

Influence of Certain Technological Traits on Yield Quality in Lettuce

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Abstract. Researches were carried on at the UASVM Cluj-Napoca, Faculty of Horticulture, Horticulture and Landscape Design Dpt., in 2011, in order to study the influence of some technological traits applied to lettuce cultivated in greenhouse, on their nutritive value. The results obtained recommend Pronto cultivar for protected area, when fertilized with 500 kg/ha NPK and planted with a density of 156,250 pl/ha for a good economic efficiency. This cultivar presents positive deviation for all the three studied characters when analyzed statistically.

Keywords: lettuce, cultivar, soluble dry, organic acids, vitamin C, qualitative traits.

INTRODUCTION

Most modern diets require daily intake of fresh vegetables for supplying the organism with natural vitamins and minerals. Lettuce is one of the vegetables widely consumed all over the year. Its rather short vegetation period and resistance to low temperatures, permit the extension of consumption period even for extra-season, in protected areas.

Lettuce may be used fresh or cooked; it presents a high water and vegetal fiber content, with numerous benefic effects on health. It contains a large number of minerals (Ca, Fe, Mg, P, K), vitamins (C, B₁, B₂, PP, K, E), alkaloids due to which stimulates digestion, reduces the risk of occurrence of heart diseases and cancer (Indrea *et al.*, 2007). Vitamin C, present in lettuce leaves, prevents the transformation of nitrates in nitrites both in plant and in human body after ingestion (Hill, 1991 cited by Sima, 2007). Lettuce is the most important species grown as monoculture or intercalated culture in greenhouses during the cold winter period. The achievement of high quality yield, in efficient economic conditions, assumes improved growing technologies based on the relation between each variety and the environmental conditions and rational application of chemical fertilizers (Lazăr *et al.*, 2005; Lazăr, 2006).

MATERIALS AND METHODS

Our experiment on lettuce was set up in the greenhouse of the Vegetable growing Dpt. of the UASVM Cluj-Napoca, during 7.02-16.04.2011 with two cultivars (Pronto and Limax), while the qualitative analyses had been carried out in the laboratory of Horticultural products technology Dpt.

Seedlings were pricked out in 5/5 cm nutritive cubs then planted in two variants of density: (1) at 0.30/0.25 m distance between rows and plants/row obtaining 12.5 plants/m² and (2) at 0.30/0.20 m between rows and plants, with a density of 15.6 plants/m². Mineral fertilizations with N:P:K (15:15:15) have been applied to both density variants with 300 kg/ha and 500 kg/ha, respectively. The three studied factors (cultivars × density × fertilizer doses)

finally made up a trifactorial experiment ($2 \times 2 \times 2$) with eight variants, each one covering a surface of 28.8 m^2 , in three replications, with $9.6 \text{ m}^2/\text{replication}$ (Tab. 1)

Tab. 1

Scheme of the experimental variants

| No. of var. | Fertilizer dose (kg/ha NPK) | Density (no. pl./ha) | Cultivar |
|-------------|-----------------------------|----------------------|----------|
| 1. | 300 | 125,000 | Pronto |
| 2. | | | Limax |
| 3. | | 156,250 | Pronto |
| 4. | | | Limax |
| 5. | 500 | 125,000 | Pronto |
| 6. | | | Limax |
| 7. | | 156,250 | Pronto |
| 8. | | | Limax |

By the end of the vegetation period (commercial maturity) morphologic and quality traits were studied, namely: head diameter and weight, leaf number, content of soluble dry, organic acids and vitamin C. The present paper reveals the qualitative performances of the two studied lettuce cultivars; Pronto fertilized with 300 kg/ha N:P:K and planted at a density of 125,000 pl/ha being considered as control, the obtained results being statistically analyzed.

RESULTS AND DISCUSSIONS

The unilateral influence of fertilizer doses applied to lettuce on the studied quality traits are presented in Tab. 2. All studied characters (soluble dry, organic acid level and vitamin C content) present positive, very and distinctly significant deviation as to the control cultivar fertilized with 300 kg/ha NPK.

Tab. 2

Unilateral influence of fertilizer doses on qualitative performances in lettuce

| Fertilizer dose (kg/ha NPK) | Soluble dry | | Organic acids | | Vitamin C | |
|-----------------------------|-------------------------|-----------------------------|-------------------------------------|----------------------------|--|----------------------------|
| | Soluble dry content (%) | Significance of differences | Organic acid content (% malic acid) | Significance of difference | Vitamin C content (mg/100g raw material) | Significance of difference |
| 300 (Ctr) | 3.67 | - | 0.51 | - | 14.41 | - |
| 500 | 4.17 | 0.50** | 0.76 | 0.25*** | 17.36 | 2.95*** |
| DL 5% | | 0.28 | | 0.08 | | 1.15 |
| DL 1% | | 0.41 | | 0.11 | | 1.68 |
| DL 0.1% | | 0.61 | | 0.17 | | 2.51 |

The combined effect of fertilizer doses \times cultivars (Tab. 3) on soluble dry content stresses Pronto cultivar as having a very good response to higher fertilizer doses, with a 0.92% yield increase, very significant vs. control. In Limax cultivar this character presents negative deviations in both density variants, without any statistic significance. The organic acids level and vitamin C content present significant and distinctly significant positive deviations vs. control, regardless the cultivar and fertilizer doses applied. The higher fertilizer dose (500 kg/ha) applied to Pronto cultivar increases the soluble dry content in the detriment to the acidity level and vitamin C content.

Tab. 3

Influence of fertilizer doses applied × cultivars interaction on qualitative traits in lettuce

| Variant | | Soluble matter | | Organic acids | | Vitamin C | |
|--------------------------------|--------------|-------------------------|----------------------------|-------------------------------------|----------------------------|--|----------------------------|
| Fertilization dose (kg/ha NPK) | Cultivar | Soluble dry content (%) | Significance of difference | Organic acid content (% malic acid) | Significance of difference | Vitamin C content (mg/100g raw material) | Significance of difference |
| 300 | Pronto (Ctr) | 3.80 | - | 0.41 | - | 13.43 | - |
| | Limax | 3.53 | -0.27 | 0.74 | 0.33*** | 17.42 | 3.98*** |
| 500 | Pronto | 4.72 | 0.92*** | 0.61 | 0.20** | 15.38 | 1.95* |
| | Limax | 3.62 | -0.18 | 0.79 | 0.38*** | 17.30 | 3.87*** |
| DL 5% | | 0.40 | | 0.11 | | 1.63 | |
| DL 1% | | 0.58 | | 0.16 | | 2.37 | |
| DL 0.1% | | 0.87 | | 0.24 | | 3.55 | |

As observed in Tab. 4, the interaction of the applied fertilizer doses and plant density in lettuce influence the three qualitative traits studied as follows: soluble dry increases significantly when the higher dose (500 kg/ha) of mineral fertilizer is applied; the organic acid level increases very significantly with the density of plants (0.77-0.76%) with a very small decrease in low density and high fertilizer dose (-0.08% vs. control); vitamin C is synthesized in the highest quantity when density is 156,250 pl/ha and at a 300 kg/ha NPK fertilization. Negative deviations of vitamin C content can be observed in both variants fertilized with 500 kg/ha NPK, a special attention should be paid to the variant with 125,000 plants/ha density with a distinctly significant negative deviation (-4,45 mg/100 g raw material) as to control. The lower acidity level recorded in the variant fertilized with 500 kg/ha NPK planted at 125,000 plants/ha density is correlated with the decrease of vitamin C content, as it is well known that foodstuffs with high acidity preserves better vitamin C and vice-versa (Beceanu *et al.*, 2003).

Tab. 4

Influence of fertilizer doses applied × planting density interaction on qualitative traits in lettuce

| Variant | | Soluble dry | | Organic acids | | Vitamin C | |
|--------------------------------|----------------------|-------------------------|----------------------------|-------------------------------------|----------------------------|--|----------------------------|
| Fertilization dose (kg/ha NPK) | Density (nr. pl./ha) | Soluble dry content (%) | Significance of difference | Organic acid content (% malic acid) | Significance of difference | Vitamin C content (mg/100g raw material) | Significance of difference |
| 300 | 125,000 | 3.65 | - | 0.55 | - | 16.40 | - |
| | 156,250 | 3.68 | 0.03 | 0.77 | 0.22** | 18.87 | 2.47** |
| 500 | 125,000 | 4.03 | 0.38 ^(*) | 0.47 | -0.08 | 12.42 | -4.45 ^{ooo} |
| | 156,250 | 4.30 | 0.65** | 0.76 | 0.21** | 15.85 | -1.02 |
| DL 5% | | 0.40 | | 0.11 | | 1.63 | |
| DL 1% | | 0.58 | | 0.16 | | 2.37 | |
| DL 0.1% | | 0.87 | | 0.24 | | 3.35 | |

The interaction of the three studied factors (fertilizer doses × cultivar × plant density)

remarks cv. Pronto, as accumulating a relative high soluble dry with both fertilizer doses and densities analyzed, distinctly and very significant differences being observed only when 500 kg/ha mineral fertilizer was administrated. Furthermore, if all qualitative traits studied are taken in consideration, we can notice that the interaction of the three factors distinguishes cv. Pronto as very and distinct significantly exceeding the control in most variants.

Meanwhile cv. Limax, under the interaction of the three factors, presents a very significantly higher acidity level at a 156,250 plants/ha density in both fertilization variants and a significantly lower vitamin C content in the same fertilization conditions when planting density was 125,000 plants/ha vs. control.

Tab. 5

Influence of fertilizer doses applied × cultivar × planting density interaction on qualitative traits in lettuce

| Variant | | | Soluble dry | | Organic acids | | Vitamin C | |
|-----------------------------|--------------|----------------------|-------------------------|----------------------------|-------------------------------------|----------------------------|--|----------------------------|
| Fertilizer dose (kg/ha NPK) | Cultivar | Density (nr. pl./ha) | Soluble dry content (%) | Significance of difference | Organic acid content (% malic acid) | Significance of difference | Vitamin C content (mg/100g raw material) | Significance of difference |
| 300 | Pronto (Ctr) | 125.000 | 3.57 | - | 0.47 | - | 14.50 | - |
| | | 156.250 | 4.03 | 0.46 | 0.72 | 0.25** | 18.87 | 4.37** |
| | Limax | 125.000 | 3.73 | 0.16 | 0.35 | -0.12 | 12.37 | -2.13 ⁰ |
| | | 156.250 | 3.33 | -0.24 | 0.76 | 0.29** | 15.97 | 1.47 |
| 500 | Pronto | 125.000 | 4.83 | 1.27*** | 0.62 | 0.15 ^(*) | 18.30 | 3.80** |
| | | 156.250 | 4.60 | 1.03** | 0.82 | 0.35*** | 18.87 | 4.37** |
| | Limax | 125.000 | 3.23 | -0.34 | 0.60 | 0.13 | 12.47 | -2.03 ⁰ |
| | | 156.250 | 4.00 | 0.43 | 0.76 | 0.29** | 15.73 | 1.23 |
| | | DL 5% | | 0.56 | | 0.16 | | 2.30 |
| | | DL 1% | | 0.82 | | 0.23 | | 3.35 |
| | | DL 0.1% | | 1.23 | | 0.34 | | 5.03 |

CONCLUSIONS

Experimental results obtained, concerning the influence of certain technological traits applied to lettuce grown in greenhouses, on their qualitative performances, authorize the following conclusions and recommendations:

- increase of the applied fertilizer doses from 300 to 500 kg/ha pays a positive influence on the studied characters by increasing the accumulated organic substances;
- the interaction fertilizer dose × cultivar influences cv. Pronto in order to achieve a distinctly significant soluble dry content vs. control when 500 kg/ha NPK is applied, and a slightly reduced level in organic acids and vitamin C in the same conditions;
- the effect of interaction fertilizer dose × density results in a distinctly significant negative influence on ascorbic acid level at high fertilizer doses and low density;
- the influence of interaction fertilizer dose × cultivar × density on qualitative traits in lettuce recommends cv. Pronto for greenhouse conditions, fertilized with 500 kg/ha NPK,

planted at 156,250 plants/ha density, as the best studied variant, ensuring good economic income without damaging quality and nutritious value.

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