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# EFFECTS OF ORGANIC FERTILIZERS ON THE GROWTH AND NUTRIENT UPTAKE OF CUCUMBER (*CUCUMIS SATIVUS* L.) SEEDLINGS

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**Abstract.** *Pot experiment was conducted to compare the effects of organic fertilizers on growth, phosphorus and potassium uptake of cucumber. The study was conducted on humic sandy soil with treatments of 1: control; 2:horse manure with straw (30t/ha); 3:horse manure with sawdust (30t/ha); 4: cattle manure (30t/ha); 5: food waste compost (30t/ha); 6-9 organic fertilizers with 60t/ha. The effects of fertilizers were investigated after a month and 5 further months incubation period. Fresh weights of cucumber seedlings were not greatly influenced by manures and compost, but phosphorus and potassium uptake were significantly enhanced. Horse manure with straw, food waste compost and cattle manure proved to be effective and horse manure with sawdust was the least effective organic fertilizer in terms of growth of cucumber seedlings and nutrient supply ability.*

**Keywords:** organic fertilizers, cucumber seedlings, nutrient

## 1. Introduction

Use of organic manure is one of the oldest methods of soil cultivation [1]. Manure may help in the improvement of soil structure, the physico-chemical, microbiological properties of soil, may improve the quantity and quality of the yield, through increasing microbial activity and plant nutrients of soils [2, 3]. Organic fertilizers besides containing high level of organic matter also contain macro- and micronutrients [4, 5].

In recent years the application of organic fertilizers has received great attention in sustainable agriculture [6]. They might have been major components of organic farming, which offer an economically and ecologically attractive means of reducing external inputs and improving internal resources [7, 8]. Different kinds of organic amendments including farmyard manure [9], composts [10] have been

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applied to enhance both crop yield and soil quality all over the word. The expression of "solid manure" means when farmed animals are kept on bedding material which is collected together with all excreta. Farmed animals might be a variety of animals like pig, horse, cattle, etc. Quality and composition of manures from various domestic animals are mostly significantly different. These are also influenced by bedding materials and composting process of organic manures as well.

The stalls of horses are bedded to absorb urine, moisture, and gases and to increase the comfort, health, and well-being of horses [11]. Bedding materials may be recycled book paper, sawdust and straw. Straw and sawdust are the most common materials used as main or extra bedding [12]. Bedding has effects on the volume and quality of manure. The management and composting of horse manure can be improved by choosing bedding material. Differences have been found in the process of composting horse manure bedding with sawdust or straw [13, 14]. The horse manure with different bedding materials using as organic fertilizer may have different effect on the soil properties and on the yield.

Food waste is large component of the waste stream in Hungary. Restaurants, food factories and canteens of schools produce million tons of commercial organic waste that may be composted. This compost may represent one of the alternatives for achieving the goal of ensuring integrated and sustainable waste management [15, 16]. Food waste compost is generally higher in nutrient values and lower in other contamination than most types of composts, thus making it more valuable in the market [17, 18].

The main goal of this study was to investigate the effects of organic manures with different origin (horse, cattle), various bedding materials (straw, sawdust) and diverse doses (30t/ha, 60t/ha) and the impact of food waste compost on the growth and nutrient uptake of cucumber seedlings.

## 2. Materials and method

The pot experiment was performed on humic sandy soil with cucumber seeds. The examined organic fertilizers were cattle and horse manures. Horse manure was produced with different bedding materials, namely straw and sawdust. The effects of manures were compared to the effect of food waste compost. Compost was obtained from restaurant food residuals. Food residuals were mixed with wood waste and were composted for 90 days. Organic amendments were mixed with humic sandy soil at two different doses, 30t/ha and 60t/ha. The 150g soil-manure mixture were put into pots. The main properties of soil were: pH($CaCl_2$): 6.01; $K_A$:26 (Soil plasticity index according to Arany, described [19]; Hu %: 1.3; AL-$P_2O_5$:274mg/kg; AL-$K_2O$: 286 mg/kg. The treatments were the follow: 1: control; 2: horse manure with straw, 30t/ha; 3: horse manure with sawdust, 30t/ha; 4:

cattle manure, 30t/ha; 5: food waste compost, 30t/ha; 6: horse manure with straw, 60t/ha; 7: horse manure with sawdust, 60t/ha; 8: cattle manure, 60t/ha; 9: food waste compost, 60t/ha.

Organic fertilizers with different doses were mixed with the soil thoroughly one month before starting the experiment. The main characteristics of different organic fertilizers are described in Table 1.

**Table 1)** Characteristics of organic fertilizers applied

| | N% | C% | C/N | AL-$P_2O_5$ mg/kg | AL-$K_2O$ g/100g |
|---|---|---|---|---|---|
| horse manure with straw | 3.87 | 31.90 | 8.24 | 820 | 4.030 |
| horse manure with sawdust | 0.980 | 11.64 | 11.88 | 730 | 0.939 |
| cattle manure | 2.31 | 27.22 | 11.79 | 670 | 1.359 |
| food waste compost | 0.841 | 13.65 | 16.22 | 714 | 0.673 |

Ion exchanged water was added to all pots to keep the soil at constant moisture (60% of the water-holding capacity) using daily weighing. Soil-manure mixture had been incubated at room temperature and constant moisture for four weeks. After four weeks incubation period pot experiment was started. Ten seeds of cucumber "Rajnai fürtös" were sown in all pots. The seedlings had been grown for eight days after sawing. After the first germination experiment all pots had been incubated again at room temperature and constant moisture for five further months (totally six-month incubation) in order to organic matter could be able to mineralise. After incubation period the germination experiment were repeated again as the same way as the first experiment.

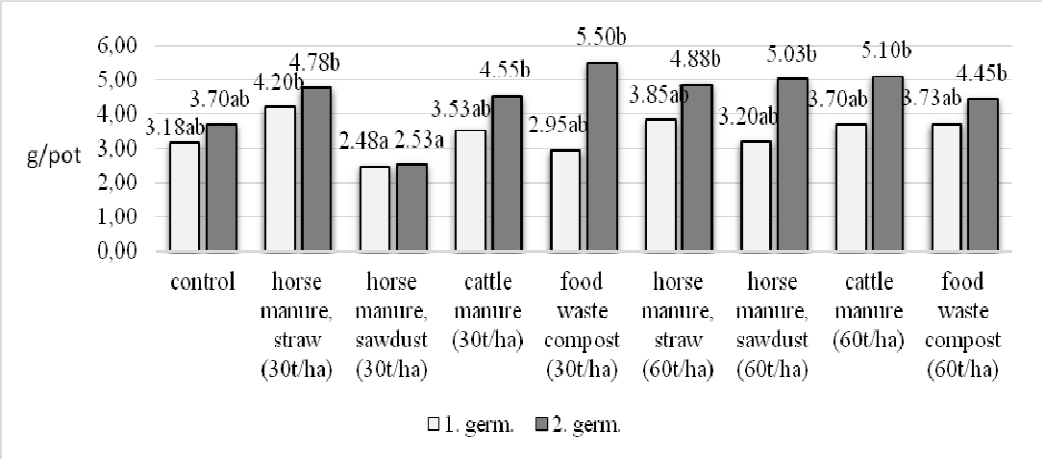
Fresh weights and after drying at 60 $^{o}$C, dry weights of leaves per pots were determined in both germination experiments. Leaves after drying were digested by $H_2SO_4$-$H_2O_2$ methods and phosphorus and potassium were measured. P was measured by colorimetrically using the molybdenum blue colorimetric method, potassium was quantified by flame emission spectrophotometry. The P and K uptake of plant per pot were counted from data of fresh weights and P and K contents of seedlings.

Analysis of variance was carried out on the data by SPSS statistics 1.3 program in order to provide a statistical comparison between the treatment means. The mean differences among treatments were analyzed through Tukey post hoc test. Significant differences ($P < 0.05$) between treatments in figures are indicated by different letters.

## 3. Results and discussion

### 3.1. Growth of cucumber seedlings response to soil-fertility treatments

Germination experiments were taken after a month and after five further months after fertilizers applications. The changes of fresh weights of seedling of cucumber in the first and second germination experiments are presented in Figure 1.




*Significant differences ($P < 0.05$) between treatments are indicated by different letters

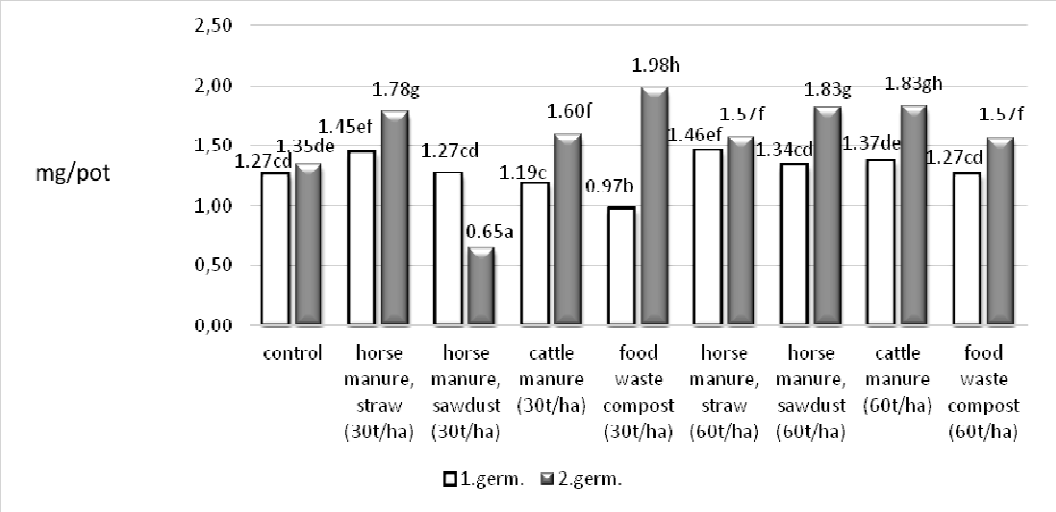
**Fig. 1.** Means of fresh weights of seedling in the first and second germination experiments (g/pot)

Fresh weights of seedling ranged between 2.48-4.2 g/pot after one month of organic fertilizers application. Although there were no significant differences between values of different organic manure treatments compared to control, it is worth to mention that the value of horse manure with sawdust in 30t/ha dose tended to be a little bit lower and the other horse manure with straw tended to be a little bit higher than the control. The higher doses (60t/ha) of fertilizers did not alter the weights of cucumber compared to lower ones.

After cutting cucumber plants, all pots were incubated for five further months and the germination experiment was repeated. In that case the weights of seedlings were higher and ranged between 2.53-5.5 g/pot. All fertilizers except for horse manure with sawdust in 30t/ha dose, slightly increased the growth of seedlings. Horse manure with sawdust caused a small decrease in values compared to control and other treatments. Organic fertilizers in 60t/ha dose did not cause further change in weights compared to values with 30t/ha.

### 3.2. Phosphorus and potassium uptake of cucumber seedlings

The values of phosphorus uptake of cucumber seedlings as a function of different treatments in first and second germination experiments are presented in *Fig. 2.*



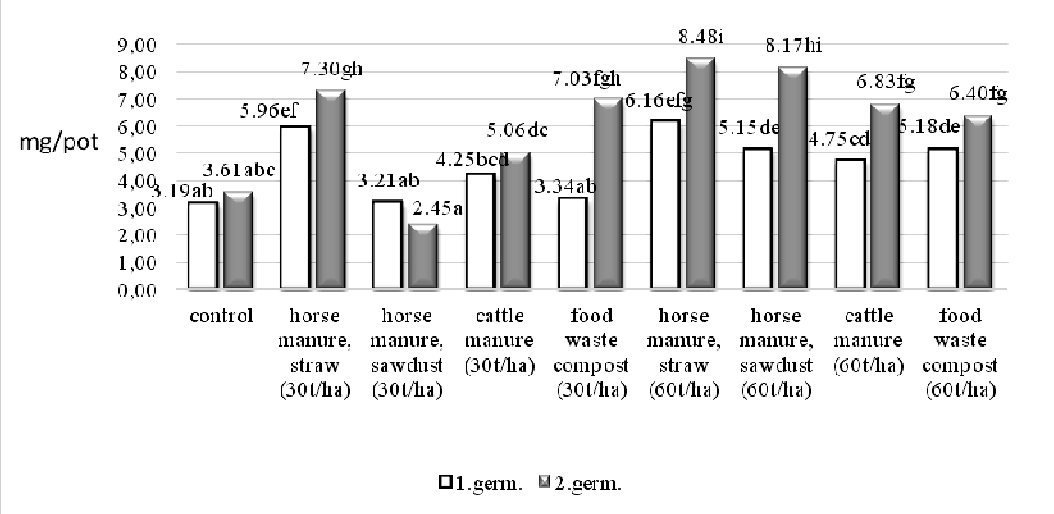

*Significant differences (P < 0.05) between treatments are indicated by different letters

**Fig. 2.** Means of phosphorus uptake of seedlings in first and second germination experiments (mg/pot)

Phosphorus uptake of plants varied between 0.97-1.46 mg/pot in the first germination experiment. Among fertilizers with 30t/ha dose the highest value (1.45 mg/pot) was resulted by horse manure with straw and the lowest one 0.97mg/pot) caused by food waste compost. The 60t/ha dose of horse manures did not alter the P uptake of plant compared to values of lower dose. The higher dose of cattle manure and food waste compost significantly increased the P uptake of cucumber compared to values of 30t/ha dose of fertilizers.

As a result of five-month incubation period the phosphorus supply ability of fertilizers increased. The P uptake of seedling increased in all treatments except for in the treatment of horse manure with sawdust (30t/ha). The highest P uptake (1.98 mg/pot) of plant was measured in the treatment of food waste compost (30t/ha). 60t/ha dose of compost did not increased further the P uptake of plant. The lowest value appeared in treatment with horse manure with sawdust, but the 60t/ha dose of this fertilizer significantly increased the P uptake compared to control. Cattle manure with 30t/ha dose also significantly increased P uptake of plant compared to control, and the higher dose further increased this value.

Potassium uptake of cucumber plants as a function of different treatments in the first and second germination experiments are presented in *Fig. 3.*




*Significant differences (P < 0.05) between treatments are indicated by different letters

**Fig. 3.** Means of potassium uptake of seedlings in first and second germination experiments (mg/pot)

The potassium uptake of plants varied between 3.21-6.16 mg/pot in the first germination experiment. Among fertilizers with 30t/ha dose the highest value was resulted by horse manure with straw (5.96 mg/pot) followed by value of cattle manure (5.06 mg/pot). 60t/ha dose of these fertilizers did not enhance further the potassium uptake of plants.

After five months further incubation period the potassium supply ability of organic fertilizers increased except for horse manure with sawdust and ranged between 2.45-8.48 mg/pot. Highest K uptake of plants was measured in treatments of horse manure with straw and food waste compost. The 60t/ha dose of horse manure with straw further increased the values, but compost did not caused further change. Cattle manure with 30t/ha dose also significantly increased K uptake of plant compared to control, and higher dose further increased this value.

## Conclusions

Organic fertilizers did not cause significant effect on growth of cucumber seedling at the beginning of the growth, only small changes were detected in values. Horse manure with straw, cattle manure and compost in 30t/ha dose tended to enhance growth while horse manure with sawdust caused slightly reduced weights. 60t/ha

dose of fertilizers did not influence growth values compared to values of lower dose.

Organic fertilizers increased phosphorus and potassium uptake of seedling. After a month of fertilizers application horse manure with straw supplied the highest amount of phosphorus and potassium compared to control and other treatments. After five months further incubation period the P and K uptake of plants increased except for in the treatment of horse manure with sawdust where the phosphorus uptake of plants decreased. After longer incubation period of fertilizer-soil mixture the highest nutrient uptake were resulted in treatments of food waste compost and horse manure with straw, followed by value of cattle manure. 60t/ha dose of these fertilizers further increased nutrient uptake in most cases.

Favourable effect of horse manure with straw, cattle manure and food waste compost with 30t/ha dose was justified, but positive effects of horse manure with sawdust could not be proved.

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