Geophysical Research Abstracts
Vol. 20, EGU2018-9425-3, 2018
EGU General Assembly 2018

The K to (Ca+Mg) ratio effect on potassium availability for plants – splitting soil- from plant-related interactions

Anindita Seth, Roee Gothelf, and Moshe Shenker
The Hebrew University of Jerusalem, Soil and Water Sciences, Rehovot, Israel (moshe.shenker@mail.huji.ac.il)

The energy of K^+ to (Ca^{2+} + Mg^{2+}) exchange in soils, expressed as ΔF, represents the intensity factor in plant K nutrition. To elucidate whether the ratio K^+/(Ca^{2+} + Mg^{2+}) affects K nutrition of plants through plant physiological interactions, such as competition, or through soil-related interactions, the influence of various ratios of K concentration to (Ca+Mg) concentration on the growth and K uptake of tomato (Lycopersicum esculentum Mill.) plants was examined in soil, perlite, and hydroponic culture.
Nutrient solutions with six combinations of four ΔF values (-3500 to -2000 cal mol^{-1}) and three K concentrations (0.2 to 1.8 mM) were used in a hydroponic experiment. Fertigation with three ΔF levels (-3600 to -3214 cal mol^{-1}) at a fixed K concentration (0.63 mM) and with three K concentrations (0.51 to 1.52 mM) at a fixed ΔF value (-3324 cal mol^{-1}) were used in a soilless perlite experiment. In the soil culture, a clayey soil (62% clay) with ΔF values of -5037, -3600 and -3200 cal mol^{-1} and a sandy soil (92% sand) with ΔF values of -3200, -2834 and -2200 cal mol^{-1} were used with N and P, but no K, fertigation during plant 30-days growth period. The two soils largely differed in their potential buffer capacity (PBC) for K availability, with PBC of 21.4 to 34.2 meq kg^{-1} $(Ca+Mg)^{0.5}$ $(K)^{-1}$ for the clayey soil and 1.1 to 1.7 meq kg^{-1} $(Ca+Mg)^{0.5}$ $(K)^{-1}$ for the sandy soil.
In hydroponic culture, at a constant ΔF level, biomass yield and K uptake increased significantly ($P \leq 0.01$) with increasing K concentration in the nutrient solution, but varying ΔF value at a constant K concentration did not result in any significant impact on yield or K uptake by the plants. In the perlite culture, increasing K concentrations in the nutrient solution resulted in a higher K concentration in the youngest mature leaves ($p \leq 0.05$), regardless of the ΔF value of the solution, whilst decreasing ΔF of the solution had no significant impact on plant K concentration or plant growth. In contrast to the hydroponic and soilless culture, for both soils shoot K concentration and shoot dry weight were significantly correlated with the soil ΔF level and were affected by soil PBC.
It is concluded that K uptake by tomato plants strongly depends on K concentration in the root-zone solution while the rather large root selectivity for K^+ probably results in rather small effect of the competing cations Ca^{2+} and Mg^{2+}. On the contrary, in soils, ΔF represents the soil-related energy needed for releasing K^+ from its exchangeable positions in the soil. The energy needed for K+ extraction from the soil is ultimately invested by the plant and is related to the ratio between K^+ and (Ca^{2+} + Mg^{2+}) in the soil solution. In soils, the K^+ concentration is dependent on the (Ca^{2+} + Mg^{2+}) concentrations, thus the cation exchange and the PBC of the soil affect K nutrition in soils.