greenness

Since the more cover rate in lawn ground provides more traffic tolerance (Minner and Valverde, 2006) therefore in this study the cover rate of each plot was determined in terms of covering more than 90 percent of the surface plots. Different seasons in terms of cover rate showed significant differences in comparison with each other. The most cover rate was observed in the spring and had no significant difference with fall and winter ($p > 0/01$). The summer was indicated the lowest cover rate (Fig. 4). The other factor that affects the quality of lawn is density. Density is number of shoot or tiller per unit area which is depending on the lawn's genetic and environmental factors. Lawn density influence uniformity and appearance of the lawn (Fallahian, 2006). In different seasons, lawn's density showed significant influence. The difference between fall and winter in terms of density was not significant (Fig. 5). With the comparison of the rate of greenness between different seasons, the fall and summer had the best and the least greenness respectively; but winter and spring had no significant difference with each other in this case (Fig. 6).

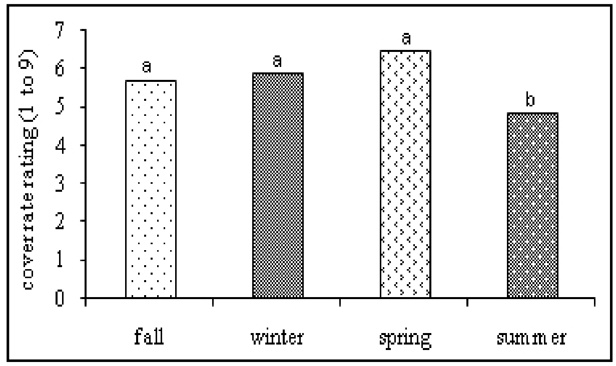


**Fig. 4. Comparison of the cover rate in different seasons.**

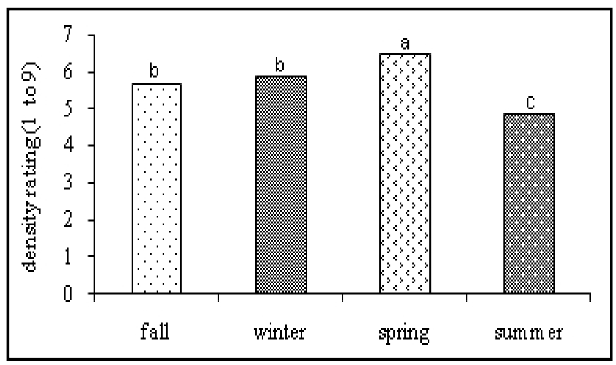


**Fig. 5. Comparison of the density in different seasons.**

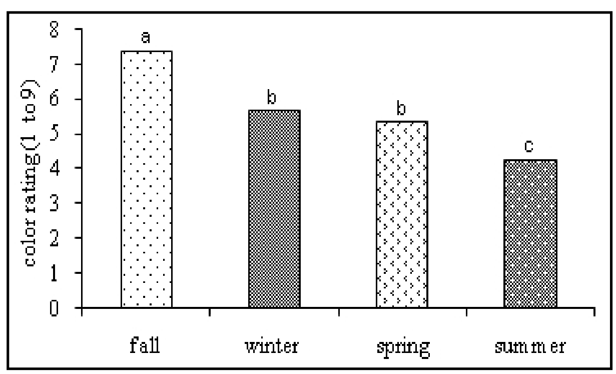


**Fig. 6. Comparison of the greenness (color rating) in different seasons.**

Generally, color, cover rate, and density are under influence of species and cultivar, maintenance operations, environmental factors, disease, severity and type of traffic (Fallahian, 2006). For example, in Adavy *et al*., (2005) experiment, it was determined that temperature has an influence on the lawn color. The color difference is specified especially in early and late of growing season (Fallahian, 2006). Since the optimum temperature for the growth of cool season lawn is 15/5-24$^0$C, with increasing temperature in summer, the color quality was reduced (Fig. 6), while the best color quality was observed in the fall. Also, suitable temperature and rainfall in fall created more cover rate and density in experimental plots of this season (Fig. 4; Fig. 5). On the contrary, the average cover rate and unsuitable density were observed in summer. Fertilization programs strongly influence the lawn growth and its ability to withstand various damages. The result of high consumption nitrogen in the lawn is an excessive increase in cover rate and density and reduction in lawn traffic tolerance. Also, potassium fertilizers with preserving carbohydrates inappropriate level caused an increase in stem growth and create dark green color in leaves so in this way influence many stresses like traffic stress (Trenholm, 2000). In this study, the most and the least nitrogen and potassium content of the plant were observed in the fall and summer samples respectively (Fig. 2; Fig. 3). The other effective factor on the cover rate and the number of plants in each plot is soil compaction. Compacted soils play the most important role in reducing natural growth of lawn (Fallahian, 2006). Compact soil reduces its permeability against the movement of lawn proliferation organs (Rhizome and Stolons). Rhizome and Stolons grow rapidly in soils with balanced texture while they're spreading is decreased due to the heavy texture or compaction rose by foot traffic (Kafi and Kaviani, 2002). In this study, with applied compaction treatments at the end of every month, formation of a rigid layer in soil surface was quite evident to form in summer time. Such a layer at the soil surface will prevent absorption and passage of water, nutrient and gas exchange between soil and atmosphere, therefore, the rate of plant density and cover rate in summer was less than other seasons. Since in most plants especially lawns, water shortage are the main factor in limiting the growth of plants (Arghavani *et al*., 2006), hence in the fall due to more rainfall more cover rate and density was observed than summer (Fig. 4; Fig. 5). As it mentioned the stage of lawn growth influence the amount of cover rate and density. So that in this study the amount of these factors in the fall and winter were less than spring. With the passage of time and development of tillering, maximum density and cover rate were observed in spring. Also due to applied compaction at the end of every month, the least cover rate and density was observed in summer. These results were consistent with Tehrani far *et al.*, (2005) results. If all the mentioned conditions were suitable, maximum density and cover rate and also best color quality would be observed.

### 3.3 Height

In the current study, the effect of the different beds and compactions were determined on the total mean of lawn height. With the comparison of the height rate in different seasons, a significant difference with the probability of 1 percent, in terms of height rate was observed between seasons. According to Fig. 7, the maximum and the minimum height was observed in the spring and summer respectively.

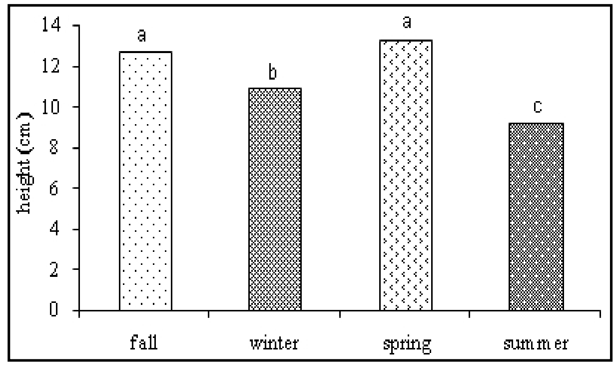


**Fig. 7. Comparison of the height in different seasons.**

Since the desirable growth of investigating the lawn as a cool season plant occurs at a temperature range between 15/5-24$^0$C, so as the weather became warmer, the lowest height growth was observed in summer. On the other hand, the growth of many plants is related to the available amount of water. More rainfall in fall, winter and spring could be another reason for higher plant height in these three seasons compared with summer. Observing highest potassium content of plant in fall and lowest in summer confirms the above theory. Because, potassium is known as an osmotic active element and effective in water absorption and its deficiency is observed to a reduction in plant growth rate (Malakoti and Homaii, 2005). So generally the main reasons for low growth and low height of plants in the summer could be: less rainfall, reduction in aeration and nitrogen content of the plant (Fig. 2), high temperature and lawn standstill in this season. Also, the amount of height in fall due to enough nitrogen offered (Fig. 2), appropriate aeration and temperature was more than winter. While maximum height was observed in spring with less nitrogen plant. This shows that lawn has reached its maximum growth stage in this season. More density and cover rate in this season confirm the above theory (Fig. 4; Fig. 5).

### 3.4 Plant Dry Matter

Fresh Plant materials are made from water, minerals and organic compounds. With the comparison of the total mean of the leaves dry matter in all four seasons, the difference between seasons was significant in the probability level of one percent. So that the percent of the dry matter rate from fall to summer showed an increasing trend respectively (Fig. 8).

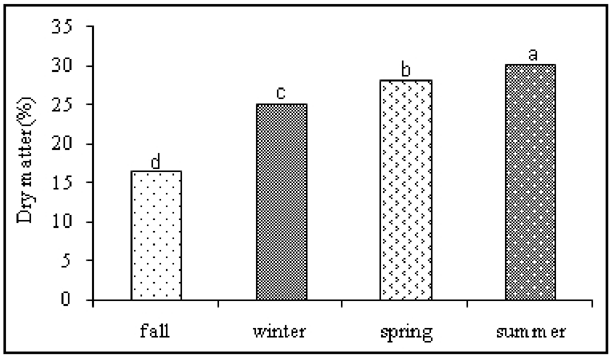


**Fig. 8. Comparison of the plant dry matter in different season.**

Increase in percent of the lawn dry matter in summer might be related to the more fiber percent, lower moisture, and type of leaf tissue in this season so that all treatments in the fall and winter had a softer texture than spring and summer. On the other hand, numerous experiments show that 75 percent of lawn fresh tissue is composed of water. The amount of this water also depends on the type of plant tissue, environment moisture and plant age (Elyas Azar, 1995). So obviously younger tissue (lawn in the fall), due to more moisture in the environment and less age had less dry matter than older tissue (lawn in summer). In this study, reduction in potassium content of plant in summer (as an osmotic active element and effective in water absorption) and also its increase in fall confirmed the above theory.

## 4. Conclusion

In each three compactions, the best color quality, maximum density, and cover rate were associated with manure and the minimum of these factors was related to control and LM in different seasons. In the fall, the maximum chlorophyll of first, second and third compaction was observed in SMC, mixture 2 and manure treatments separately. In winter, manure and RH treatments of first and second compaction and manure treatment of third compaction showed the maximum chlorophyll. Finally, in spring, the maximum chlorophyll of each three compactions was detected in mixture 2. Control and LM treatments in all compaction contained the least chlorophyll.

According to the result of the current study, each of bed mixtures includes SMC or livestock manure would be suggested to the relevant experts in order to improve qualitative traits of sport lawn in a particular season.

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