Effects of ammonium to urea ratio on N nutrition in maize plants

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Roots of plants are constantly exposed to different nitrogen sources concomitantly present in the rhizosphere. In particular the use of mixed nitrogen forms in cultivated soils allows to have urea and ammonium simultaneously available for the root acquisition after a fertilization event. A combination of different nitrogen-sources is known to lead to positive effects on the nutritional status of crops. The aim of the present work was to investigate the physiological response of maize plants when supplied in hydroponic solution with a mixture of urea and ammonium (treatments: 1:0, 3:1, 1:1, 1:3, 0:1 urea:ammonium ratios; as controls: – N and nitrate-fed plants).

After 7 days of treatment, higher nitrogen accumulation in shoots and roots was detected when the inorganic N sources were applied to nutrient solutions (as ammonium or nitrate), while the urea treatment (1:0) determined an overall reduction in the nitrogen concentration of plant tissues. ^{15}N-labelling experiments indicated that within 24 hours of treatment, ammonium-treated plants showed similar influx rates of ammonium by high affinity transport system and similar capability to acquire ammonium (as ^{15}N accumulation in plant tissues), independently of the amount of the cation present in the nutrient solution. After 7 days some changes in ammonium acquisition occurred among treatments, with the highest use efficiency of ammonium in the treatment 3:1 urea:ammonium. On the other hand, no change in the use efficiency of ^{15}N-urea fertilizer by maize plants was observed among treatments, independently of the urea:ammonium ratio in the nutrient solution.

The multivariate analyses (PCA) of elemental composition of maize plants after 7 days of treatment discriminated four groups, where all samples deriving from ammonium-containing treatments clustered together. Data suggest that the elemental composition of maize plants is more influenced by ammonium in the external media than by urea. Furthermore, we provide for the first time the ionomic profile of plants fed with urea as the sole N-source. After 7 days urea-treated plants showed high concentration of P, S, Mg, Mn Fe, Zn in comparison to N plants.

This study provides new insights that can contribute to nitrogen fertilization management in order to maximize the nitrogen use efficiency by crops and limit the economical and environmental impact of nitrogen fertilization.

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