# The effect of nitrate/ammonium/urea proportions and potassium concentrations on the production of tomato seedlings

In Mexico, tomato seedlings are propagated in greenhouses before transplant in open field tomato cultivation. Most of the substrates used during propagation do not contain sufficient quantities of nutrients to fulfill the seedlings requirement for optimal development. In this study the objective was to evaluate the effect of nitrogen form in this cultivation, since it is known from literature that replacement of a small proportion of the nitrate-nitrogen by ammonium can improve plant growth. Additionally the effect of increasing potassium rate was studied, as potassium is the second major element needed by tomato plants and may alleviate potentially negative effects of ammonium in the nutrient solution. In a completely randomized, factorial design, the effect on four proportions of $NO_3^-$ /$NH_4^+$ /urea and two concentrations of potassium in the nutrient solution on seedling growth and mineral composition of the plants were evaluated.

Seeds were sown in polystyrene containers with 30 $cm^3$ holes filled with 1:1 turf vermiculite mixture, and nutrient solutions were applied directly with germination of the seeds till the end of the experiment 46 days after sowing. The rate of nutrients was increased in steps every 10 days from 50% to 75%, till reaching 100% of the final concentration of both cations and anions of 20 $mol/m^3$. Steiners recipe for nutrient solution was modified, with 12 $mol/m^3$ N as standard. The four treatments with differing ratios of the three N-sources are given in Table 1. Potassium was applied in two concentrations, 7 and 9 $mol/m^3$.

The results showed that a number of parameters describing seedling quality increased

by replacing 15% of the total nitrate-nitrogen by a similar amount of urea or a mixture of ammonium and urea (Table 1). The mineral composition of leaves and roots responded to the treatments as well. At 7 mol/$m^3$ of K, the content of N in leaves and roots increased when 15% of the $NO_3^-$ was replaced by any of the other N-sources (Figures 1,2). The P-content of leaves and roots increased with replacement of 15% of the $NO_3^-$ with ammonium, but remained at similar levels when replaced by urea.

An interaction between the N-source ratio and the amount of K in the nutrient solution was observed on the concentration of N in the leaves, stem and roots, and on the content of calcium or magnesium in the roots. Increasing the dose of K in the nutrient solution decreased the amount of N accumulated in the leaves in the presence of ammonium (85/15/0) compared to the standard K dose. In the roots, increased dose of K decreased the amount of N accumulated in the roots in the presence of urea (85/15/0 and 85/7,5/7,5). Calcium and magnesium uptake in the roots were not influenced by increased K-dose, except when 15% urea was added, in which case the cation-concentration in the roots was lowered.

*Table 1. Response of parameters indicative of quality of tomato seedlings to nutrient solutions differing in ratio of three N-sources. Means followed by the same letters are not significantly different (Tukey, $P \leq 0,05$).*

| Ratio N-sources in n.s.<br>Dosis de fuentes de N en soluciones nutritivas | Stem diameter<br>Diámetro del tallo | Root volume<br>Volumen de raíz | Total plant mass<br>Masa total de la planta | Shoot/Root<br>Tallo/Raíz |
|---|---|---|---|---|
| $NO_3^-/NH_4^+$/Urea | (mm) | (ml) | (g DW/plant) | (ratio DW) |
| 100/0/0 | 3,7 b | 0,18 c | 1,2 ab | 8,7 b |
| 85/15/0 | 3,8 b | 0,19 bc | 1,2 b | 9,1 b |
| 85/0/15 | 4,0 a | 0,20 b | 1,3 a | 10,4 a |
| 85/7,5/7,5 | 3,8 b | 0,22 ab | 1,3 ab | 9,0 b |

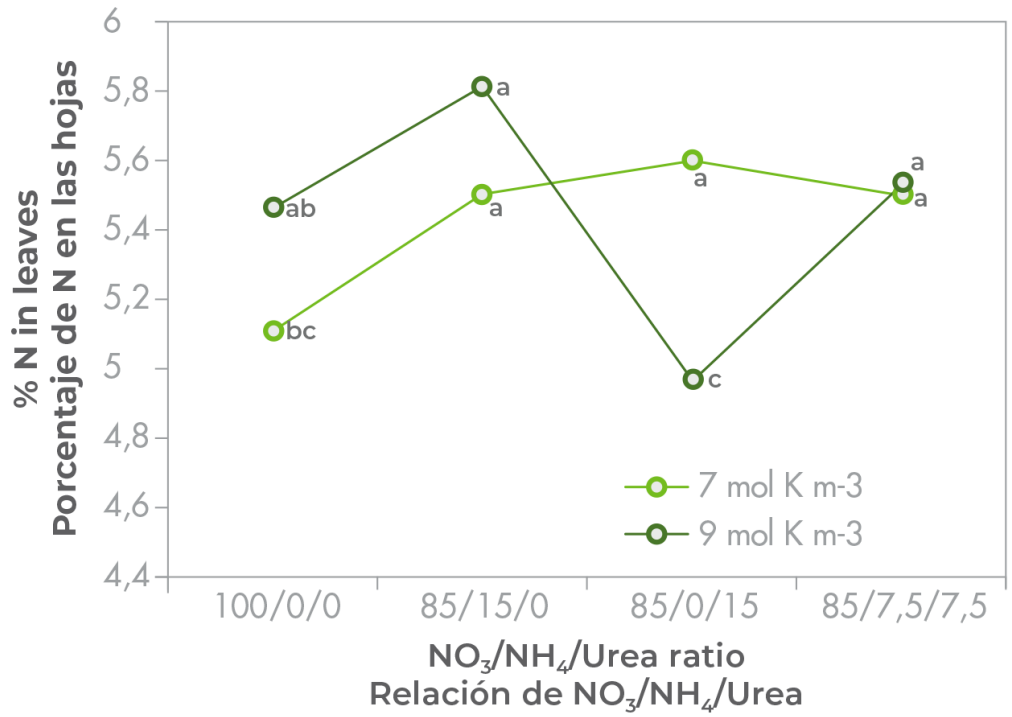


*Figure 1. Percentage nitrogen (N) in the leaves of tomato seedlings supplied with nutrient solutions containing three different N-sources in 4 ratios, and 2 rates of potassium (K). Data points labeled with the same letters in each column and row are not significantly different (Tukey, P ≤ 0,05).*

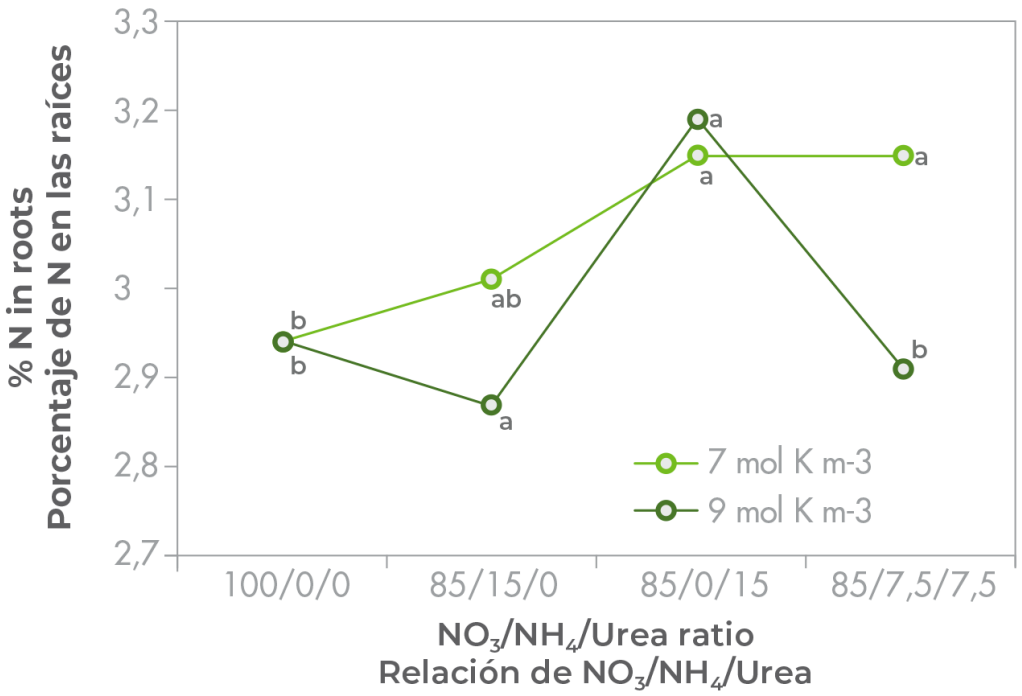


*Figure 2. Percentage Nitrogen (N) in the roots of tomato seedlings supplied with nutrient solutions containing three different N-sources in 4 ratios, and 2 rates of potassium (K). Data points labeled with the same letters in each column and row are not significantly different (Tukey, P ≤ 0,05).*