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Effect of Fertilizer and Soil Compactness Interaction on N, P and K in the Culture of Lawn

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Abstract

Under favorable soil conditions such as existence of easily destructible organic compounds, balanced heat and moisture, adequate ventilation and abundant nutrients, organic materials are mineralized. Once mineralizing occurs, mineral elements like P, S, Ca, Mg, K and other cations are released. A related study was conducted to determine the effect of seven organic fertilizers (Leaf Mold (LM), Rice Husk (RH), manure, Spent Mushroom Compost (SMC), mixture of LM, RH and SMC (M1), mixture of LM, RH and manure (M2) with the ratio of 1:1:1 and control) at three levels of soil compactness (roller weight of 36, 56 and 76 kg) on N, P, K content of soil and aril parts of sport lawn. Treatments were applied as 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 of this study, in all three compactness levels, treatments containing manure and SMC showed more N and K in contrast to control treatment. The most content of soil P in each compactness level was observed in plots fertilized with manure. The manure and control treatments showed the most and the least amount of plant nitrogen in all compactness treatments respectively. The manure and SMC treatments and also treatments containing these organic matters increased plant phosphorus content in compare with RH, LM and control treatments. Also in three compactness, manure and SMC treatments showed more plant potassium in contrast to control.

Keywords: Culture bed, Mineralization, Sport lawn.

INTRODUCTION

Adding organic and inorganic materials to the soil before lawn cultivation improves soil conditions and accelerates root growth. Organic materials are vital factors for soil fertility (Naderi and Kafi, 2005). Soil micro organisms use soil organic materials as food and remove nutrients over their use. This releasing is called mineralization (Jamialahmadi *et al.,* 2006). Temperature, moisture, soil physicochemical characteristics, different stages during analysis process and also chemical composition of used organic material are some effective factors on mineralization (Mahmoudi and Hakimian, 1995; Tajbakhsh *et al.,* 2005). Knowledge of the extent of organic fertilizers effect on soil different nutrients could help us to plan plant nutrition and to supply plant required nutrients (Charati *et al.*, 2009). In a research, changes of available nutrients in nutrient solution extract of rice husk, poultry manure, sawdust, lawn cutting residues, and common coal organic fertilizers during different times of 4, 12, 36, 108, and 324 h was investigated. Their results showed that the amount of available elements of different organic materials differ significantly as the highest and the lowest N devoted to poultry manure and common coal respectively. There were no changes for P in lawn cutting residues after 36 h and in the rest treatments after 108 h. The highest amount of P was related to poultry manure. There was a steady variation in metallic ions concentration of nutrient solution extract during 36 to 108 h for which common coal contained the lowest K and rice husk and poultry manure contained the highest K (Yansong *et al.,* 2007). Ofuni and Rezaeinejad (1998) studied the effect of manure and Isfahan compost on soil chemical characteristics and nutrients absorption by corn. Results of this research showed that organic fertilizers increase significantly organic material, P, K and total N percentage in soil. In another research, the effect of different organic fertilizers on chemical characteristics and enzymatic activity of oxisole soil was inspected under intensive culture of vegetable during 4 years. Five organic fertilizers comprised manure compost (cow, pig, and poultry), pea residues and also soybean flour as well as using a chemical fertilizer called CF. Averagely, the highest amount of N mineralization was related to poultry manure and then pig manure compost. It means that organic N decomposing two mentioned treatments is more than other ones (Chang *et al.*, 2008). Also a research has been carried out on the impact of different amounts of compost on the content of phosphorous, nitrate and organic carbon of *Stenotaphrum secundatum* lawn. It was revealed that after 29 months of adding compost, the content of soluble organic C and also P availability enhanced but nitrate availability decreased severely (Wright *et al.*, 2008).

Considering the positive roles of organic fertilizers in improving soil physicochemical and biochemical characteristics and also different absorption of nutrients in various compactness levels, in the present study, we investigated the effect of several culture beds in some compactness levels on N, P and K amounts of soil and aerial parts of sport lawn under Gorgan conditions.

MATERIALS AND METHODS

This experiment was performed in research farm and laboratories of plant production College of Gorgan University of Agricultural Sciences and Natural Resources during 2008-2009 by split plots design in three replications. Used lawn 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). Bed cultures included leaf mold (LM), rice husk (RH), spent mushroom compost (SMC), manure, mixture of LM, RH and SMC (M_1), mixture of LM, RH and M (M_2) in ratio of 1:1:1 and also control and three compactness treatments contained rollers with weights of 36, 56 and 76 kg. This project was performed in a field with area of 350 m^2. After plowing, leveling and implementation scheme, the field was divided into 63 experimental units with dimensions of 2 × 2 m^2 and the distance between the experimental units was considered one meter. Organic fertilizers applied to the soil surface (silty clay loam) in a three cm layer and incorporated with shovel to a depth of 10 to 15 cm. At the end of each month, three com-

paction 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 45 gr/ m^2, other lawn maintenance operation was conducted regularly and similarly in all plots. In the middle of fall, soil samples were collected of 0 to 15 cm depth of all plots and were transferred to the lab. Soil samples were dried in open area, were powdered, were passed of 2 mm mesh and were maintained in numbered nylon bags for chemical analysis. Kjeldahl was used to measure soil total N. The amount of absorbable K was determined by ammonium acetate extraction method and by Olsen method for absorbable P (Aliehyaei and behbahani, 1993).Also at the mid of fall, samples of every plot were taken using a mower with cutter blade set at 5 cm above ground. Dry matter rate of different treatments was determined after drying fresh samples at 75-80 ˚C for 48 hours (Adavi *et al*., 2005). To determine the nitrogen in plant tissues, Kjeldahl device was used (Emami, 1996). After the preparation of plant tissue extract, the amount of potassium and phosphorus were measured by flame photometer and spectrophotometer device respectively (Aliehyaei and Behbahani, 1993). Data were analyzed by SAS software. Mean comparisons were carried out by LSD test ($p \leq 0.05$) (Soltani, 2007). Microsoft Excel 2007 was used for drawing graphs.

RESULTS AND DISCUSSION

Nitrogen

Fertilizer and compactness variance analysis results showed that their interaction is significant ($p \leq 0.01$) for total N. Means comparison also showed that total N amount of fertilized plots is higher than control plots. As SMC and manure treatments contained the highest amount of N in all three compactness levels. Total N contents of M_1 and M_2 treatments in all three compactness levels did not vary significantly (Fig. 1).

In a study on the effect of different amounts and sources of organic fertilizers compost, cow, poultry and sheep manures on the productivity of greenhouse cucumber, it was detected that poultry manure impact on yield increasing is more apparent. Fertilizers analyses also showed that nutrients concentration in these fertilizers is almost similar to their effect on cucumber productivity enhancement (Ghaffarinejad, 2009). In the present study also, by N content measurement of four organic materials before treating the highest amount was detected in manure and SMC treatments (Table 1). Hence, the highest N content in three compactness was observed in two mentioned treatments.

Also, the interaction of fertilizer and compactness treatments on plant N was significant. As it has been shown in Fig. 2, in all three compactness levels, the highest and lowest plant N amounts were found in manure and control treatments respectively. N mineralization in organic residuals depends on different factors such as residuals' type and form (Nourbakhsh, 2004). Larger particles and more lignin and cellulose content will result in lower decomposition rate (Haghnia, 1995). The present study demonstrated as well that plants cultured in LM and RH (alone) contained lower N (Table 1) towards the rest treatments (except control) due to comprising lower N, higher lignin and cellulose and in result lower mineralization in the most compactness.

Phosphorus

Interaction of fertilizer and compactness treatments on P content of soil was significant ($p \leq 0.01$). According to Fig. 3, in all three compactness levels, the highest P amount attributed to the plots containing manure. The lowest amount of P for the first and second compactness levels was found in LM treatment and for the third compactness level was related to control treatment. There was no significant difference among M_1 and M_2 as well as control, LM, and RH in all three compactness levels for absorbable P amount.

The interaction of fertilizer and compactness treatments on plant P content was insignificant while the effect of fertilizer on it was significant. Maximum and minimum P concentrations in this season were found in manure and control treatments respectively (Fig. 4).

Measuring P content of four organic materials used in this research, manure and SMC treatments contained the highest P amount (Table 1). So, treatments containing these two organic materials showed the highest P amount to the rest treatments.

On the other hand, mentioned organic materials inhibit P stabilizing and its converting to insoluble compounds by decreasing pH and making organic – metal complexes (Keshavarz and Delavari, 2009; Samar and Malakouti, 1998; Nourbakhsh, 2004; Forghani and Kalbasi, 1994; Naghizadehasl *et al.*, 2009; Wright *et al.*, 2008).

Potassium

Interaction of fertilizer and compactness on soil usable K amount and plant K was also significant ($p \leq 0.01$). Mean comparison showed that the highest K content in all three compactness levels was related to manure and SMC treatments, while, the lowest one was observed in control treatment (Fig. 5; Fig. 6).

Because of high K amount in two organic materials of manure and SMC (Table 1), it is obvious to find more K in plots containing these two above organic materials to control treatment.

Also, since organic acids obtained of organic materials' decomposition play apparent role in K releasing and increasing soil CEC (Talibudeen *et al*., 1978; Kouchaki and Khalghani, 1998), all fertilizer treatments showed more K than control treatment. In this case, there are numerous reports by researchers indicating increase in CEC and in result increase in nutrients' availability such as K due to mixing organic materials with soil (Aoyama, 1999; Hudson, 1994; Mikhailova, 2003; Berry, 2003; Kabiri nejad *et al.*, 2009).

Another reason for more K content of fertilizer treatments over control treatment is that these fertilizers provide ideal conditions for beneficial micro and macro organisms by making available adequate water, food, air and temperature (Tajbakhsh, 2005; Kuma and Malik, 2000) and through which enhance nutrients like K availability for plant (Wortmann and Jasa, 2003).

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Tables

Table 1. Chemical analysis results of four organic fertilizers before treatment application.

nutrient	LM	RH	SMC	Manure
Nitrogen (%)	0.94 c	0.87 d	1.53 b	1.96 a
Phosphorus (%)	0.08 d	0.13 c	0.2 b	0.35 a
Potassium (%)	0.2 d	0.52 c	1.54 a	1.28 b
Magnesium (%)	0.61c	0.19 d	0.94 b	0.97 a

* Same letters in a row shows non-significant differences ($p \leq 0.05$)

Figures

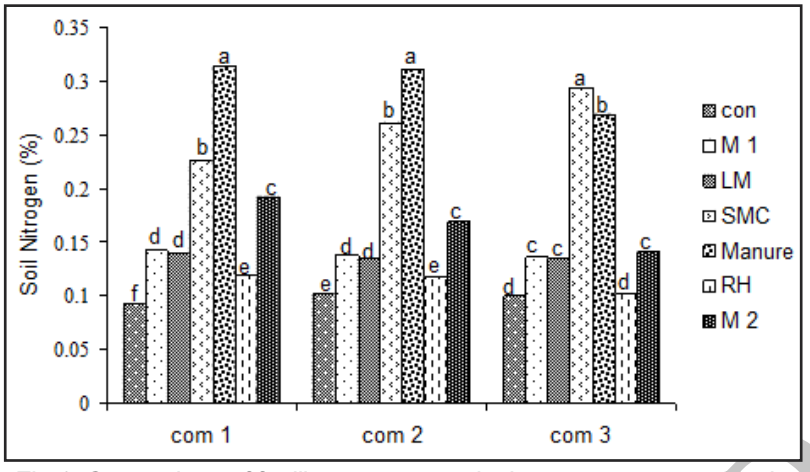

Fig.1. Comparison of fertilizer treatments in three compactness levels on soil total N in fall. Means followed by the same letter(s) are not significantly different ($p \leq 0.05$).

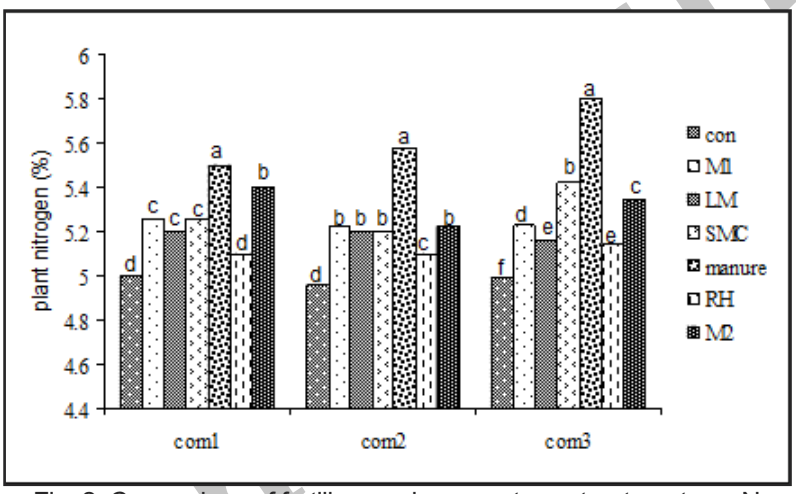

Fig. 2. Comparison of fertilizer and compactness treatments on N content of plant in fall. Means followed by the same letter(s) are not significantly different ($p \leq 0.05$).

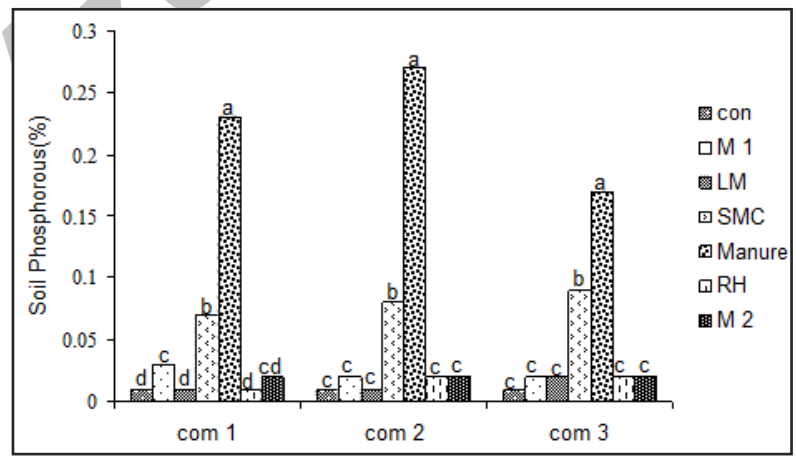

Fig. 3. Comparison of fertilizer treatments in three compactness levels on soil absorbable P in fall. Means followed by the same letter(s) are not significantly different ($p \leq 0.05$).

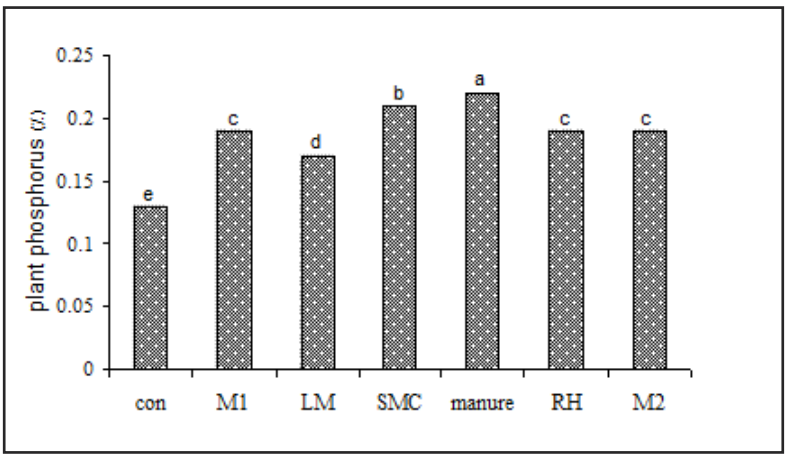

Fig. 4. Comparison of fertilizer treatments on P content of plant in fall. Means followed by the same letter(s) are not significantly different ($p \leq 0.05$).

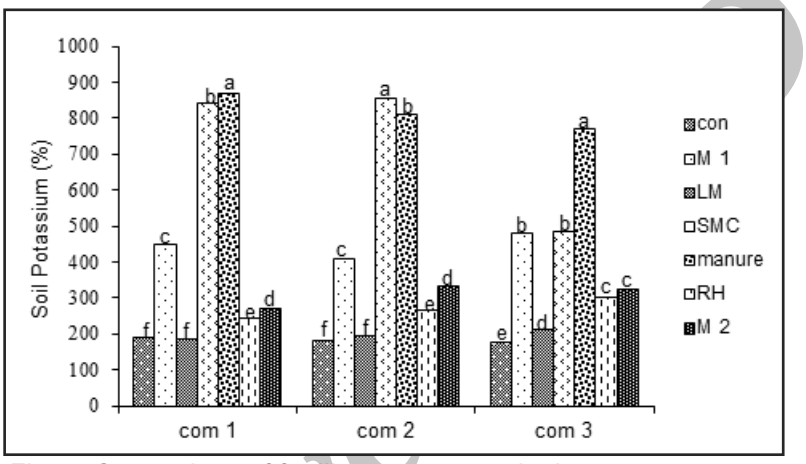

Fig. 5. Comparison of fertilizer treatments in three compactness levels on soil absorbable K in fall. Means followed by the same letter(s) are not significantly different ($p \leq 0.05$).

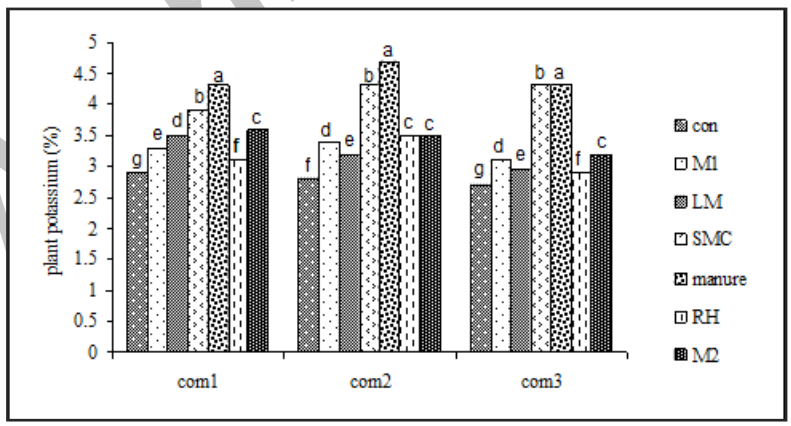

Fig. 6. Comparison of fertilizer treatments in three compactness levels on soil absorbable K in fall. Means followed by the same letter(s) are not significantly different ($p \leq 0.05$).