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Variation of nitrogen isotopic composition of Maize supplied with ammonium or nitrate

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Because of its integrative character, the isotopic biogeochemistry allows identifying the origin of elements present in the environment and the processes affecting their concentration. For nitrogen, it is well known that nitrification, denitrification and volatilization are processes undergoing a significant isotopic fractionation leading to 15N enrichment of the residual substrates. Natural variation in nitrogen isotopic composition in soils is a potentially powerful tool to allow a better characterization of nitrogen cycling dynamics. Plants and their tissues integrate nitrogen dynamics in soils. Consequently, the δ15N of plants could be used as an indicator of nitrogen cycling dynamics in soil. The present problematic is to understand how the plant δ15N and the different plant tissues δ15N can be linked to the δ15N of soil solution, hence the N dynamics in soil. Some studies underline that uptake and assimilation within plant of N by plants can cause an isotopic fractionation. However, some basic questions remain unanswered about when and to what extent fractionation occurs during plant uptake and assimilation of N. Our hypothesis is that form and concentration of nitrogen influence the fractionation during uptake and assimilation and finally control the plant tissues δ15N. Nitrogen fate within plants is complex because there are multiple absorption and assimilation pathways depending on N forms and concentration. Uptake of both nitrate and ammonium occurs by two different carrier systems: high-affinity carrier systems active for concentration below 500 uM and low affinity carrier systems active for concentration above 500 uM, they may lead to different magnitudes of uptake fractionation. Furthermore, ammonium assimilation occurs only in root to avoid toxic accumulation whereas nitrate assimilation can occurs in roots and leaves and nitrate can be storage in the vacuole. The hypothesis generally proposed is that in the case of nitrate nutrition, the isotopic fractionation associated to the first assimilation in root enriched the nitrate residual which is exported to shoot. The shoot could be 15N enriched relative the root. In order to test the influence of the form and the concentration of N, we conducted kinetics hydroponic experiments. The experimentations were realized with 30 days old seedlings of maize in a nutritive solution containing nitrate or ammonium at two concentrations (0.2 and 2 mM). We followed the δ15N-NO3- and δ15N-NH4+ in solution throughout kinetics with azide method. In parallel, we measured plant tissues δ15N (leaves, stems and roots). The δ15N-NO3- and δ15N-NH4+ extract from each tissue were also measured. The first results in solution showed a significant isotopic fractionation during uptake with 0,2 mM nitrate nutrition (ε = - 2,8 ‰. Plant δ15N were constantly lower than solution δ15N-NO3- and we observed a range of discrimination between solution δ15N-NO3- and plant δ15N of 2,8 to 5.9‰Ḟor the 2 mM ammonium and nitrate treatment, we observed: steam δ15N > leaves δ15N > roots δ15N. For the 0,2 mM ammonium and nitrate treatment, the difference between steam δ15N ,leaves δ15N and roots δ15N vary. For nitrate and ammonium nutrition, the difference of δ15N between plant tissues is the same. However, the pattern of δ15N in different plant tissues changes according to the nitrogen concentration, the pattern of δ15N in different plant tissues changes. Contrary to the hypothesis, the N form could not play a major role in the pattern of δ15N plant tissues, but the external nitrogen concentration and so the flux of nitrogen which circulates and is assimilated in plant could strongly influence the δ15N plant tissues δ15N.