Planting densities affect nitrate concentration in spinach (*Spinacia oleracea* L.) cultivated in floating hydroponic system root

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INTRODUCTION

An important aspect of the production of leafy vegetables is the reduction of their nitrate content because of its indirect negative effects on human health. Nitrate is relatively non-toxic but its metabolites could cause carcinogenesis.

Light is one of the main factors involved in the accumulation of nitrate in plants especially under low light intensity.

OBJECTIVE

To evaluate concentration of nitrates in baby spinach leaves, growing at different densities in a floating hydroponic system root expressed as dry mass

MATERIALS AND METHODS

Spinach *(Spinacia oleracea* L. cv. monstruosa viroflay) was grown in a floating trays system. Three planting densities were used **(Fig. 1).** The plants were maintained in nutrient solution with an electrical conductivity of 2,1 dS m^{-1} and pH 6. Three harvest manual were performed (day 28, 32 and 38 after transplant).

Determinations

Leaf area index. Leaf area meter (Li-Cor modelo 3050A/4, Nebraska, USA).

Dry mass. The leaves were dried in a drying oven at 70 °C with forced air circulation (LabTech model LDO-750F, Korea) for 24 h. The mass was determined with an electronic balance (Radwag, model AS100 / C / 2 Poland).

Concentration of nitrates. It was determined by the method of selective ion (Sadzawaka *et al*., 2007).

Nitrate reductase activity. According to Scheible *et al*. (1997), based on the quantification of nitrite formed in the reaction catalyzed by the enzyme

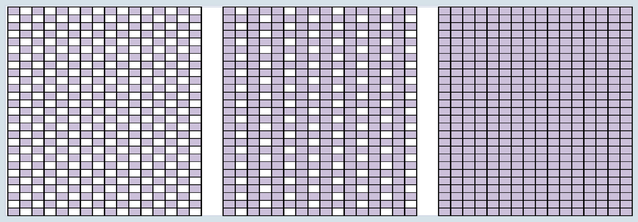

Fig. 1. Densities applied, T1: 862 pl m^{-2}; T2: 1,296 pl m^{-2} ; T3: 1,728 pl m^{-2}

Fig. 2. Spinach crop stages

RESULTS

Dry mass

The density 862 plants•m^{-2} (T1) showed a significant high dry mass compared to the highest density (Fig. 3). The dry mass is increased at low density, as synthesized a higher amount of assimilates.

Leaf area index

The first, second and third harvest showed significant differences between T1 and T3 treatments (Fig.4).

The leaf area index is higher in the treatment of higher planting density, as there is a greater leaf area per soil space compared to other treatments. This directly influences the amount of light intercepted by the plant.

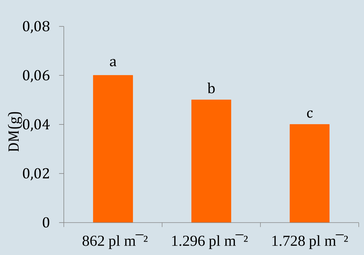

Fig. 3. Dry mass per densities treatment. Values represent the mean of three harvests . Different letters indicate statistically significant differences between treatments (Tukey ≤ 5%).

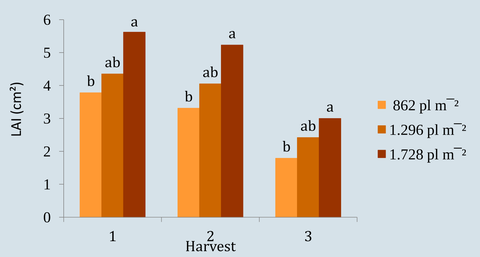

Fig. 4. Leaf area index per harvest. Harvest 1: Day 28; harvest 2: Day 32; havest 3: Day 38. Different letters indicate statistically significant differences between treatments (Tukey ≤ 5%).

Concentration of nitrates and low nitrate reductase activity

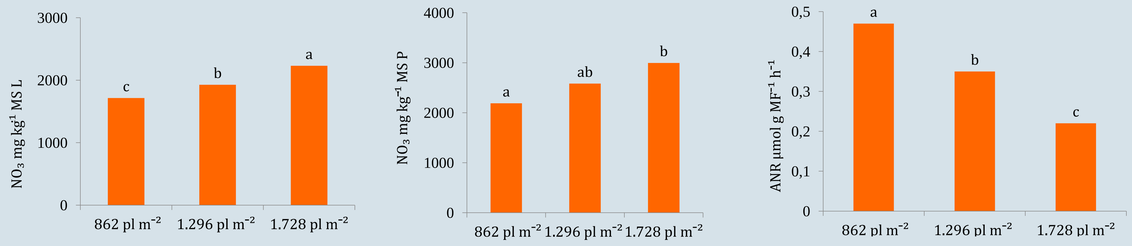

Fig. 5. Concentration of nitrates leaf (a) and petiole (b) and nitrate reductase activity (c). Different letters indicate statistically significant differences between treatments (Tukey ≤ 5%).

Nitrate concentration was higher in petiole than leaf (Fig. 5 a y b) in three harvest performed.

The higher planting density, lower light intensity. The effect of low light is primarily due to restricted nitrate reductase activity. The nitrate reductase activity was 0.47 µmol g FM-¹ h-¹ for low density compared to 0.22 µmol g FM-¹ h-¹ obtained in high density (Fig. 5 c).

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CONCLUSION

It was concluded that concentrations of nitrate in baby spinach leafs was affected by the planting densities. Higher densities planting obtained high concentrations of nitrates due probably to lower solar interception. Accumulated nitrates were higher in petiole than leaf.

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