

MORPHOLOGICAL BEHAVIORS AND PRODUCTIVITY OF PEPPER PLANTS UNDER INFLUENCE OF LEAF FERTILIZER KRISTALON

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Abstract

The main aim of the present study was to establish the effect of leaf fertilizer Kristalon in doses 1.5 g/l; 3.0 g/l and 6.0 g/l on the development and productivity of pepper cultivars Kurtovska kapia 1619 and Bulgarski rotund. The morphological characteristics, yield and quality of fruit have been explored. The strongest morphological development was observed in 1.5 g/l. The yield was highest for first cultivar in this dose while for other cultivar – in 6.0 g/l. It has been established that the thickness of pericarp, content of dry matter and vitamin C improved.

Keywords: pepper, Kristalon foliar fertilizer, productivity, morphological behavior

INTRODUCTION

[Papadopoulos et al. 1999] applied the leaf fertilizers in stage of mass flowering of pepper and established increase of yield by 13.0 %. [Lin, B. et al. 2001] report similar results. The pepper plants were foliar dressed and an increase of yield was observed by 4.2-27.8%. High productivity of this crop after treatment with leaf fertilizers with microelements has also been pointed out by [Simonne E.H. et al. 1998]. After application of certain leaf fertilizers [Ascari et al. 1995] achieved earlier flowering of pepper with twenty days and increased the number of fruit per plant and the fruit size. [Padem et al. 1999], [Thokur et al. 2000], [Panayotov 1995] and [Panayotov 2001] obtained higher yield of pepper by 4.2 % to 27.8% under the influence of different modification of foliar fertilizers. It should be mentioned that [Bracy et al. 2002] supports an opposing view. He did not observe a stimulation effect on pepper after leaf dressing with calcium supplements. [Mulyono 2003] provoked more intensive vegetative growth and increase of the yield of pepper through the application of leaf fertilizers Kristalon in dosage 1.0 g/l.

The main goal of the present study is to establish the influence of leaf fertilizer Kristalon on the morphological development and productivity of pepper.

MATERIALS AND METHODS

The trials were carried out in 2001-2003 in the experimental field of the Department of Horticulture at the Agricultural University of Plovdiv, Bulgaria. The plants of the typical Bulgarian pepper cultivars- Kurtovska kapia 1619 and Bulgarski rotund have been grown following the traditional technology for middle early open field production in South Bulgaria. The transplants were produced in a plastic house, sowed on 15 March, and transplanted to the field in mid-May by the scheme 60 x 15 cm. The following quantities of mineral fertilizers: 180 kg.ha⁻¹ P₂O₅, 100 kg.ha⁻¹ K₂O and 210 kg.ha⁻¹ N were applied. The experiments were carried out in four replications by 5.5 m² each. The leaf fertilizer Kristalon was applied as water solution in concentrations of 1.5 g/l; 3.0 g/l and 6.0 g/l at the stage of flowering, within a ten-day interval until the moment of technological ripening of the fruit. Kristalon is a product of Hydro Agry company, Rotterdam and it contains N:P:K:Mg at 13:5:26:3 ratio and the microelements B, Fe, Mn, Cu, Mo and Zn. The plants were thoroughly sprayed the quantity of the ready solution being 80 l/ha. The control plants were sprayed with the same quantity of water. The adhesive was added to the solution.

The morphological characteristics – weight, length and diameter of stem; number, weight and area of leaves on 15 plants were analyzed on the 20th day after the last

treatment. The index of the development was determined by the morphological characteristics using the equation (1):

$$I_g = \frac{\Sigma + (P - 100)}{n} \quad (1)$$

where P is the relative value of the investigation feature toward the control, n – number of the studied characteristics. The thickness of pericarp, content of dry matter and vitamin C by Mury [Stambolova et al. 1978] were analyzed. The yield was established. The unit 1.0 dka equals 0.1 ha.

RESULTS AND DISCUSSION

It could subsequently be summarized that leaf fertilizer Kristalon influenced the vegetative development of pepper plants. The weight of stem (**Figure 1**) increased after foliar dressing, without having to make use of dose 6.0 g/l for Kurtovska kapia 1619 and 3.0 g/l for Bulgarski rotund in 2003. The highest stem weight was observed in cultivar Kurtovska kapia 1619 for variant 1.5 g/l Kristalon – 60.8 g or with 17.9 g above the control. In Bulgarski rotund the biggest effect was also established in this concentration. The average values showed that with the increase of the fertilizer the weight of stem decreased.

Cultivar response was observed with respect to the length of stem (**Figure 2**). The plants with highest stems from Kurtovska kapia 1619 were established in 1.5 g/l – 61.3 cm as compared with 54.3 cm for the control. In Bulgarski rotund the application of Kristalon provoked a decrease of stem length with exception of each variant in 2002. As with the previous feature – weight of stem, here also the increase of the concentration of the fertilizer didn't lead to excessive stem growth.

The diameter of plants (**Figure 3**) changed in small limits. In Kurtovska kapia 1619 only for 6.0 g/l it decreased while for Bulgarski rotund for 1.5 g/l and for 6.0 g/l it increased, but for 3.0 g/l the plant diameter was smaller than the control.

The leaf development also undergoes changes after treatment with Kristalon. In more of the variants of cultivar Kurtovska kapia 1619 the plants had a higher number of leafs (**Figure**

4). Through 2002 each concentration inhibited this index. In summary it could be pointed out that the greatest stimulation effect provoked 1.5 g/l and for 6.0 g/l a decrease was observed. The number of leaves from Bulgarski rotund by the average values increased by 1.5 g/l – 141.57 and by 6.0 g/l – 138.2 while for the control it was 131.3.

The data for weight of leaves is presented in **Figure 5**. The lowest concentration of the fertilizer contributed to the development of leaves with highest weight for both cultivars. Throughout 2002 for Kurtovska kapia 1619 a lower weight of the leaves was observed as compared with the control plants. The average data for the leaf demonstrated that in each dose, excluding 3.0 g/l for Kurtovska kapia 1619, the weight of the leaves was higher as compared to the control.

Strong stimulation effect was established for the leaf area (**Figure 6**). The largest one was measured in 1.5 g/l Kristalon, for the studied cultivars, though throughout 2001 and 2002 an inhibition was observed for Kurtovska kapia 1619, but the stimulation effect in 2003 was strong and stable. The increase for this cultivar was 18.92 % more than the control and for other cultivar-41.5 %

The Index of development (I_g) can be used as a generalization of morphological behaviors (**Table 1**). The results categorically confirmed the emphasized tendency in the previous discussion that the best stimulation effect from foliar dressing with Kristalon was provoked by the lowest concentration. In these variants the indexes were 16.77 and 23.32 for Kurtovska kapia 16191 and for Bulgarski rotund respectively. For the first cultivar the lowest and negative index – $I_g = -13.08$ was established for 6.0 g/l. This was due to the inhibited development of stem diameter and of the number and area of the leaves. For the other cultivar the weakest vegetative development calculated for 3.0 g/l - $I_g = 5.39$, because the length and the diameter of the stem and the number of leaves lower values than the control were established. The most important parameter of the effectiveness of an agricultural practice is its influence on the productivity and

yield. Some cultivar differences in yield were established. The effect of foliar dressing of pepper productivity was strongest for Kurtovska kapia 1619 in lowest concentration. The yield was 26.39 % more than the control. Only in one year-2001, the highest yield was obtained for this cultivar in 6.0 g/l variant. However, for Bulgarski rotund this trend was observed when highest doses were applied and the increase was by 12.64. %. It was determined that 2001 was the most productive year for Kurtovska kapia 1619 while for the other cultivar it was 2002. The statistically significant effect was established. Leaf fertilizer Kristalon stimulated both the vegetative development and productivity of pepper. [Franke 1986] and [Alexander 1987] found similar trends for the effect of foliar application. For Kurtovska kapia 1619 the highest effect for vegetative and productive development coincided and for Bulgarski

rotund it was reverse. Another target of the application of leaf fertilizers is the fruit quality (Table 2).

The basic characteristic of pepper fruit is the thickness of the pericarp. This feature improved in each variant for both cultivars, especially in 1.5 g/l. The increase was by 0.7 mm and 1.2 mm for Kurtovska kapia 1619 and for Bulgarski rotund respectively.

The content of dry matter also increased and in Kurtovska kapia 1619 it reached 7.8 % for 3.0 g/l and for 6.0 g/l and in 7.1 % for control while for Bulgarski rotund it varied from 7.5 % (control) to 8.0 % (3.0 g/l). The fruits with highest content of vitamin C were those from variant 1.5 g/l for Kurtovska kapia 1619 and in 3.0 g/l for Bulgarski rotund. The increase was by 5.8 mg% and 11.0 mg% for the first and for the second cultivar study respectively.

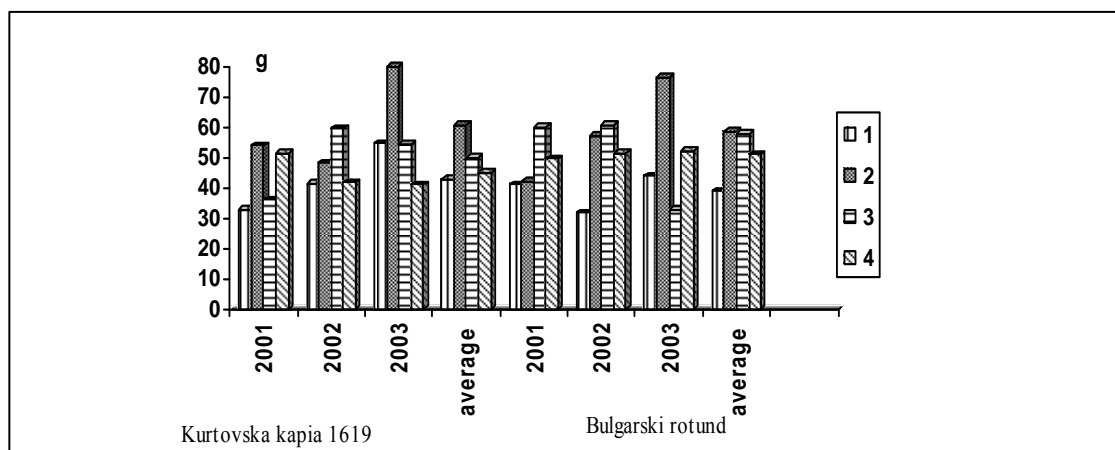


Figure 1 – Weight of stem after application of leaf fertilizer Kristalon
1 – Control; 2 - 1.5 g/l ; 3 – 3.0 g/l; 4 – 6.0 g/l

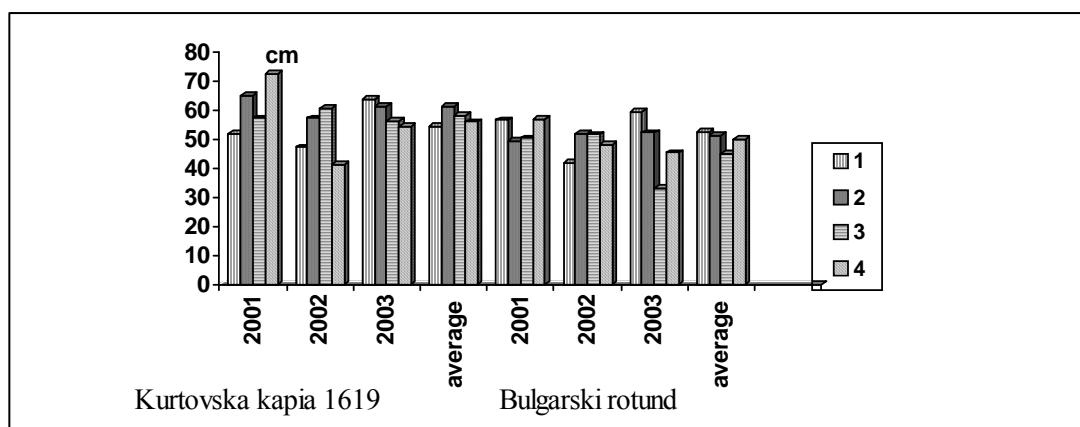


Figure 2 - Length of pepper stem after application of leaf fertilizer Kristalon
1 – Control; 2 - 1.5 g/l ; 3 – 3.0 g/l; 4 – 6.0 g/l

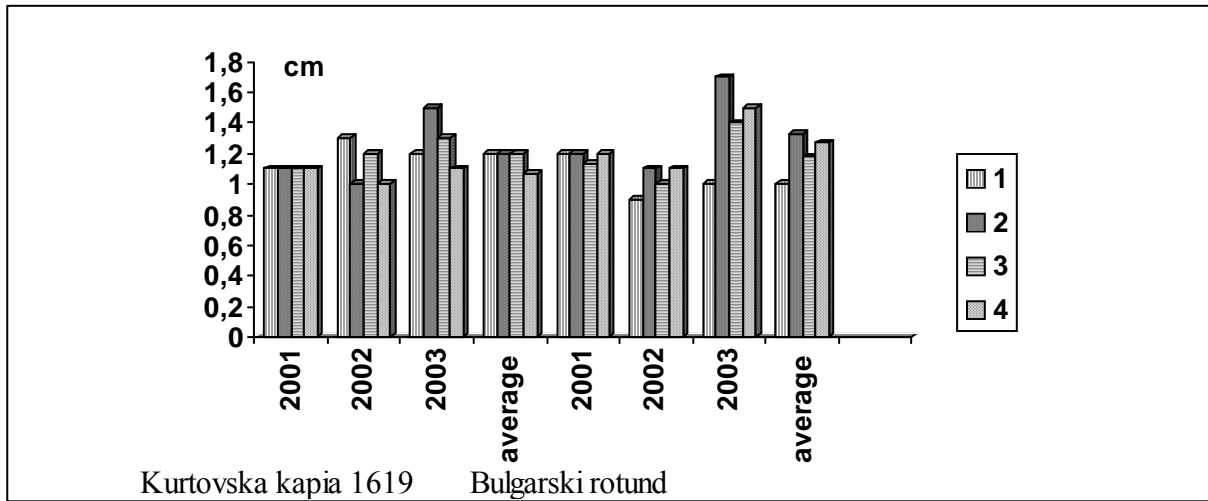


Figure 3 - Diameter of pepper stem after application of leaf fertilizer Kristalon
 1 - Control; 2 - 1.5 g/l; 3 - 3.0 g/l; 4 - 6.0 g/l

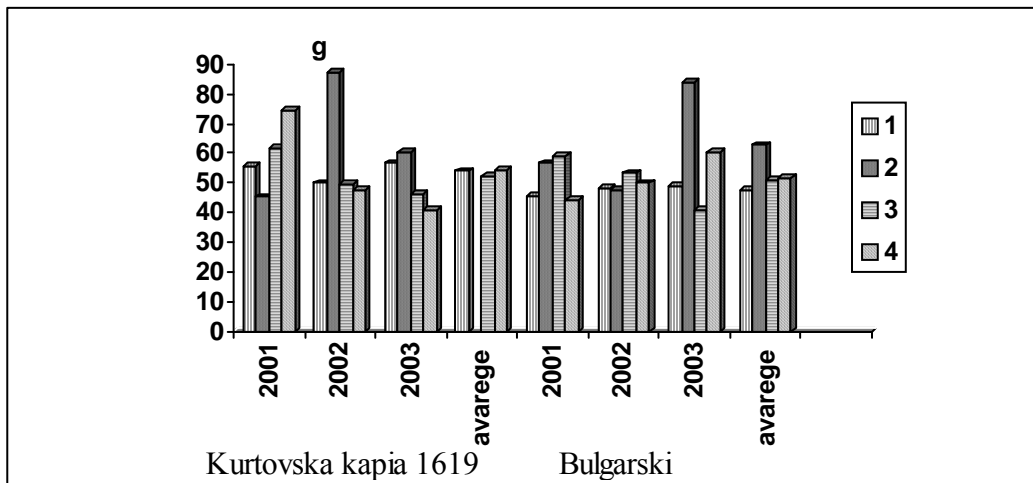


Figure 4 - Number of leafs of pepper plant after application of leaf fertilizer Kristalon: 1 – Control; 2 – 1.5 g/l; 3 – 3.0 g/l; 4 – 6.0 g/l

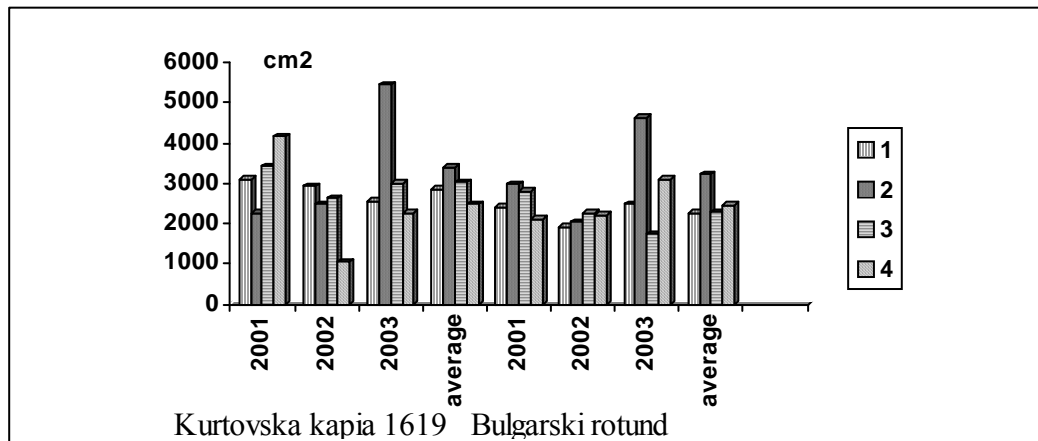


Figure 5 - Weight of leafs of pepper plant after application of leaf fertilizer Kristalon: 1 – Control; 2 – 1.5 g/l; 3 – 3.0 g/l; 4 – 6.0 g/l

Index of development (I_g) and yield (kg/dka)

№	<i>Kurtovska kapia 1619</i>					<i>Bulgarski rotund</i>				
	<i>I_g</i>	<i>01</i>	<i>02</i>	<i>03</i>	<i>Average</i>	<i>I_g</i>	<i>01</i>	<i>02</i>	<i>03</i>	<i>average</i>
1	0	3264.1	2582.0	2179.7	2675.2	0	1880.2	2801.1	2050.5	2243.9
2	16.77	4024.0	3210.8	2908.8	3381.2	23.32	2046.2	2937.0	2081.2	2354.8
3	5.78	4395.2	3127.4	2463.1	3328.6	5.39	2067.1	3138.8	2094.3	2433.4
4	-13.08	4535.1	2782.2	2046.3	3121.2	9.13	2288.3	3185.2	2109.2	2527.6
GD 5.0%		556.9	421.1	244.5	666.0		265.9	229.0	213.0	176.5
1.0%		774.8	682.4	382.2	964.6		405.1	361.6	352.9	255.6
0.1%		1082.2	903.0	555.3	1447.0		640.2	535.4	508.3	383.4

Table 2

Quality of fruit

	<i>Thickness of pericarp-mm</i>				<i>Content of dry matter - %</i>				<i>Content of vitamin C – mg%</i>			
	<i>01</i>	<i>02</i>	<i>03</i>	<i>average</i>	<i>01</i>	<i>02</i>	<i>03</i>	<i>average</i>	<i>01</i>	<i>02</i>	<i>03</i>	<i>Average</i>
<i>Kurtovska kapia 1619</i>												
1	4.1	4.2	4.2	4.2	7.0	6.8	7.5	7.1	189.2	197.3	186.0	190.8
2	4.9	4.9	5.0	4.9	7.5	7.3	8.1	7.6	192.2	202.5	195.3	196.6
3	4.4	3.9	4.3	4.2	7.7	7.7	7.9	7.8	188.9	200.0	198.0	195.6
4	4.8	4.9	4.7	4.8	7.6	7.7	8.0	7.8	195.6	199.8	188.8	194.7
GD 5.0%	0.2	0.6	0.8	0.3	0.4	0.4	0.2	0.28	4.1	3.0	2.8	6.8
1.0%	0.3	1.3	1.0	0.4	0.6	0.7	0.3	0.41	6.3	5.2	4.1	9.8
0.1%	0.4	1.9	1.6	0.7	0.9	1.3	0.5	0.62	8.2	7.3	6.3	14.8
<i>Bulgarski rotund</i>												
1	6.2	6.3	6.1	6.2	7.6	7.0	7.9	7.5	195.7	188.0	200.2	194.6
2	7.2	7.4	7.6	7.4	8.2	8.0	7.6	7.9	211.2	196.2	193.9	200.4
3	6.8	6.7	7.5	7.0	8.8	7.8	7.5	8.0	208.5	198.2	210.2	205.6
4	7.1	6.6	7.4	7.0	8.4	8.1	7.4	7.9	197.3	189.0	209.6	198.6
GD 5.0%	0.2	0.5	1.2	0.51	0.4	0.9	0.3	0.8	2.1	2.4	2.75	12.4
1.0%	0.3	0.8	2.0	0.74	0.6	1.3	0.4	1.17	3.5	3.7	3.98	18.0
0.1%	0.5	1.2	3.2	1.12	0.9	2.0	0.6	1.76	5.9	6.0	5.87	27.0

About *Tables 1* and *2* numbers from 1 to 4 – are the variants like in figure 1

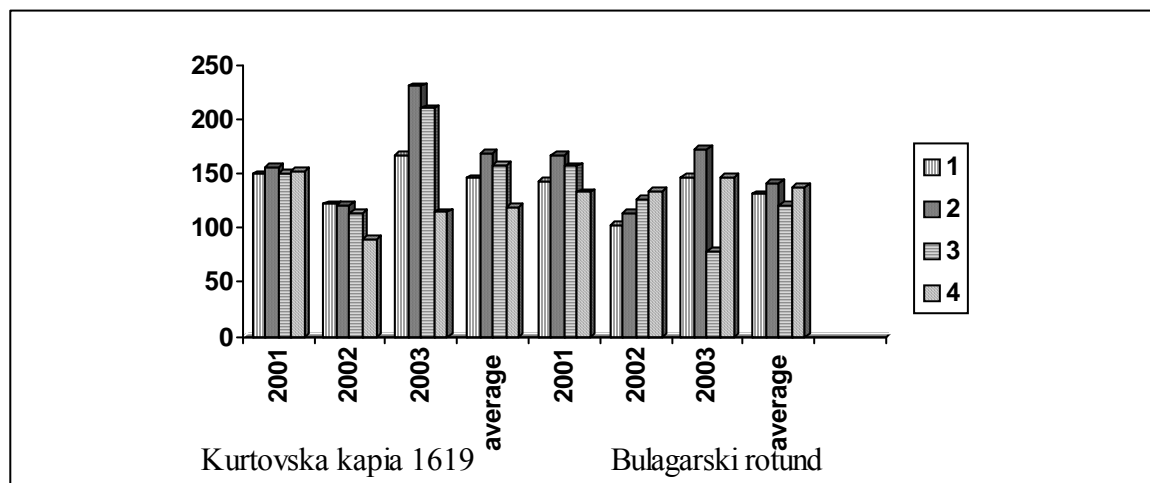


Figure 6 -Leaf area of pepper plant after application of leaf fertilizer Kristalon
1 – Control; 2 – 1.5 g/l; 3 - 3.0 g/l; 4 – 6.0 g/l

CONCLUSIONS

In sum, Kristalon leaf fertilizer provoked strong influence on the morphological behaviors and on the yield of pepper.

The vegetative development, determined by the Index of development, was highest for lowest concentration for both cultivars.

It was observed that the weight of stem increased and the length was higher only for Kurtovska kapia 1619, while the diameter of stem changed only in short limits. The number, weight and area of the leaves improved rapidly in concentration 1.5 g/l.

Certain cultivar responses were established for the productivity factor.

The highest yield for Kurtovska kapia 1619 was obtained in 1.5 g/l while for Bulgarski rotund it was in 6.0 g/l.

The thickness of the pericarp, the dry matter content and vitamin C content were improved under the effect of Kristalon leaf fertilizer.

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