Changing of some parameters of the soil-plant system as an effect of different composts

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SUMMARY

Composting is an alternative way for practicing site-specific and environmental friendly plant nutrient supply. Our aim was to study the effect of different composts on plant and soil system.

Pot experiment with acidic sandy soil blended with three composts in five (0%, 5%, 10%, 25% and 50%) proportion was set up. Our experimental plant was perennial ryegrass *(Lolium perenne L.)*. After the harvest of ryegrass we measured the fresh and dry weight of harvested plants, the P-, K-, Mg-contents, and the pH of soils.

The three composts had different effect on dry weight production and on nutrient-supply of soil. We established that one of the compost had significantly larger effect on the dry weight of ryegrass compared to the others. In this study we proved that favourable compost/soil proportion is different in the case of different composts.

INTRODUCTION

The location of waste emitted in increasing volume is one of the most important environmental problems of sustainable development. The disposal of by-products and waste materials formed in the public spaces of cities and during the processing of agricultural row material in a landfill is inconceivable, so we have to recycle them (Simándi, 2008).

One of the solutions for this problem is composting. Beyond this the fertilization of horticultural crops with the composted waste materials, containing a large amount of organic matter content, is one of the alternative, environmental friendly plant nutrient supply practices.

Scientific research on the positive effect of compost on soil parameters and yield has been published widely both in Hungarian and international literature (Gigliotti et al., 1966, Kádár-Morvai, 2007, Keserű, 2007).

The reason of that we chose the more accurate cognition of compost utilization is to do more effective and site-specific the nutrient supply with composts. Our aim was to study and evaluate the relations between the dry matter productions of plant, the compost:soil ration and the nutrient content of soil.

MATERIALS AND METHODS

Compost utilization experiment with 3 different composts under controlled conditions was set up in the glasshouse of the Department of Agricultural Chemistry and Soil Science. Our aim was to study the effect of different composts on plant and soil system.

We received the 3 composts from one of the partners of University of Debrecen in 2009. The composition and the production method of them is confidential. Composts were 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%), in four repetition *(Table 1)*. After the volumetric mixture we set up the pots randomised.

Table 1

The compost-soil ratio of treatments

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

After one week maturation of compost-soil mixture we sowed perennial ryegrass *(Lolium perenne L.)*. The advantage of ryegrass is that it grows quite fast, tolerates the glasshouse conditions well and it indicates the effect of treatments well. After the shooting of ryegrass the water supply of the 2.5 kg pots was carried out at 60 per cent of field water capacity of soil. In our department previous researches confirmed that irrigation at 60 per cent of field water capacity is optimal in sandy soils (Loch et al., 1992).

After the harvest we measured the fresh- and dry mass of ryegrass. We investigated the 0.01 M $CaCl_2$ extractable P-, K-, Mg-content and the pH values of dried and sieved soils.

Chemical analysis:

a.) 0.01 M $CaCl_2$-soil extraction method

The P-, K-, Mg-contents of the soils were measured in 0.01 M $CaCl_2$ extractant (Houba et al., 1990) with UNICAM SP95B AAS and SKALAR Continuous Flow Analyzer at the laboratory of the Department of Agricultural Chemistry and Soil Science. We measured the pH of the soils after 0.01 M $CaCl_2$ extraction.

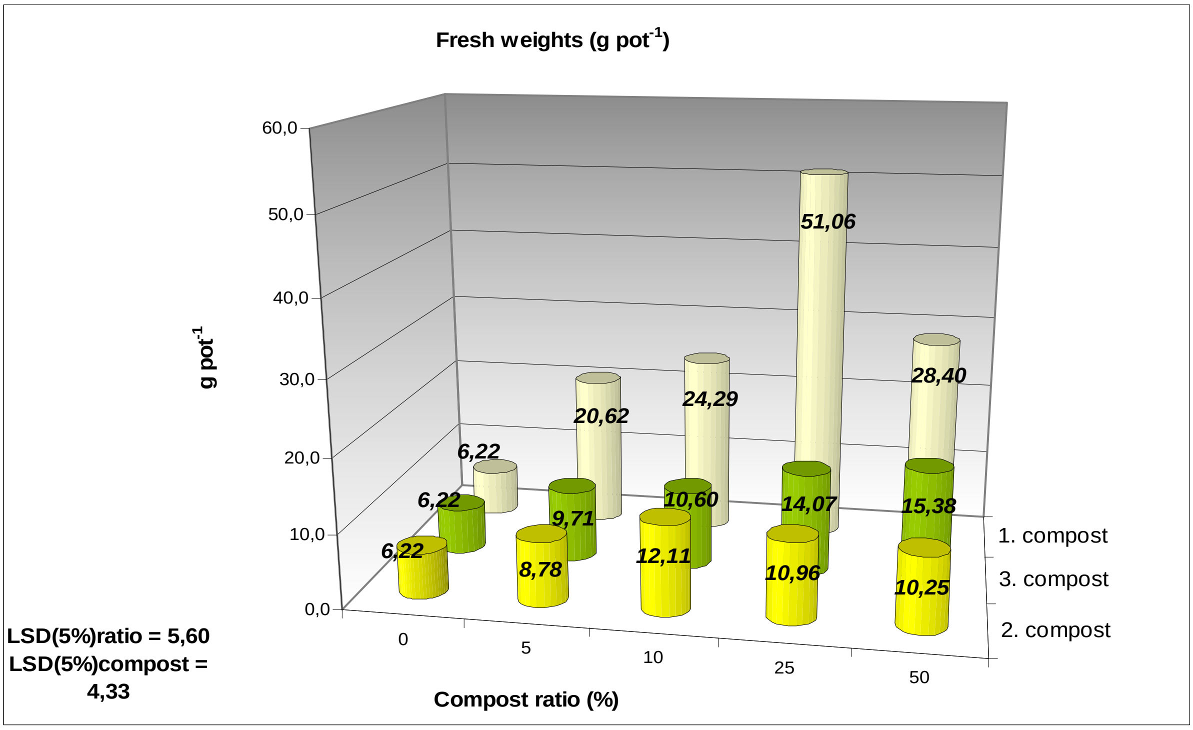
b.) Statistical analyses

We used variance analyses for the processing of the data. All statistical analyses were performed with a Microsoft Excel Macro (Tolner, 2008; Vágó, 2008) according to Sváb (1981). With this program we determined the significance level of the treatment effect and significant difference in P = 5% (LSD5%).

RESULTS AND DISCUSSION

The fresh- and dry weights of ryegrass in each treatments (5 compost: soil rate; 3 compost) are shown in *Figure 1* and *Figure 2.*

Figure 1: **Fresh weight production of ryegrass in each treatment (g pot^{-1})**



As it is represented in *Figure 1* and *Figure 2* the compost:soil ratio and the different composts had a significant effect (P = 0.1%) on the fresh and dry weight of ryegrass.

We found the highest positive effect in the case of 1st compost. If a 25% compost dose were applied, the fresh weight increasing effect of 1st compost would reach a value of 45 g pot^{-1}. The increasing dose of compost didn't caused higher yields. It can be stated that the optimal compost:soil ratio is 25:75%. The 25 and 50% dose of 3rd compost increased significantly the yield. The yield increasing effect of 50% compost was nearly 10 g pot^{-1}. The 2nd compost had a moderate effect, but the 10% compost dose increased significantly the dry and fresh weight of ryegrass. As the data show the recommended compost doses are different for each compost.

Figure 2: **Dry weight production of ryegrass in each treatment (g pot^{-1})**

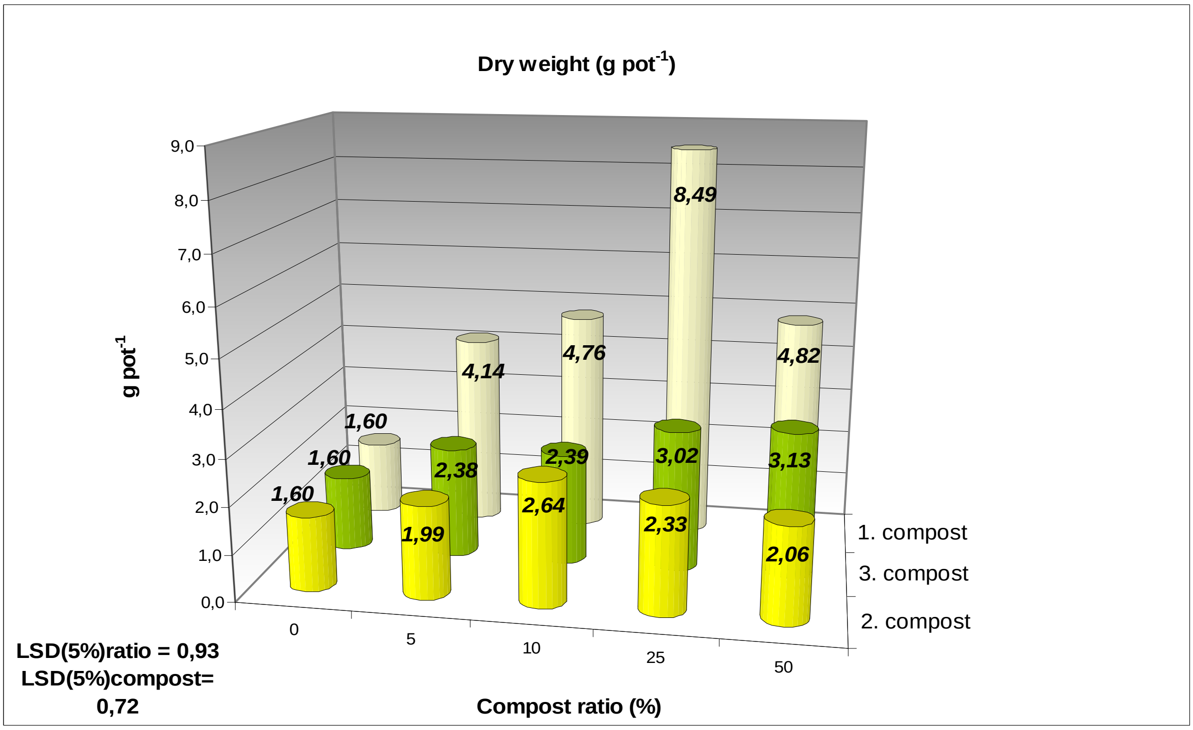
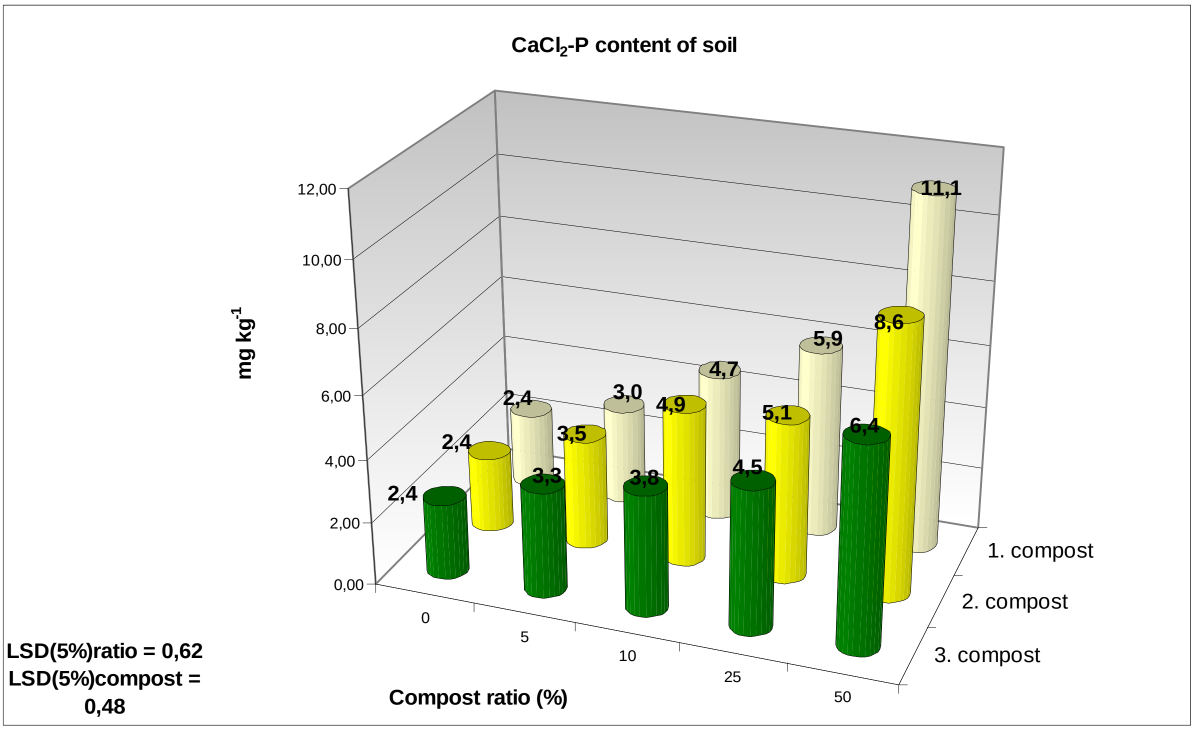


Figure 3: **The 0.01 M $CaCl_2$ extractable P content of soil**



The P-, K-, Mg content of the soil determined in 0.01 M $CaCl_2$ are represented in *Figure 3, 4, 5*. The compost:soil ratio modified significantly (P = 0.1%) the $CaCl_2$ extractable nutrient content.

All studied compost increased significantly the amount of $CaCl_2$-P *(Figure 3)*. The applying of 50% compost increased the P content of soil by 2-4 times higher. We found the highest easily available P concentration (11 mg kg^{-1}) in case of 1st compost. A moderate effect was observable with the 2nd and 3rd compost.

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

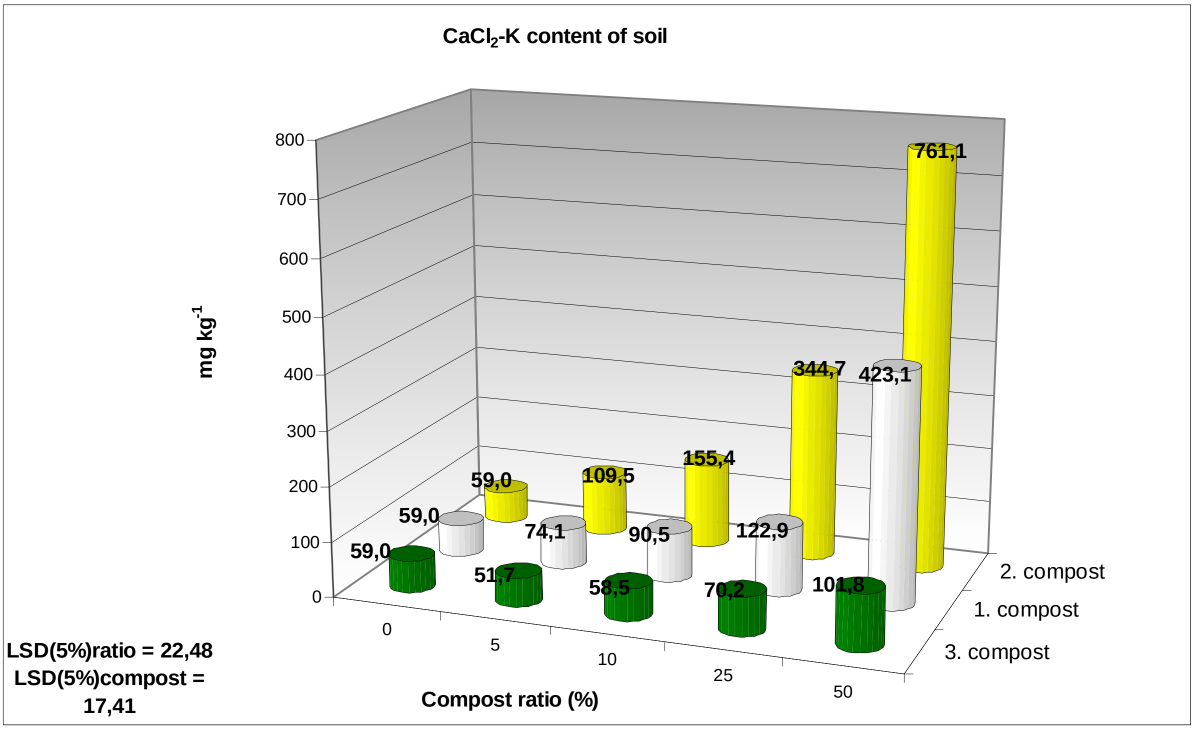
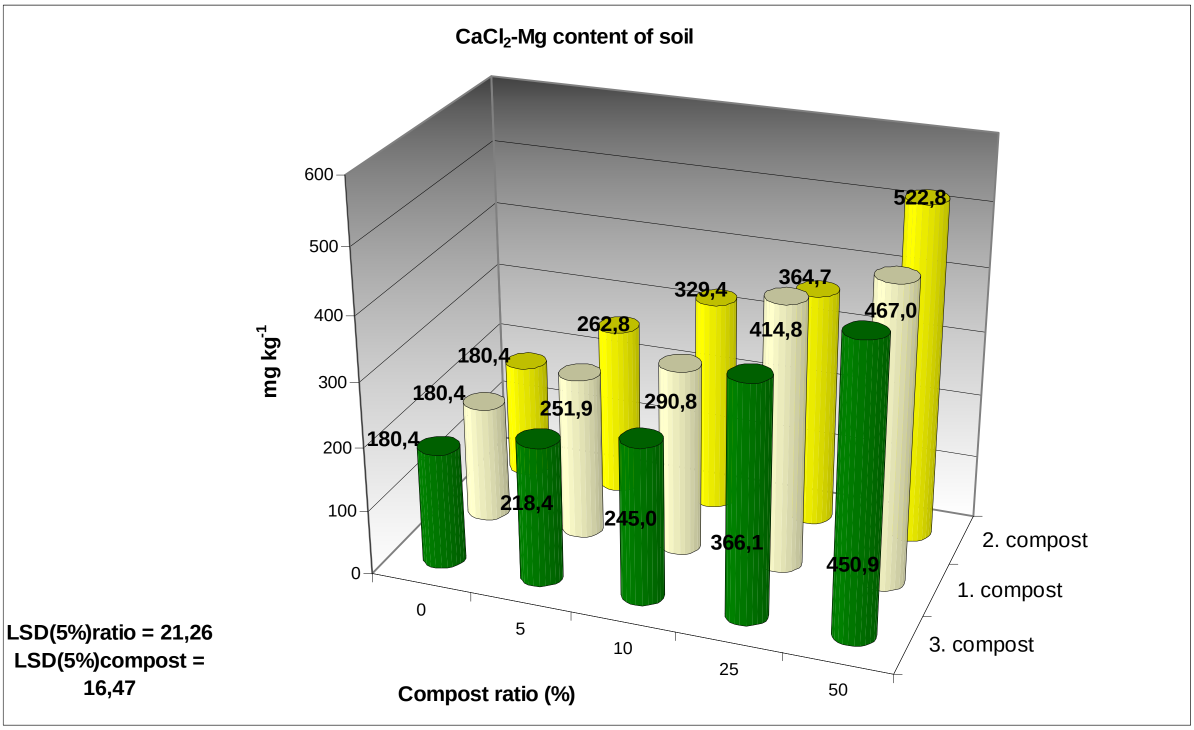


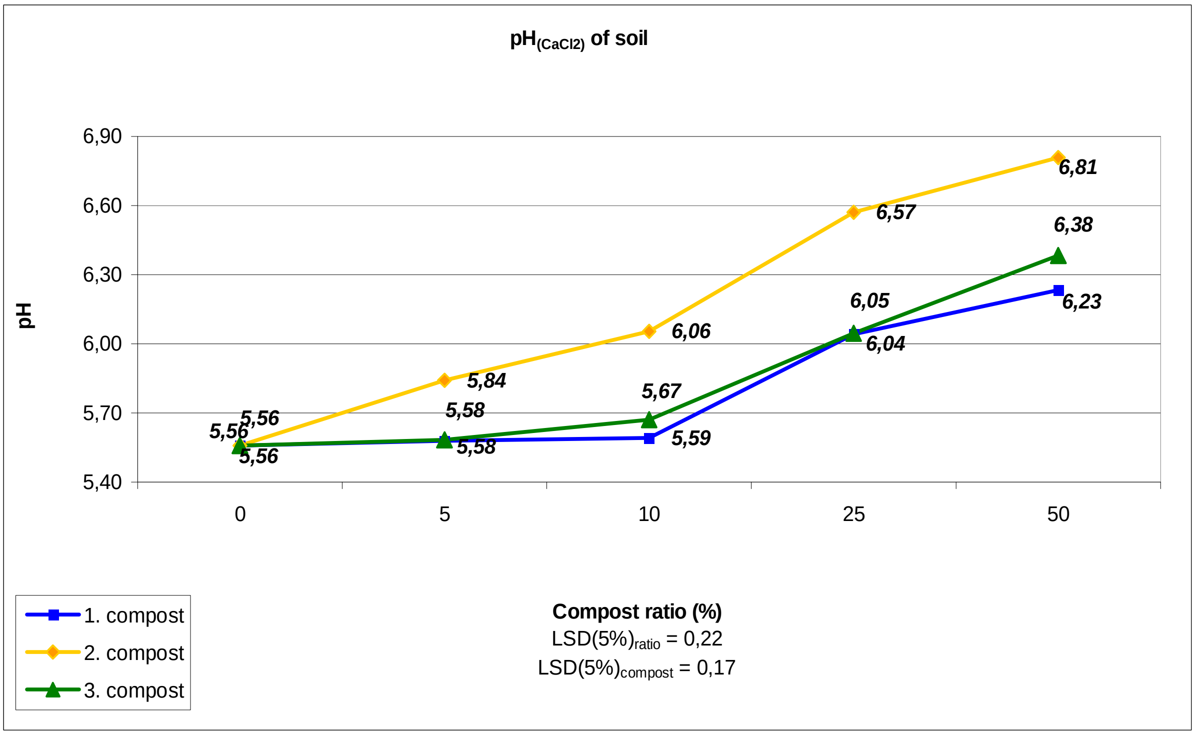
Figure 5: **The 0.01 M $CaCl_2$ extractable Mg content of soil**



As it is represented in *Figure 4 and Figure 5* the increasing compost rates caused the increasing of K, Mg content of soil. The $CaCl_2$-K and -Mg content of the 2nd compost was higher than that of other composts. We found the lowest nutrient content in case of 3rd compost.

The pH values of the soils determined in $CaCl_2$ extracts are shown in *Figure 6*. The treatments increased significantly the pH values of soils (P = 0.1%). The 2nd compost had the highest effect on the pH. All ratios caused significant increase. If a 50% compost dose were applied the pH would be in neutral range (pH = 6.81). In case of 1st and 3rd composts the 25 and 50% dose caused significant increase.

Figure 6: **$pH_{(CaCl2)}$ of soil**



CONCLUSIONS

From the results of the study it was concluded as follows:

- However the nutrient content and pH of soils increased significantly as an effect of increasing compost doses, the optimal compost doses in respect of fresh and dry weight production were different in case of each compost.
- The 1st compost affected the highest increase in the amount of yield, and the optimal compost:soil rate was 25:75%.
- The optimal dose of 3rd compost was the 50% rate. The 2nd compost had a moderate effect, but the 10% compost dose increased significantly the dry and fresh weight of ryegrass.

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