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## INFLUENCE OF LEAF FERTILIZER MASTERBLEND ON THE YIELD AND QUALITY OF PEPPER SEEDS

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**ABSTRACT:** *The aim of the present study was to establish the influence of leaf fertilizer Masterblend on the yield and sowing quality of pepper seeds. The experiments were carried out with typical Bulgarian pepper cultivars Kurtovska kapia 1619 and Bulgarski rotund. The leaf fertilizer Masterblend was applied in doses 1.5 g dm<sup>-3</sup>, 3.0 g dm<sup>-3</sup> and 6.0 g dm<sup>-3</sup>. The pollen fertility, number of seed per fruit, percentage of fully developed seeds, weight of 1000 seeds, seed yield, index of seed productivity, first count, germinability (final count), fresh matter of sprout, length of embryo root and hypocotile were investigated. Masterblend improved seed formation and seed productivity of pepper. The most appropriate concentration for Kurtovska kapia 1619 was 3.0 g dm<sup>-3</sup> while for Bulgarski rotund it was 1.5 g dm<sup>-3</sup>, where yield increased by 20.12% and 36.53%, respectively. The germinability was higher in comparison to seeds from non-treated plants.*

**Key words:** *pepper, seed, yield, germinate, vigor, fertilizers, productivity*

**INTRODUCTION:** Application of leaf fertilizers improves overall development of plant and provoke not only more intensively vegetative growth but also stimulates the generative behaviors of the plants (Waranke, 2001). According to El-Fouly M. and El-Sayed (1997) this fertilization is a comparatively easy and fast method for supplying and assimilation of nutrient elements from plants at the moment when their needs are the highest. Granberry (1990) reported that the leaf dressing of pepper is efficiently when contributed for compensation of the deficiency in nutrition of the plants. Frutos et al. (1996) and Rodriguez et al. (2000) in leaf feeding of pepper observed better growth, set more fruits and higher yield. The increase the yield of pepper after treatment with leaf fertilizers also pointed out and Papadopoulos et al. (1999) and Lin, B. et al. (2001). In our previous study of Masterblend the highest yield of pepper fruits was established in concentrations 1.5 g/l and 3.0 g/l, depending on cultivar (Panayotov, 2004). Panayotov et al. (1996), Panayotov (2000), Panayotov N. and Dris (2000) concluded that by means of leaf fertilizers Lactofol and

Campofort the quantity and quality of pepper seed increased.

The main goal of the present study was to establish the influence of different concentrations of leaf fertilizers Masterblend on the yield and quality of sweet pepper seeds.

### Material and methods

The trials were carried out in 2001-2003 in the experimental field of the Department of Horticulture at the Agricultural University, Plovdiv, Bulgaria. The plants of typical Bulgarian pepper cultivars Kurtovska kapia 1619 and Bulgarski rotund were grown according to the traditional technology for middle early open field production for South Bulgaria. The transplants were produced in a plastic house sowed on 15 March and transplanted in the field in the middle of May by the scheme 60 x 15 cm. The following quantity of mineral fertilizations: 18 kg dka<sup>-1</sup> P<sub>2</sub>O<sub>5</sub>, 10 kg dka<sup>-1</sup> K<sub>2</sub>O and 21 kg dka<sup>-1</sup> N were applied. The experiments were carried out in four replications by 5.5 m<sup>2</sup> each. The leaf fertilizer Masterblend was applied as water solution at concentra-

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tions 1.5 g dm<sup>-3</sup>; 3.0 g dm<sup>-3</sup> and 6.0 g dm<sup>-3</sup> at the stage of flowering, by a ten-day interval until the moment of fruit setting. Masterblend is a product of Masterblend Fertilizers company, USA and it contains N:P:K at ratio 20:20:20 and the microelements. The plants were sprayed to the very good wet and the quantity of solution was 80 l dka<sup>-1</sup>. The control plants were sprayed with the same quantity of water. The adhesive was added to the solution. The pollen fertility was determined twenty days after the last treatment with the acetocarmin preparations. Seed yield was obtained at full physiological maturity. The number of seeds per fruit and the percentage of the fully developed seeds to all seeds in a fruit were investigated in an average sample of ten fruits at the moment of seed extraction. The index of seed productivity (Y) was calculated as a ratio of seed quantity (kg dka<sup>-2</sup>) to the fruit quantity (t dka<sup>-1</sup>). The weight of 1000 seeds, first count (germination energy),

germinability (final count), (ISTA, 2003), rate of germination by Piper (1952) and simultaneity of germination by Strona (1966) were analyzed. Fresh weight of sprouts of one seed, length of embryo roots and length of hypocotile on the twenty sprouts were measured at the moment of germinability determination (at the 14<sup>th</sup> day). Statistical analysis was done by ANOVA.

### Results and discussion

The normally pollenation, which is very important in relation with seed production depends strongly on pollen fertility. Leaf fertilizer Masterblend improved this parameter (Table 1). The highest values were established in variant 3.0 g dm<sup>-3</sup> - 94.95 and 93.3% for Kurtovska kapia 1619 and for Bulgarski rotund, respectively. The highest concentration inhibited pollen fertility for both cultivars in short limits, stronger for first one.

Tab. 1 Pollen fertility and characteristics of seed productivity of pepper after application of leaf fertilizer Masterblend (average 2001-2003)

Variants (doses)	Kurtovska kapia 1619					Bulgarski rotund				
	Pollen fertility (%)	Y	Seed numbers	Fully developed seed (%)	Weight of 1000 seeds (g)	Pollen fertility (%)	Y	Seed numbers	Fully developed seed (%)	Weight of 1000 seeds (g)
Control	90.0	7.60	197.8	90.25	5.70	89.6	7.40	211.0	94.30	7.00
1.5 g dm <sup>-3</sup>	91.7	8.29	212.8	92.71	6.01	93.3	8.38	239.5	97.26	7.20
3.0 g dm <sup>-3</sup>	94.9	9.24	221.3	96.90	5.68	93.7	8.01	254.2	95.24	7.16
6.0 g dm <sup>-3</sup>	82.5	8.73	260.5	89.32	5.99	88.5	7.85	222.3	94.70	6.97
p=0.05	1.5	1.0	10.7	1.6	0.33	2.2	0.9	16.2	1.2	0.26
GD p=0.1	2.3	2.1	16.1	2.5	0.48	3.0	1.4	24.2	1.9	0.40
p=0.01	3.4	3.3	24.7	3.8	0.72	4.5	2.2	36.9	2.8	0.61
r with Y			0.57	0.63				0.73	0.91	

The index of seed productivity gives great information about the state of seed quantity and for coming seed yield. It increased under the effect of leaf fertilizer. The highest was for Kurtovska kapia 1619 in dose 3.0 g dm<sup>-3</sup> - 9.24 and for Bulgarsko rotund in 1.5 g dm<sup>-3</sup>. While for the controls it was 7.60 and 7.40, respectively. With increasing the dose the ratio seeds/fruits mass decreased in comparison to the previous concentration, but also it was higher than of the non-treated plants.

Application of Masterblend influenced strongly the number of seeds per fruit. With the increase of the concentration the number also increased with exception for 6.0 g dm<sup>-3</sup> in

Bulgarski rotund. The increase was between 15.0 (1.5 g dm<sup>-3</sup>) to 62.7 (6.0 g dm<sup>-3</sup>) for Kurtovska kapia 1619 and between 28.5 (1.5 g dm<sup>-3</sup>) to 43.2 (3.0 g dm<sup>-3</sup>) for Bulgarski rotund. For the last cultivar in variant 6.0 g dm<sup>-3</sup> this feature is decreased in comparison to lower quantity of fertilizer but was higher than the control. The correlation coefficient with index of seed productivity was positive - middle for Kurtovska kapia 1619 r=0.57 and strong for other cultivar r=0.73.

Other considerable characteristic, which show the effect of the applied foliar dressing upon the seed development is the percentage of fully developed seeds. Each concentration

increased this percentage, but the variation was weak. The highest values were established in  $3.0 \text{ g dm}^{-3}$  for the first cultivar - 6.65% above the control and in  $1.5 \text{ g dm}^{-3}$  for the other cultivar - 2.96% above. In both mentioned concentrations the index of seed productivity was the highest too. Small decrease was calculated in  $6.0 \text{ g dm}^{-3}$  for Kurtovska kapia 1619. Correlation with this index was the same as for the number of seeds - positive and middle for this cultivar -  $r=0.63$  and strong for Bulgarski rotund -  $r=0.91$ . It indicated that those two characteristics were in a very strong

association and to a great extent they determined the seed productivity of pepper plants.

The changes in the weight of 1000 seeds were small. The augmentation for Kurtovska kapia 1619 was with 5.43% in  $1.5 \text{ g dm}^{-3}$  and 5.085 in  $6.0 \text{ g dm}^{-3}$ . For Bulgarski rotund the increase was even weakly - 2.85% and 2.28% for the first two doses, respectively. Insignificant decrease was established in  $3.0 \text{ g cm}^{-3}$  for Kurtovska kapia 1619 and in  $6.0 \text{ g dm}^{-3}$  for Bulgarski rotund.

More of the differences between the variants were statistically significant.

Tab. 2. Seed yield after application of Masterblend (kg/dka)

Variants (doses)	Kurtovska kapia 1619				Bulgarski rotund				
	2001	2002	2003	Average	2001	2002	2003	Average	
Control	23.15	13.11	24.56	20.27	15.64	13.03	21.35	16.67	
$1.5 \text{ g dm}^{-3}$	23.30	15.70	29.01	22.67	23.15	17.50	27.65	22.76	
$3.0 \text{ g dm}^{-3}$	23.15	17.18	32.74	24.35	22.73	18.26	22.86	21.28	
$6.0 \text{ g dm}^{-3}$	22.63	18.70	29.46	23.59	17.90	17.29	27.53	20.91	
p=0.05	1.4	1.6	2.1	3.6	1.7	2.4	1.3	4.0	
GD p=0.1	2.2	2.4	3.0	5.3	2.6	3.6	2.0	5.8	
p=0.01	3.3	3.7	4.5	8.0	3.8	5.4	3.1	8.7	
r with Y					0.98				0.96
r with concentrations					0.73				0.45

The best important behavior for evaluation of the agricultural practices is the effect under the plant productivity. In Table 2 are shown the data for seed yield. Each dose in both cultivars increased the seeds productivity. In average data was established the cultivar responses considered to the influence of different fertilizer quantity. In Kurtovska kapia 1619 the increase was between 11.84% ( $1.5 \text{ g dm}^{-3}$ ) to 20.12% ( $3.0 \text{ g dm}^{-3}$ ). A weak decrease in comparison with previous concentration was observed for  $6.0 \text{ g dm}^{-3}$ . In other cultivar however with the increase of the dose the seed yield decreased, but was higher than of non-treated plants. The highest was for the lowest quantity - 36.53% above the control. The genotype response to application of foliar dressing in bell pepper also established Papadopoulos et al. (1999). He emphasized that determinative parameters under the effect are the quantity and the timing of application. Along these lines are the conclusions of Silvester J. and Morad (1996) that successful period for foliar application is when the generative parts of the plants and productive organs are in the intensive growth and develop-

ment. In generalizing it could be pointed out for both cultivars that the highest yield was obtained in 2003 and the lowest in 2002, but also bigger toward the control. It is suggested for the influence of the different climatic conditions on the effect of foliar feeding. Chamel (1986) and El-Fouly M. and el-Sayed (1997) reported that the influence of foliar fertilizers strongly depends on the soil and climatic parameters. The variants with the highest yield characterized with the biggest values of index of seed productivity and the percentage of fully developed seeds. This once again confirmed the role of those two factors under the seed productivity. For it corroborates the established strong positive correlation coefficient of seed yield and index of seed productivity. For Kurtovska kapia 1619 it was  $r=0.98$  and for Bulgarski rotund -  $r=0.96$ . It was observed a difference for correlation with fertilizers concentrations. In both cultivars it was positive, but it was high for Kurtovska kapia 1619  $r=0.73$  and middle for Bulgarski rotund  $r=0.45$ . This weaker correlation coefficient in the second cultivar could be due to the lower yield, established for higher concentration in

comparison with the less one. Most of the differences between the variants were statistically significant.

The sowing qualities of pepper seeds under the influence of leaf fertilizers Masterblend, except for the seed productivity, are also to significant. In the germinative energy some cultivars features were observed (Table 3). For Kurtovska kapia 1619 in each investigated dose it was higher than the control. The increase varied from 6.3% in 3.0 g dm<sup>-3</sup> to 11.3% in 6.0 g dm<sup>-3</sup>. In Bulgarski rotund however this characteristic decreased even though weak in comparison with non-treated plants. The differences between concentrations were insignificant, but with control - were from 3.9% to 4.6% in the discussed concentrations for previously cultivar. Most important parameter for seed quality is the germinability. In each variant was established the stimulation

effect. In both cultivars the highest percentage of germinated seeds was observed for the highest concentration - with 6.1% and 3.8% above the control for Kurtovska kapia 1619 and for Bulgarski rotund, respectively. The weakest increase was in dose 3.0 g dm<sup>-3</sup> for the first cultivar and 1.5 g dm<sup>-3</sup> for the second one. The rate of germination was also characterized with cultivar responses. The applied Masterblend improved it for Kurtovska kapia 1619 in each quantity. The best rate was in 6.0 g dm<sup>-3</sup>. For Bulgarski rotund it was higher only in 3.0 g dm<sup>-3</sup>, but for other doses it was worse. The similar trend was established also for simultaneity of germination - increased in Kurtovska kapia 1619, mostly for 1.5 g dm<sup>-3</sup>, but in Bulgarski rotund decreased with 1.99% (6.0 g dm<sup>-3</sup>) to 2.32% (1.5 g dm<sup>-3</sup>). The statistical significance between most of data was established.

Tab. 3. Pepper seed viability after application of leaf fertilizers Masterblend (average 2001-2003)

Variants (doses)	Kurtovska kapia 1619				Bulgarski rotund			
	Germinative energy (%)	Germinability (%)	Rate of germination (days)	Simultaneity of germination (%)	Germinative energy (%)	Germinability (%)	Rate of germination (days)	Simultaneity of germination (%)
Control	34.2	77.1	7.20	7.50	53.7	81.3	5.60	10.70
1.5 g dm <sup>-3</sup>	41.2	79.4	6.47	8.70	49.3	82.2	6.38	8.38
3.0 g dm <sup>-3</sup>	40.5	78.7	6.72	8.11	49.8	84.4	5.20	8.68
6.0 g dm <sup>-3</sup>	45.5	83.2	6.14	8.36	49.1	85.1	6.44	8.71
p=0.05	5.4	1.9	0.7	0.8	3.2	2.1	0.6	1.1
GD p=0.1	8.0	2.8	1.1	1.2	4.9	3.2	0.9	1.8
p=0.01	11.9	4.1	1.7	1.9	7.4	4.9	1.4	2.7

Tab. 4. Morphological feature of pepper seeds sprouts after application of leaf fertilizer Masterblend (average 2001-2003)

Variants (doses)	Kurtovska kapia 1619			Bulgarski rotund		
	Fresh weight (mg)	Length of embryo root (cm)	Length of hypocotyls (cm)	Fresh weight (mg)	Length of embryo root (cm)	Length of hypocotyls (cm)
Control	30.7	3.81	3.23	43.3	4.02	3.43
1.5 g dm <sup>-3</sup>	37.9	4.03	3.77	44.6	4.43	3.55
3.0 g dm <sup>-3</sup>	30.7	3.76	3.78	36.7	4.20	3.36
6.0 g dm <sup>-3</sup>	33.5	3.67	3.39	35.4	3.87	2.98
p=0.05	2.8	0.52	0.51	1.8	0.38	0.40
GD p=0.1	3.3	0.79	0.75	2.7	0.57	0.61
p=0.01	4.9	1.2	1.13	4.1	0.86	0.80

The vigor of sprouts characterizes very well the seed quality and power. Most suitable it is the determination by means of the fresh

matter of sprouts and length of embryo roots (Copeland L. and Mc Donald 1995). The data are shown on Table 4. Fresh matter of sprouts

was increased under the application of Masterblend. It was higher in variant 1.5 g dm<sup>-3</sup> augmentation with 23.45% and 10.19% for Kurtovska kapia 1619 and for Bulgarski rotund, respectively. Length of embryo root increased only for 1.5 g dm<sup>-3</sup> for Kurtovska kapia 1619 and for this one and the next concentration for other investigated cultivar. The changes varied in small limits. Other studied feature of seed sprouts is the length of hypocotil. The effect of Masterblend for this parameter depends on cultivar. In Kurtovska kapia 1619 and increase with 4.95 (6.0 g dm<sup>-3</sup>) to 17.02% (3.0 g dm<sup>-3</sup>) was measured. For other cultivar however it was higher only in 1.5 g dm<sup>-3</sup> and in other concentration decreased, mostly from 6.0 g dm<sup>-3</sup>.

### Conclusions

Leaf fertilizer Masterblend influenced strongly the seed productivity and sowing quality of pepper.

This fertilizer improved weakly the pollen fertility and increased greatly the index of

seed productivity. The number of seeds and the percentage of fully developed seeds increased significantly also, but the weight of 1000 seeds varied in short limits.

The yield of pepper seed was higher after application of Masterblend. The best doses were for Kurtovska kapia 1619 3.0 g dm<sup>-3</sup> and for Bulgarsko rotund 1.5 g dm<sup>-3</sup> where the seed productivity was with 20.12% and with 36.53% above the control, respectively for mentioned cultivars.

As about the sowing quality the some cultivar responses were established. The germinative energy as well as the rate and simultaneity of germination increased in Kurtovska kapia 1619, while for Bulgarski rotund decreased, but the germinability was higher in both cultivars and was the best in the highest concentration.

The seed sprouts were with higher fresh matter. Cultivar differences were observed for length of embryo root and hypocotile. The increase of the first parameter was stronger for Bulgarski rotund and decreased for Kurtovska kapia 1619, however for the other characteristic the trend was the opposite.

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