INTRODUCTION. Chloride (Cl) is a micronutrient because it is supposed to be needed in a small quantity for a healthy growth in higher plants (<50-100 mM in the nutrient media, Johnson et al., 1957). However, Cl is a strange micronutrient since actual Cl concentration in plants is typical of the content of a macro nutrient (about 50-300 times higher than the content required as essential micronutrient, Marschner, 1995). This accumulation requires a very high cost of energy (Brumós et al., 2010), and because of Cl is the major osmotically active solute in the vacuole (Flemmos, 1998), we hypothesize that when it is accumulated to levels that are typical of the content of a macro nutrient, Cl may fulfill a poorly understood biological role when accumulated to such high levels, and it may have an impact in osmoregulation, water relations and drought resistance in higher plants.

OBJECTIVES. We aimed to elucidate the involvement of Cl in the development, water balance and drought resistance of tobacco plants in response to increasing concentration of anions and the correlations to different water parameters, including a complete leaf water/osmotic potential measurement.

EXPERIMENTAL DESIGN. Tobacco plants were grown subjected to different treatments: basal nutrient solution (BS); BS supplemented with different concentrations of Cl salts (CL); BS supplemented with different concentrations of NO3- salts (N); BS supplemented with different concentrations of SO4-2 salts (SP). All treatments (CL, N and SP) contained the same concentration of charge-balancing cations. Plants were subjected to two irrigation treatments: optimal irrigation (Control, at 100% of field capacity), and water deficit (drought), in which pots were irrigated every two days to 60% of field capacity. As it was shown before (Franco-Navarro et al., 2013a,b), Cl deficiency symptoms were observed in BS, N or SP treatments, and no differences were observed in three of the main leaf cation content (Ca2+, Mg2+ and K)

1. Cl INCREASED LEAF EPIDERMAL CELL ELONGATION

2. Cl PROVIDED ADDITIONAL LEAF OSMOLARITY AND TURGOR

3. Cl REDUCED STOMATAL CONDUCTANCE

4. Cl IMPROVED WATER USE EFFICIENCY

5. LEAF Cl CONTENT CORRELATED TO ANATOMICAL AND WATER PARAMETERS

6. Cl IMPROVED WATER DEFICIT RESISTANCE

CONCLUSIONS

1. When fed with Cl levels in the millimolar range (1-5 mM), plants take up Cl to levels which are typical of the content of a macro nutrient (Franco-Navarro et al., 2012), and its specific biological role cannot be induced by anionic macro nutrient (NO3-, SO4-2 or PO4-3).

2. Leaf cations content (K+, Ca2+, Mg2+) was similar in plants treated with CL, N, and SP supplements (Franco-Navarro et al., 2013a,b). Cl nutrition in contrast to SO4-2/PO4-3 nutrition promotes adult plant growth through leaf elongation and leaf expansion (Fig. 1).

3. Cl provides additional osmolarity that decreases osmotic potential and increases water use efficiency (Clue) (Fig. 2). Cl improves stomatal conductance and efficiency of photosynthesis (Fig. 3). Reduced transpiration (Clue) (Fig. 4). Efficiency of photosynthesis is not correlated to leaf conductance. Cl enhanced leaf growth and photosynthesis (Fig. 5).

4. Drought plants treated with Cl shows better plant growth, higher efficiency of photosynthesis II and improved photosynthetic and water parameters in contrast to BS, SP or N treated plants (Fig. 6).

5. Biological functions indicated in the scheme (Fig. 7 summarizes the results obtained in this work.

REFERENCES


