



The influence of mineral-organic fertilizers on the yield and quality of iceberg lettuce

INTRODUCTION

Lettuce, mainly consumed as a fresh product, is an important leafy vegetable containing natural antioxidants. Lettuce is a plant with rather high nutritional requirements, having little ability to receive nutrients from the soil, so it is necessary to permanently use fertilizers for easy uptake. Preparations stimulating plant growth and development, commonly called biostimulators, are used in modern horticulture worldwide. In Poland, however, they are not registered as biostimulators, but as mineral-organic fertilizers. They stimulate the synthesis and activity of natural hormones and improve water uptake of minerals. They increase the chlorophyll content, leaf area, intensity and efficiency of photosynthesis, stimulate the growth of vegetative mass, lead not only to an increase in yield, but also improve its quality.

Lettuce is an important leafy vegetable containing natural antioxidants: polyphenols and ascorbic acid. The concentration of phenolic acids and flavonoids in lettuce leaves is dependent on environmental conditions. The storage process can contribute to a significant decrease in their content.

MATERIAL AND METHODS

The experiment was carried out at the Department of Vegetable and Medicinal Plants, WULS-SGGW. The effect of mineral-organic fertilizers (Folical and InCa from Arysta Life Science Co.) and calcium nitrate on the yield and quality of lettuce cultivar 'Challenge' (Syngenta) and 'Diamantinas' (Rijk Zwaan) was estimated. Seeds were sown on two dates – in the spring and summer time. After four weeks, the plants were planted in the field. Mineral-organic fertilizers were applied according to the producer's recommendations: seedlings were sprayed once with InCa, and then the plants were sprayed with Folical, InCa, and calcium nitrate every 10-14 days since the phase of re-growth after planting till harvest. The yield, dry matter, content of vitamin C, macronutrients, and polyphenol oxidase activity were determined.

RESULTS

Table 1. Yield of lettuce depending on the time of cultivation, cultivar and treatment (kg × m⁻²)

Term of cultivation	Cultivar	Preparation					Means for cultivation terms	Means for cultivars
		Control	Calcium nitrate	InCa 0.2%	InCa 0.3%	Folical		
I	Challenge	4.25 a	4.35 a	4.81 a	4.47 a	4.37 a	4.82 a	3.99 b
	Diamantinas	5.35 a	5.46 a	5.19 a	5.12 a	4.80 a		5.15 a
II	Challenge	3.13 a	3.76 a	3.83 a	3.78 a	3.19 a	4.33 b	
	Diamantinas	5.04 a	5.07 a	5.40 a	5.21 a	4.89 a		
Means for preparations		4.44 ab	4.66 ab	4.81 a	4.64 ab	4.31 b		

Table 2. The dry matter content in lettuce leaves depending on the time of cultivation, cultivar and treatment (%)

Term of cultivation	Cultivar	Preparation					Means for cultivation terms	Means for cultivars
		Control	Calcium nitrate	InCa 0.2%	InCa 0.3%	Folical		
I	Challenge	2.74 a	2.79 a	1.77 a	2.22 a	2.69 a	2.72 b	2.85
	Diamantinas	2.89 a	2.48 a	2.61 a	2.52 a	4.55 a		3.06
II	Challenge	36.00 a	3.25 a	3.04 a	3.10 a	3.51 a	3.18 a	
	Diamantinas	3.39 a	3.15 a	2.99 a	2.93 a	3.07 a		
Means for preparations		3.09 a	2.92 a	2.60 a	2.69 a	3.46 a		

CONCLUSIONS

1. The use of calcium fertilizers had a significant impact on the yield of lettuce cultivars 'Diamantinas' and 'Challenge'. The best yielding was achieved after treatment with InCa at the concentration 0.2%.
2. Plants grown in the summer time were characterized by a higher content of dry matter, vitamin C, calcium, potassium, as well as nitrates. However, plants grown in spring time had higher antioxidant activity.
3. Challenge cultivar had higher content of vitamin C, dry weight, calcium and potassium, also showed a higher antioxidant activity, but contained more nitrates than 'Diamantinas'.

Table 3. The vitamin C content in lettuce leaves depending on the time of cultivation, cultivar and treatment (mg × 100 g⁻¹)

Term of cultivation	Cultivar	Preparation					Means for cultivation terms	Means for cultivars
		Control	Calcium nitrate	InCa 0.2%	InCa 0.3%	Folical		
I	Challenge	5.52 a	6.46 a	5.67 a	6.10 a	5.52 a	5.45 b	6.43 a
	Diamantinas	4.14 a	6.10 a	5.23 a	4.65 a	5.08 a		5.77 b
II	Challenge	7.19 a	7.26 a	7.84 a	5.74 a	7.04 a	6.75 a	
	Diamantinas	6.32 a	6.54 a	6.90 a	6.39 a	6.32 a		
Means for preparations		5.79 ab	6.59 a	6.41 ab	5.72 b	5.99 ab		

Table 4. DPPH antioxidant activity in lettuce leaves depending on the time of cultivation, cultivar and treatment (%)

Term of cultivation	Cultivar	Preparation					Means for cultivation terms	Means for cultivars
		Control	Calcium nitrate	InCa 0.2%	InCa 0.3%	Folical		
I	Challenge	15.54 c	13.57 c	13.64 c	18.11 bc	12.13 cd	14.56 a	19.15 a
	Diamantinas	13.05 c	13.48 c	19.77 bc	13.08 c	13.24 c		10.71 b
II	Challenge	27.23 a	23.65 ab	24.16 ab	21.24 b	22.23 ab	15.30 a	
	Diamantinas	6.18 d	5.44 d	7.80 d	7.46 d	7.59 d		
Means for preparations		15.50 ab	14.04 b	16.34 a	14.97ab	13.80 b		

Table 5. The calcium content in lettuce leaves depending on the time of cultivation, cultivar and treatment (mg × 100 g⁻¹ FW)

Term of cultivation	Cultivar	Preparation					Means for cultivation terms	Means for cultivars
		Control	Calcium nitrate	InCa 0.2%	InCa 0.3%	Folical		
I	Challenge	12.75 c	10.25 cd	11.49 cd	10.99 cd	10.74 cd	10.53 b	16.39 a
	Diamantinas	10.53cd	8.37 d	9.95 cd	10.61 cd	9.64 cd		11.30 b
II	Challenge	26.97 a	19.64 b	19.11 b	21.79 b	20.18 b	17.16 a	
	Diamantinas	13.04 c	13.22 c	12.50 c	12.86 c	12.32 c		
Means for preparations		15.82 a	12.87 b	13.26 b	14.06 b	13.22 b		

Table 6. The potassium content in lettuce leaves, depending on the time of cultivation, cultivar and treatment (mg × 100 g⁻¹ FW)

Term of cultivation	Cultivar	Preparation					Means for cultivation terms	Means for cultivars
		Control	Calcium nitrate	InCa 0.2%	InCa 0.3%	Folical		
I	Challenge	109.30c	103.94 c	108.19 c	104.95 c	100.82 c	103.05 b	162.42 a
	Diamantinas	104.44c	99.32 c	99.73 c	102.35 c	97.45 c		101.31 b
II	Challenge	305.35a	182.01 b	190.86 b	220.12 b	198.69 b	160.69 a	
	Diamantinas	108.47c	105.68 c	100.21 c	96.59 c	98.92 c		
Means for preparations		156.89a	122.73 b	124.75b	131.00b	123.97 b		

Table 7. The nitrates content in lettuce leaves depending on the time of cultivation, cultivar and treatment (mg × 100 g⁻¹ FW)

Term of cultivation	Cultivar	Preparation					Means for cultivation terms	Means for cultivars
		Control	Calcium nitrate	InCa 0.2%	InCa 0.3%	Folical		
I	Challenge	35.37 a	37.02 a	35.54 a	33.07 a	33.81 a	32.99 b	47.98 a
	Diamantinas	35.16 a	28.87 a	31.43 a	28.29 a	31.31 a		43.62 b
II	Challenge	62.75 a	64.01 a	60.95 a	59.97 a	57.37 a	58.62 a	
	Diamantinas	63.59 a	57.26 a	52.66 a	52.69 a	54.93 a		
Means for preparations		49.22 a	46.79 ab	45.14 b	43.50 b	44.35 b		

