

Full Length Research Paper

Differential nitrate accumulation, nitrate reduction, nitrate reductase activity, protein production and carbohydrate biosynthesis in response to potassium and sodium nitrate

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For most of the cultivated crops, nitrate is the major source of nitrogen. Most steps in the nitrate assimilatory pathway are nitrate inducible. In this study, *Cucurbita pepo* were grown in washed sand per pot at three potassium and sodium nitrate supplies (25, 50 and 100 mM) to investigate the effects of nitrate salts supply on nitrate accumulation, amino acid biosynthesis, total protein production, nitrate reductase activity and carbohydrate biosynthesis in the roots and leaves of the plants. The results indicate that both sodium and potassium nitrate supplementation had stimulatory effects on all of the mentioned factors in a dose dependent manner. In low concentration ranges (25 and 50 mM), nitrate stimulated nitrate assimilation pathway, but at 100 mM nitrate, this pathway was suppressed. However, potassium nitrate supplementation increased all of these parameters more than sodium nitrate supplementation. Both sodium and potassium nitrate, as inducers, had significant effects on both the nitrate assimilation and metabolism in low concentrations. However, the effects of potassium nitrate were higher than sodium nitrate, which was due to the positive effects of potassium on the enzyme activity, sugars transport, water and nutrient transport, protein synthesis and carbohydrate metabolism. In conclusion, potassium nitrate has better effect on the nitrate assimilatory pathway and protein and carbohydrate metabolisms.

Key words: Nitrate salts supply, nitrate accumulation, nitrate reductase activity, amino acid, protein, carbohydrate, potassium nitrate, sodium nitrate.

INTRODUCTION

Nitrate is a major source of inorganic nitrogen utilized by most plants. Nitrate in soil after being taken up by plant roots is: (1) reduced in root cells, (2) stored in the root cells vacuoles, (3) transported in the xylem through transpiration stream to be reduced in the leaves, or (4) storage in the leaf vacuole cells to be released later and reduced in the cytosol (Jackson et al., 2008). The nitrate assimilatory pathway is mediated by two enzymes, nitrate reductase (EC 1.6.6.2) and nitrite reductase (EC 1.7.7.1), which catalyze the stepwise reduction of nitrate to nitrite and nitrite to ammonia, respectively. Nitrate is first

reduced to nitrite in the cytosol by nitrate reductase. Nitrite is then transported to the chloroplasts where it is reduced to ammonium by nitrite reductase. Ammonia itself can enter amino acids, proteins and nucleic acids using carbon skeletons derived from metabolites, synthesized by photosynthesis. Nitrate is reduced more efficiently in the leaves because of the readily available reductants, energy supply and carbon skeletons provided by photosynthesis (Oaks, 1994). Most steps in the nitrate assimilatory pathway are nitrate inducible. Nitrate strongly stimulates the transcription of nitrate transporters and nitrate reductase genes (Chen et al., 2004; Skrdleta et al., 1979; Stohr, 1999; Sivasankar et al., 1997).

The differential effects of nitrate salts on the nitrate and nitrite accumulation, amino acid, protein, carbohydrate and other biomass production is less studied. Thus, in

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