THE EFFECT OF COMPOST DOSES ON P- AND K-CONTENTS OF THE SOIL AND INDICATOR PLANT *(Lolium perenne L.)*

Szabó Anita, Emese Berta-Szabó, Andrea Balla-Kovács, Anita Jakab, Imre Vágó

Institute of Agricultural Chemistry and Soil Science,
Centre for Agricultural and Applied Economic Sciences,
Faculty of Agricultural and Food Sciences and Environmental Management
University of Debrecen
e-mail: szaboanita@agr.unideb.hu

Abstract
Nowadays, the interest of human society is to be concerned with the store of the agricultural side products. This is the reason why the human race is at risk because of production and volume of the wastes get higher.
Composting gives an excellent choice to recycle the huge amount of the organic wastes, which produced by the agricultural and industrial sector. The compost – completed with suitable additives or rather following right treatment technology – is excellently appropriate to apply in the nutrient management of horticulture and in soils having poor nutritional status. The application of the compost in optimal doses decreases the fertilizer requirement.

Keywords: recycling, compost ratio, P- and K-content

INTRODUCTION

The favourable effects of composts, made by biological waste materials, on soil fertility, yield and nutrient uptake of plants were published in many studies (Lee et al., 2003; Arancon et al., 2004; Füleky – Benedek, 2010). In contrast, Kádár et al. (2009) found that compost fertilization had no significant effect on yield. The disaggreements come from the different composition of diverse composts which is also influenced by seasonality.

In spring and autumn the primary materials of compost could be twigs originated from the pruning of trees and bushes or agricultural straw/chaff mixture. In summer the amount of agro-industrial by-products could be dominant. With the recycling of these seasonal organic wastes the amount of wastes disposed in landfills could be decreased (Simándi, 2008) and compost with a diverse composition could be produced (Harada, 1990).

After mixing primary materials the treatment was completed with additives (bacterial cultures). It is also important to measure the temperature during the process of composting (Alexa-Dér, 1998). As an effect of microorganisms toxic substances are neutralized, organic matters are mineralized, and produced carbon dioxide is emitted into the atmosphere (Dienes, 2002). The quality of the end-product is related to the conditions of mineralization and composition of primary materials (Kocsis, 2005).

Production of composts with a high quality and application of them under horticultural crops solves not just the problem of waste disposition, but it has a favorable effect on soil characteristics and increases soil fertility (Elfoughi et al., 2010), so it can increase the yield as well (Gigliotti et al., 1966; Keserű, 2007). In addition to these, composting is the most cost-effective option of waste management (Araújo et al., 2010).

MATERIALS AND METHODS

The studied compost was produced and provided by one of the partners of the University of Debrecen in the summer of 2009. A pot experiment, under controlled conditions, was set up in the greenhouse of the Institute of Agricultural Chemistry and Soil Science. Compost was sieved (< 2 mm), because degradation of the large particles in the pots is slow. Composts were mixed with acidic sandy soil in four proportions (5 %, 10 %, 25 % and 50 %), so with the control there were five treatments in four replications *(Table 1)*. After the volumetric mixture the pots were set up randomized.

Table 1

The compost-soil ratio of treatments

Treatments	**Compost ratio (%)**	**Sandy soil ratio (%)**
1.	0	100
2.	5	95
3.	10	90
4.	25	75
5.	50	50

After one week maturation of wet compost-soil mixture in 7th of September perennial ryegrass *(Lolium perenne L.)* was sowed. This indicator plant grows quite fast, tolerates the greenhouse conditions well and it indicates the effect of treatments well. In the greenhouse the water supply of pots was independent from the weather conditions: after the shooting of ryegrass (21st of September) the water supply of the 2.5 kg pots was carried out at 60 per cent of field water capacity of soil, because it is optimal, according to the previous researches of the Department of Agricultural Chemistry (Loch et al., 1992).

After a vegetation period of four weeks, in 15th of October, the ryegrass was harvested and air-dryed. The drying was continued at 40 ^{o}C to constant mass of plant and the dry matter production was determined. The 0.01 mol dm^{-3} $CaCl_2$ extractable P- and K-contents of soil was measured: The test plant dry matter was decomposed by addition of H_2SO_4 - H_2O_2 mixture and the P- and K-contents of plant were measured.

Methods of chemical analysis:

Air dried and sieved (< 2 mm) soil samples were shaken for 2 hours with 0.01 M $CaCl_2$ extractant (1:10 soil:solution ratio) according to Houba et al. (1990). Suspensions were centrifuged in a bench centrifuge at 2500 rpm for 10 minutes and the phosphorus contents of the supernatants were analyzed with an auto-analyzer (Continuous Flow Analyzer, Scalar SAN PLUS SYSTEM). To determine potassium content, suspensions were filtered (12-15 µm), than analyzed by flame emission spectrophotometry (UNICAM SP95B AAS).

After the grinding of the dried plant samples, 0.5 g of these were digested with a mixture of 5 cm^3 H_2SO_4 (96 %) and 5 cm^3 H_2O_2 (30 %) at 280 ^oC. Mineralized samples were made up to 50 cm^3 with twice distillated water at room temperature. The filtered solutions were analyzed. The P content was measured by the method of Tahmm et al. (1968) with spectrophotometer (METERTEK SP-850), and the K contents by flame emission spectrophotometer (UNICAM SP95B AAS). The measurements were carried out at the laboratory of the Institute of Agricultural Chemistry and Soil Science.

Statistical analyses:

For the processing of the data variance analyses was used. All statistical analyses were performed with a Microsoft Excel Macro developed by L. Tolner (Aydinalp et al., 2008; Tolner et al., 2008, Vágó et al., 2008) according to Sváb (1981). With this program the significance level of the treatment effect and significant differences at $P \leq 0.05$ were determined.

RESULTS AND DISCUSSION

The average values of the ryegrass dry mass in each treatment are represented in *Figure 1*. According to the statistical analysis of the data, the dry matter production of ryegrass was affected by the treatments on a highly significant level (P ≤ 0.01).

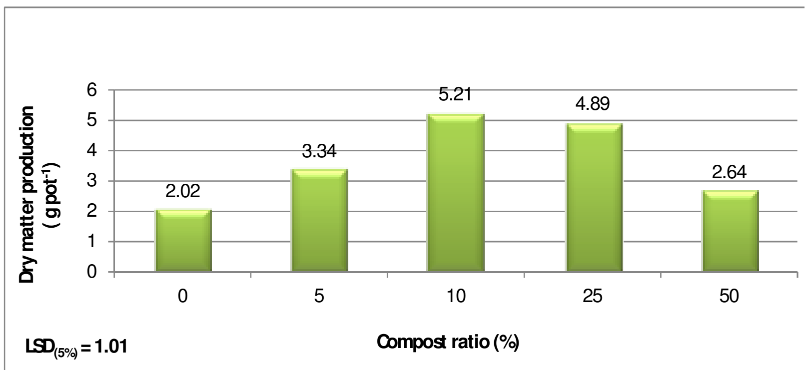

Figure 1: Dry matter production of ryegrass in each treatment (g pot^{-1})

The 10 % compost rate had the highest positive effect on dry mass. The effect of 25 % compost rate was moderately positive. In contradict, the 50 % compost rate decreased the yield. The possible reasons are the unfavourable nutrient uptake conditions caused by the high organic matter content and the ion antagonism. The results confirmed that high rate compost treatments have unfavourable effects as well. The 10-25 % compost rate seemed to be optimal.

The 0.01 M $CaCl_2$ extractable K contents of the treated soils after harvest are given in the *Figure 2*. By the increasing of compost rate potassium content increased significantly.

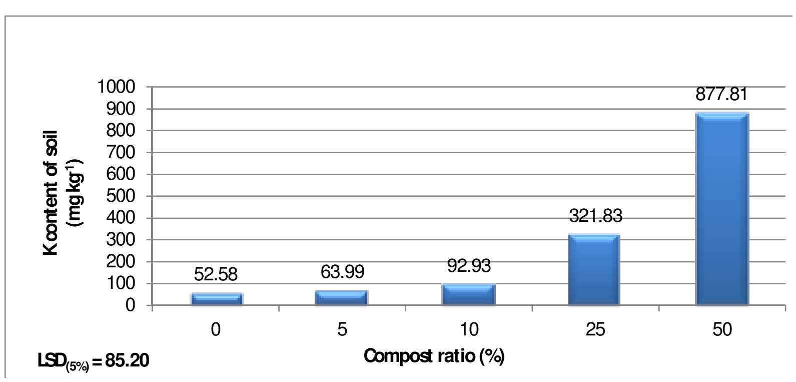

Figure 2: The 0.01 M $CaCl_2$ extractable K content of soil

5-10 % compost rates also increased K content, but these effects were not significant. In these treatments the plant growth was intensive, and plant uptake probably decreased the potassium content during vegetation period. The K content of the 20 and 50 % compost rate treatments was remarkable, and may be antagonized the uptake of other cations.

Potassium content of plant samples harvested after four weeks growing period are represented in *Figure 3*. It can be established that each compost rate increased potassium uptake, except the highest treatment. The potassium content of 5 and 50 % compost treatment did not differ significantly. According to our results the 50 % rate decreased plant growth and potassium uptake as well, and the 10-25 % rates were optimal regarding potassium uptake.

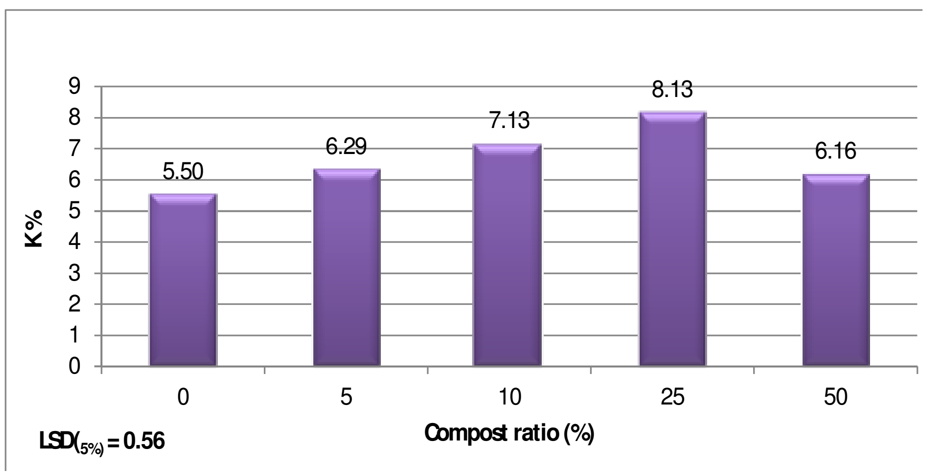

Figure 3: The K content of plant

Phosphorus content of the treated soils after harvest measured by 0.01 M $CaCl_2$ method is given in *Figure 4*. The treatments increased the easily available phosphorus content. The effect of 25-50 % compost rates was statistically proven.

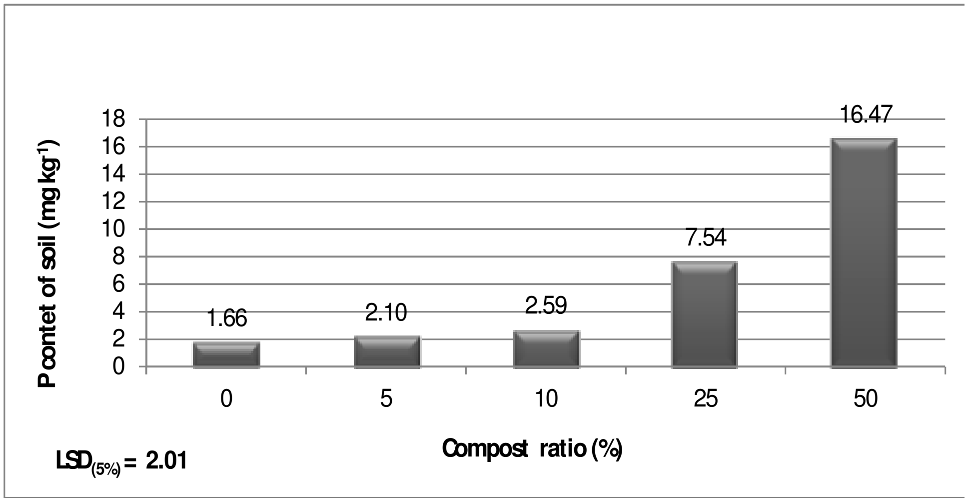

Figure 4: The 0.01 M $CaCl_2$ extractable P content of soil

The phosphorus content of ryegrass dry mass as an effect of treatments is represented in *Figure 5*. There were no significant differences between the plant P content of the treatments except the highest compost ratio. The 50 % treatment decreased the nutrient uptake significant; that is in accordance with the previous results.

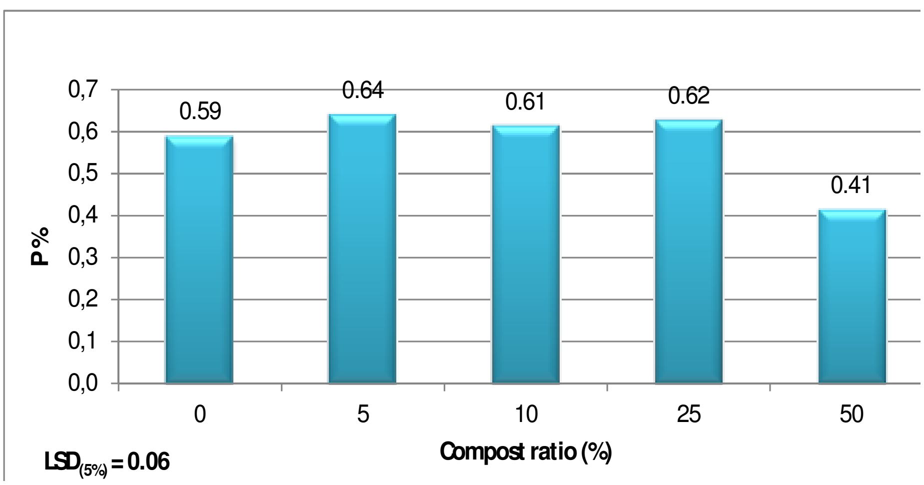

Figure 5: The P content of plant

CONCLUSION

The results of our experiment proved that the compost treatments increase significantly the potassium and phosphorus contents of the soil. According to the yield data and the plant nutrient uptake the optimal compost rate varies between 10 and 25 %. The 50 % rate treatment inhibit the growth of ryegrass. The exact explanation of this effect needs further investigations. On the base of our results we plan to set up pot experiment with further treatments (20, 30, 40 % compost rates) to determine more exactly the optimal compost rate and the inhibitory effect of compost.

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