Title Influence of nitrogen nutrition on spinach leaf fragility, composition and postharvest quality

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Abstract

Inorganic forms of nitrogen and nitrogen availability are major determinants of the nutritional composition and overall quality of crops. Spinach plants (cv Whale) were grown hydroponically with four nitrogen regimes (50, 125 and 200 ppm total N (80:20 nitrate to ammonium) and 180 ppm total N (55:45 nitrate to ammonium) and harvested before dawn after 30-35 days of cultivation. The texture profiles of leaf 8 and 16 as well as the nutritional composition and agronomic traits of these plants at harvest were significantly impacted by the culture conditions. Leaf texture was negatively impacted by increasing nitrogen fertilization. Leaves from the high nitrogen treatments, irrespective of nitrogen form, were on average 30% less tough than leaves cultivated under low nitrogen fertilization. Plants cultivated with high nitrate concentrations had significantly reduced cell wall pectin content with concomitant increments in non-soluble sugars while low nitrate and ammonium fertilized plants produced the opposite effect. In addition, plants from high nitrogen treatments had significantly thicker leaves and spongy mesophyll with bigger cells and intercellular spaces. High nitrogen nutrition produced yields of over 60 g/plant while yield from low N treatments was 27 g/plant. Increasing nitrogen supply to the plants resulted in unsafe levels of nitrate and oxalic acid in the leaves (10,500 ppm and 35 mg g^{-1} DW respectively) at the highest N concentration.

High ammonium supply to the plants resulted in lower nitrate, but higher ammonium, concentrations in harvested leaves. High nitrogen supply did not significantly increase iron concentrations in spinach leaves but total chlorophyll and carotenoids marginally increased with increased N supply. Total sugars were higher from low nitrogen and high ammonium regimes.

During storage the postharvest quality of spinach was significantly reduced in plants cultivated with high nitrate or ammonium fertilization. Overall no net improvement in spinach nutritional quality, leaf texture and postharvest shelf life was obtained by increasing nitrogen fertilization in hydroponic culture. Nitrogen concentrations below 100 ppm would improve the nutritional quality, shelf life and

texture profile of this leafy green cultivated in hydroponic culture. The tradeoff for these improvements is lower yield.