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Tamarix spp.: populations, plants and leaf responses under extreme conditions

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Mediterranean countries are expected to experience a pronounced increase in the average air temperatures and an alteration of the precipitation patterns (distribution, intensity and duration) as a result of the global climate change, which might damage vegetation and soil structure. In this region, wetlands and coastal areas are increasingly at risk, as they are particularly exposed to a range of hazards connected to climate change, such as drought, flooding, and salinization caused by the increase in the average seawater level. In these areas, it is possible to find plants adapted to survive under extreme environmental fluctuations, such as Tamarix spp. This genus is composed of about ninety species, part of which are naturally distributed in the Mediterranean region, and are characterised by high endurance of adversities. In Italy, Tamarix species are eleven, and occupy coastal dunes and riverbanks of Southern regions. The most widespread species are Tamarix gallica and Tamarix africana. Although they play a fundamental ecological role in dunes fixation and in inhabiting salinized areas that would otherwise be subjected to desertification, their distribution, ecology and physiology are not well known. The knowledge of the specific and intra-specific diversity of any endangered species is the first step for conservation practices, as some of them may be selected for their natural tolerance to a particular stress, and may be conserved and used in the future for the restoration of damaged ecosystems in which these species are already present. Here, we present the results of an overall study which aims to describe natural Italian Tamarix spp. populations and their structure, and to characterise plant and leaf responses under natural and stress-induced conditions, with particular regard to extreme events like flooding and water salinity.
Populations and plants structure significantly differed according to soil salinity and water availability. Particularly, plants growth and dimensions were lower under high soil or water NaCl concentrations. Although Tamarix gallica was more frequent in the dune environment and more tolerant to salinity compared to Tamarix africana, probably as a result of its capacity to extrude more salt at increasing NaCl concentrations, its gas exchanges capacity was also reduced under high saline conditions (200-400 mM), which could occur in particularly dry periods (summer). Gas exchanges reduction under saline conditions was primary due to non stomatal limitations, and particularly to a decreased RuBisCO activity, probably caused by the increase in leaf salt accumulation over a tolerated threshold, which induced a reduction of the net assimilation rates. Under higher salinity, photosystem damage was also observed, coupled with an increase in salt extrusion, and with a reduction of stomatal conductance. Tamarix spp. were very tolerant to continuous flooding. Particularly, photosynthesis did not decrease in plants subjected to this condition for more than one month. This tolerance is the result of adventitious roots emission, which enable gases (particularly oxygen) to be transport to/from the roots from/to the atmosphere. Thus, complete or partial continuous soil submergence expected in the future could probably not affect Tamarix growth. These results, coupled with the high rates of transpiration due to a constant stomatal aperture, even during the night, suggest a positive role of Tamarix spp. in the restoration of areas temporary subjected to flooding. Tamarix spp. could also be used for the desalinisation of salinized soils, as about 90% of the salt present in the soil solution is extruded through the leaf salt glands.