S08P05

Role of ammonium nutrition on salt-induced oxidative stress in 'Carrizo' citrange plants

Fernández-Crespo E.[1], Gómez-Pastor R.[2], Matallana E.[2], Llorens E.[1], Lapeña L.[1], Scalschi L.[1], Camañes G.[1] and García-Agustín P.[1]

[1]Universitat Jaume I (UJI), Ciencias Agrarias y del Medio Natural, Spain; and [2]Universitat de Valencia (UV), Bioquímica y Biología Molecular, Spain. ellorens@uji.es

Salinity is amongst the most significant environmental factors responsible for substantial losses in agricultural production worldwide and it is a critical problem especially in citrus since they are one of the most globally important horticultural crops considered as salt sensitive. Salt stress has two effects on plants, an initial osmotic shock followed by a toxic phase due to ion accumulation. Moreover, a high cellular NaCl concentration enhances accumulation of reactive oxygen species (ROS). To avoid such salt stress-derived injuries, tight regulation of ROS homeostasis is necessary and is provided by a network through complex loops between oxidants and scavengers. NH4is a paradoxical nutrient ion because it is a main N source, but high concentrations of this ion in the soil may cause damaging effects. In this study, we have analyzed the influence of NH_4 nutrition on 'Carrizo' citrange plants undergoing 90 mM NaCl. Plants were grown with 1 mM NH_4NO_3 (control) and 5 mM N-NH_4. To clarify the relationship between the antioxidant mechanisms induced by ammonium nutrition and salt tolerance, we analyzed enzymatic antioxidant activities (SOD, CAT, GR), ascorbate and glutathione concentrations and antioxidant properties of proline and putrescine. 'Carrizo' plants showed optimal growth in both treatments and we confirmed that N-NH_4treatment enhance resistance to salt stress. Based on this evidence, we hypothesized that N-NH_4treatment triggers mild chronic stress in 'Carrizo' which could prime plant defenses by stress imprinting, thus conferring plant resistance. Moreover, subletal concentration of ammonium could act as a mild oxidative stressor triggering antioxidant cellular machinery against subsequent salt stress.

S08P06

Characterization of the *Arum*-type mycorrhiza in *Citrus macrophylla* rootstock under salinity stress

Rodríguez Morán M.[1], Navarro J.M.[1] and Morte A.[2]

[1]Departamento de Citricultura, IMIDA, Murcia 30150, Spain; and [2]Departamento Biología Vegetal y Botánica, Facultad de Biología, Universidad Murcia 30100, Spain. ringil_1@hotmail.com

Arum and *Paris* mycorrhizas are two major morphological classes of arbuscular mycorrhizal (AM) symbiosis which differ in fungal structures. AM symbiosis is thought to increase host resistance to salinity stress, a characteristic that could be interesting in areas where the scarcity of irrigation waters force to growers to use low-quality irrigation water. The type of AM colonization was analyzed in order to study if it is influenced by saline conditions. Seedlings of *Citrus macrophylla* (CM) were inoculated with a mixture of two AM fungi. Ninety-six days after inoculation, plants were irrigated with Hoagland modificated solution containing 0, 20, 40, 60 and 80 mM NaCl. CM showed an *Arum*-type mycorrhiza. Epidermical cells were never colonized and, the infection developed longitudinally and radially in the cortex of the root by many intercellular hyphae. Branches from intercellular longitudinal hyphae gave rise to arbuscules in the cells. These arbuscules were scattered in the cells of the medium and inner cortex, with the outer cortical cell layers relatively free of intracellular fungal structures. The vesicles were also located in the intercellular spaces of the same cortical cell layers. Most of the mycorrhizal roots under salt treatments showed an increasing number of vesicles respect to mycorrhizal roots without salt treatment. Under salinity stress, no differences were observed in the mycorrhizal colonization percentages. This could explain the observed increasing tolerance of mycorrhizal plants under high level of salinity.

S08P07

In vitro screening of four genotypes of citrus for salt tolerance

Chetto O.[1], Dambier D.[2], Fadli A.[1], Talha T.A.[3], Benkirane R.[1] and Benyahia B.H.[3]

[1]Ibn Tufail University (UIT), Morocco; [2]Center for International Cooperation in Agronomic Research for Development (CIRAD), Genetic Improvement of Vegetatively Propagated Species, France; and [3]National Institute of Agronomic Research (INRA), Laboratory of Citrus Improvement and Biotechnology, Morocco. ouiam_ch@hotmail.com

Soil and water salinity is an important abiotic stress that can affect both production and quality of citrus. The use of tolerant rootstocks in these conditions would be the solution the most used. The objective of this study

was to compare *in vitro* behavior of four citrus genotypes in terms of tolerance to salinity. The genotypes used were 'Cleopatra' mandarin, 'Chios' mandarin, 'Shamouti' orange and 'Star Ruby' grapefruit. Salt tolerance was evaluated by determination of callus and suspension cells growth, the fresh and dry weight, water content and chloride ion content after one month of culture in solid and liquid media supplemented with NaCl at different concentrations: 50, 100, 150 and 200 mM. At 0 mM NaCl, the results revealed that callus of the four genotypes tested have a similar behavior in term of tolerance to salinity as the suspension cells. However, a differential behavior was observed at high salt concentrations depending on genotypes and the nature of medium.

S08P08

Screening of ten citrus rootstocks for salt tolerance at seedling stage

Fadli A.[1], Chetto O.[1], Talha A.[2], Beniken L.[2], Benkirane R.[1] and Benyahia H.[2]

[1]Ibn Tofail University (UIT), Department of Plant Science, Kenitra, Morocco; and [2]Kenitra Regional Center for Agricultural Research (CRRAK), Department of Plant Breeding and Phytogenetic Ressources Conservation, Kenitra, Morocco. a.fadli.uit@gmail.com

Salinity affecting 35% of Moroccan irrigated soils represents a serious problem for citrus production in these areas. Furthermore, the wide spread of Tristeza disease in the mediterranean region will soon limit the use of sour orange which is a salt tolerant rootstock commonly used in Morocco. Since then, the selection of new salt tolerant rootstocks has become an important research area for citrus breeding programs. In this study, nine citrumelo (C.) rootstock lines i.e. 'C. 57-98-502', 'C. 57-98-506', 'C. 4475 BB6A9', 'C. 4475 AB6A4', 'C. 4475 B2.G3', 'C. sacaton 30057', 'C. Swingle 74.1', 'C. Swingle F.9.22.5 (80.1)' and 'C. Winter Haven B231431' were evaluated for salinity tolerance by applying a fast test of screening. The seedlings of these rootstocks were grown in greenhouse conditions and treated for two months with a saline solution containing NaCl at 0, 35 and 85 mM concentrations. 'Rangpur' lime was included in the experiment as control. The results showed a wide variation of response. At high level of salinity (85 mM), 'C. Winter Haven' maintained a higher growth, higher number of leaves and higher leaves water content than the other rootstocks studied and manifested less toxicity symptoms (necrosis, defoliation of leaves). However, in the same concentration, 'C. Swingle 74.1' and 'C. B2.G3' proved to be more performants respectively in regards to leaves chlorophyll and chloride contents. In general, the study suggested that the salt tolerance of the ten rootstocks can be classified in the following ascending order : 'C. B2.G3', 'C. 4475 BB6A9', 'C. sacaton 30057', 'C. 57-98-506', 'C. 57-98-502', 'C. Swingle 74.1', 'C. Swingle F.9.22.5', 'C. 4475 AB6A4', 'C. Winter Haven B231431', 'Rangpur' lime.

S08P09

Physiological response of *Citrus macrophylla* inoculated with arbuscular mycorrhizal fungi under salt stress

Navarro J.M.[1], Morte A.[2], Rodríguez Morán M.[1] and Pérez-Tornero O.[1]

[1]Instituto Murciano de Investigación y Desarrollo Agrario y Alimentario (IMIDA), Citriculture, Spain; and [2]Universidad de Murcia. Facultad de Biología Vegetal y Botánica, Spain. josefam.navarro2@carm.es

Seedlings of *Citrus macrophylla* were inoculated with arbuscular mycorrhizal (AM) fungi, or left non-inoculated (-AM). Forty-five days after inoculation onwards, half of the AM and -AM plants were irrigated for three months with a nutrient solution containing 50 mM NaCl. Due to the high sensitivity of *C. macrophylla* to salinity, AM inoculation only partly compensates the growth limitations imposed by salinity. The high intercellular CO2 and the oxidative stress levels suffered by -AM plants decreased with AM inoculation. Although salinity strongly decreased photosynthesis in -AM plants, AM colonization alleviated this decrease in AM plants due to the higher total chlorophylls than in -AM. However, the chlorophyll and photosynthesis levels found in AM under salinity were still lower than in control treatments, so AM did not completely compensate for the negative effect of salinity on the photosynthetic response. Although AM significantly increased the water percentage in leaves, it did not modify the water potential in AM or -AM plants. Mycorrhizal inoculation increased the osmotic potential and consequently decreased turgor. However, this decrease did not affect the physiological processes that depend of leaf turgor such as photosynthesis, which even increased in AM plants. Given that, in the saline conditions used, AM plants had higher leaf Cl levels than -AM plants but showed better growth and a better physiological response, leaf Cl concentration was not related with salt tolerance in this experiment.