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# THE EFFECTS OF DIFFERENT NPK DOSES OF RED PEPPER'S YIELD AND VEGETATIVE PARTS

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**Abstract**: Red pepper (type Hírös) was cultivated in plant pot, in research garden of Kecskemét College, Faculty of Horticulture. Plant pots were in semi-subsurface position full with sandy soil typical for the Danube-Tisza sand ridges. Our aim was to investigate changes in productivity, yield and NPK content of leaves correlation with increased NPK doses on sandy soil with low humus content and average nutrient supply. We used Hydrofert NPK 15-30-15 fertilizer. The amount of nitrogen and potassium per hectare were 150, 300, 450, 600 kg, and the amount of phosphorus was the double of these. Fertilizer was spread with irrigation into the soil of plant pots. Total doses were given used in three equal portions, between May and July, in all treatments for better nutrient utilization. Harvest was during the biological ripeness of red pepper, between August and September. Compared to the control samples yield increased spectacularly in every treatment. At the same time, utilising the highest amount of fertilizer did not decreased the yield compared to smaller amounts. It means we can reach balanced increase of yield with high amount of NPK fertilizer on sandy soil. High salt concentration in the root zone did not hinder development of the plants.
**Keywords**: red pepper, nutrient supply, NPK fertilization, NPK content

## 1. INTRODUCTION

Soil fertility is a determining factor in agro-ecosystems. Sandy soils with humus typical for the Danube-Tisza sand ridge can describe with poor or average nutrient supply ability. That is why we can observe spectacular increase of biomass and yield because of fertilization (Horinka, 2010).

In this experiment, in relation to our aim was to investigate changes in productivity, yield and NPK content of leaves with increased NPK doses on sandy soil with low humus content and average nutrient supply.

## 2. MATERIAL AND METHOD

Our fertilization experiment with NPK nutrients was carried out in the research garden of Kecskemét College, Faculty of Horticulture. Red peppers were planted in 60 cm diameter outdoor plant pots, in semi-subsurface position. Plant pots were full with sandy soil with humus, which is typical for the wider area and the research garden too. The bottoms of the plant pots were open, and they had a sinkhole and a deflector, to avoid stagnant water.

Our investigation was carried out in the growing season of 2012. In early March, we made soil investigations before planting. On the basis of this, the most important parameters of soils in plant plots were the following:

$$K_A = 32;\ pH_{(KCl)} = 7{,}50;\ humus\% = 2{,}50\ m/m\%;\ CaCO_3\% = 3{,}00\ m/m\%.$$

Phosphorus ($P_2O_5$) and potassium ($K_2O$) supply of soils in plant pots was at good and medium level. We had 20 plant pots altogether. Their soil parameters – which were investigated separately – were similar, so we can assume that the soil of plant pots were homogeneous.

Red pepper planting was carried out on 29$^{th}$ May (type Hírös). Three young plants were planted in one plant pot, so we had three plants in one repetition with every nutrient dose.

After planting NPK fertilizer was spread with irrigation into the soil of plant pots. We used Hydrofert (R) (Biochim Hungary Kft. Szeged) NPK 15-30-15 % fertilizer, which is a phosphorus-

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dominant, up-to-date starter fertilizer. Every treatment had a control, and four uniformly advanced doses, with the following amounts:

150-300-150; 300-600-300; 450-900-450; 600-1200-600 kg $ha^{-1}$.

We had four repetitions for every doses of fertilizer. Total doses were given used in three equal portions, in all treatments for better nutrient utilization, in every four weeks. In this way, nutrient utilization can take place after plantation, in the early flowering and the growing period.

Mechanical and chemical weed controls were applied twice against causative agents. We did not use foliage fertilizer.

We collected plant samples twice, after the growing period. The yield of the first ripening was collected on 23rd of August; second harvesting took place on 23rd of September. The total yield amount was cropped, and we measured the wet yield amount. We collected full-grown, whole leaf samples in both harvests, from the middle tierce of foliage.

As part of the investigations we measured the amount of wet yield. Leaf samples were dried, than they were under homogenization and digestion with wet destruction. We determined the total amount of nitrogen, phosphorus, potassium and calcium of leaf samples with Kjeldahl-nitrogen (MSZ-08-0783-6:1983) and ICP-OES methods (Hüvely, 2005).

**3. RESULTS**

We investigated the amount of nitrogen, phosphorus, potassium and calcium amount in the leaf and yield of red pepper. Harvest and collection of leaves took place during the biological ripeness of red pepper, between August and September.

If we investigate the yield of red pepper (Table 1), it can be seen, that the impact of increased NPK fertilizer is increased yield, which can be explained by the Mitscherlich principle. It is true especially in case of 150-300-150 kg $ha^{-1}$ treatment, where yield is triple than in control. In other treatments, the increase of yield is less than in other cases. It is confirms results of earlier investigations (Cserni et. al., 2008; 2010; Németh, 1996).

Table 1. Yield of red pepper (g) in correlation with NPK treatments

| NPK treatment (kg $ha^{-1}$) | yield (g) |
|---|---|
| 0-0-0 | 209,99 |
| 150-300-150 | 687,02 |
| 300-600-300 | 870,39 |
| 450-900-450 | 1233,38 |
| 600-1200-600 | 1434,35 |
| LSD 5% | 268,97 |

Table 2. Nutrient amounts of red pepper (m/m %) in correlation with NPK treatments

| NPK treatment (kg $ha^{-1}$) | N | P | K | Ca |
|---|---|---|---|---|
| 0-0-0 | 4,08 | 0,33 | 0,764 | 4,64 |
| 150-300-150 | 3,28 | 0,231 | 1,51 | 7,15 |
| 300-600-300 | 3,33 | 0,222 | 2,15 | 7,67 |
| 450-900-450 | 3,44 | 0,231 | 2,55 | 7,2 |
| 600-1200-600 | 3,25 | 0,216 | 2,3 | 7,48 |
| LSD 5% | 0,35 | 0,039 | 0,74 | 0,85 |

Table 2 shows average values of nutrients in dry matter m/m % in four repetitions. It can be seen that nitrogen content significantly decreases in leaf in case of 150-300-150 kg $ha^{-1}$ NPK fertilizer compared to the control sample. We can explain this with the so called attenuation-effect since bigger biomass results in smaller nutrient concentration. Under 300-600-300 and 450-900-450 kg $ha^{-1}$ treatment nitrogen concentration of leaves shows minor ascent. In 600-1200-600 kg $ha^{-1}$ NPK treatment, concentration decreases, because of provocative fertilizer dose.

Phosphorus content of leaves is demonstrated in Table 2. Phosphorus has the least mobility among macro-nutrients. This is the reason of decreased or stagnant phosphorus content despite increase fertilizer doses compared to control samples, because of the attenuation-effect.

Potassium is one of the most important nutrients for red pepper. It has high mobility compared to nitrogen, which means bad potassium supply – as boundary condition – in our experiment on sandy soil with humus.

It can be stated about potassium content of leaf samples on the basis of Table 2, that there is no attenuation-effect because of red pepper's high need of potassium. Potassium content of leaves increased in parallel with treatments up to 450-900-450 kg $ha^{-1}$ dose. Decrease of potassium content started only at 600-1200-600 kg $ha^{-1}$ fertilizer level.

It is well known that nutrients with high mobility in larger amount – as nitrogen and potassium – can be found in elderly leaves, but – thanks to mobility – nutrients wander from older vegetative parts to younger leaves and yield. As a result, while the nitrogen concentration of leaves does not increase in parallel with increased NPK doses, balanced ascent is traceable in yield. This effect is more observable in case of potassium, where vegetative parts give more amount of potassium to the yield.

Because calcium is a very important nutrient form for red pepper, too, it is worth investigating the amount of calcium in correlation with treatments (Table 2.) despite plants have no got calcium in the course of our experiment.

There has been a drastic increase in calcium content of leaf samples compared to the control sample already at 150-300-150 kg ha$^{-1}$ dose. Further increase, then smaller decrease can be detected after that. Mending nitrogen and potassium supply is in the foreground, because higher concentration of macro-nutrients improves calcium uptake from the soil.

## 4. CONCLUSIONS

On the basis of data it can be seen that NPK fertilization resulted in significant changes in red pepper yield and nutrient amount of leaves.

LSD 5 % values show that difference between averages of treatments – by statistical evaluation – has been caused by treatments. On the basis of this, it can be stated that already 150-300-150 kg ha$^{-1}$ nutrient amount increased both vegetative parts and yield. In case of sandy soils – with poor or medium nutrient supply typical for Kecskemét and its surroundings – nutrient amounts with supplement fertilization cause decrease of NPK content in leaves only at provocative fertilizer doses (600-1200-600 kg ha$^{-1}$). Despite this, it cannot be traced in yield, which shows contiguous increase.

In the course of our experiment, we substituted lacking precipitation with irrigation – very low amount of precipitation was a strong restrictive factor in outdoor growing in 2012 –, while sun and heat radiation were optimal. In this case, weather conditions were good for red pepper that is why NPK fertilization was the main factor on yield and amount of leaves.

Increased fertilizer doses had influence on the time of ripening; at 450-900-450, and especially at 600-1200-600 kg ha$^{-1}$ treatments not every berries were in ideal ripeness state, time of ripening was longer than in other cases.

In conclusions, we can say – by soil properties typical for this area (high amount of quartz sand, low humus content, bad water balance) – that NPK fertilization with provocative doses does not have adverse influence on yield and development of leaves. Moreover, already 150-300-150 kg ha$^{-1}$ fertilizer dose caused consumedly significant of yield.

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