Olive tree (Olea europaea L.) is a typical species of the Mediterranean basin, able to resist severe and prolonged drought.
The effects of water deficit on the activities of superoxide dismutase (SOD), catalase (CAT), ascorbate peroxidase (APX), guaiacol peroxidase (POD) and polyphenol oxidase (PPO) were investigated in 2-year old (cv. "Coratina") plants grown in environmental conditions characterized by high temperatures and PPFD levels and gradually subjected to a controlled water deficit stress. After 20 days without irrigation, mean predawn leaf water potential (LWP) fell from -0.37 to -5.37 MPa and this was accompanied by the suppression of net photosynthesis and transpiration. Before and during the experimental period, leaf and root samples were collected. The activities of SOD, APX, CAT and POD increased according to the severity of water stress in both leaves and roots. In particular, a significant five-fold increase in APX activity was found in leaves of plants at the maximum level of stress. POD and IAA oxidase activities showed a similar pattern and CAT activity increased during severe water deficit conditions in leaves and small roots. In contrast, the PPO activity decreased during the progression of stress in all the tissues studied. The results show that in olive tree the ability to increase antioxidant system activity, in order to limit cellular damage caused by active oxygen species (AOS), might be an important attribute linked to the drought tolerance.
Mechanisms of osmotic adjustment and appearance of damages due to drought-induced oxidative stress at cellular level, in particular in cell membranes, were studied. High levels of water stress induced the accumulation of proline (PRO) and malondialdehyde (MDA) in both leaves and roots, suggesting that water deficit is associated to osmotic adjustment and lipid peroxidation. A significant increment of lipoxygenase (LOX) activity was observed during progressive water stress in all the tissues analyzed. The results confirmed that both PRO and MDA could be considered two convenient biomarkers for water stress and lipid peroxidation in olive tree, respectively. The effects of accumulated PRO and MDA in leaves and roots were discussed in relation to physiological and environmental parameters.
The effects of water recovery following a drought stress period on the activities of SOD, CAT, APX, POD, PPO and LOX and on MDA level were also investigated. After reaching the maximum level of water stress, stressed plants were subjected to a rewatering for 30 days, under both environmental irradiance and semi-shade conditions. The activities of SOD, APX, CAT, POD and LOX and the level of MDA decreased during the rewatering period in both leaves and roots and these decrements were faster in plants grown in semi-shade conditions (SHP) than in plants under environmental light (ICP). In contrast, PPO activity increased during rewatering in all the tissue studied. The effects of water recovery on changes of antioxidant enzymes activities were discussed in relation to physiological and environmental parameters. The results showed that the lower expression of the enzymatic antioxidant system in SHP with respect to ICP could be due to a reduced need of AOS removal. On the contrary, in ICP, higher enzymatic activities are required for a better protection against a more pronounced oxidative stress, as judged from the high levels of lipid peroxidation, caused by the synergic action of water deficit and high degree of irradiance.

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