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The effect of potassium fertilization on the inner values of spice pepper

Irinyi, B.[1], Kapitány, J.[2] & Terbe, I.[3]

[1,3]BCE Faculty of Horticulture Science Department of Vegetable and Mushroom Growing, Budapest
[2]Red Pepper Research-Development PBC., Kalocsa

Summary: To reserve the fertility of soil is the basic condition of successful cultivation. The field specific nutrient supply, based on soil tests is very important in both economy and ecology aspects. Spice pepper plants have high nutrient demands. Proper nutrient supply has importance not only from the point of potential yield levels, but make a major contribution to quality. This is the reason which necessitates the rational development of nutrient supply as an the elements of the production technology. Our objective was to offer a contribution to this job through our nutrient trials. Experiments on the nutrient supply of spice pepper were set up in the 2005 growing season in order to decide whether yields and fruit composition parameters of pepper could be increased by means of increased K fertiliser doses with lower N:K ratios. Several forms of potassium were used, as well as applying microelement top dressings in the single treatments. It was found that higher K doses lead to increased yields, and the influence on dry matter and pigment content proved beneficial too. Potassium applied in the form of patentkali seemed to be better than in that of potassium-sulphate.

Key words: pepper, fertilization, potassium

Introduction

To reserve the fertility of soil is the basic condition of successful cultivation. The field specific nutrient supply, based on soil tests is very important in both economy and ecology aspects. Among macronutrients potassium has a specific status, because it does not infiltrate in organic matter, but has 60 % proportion in the ash.

Spice pepper plants have high nutrient demands. Proper nutrient supply has importance not only from the point of potential yield levels, but make a major contribution to quality. Fertilisation has influence on every quality parameter that is important for the processing industry, such as dry matter content, pigment content, sugar content and seed-skin (fruit wall) ratio.

The pepper root's nutrient digestion ability is weak in comparison with other plants. It's sensitive to salt injury, so that pepper needs continuos nutrient supply and easily available nutrients. Specific nutrient demands of spice pepper were first defined by Horváth and Bujk (1934). According to them, spice pepper takes up 137 kg/ha of N, 27 kg/ha of P_2O_5, 141 kg/ha of K_2O from the soil to produce 10 tons of raw crop, corresponding to a 5.1:1:5.4 ratio. Somewhat different values are defined in the fertilisation guidelines of MÉM NAK (Plant Protection and Agricultural Chemistry Centre of the Ministry of Agriculture and Food Industry), which are 4,8 kg/t N, 1,6 kg/t P_2O_5 and 6,5 kg/t K_2O. These amounts correspond to a 3 : 1 : 4 ratio. Both references mention potassium as the major macroelement for spice pepper.

Nutrients are demanded in different ratios in the different phenophases. The maximum of potassium uptake occurs at flowering, than absorption starts to diminish (*Márkus & Kapitány*, 2001). The rate of nutrient accumulation depends on the method used for propagation and on the variety as well. As regards transplanted stands, it is nitrogen that plants accumulate in the biggest quantities, followed by potassium and then by phosphorous. In direct sown stands it is potassium that is accumulated in the biggest rate, then come nitrogen and phosphorous (*Mécs*, 1978).

Potassium has a beneficial influence on fruiting, increasing earliness. In case of deficiency fruit size and quantity will diminish, while excessive application might make fruits more susceptible to blossom end rot, caused by the antagonism of K and Ca (*Somos*, 1981). Potassium plays an extremely important role in plant water relations. It helps survive dry periods, generating high turgor pressure in the cells. It is an activator of a number of enzymes, thus improving photosynthetic activity. It promotes the developing of carbohydrates. Potassium also increases the C vitamin content of pepper. It improves in general the stress resistance of the plant (*Ernst*, 1993). In the case of potassium overdosing we have to calculate on appearence of antagonist effects, chiefly Ca and Mg uptake disorders.

As regards qualitative parameters, optimal K supply is generally accepted to ensure the

- adequate formation of aroma, flavour and pigment compounds
- increased sugar, vitamin and protein content of the fruit

- enhanced pigment production
- higher dry matter content of the fruit
- improvement of plant resistance to abiotic stresses, in particular dry and cold tolerance (*Terbe* et al., 2002).

Nevertheless, the use of potassium fertilisers has a low level in Hungary. While in West-European countries the N:K ratio, as calculated on the basis of the amounts of fertilisers applied, is 1:0.44, in Hungary this ratio is 1:0.2-0.25 (*Terbe*, 1999).

When we calculate the amount of potassium it's necessary to consider the features of field, first of all the nutrient status of our soil. In Hungary spice pepper is grown on sandy loam in the Szeged area and deposited soil in the Kalocsa region. The soils containing more clay minerals have bigger puffer capacity. These soils usually hold more potassium, but the main part of it is fixed at the surface of minerals (this process is known as potassium-fixation). For that reason it is necessary to keep higher changable potassium level in theese kind of soils.

Pepper is sensitive to high chlorine level, so that the usege of chlorid-free fertilizers are recommended in nutrient supply.

It was an aim of the trials to test the efficiency of the different K fertiliser rates at given nitrogen and phosphorous supply levels, in particular to study the effect on fruit quality. As high K contents in the soil and in the plant might interfere with the uptake of other important elements, such as magnesium, calcium, therefore in certain treatments a magnesium containing K fertiliser (Patentkali) was applied, as well as a micro nutrient fertiliser.

Material and method

Trials were set up at the co-operative Kék-Duna at Fajsz, using Kalocsai merevszárú 622, a sweet variety with semi-determined growth, in direct sown cultivation in 2005. The experiment comprised six treatments, each of them with four repetitions. The areas of the treatments were 1 hectare, and the 50 m^2 size test parcels were selected within them.

After completion of soil tests, nutrient supply patterns of the single treatments were elaborated, as included in *Table 1*.

Besides, each treatment was given 85 t/ha farmyard manure. Treatment 1. can be considered as the control treatment, being the nutrient application practice of the co-operative itself. Sowing was done on the 17th of April because of the continuos rainy weather in this period. Top dressings were applied twice during the growing period. Plants received the first top dressing at the stage of 4–6 leaves in the form of Nitrosol in a 20 kg/ha N per treatment dose and treatments 2., 4. and 6. were also given Microtop in a 20 kg/ha dose. The second top dressing was carried out in the period of massive flowering. This time 33 kg/ha Kristallon yellow and in the case of treatments 2., 4. and 6. 20 Kg Microtop were spread. There was no need to irrigate because the rainy vegetation period ensured the optimal water supply for the plants.

Table 1. Nutrient supply patterns of the treatments

	Base (kg/ha)			Additive	
Treatment	N	P_2O_5	K_2O		
1-Control	120	120	120 (KSO_4)	Nitrosol+ Kristallon	
2	120	120	120 (KSO_4)	Nitrosol+ Kristallon	Microtop
3	120	120	200 (KSO_4)	Nitrosol+ Kristallon	
4	120	120	200 (KSO_4)	Nitrosol+ Kristallon	Microtop
5	120	120	200 (Patentkali)	Nitrosol+ Kristallon	
6	120	120	200 (Patentkali)	Nitrosol+ Kristallon	Microtop

Amount of top dressings:
Nitrosol (28% N): 20 kg/ha active ingred.
Kristallon yellow (13% N, 40% P, 13% K + microelements): 33 kg/ha active ingred.
Microtop (15% MgO, 31% SO_3, 1% B, 1% Mn): 2×20 kg/ha.

The vintage considerably determined the experiment. *Table 2* demonstrate the weather ambivalency through the vegetation period. The germination was slow (it finished in middle of may) because of adverse temperature and rainfall conditions. The belated germination and growth caused ten days prolongation of growing period.

Measurements were made to establish the amount of fruits picked from the sample parcels and the parameters of fruit composition at the moment of harvest. Qualitative indicators important to the processing industry were also determined, such as dry matter content and pigment content. Dry matter content was measured by the drying oven method and pigment content was determined by MSZ 9681-5 standard. The statistical evaluate of data were made with Microsoft Excel és ASSISTAT 7.3 softvers.

Table 2. Weather conditions of growing period (Kalocsa, April – Oktober 2005)

Month	Air	Soil 10 cm	Monthly rainfall
	Mounthly average temperature (°C)		(mm)
Április	11.6	10.4	75.5
Május	14.9	14.5	47.9
Június	19.7	19.3	114.5
Július	21.9	21.7	132.4
Augusztus	19.8	20.3	195.7
Szeptember	17.6	17.8	73.5
Október	11.8	12.2	6.9
Average	16.8	16.6	–
Sum	–	–	646.4

Results

Yield

Harvesting for each treatment from 4×50 m^2 parcels was carried out by hand on the 24–25th of October. Healthy and fully mature fruits were picked. Yield results are reported in *Figure 1*.

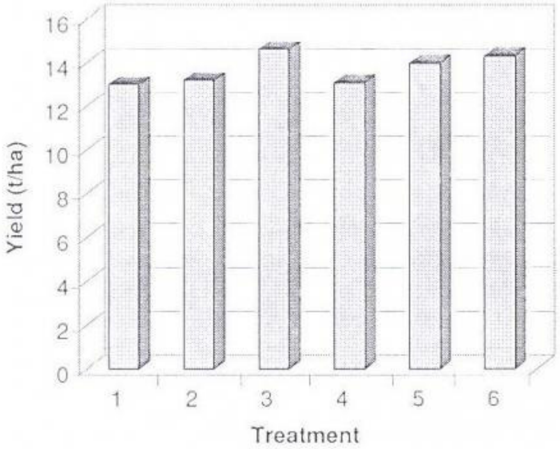

Fig. 1. Yields for the single treatment

It can be seen very well that the supplementary treatments resulted slight positive effects as compared to the practice of the co-operative itself (treatment 1). Surplus in yield was found in parcels with higher K-supply, especially in treatment 3., 5. and 6. (patent-kali). The yield-increasing effect of the micro-nutrient fertiliser Microtop is not observable for all treatment pair (1–2; 3–4; 5–6).

Compositional parameters

Dry matter content of raw fruits at the time of harvest are shown in *Figure 2*. Significant difference was found in treatment 3., where dry matter content was lower than in all other treatments. As it can be seen this parameter has a negative relation with raw fruit mass (P=0.05; LSD=1.8717).

Sample quantities of the harvested fruits were put in finely meshed nets and stored. Samples were examined in

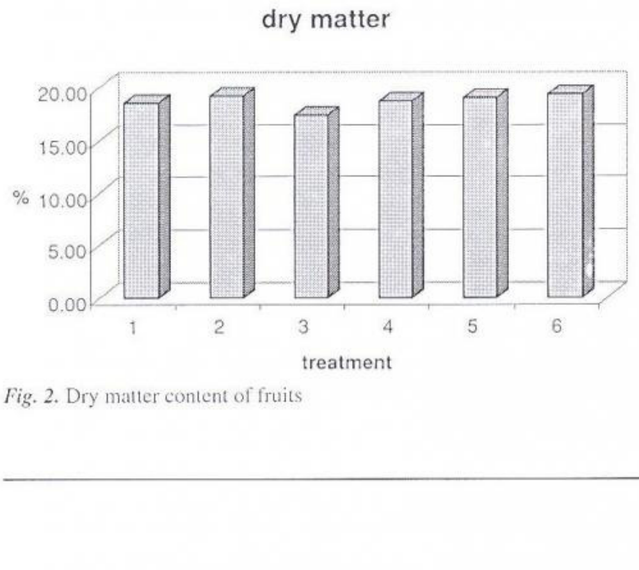

Fig. 2. Dry matter content of fruits

laboratory for the pigment content of each treatment. Results are shown in *Figure 3*.

The tendency of fruitwall pigment content is analogous with the yield results. Higher K doses (treatments 3.–6.), especially when applied in the form of patentkali, resulted higher pigment content at harvest. It was the control treatment (1) that reached the lowest pigment content.

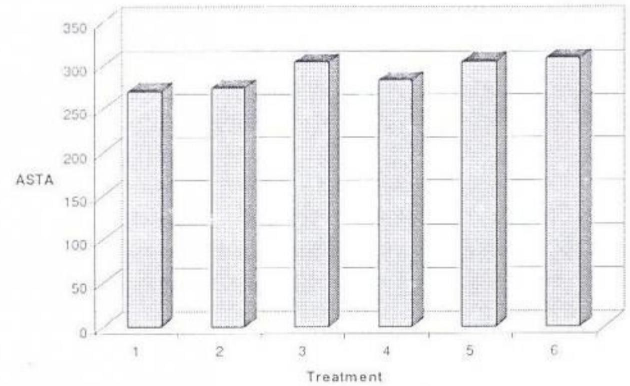

Fig. 3. Pigment contents expressed in ASTA values at the moment of harvest

Conclusions

In spite of the anadvantage weather conditions during the growing period, qualitative parameters of spice pepper fruits showed favourable values. Results demonstrate that higher K doses lead to increased yields, and the influence on dry matter and pigment content proved beneficial too. Potassium applied in the form of patentkali seemed to be better than in that of potassium-sulphate. No significant difference was seen between Microtop treatment pairs.

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