Top-dressing of paprika transplants in trays with fertilizers of phosphorus- and nitrogen surplus

Slezák, K., Kappel, N. and Tóth, K.

Szent István University, Faculty of Horticultural Science, Department of Vegetables and Mushroom Growing
H-1118 Budapest, Ménesi út 44.

Summary: By our experiments, we wished to answer the question: may top-dressing with nitrogen and phosphorus fertilizers, respectively, improve the quality of transplants grown in trays on a substrate enriched by 2 kg/m^3 of retarded fertilizers?

The experiments started in spring and autumn 2002, in a large volume plastic house. The seedlings were grown in trays. Seed was sown directly into KITE trays of 187 cells (28 cm^3 volume per cell, 779 seedlings per square meter). The trays were filled by "loose filling" (without packing) with the following soil mixture: 50% Baltic highmoor peat, 50% Pötréte lowmoor peat, 1,5 kg/m^3 feed chalk, 2 kg/m^3 slow acting chemical fertilizer of phosphorus overweight, 2 kg/m^3 superphosphate. The test plant was the vegetable paprika variety 'Tizenegyes'.

The trials were made in order to clear up if top-dressing done once or twice improves the quality of the seedlings. For this purpose, perfectly soluble fertilizers of phosphorus or nitrogen surplus were used. 3 l fertilizer solution of 0.2% concentration was given per square meter on every single occasion. The control plots received no top-dressing.

The following parameters were registered: stem diameter, plant height, fresh weight of the top, dry matter content of the top, fresh weight of the root system per plant, dry matter content of the roots.

The experimental results with top-dressing have clearly proved the insufficiency of mixing 2 kg/m^3 of retarded fertilizer into the substrate, as usual in raising paprika seedlings in trays, because of the long period of transplant raising. According to our experiments the additional nitrogen fertilization influences positively the development of green parts of plants, while the multiple application of fertilizers with higher phosphorus-content helps to develop a strong root system. We suppose, that the more often applied additional fertilizers, maybe the combination of fertilizers with nitrogen and phosphorus amount could give use even better results.

Key words: nitrogen, paprika, phosphorus, top-dressing, transplant

Introduction

The area of field grown paprika may be estimated to 3800–4000 hectares in Hungary. Today, the technology is based on setting nursery grown transplants into the field, practically all over the country.

The advantage of transplants grown in trays is that they aren't set with free roots to their final place, thus, they continue to grow without the transplanting shock, contrary to transplants grown in beds. Further, transplant raising in trays can be almost fully automatized (*Zatykó*, 1994).

For satisfying the nutrient demand of the transplants, fertilizers of slow and quick effect are given together in the course of preparing the soil block mixture. Soil blocks made of peat need regular fertigation. The recommended concentration of the nutrient solution is 0.1% in this case (*Gyúrós*, 1993).

As suggested by *Terbe* (1993), 1.5 kg fertilizer of retarded action and 2–4 kg superphosphate per m^3 should be mixed to the soil mixtures based on peat.

Zatykó (1993) suggests Volldünger solution of 0.5% as top-dressing for paprika transplants. Irrigation with pure water is necessary after top-dressing. When plants develop properly, top-dressing may be even harmful. Adequate nutrient supply is necessary from the viewpoint of phytopathology, too. The author calls the attention to the experience that conditions encouraging quick, steady plant growth are needed in order to reduce the losses caused by virus diseases.

Terbe (1999) recommends fertigations once or twice with 0.1–0.2% solutions of quickly water soluble nitrogen fertilizers of high phosphorus content in the course of 7–10 days prior to transplanting into the field, as the fertilizers mixed into the transplant growing substrate at the beginning may be exhausted by then.

According to Russian research workers, surplus phosphorus doses help vigorous root growth. The ratio of the top to the roots decreases. Nitrogen, on the contrary moves the balance towards the top ratio (*Stankov*, 1964).

Besides phosphorus and nitrogen fertilization, other nutrient elements must be taken into consideration, too. *Valšiková* (1987) relates that potassium sulphate given as 0.005% solution weekly during the transplant growing period helps earliness and increases the vitality of the plants.

Horinka (1997) summarizes the principles of fertigation in transplant raising (in a substrate mixture on peat basis)

- The fertilizer solution doses should moisten thoroughly the whole root zone (2–4 l/m^2 at least).
- If salt content is high, 15–30% more water is needed for flushing.
- For providing elevated phosphorus level, the growing medium should be filled up or a nutrient solution of high phosphorus content should be used.

By our experiments, we wished to answer the question: may top-dressing with nitrogen and phosphorus fertilizers, respectively, improve the quality of transplants grown in trays on a substrate enriched by 2 kg/m^3 of retarded fertilizers?

Material and method

The experiments started in spring and autumn 2002, in a large volume plastic house on the Experimental Farm Soroksár of Szent István University, Faculty of Horticultural Science.

For the first trial, seed was sown on 4th April, and the experiment finished on 21st May. For the second trial, the same operations were made on 3rd September and on 5th November, respectively.

The seedlings were grown in trays. Seed was sown directly into KITE trays of 187 cells (28 cm^3 volume per cell, 779 seedlings per square meter). The trays were filled by "loose filling" (without packing) with the following soil mixture: 50% Baltic highmoor peat, 50% Pötréte lowmoor peat, 1.5 kg/m^3 feed chalk, 2 kg/m^3 slow acting chemical fertilizer of phosphorus surplus, 2 kg/m^3 superphosphate.

The test plant was the vegetable paprika variety 'Tizenegyes'.

The trials were made in order to clear up if top-dressing done once or twice improves the quality of the seedlings.

For this purpose, perfectly soluble fertilizers of phosphorus (marked "P") or nitrogen (marked "N") overweight were used. 3 l fertilizer solution of 0.2% concentration was given per square meter on every single occasion. The nutrient contents of the solutions are shown in Table 1. The control plots received no top-dressing.

Six parallel repetitions were made of every treatment. The first top-dressing was done when the first true leaves reached the size of 2–3 cm. The second top dressing of the plant in the treatments marked P+P and N+N, followed 7–11 days later. The treatments marked P and N got top dressing only at the first date.

Table 1 The quantities of macroelements given by one top-dressing

Kezelések		N mg	P_2O_5 mg	K_2O mg
P; P+P	per m^2	900.00	1800.00	900.00
	per seedling	1.15	2.31	1.15
N; N+N	per m^2	1440.00	480.00	960.00
	per seedling	1.85	0.62	1.23

The following parameters were registered and the average values of 10 plants calculated:

Stem diameter: measured approximately 1 cm above the root neck by a digital slide-gauge, with the precision of 0.01 mm.

Plant height: measured from the soil surface to the growing point by a rule with the precision of 1 mm.

Fresh weight of the top: The aboveground parts of 10 plants per plot were weighed together (with the precision of 0.1g) and averaged.

Dry matter content of the top: After weighing the samples taken for the determination of the fresh weight the samples were dried till constant weight, reweighed and the dry matter content was calculated from the ratio of dry weight to fresh weight (%).

Fresh weight of the root system per plant: The roots of 5 seedlings per plot were cleaned from the soil mixture by washing, weighed together and the received value calculated to 1 seedling.

Dry matter content of the roots: The root sample weighed for the determination of the root fresh weight before was dried till constant weight, reweighed and the dry matter content calculated from the ratio of dry weight to fresh weight (%).

The results were statistically evaluated (by variance analysis and comparisons in pairs).

Results

The results of the spring trials were very similar to those of autumn trials.

The results of the measurings of the top are seen in *Table 2*.

Table 2 The effect of top-dressing on the development of the green parts (top) of the seedlings

Treatment	Stem diameter (mm)	Height (cm)	Dry matter content of the top (%)	Fresh weight of the top (g/seedling)
Spring 2002				
Control	2.44	9.55	12.59	1.48
P	2.43	9.94	11.92	1.56
P+P	2.50	9.86	11.37	1.79
N	2.31	9.40	12.42	1.44
N+N	2.61	10.35	11.68	1.81
$SzD_{99\%}$	–	–	–	–
$SzD_{95\%}$	0.157	–	–	–
$SzD_{90\%}$	0.130	0.733	–	0.298
Autumn 2002				
Control	2.30	8.72	9.42	1.32
P	2.31	9.82	8.69	1.50
P+P	2.45	9.81	8.50	1.57
N	2.33	9.35	9.48	1.44
N+N	2.40	10.33	8.59	1.68
$SzD_{99\%}$	–	–	0.847	–
$SzD_{95\%}$	–	0.946	0.625	0.217
$SzD_{90\%}$	–	0.785	0.519	0.180

Regarding stem diameter, top-dressing repeated twice either with nitrogen (N+N) or with phosphorus (P+P) proved best in spring and autumn, too. Statistical analysis showed differences in spring experimental period, where the significance level of 95% appeared in all cases with N+N treatment, except of P+P treatment.

Considering the height of the seedling, nitrogen top-dressing repeated twice (N+N) turned out to be the most favourable. The height of plants was the lowest in the control treatment.

The fresh weight of the seedlings, too, showed the highest increase after nitrogen top-dressing repeated twice (N+N). The statistical analyses proved the difference (as compared to the control and to single N top-dressing, in autumn) on 95% probability level. In this parameter, the treatment with phosphorus repeated twice (P+P) as well as single phosphorus top-dressing (P) followed the treatment N+N.

For the dry matter content of the top, the control (without top-dressing) and single top-dressing with nitrogen (N) were the best in both experiments. The lowest dry material content was found with P+P. In autumn, this treatment was inferior to the control and to single N top-dressing, on 99% significance level. N+N resulted in lower dry matter content, too, as compared to the control and to single nitrogen top-dressing (N).

Root development was furthered mainly by P+P treatment (*Table 3*). This treatment seemed to be more favourable than the others at almost every measuring, however, differences weren't verifiable on 95% probability level. Top-dressing with nitrogen (N, N+N) and the control produced poor results both in root weight and dry matter content, in almost every case.

The top weight to root system weight ratio proved best with phosphorus top-dressing repeated twice.

Table 3 The effect of top-dressing on the root system of the seedlings

Treatment	Dry matter content of the top (%)	Fresh weight of the roots (g/seedling)	Top-root weight ratio
Spring 2002*			
Control	8.20	0.53	2.78
P	8.10	0.65	2.40
P+P	8.84	0.82	2.17
N	7.89	0.67	2.15
N+N	8.27	0.73	2.50
Autumn 2002			
Control	8.83	0.39	3.56
P	9.66	0.41	3.71
P+P	8.97	0.48	3.32
N	9.02	0.38	3.85
N+N	8.40	0.45	3.79
$SzD_{99\%}$	–	–	–
$SzD_{95\%}$	–	–	–
$SzD_{90\%}$	–	0.064	–

** We measured average samples, so there is no possibility for statistical analysis.*

Conclusions

The experimental results with top-dressing have clearly proved the insufficiency of mixing 2 kg/m^3 of retarded fertilizer into the substrate, as usual in raising paprika seedlings in trays, because of the long period of transplant raising. According to our experiments the additional nitrogen fertilization positively involves the development of green parts of plants, while the multiple applying of fertilizers with higher phosphorus-content helps to develop a strong root system. We suppose, that the more often applied additional fertilizers, maybe the combination of fertilizers with nitrogen and phosphorus amount could give us even better results.

References

Gyúrós, J. (1993): A zöldségnövények szaporítása. In Túri: Zöldséghajtatás. Mezőgazda Kiadó. Budapest.

Horinka, T. (1997): Tápoldatozás a kertészeti termesztésben. Kemira Kft. Hódmezővásárhely

Stankov, N.–Z. (1964): Kornevaya sistema polevykh kultur. Kolos. Moskva.

Terbe, I. (1993): Talajművelés, trágyázás. A palántanevelés közegei. In Túri: Zöldséghajtatás. Mezőgazda Kiadó. Budapest.

Terbe, I. (1999): A zöldségnövények tápanyag-utánpótlásának rendszere. A palántanevelés talaj- (közeg-) és tápanyag-vonatkozásai. In Füleky: Tápanyag-gazdálkodás. Mezőgazda Kiadó. Budapest.

Valšiková, M. (1997): Papriky, rajčiaky a baklažany. Príroda. Bratislava.

Zatykó, F. (1994): A zöldségnövények szaporítása. Palántanevelési módok. In Balázs: Zöldségtermesztők kézikönyve. Mezőgazda Kiadó. Budapest.

Zatykó, L. (szerk.) (1993): Paprika. Mezőgazda kiadó. Budapest.