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Increase of Quinoa Tolerance to High Salinity Involves Agrophysiological Parameters Improvement by Soil Amendments

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Abstract : Several abiotic stresses cause disruptions in the properties of agricultural soils and hence their loss worldwide. Among these abiotic stresses, Salinity to which most crops were exposed caused an important reduction in their productivity. Therefore, in order to deal with this challenging problem, we rely on cultivating alternative plants that can tolerate the adverse salinity stress, such as quinoa (Chenopodium quinoa). Although even it was qualified as tolerant to Salinity, the quinoa's performance could be negatively affected under high salinity levels. Thus, our study aims to assess the effects of the application of soil amendments to improve quinoa tolerance levels under high Salinity. Thus, three quinoa varieties (Puno, ICBA-Q5, and Titicaca) were grown on agricultural soil under a greenhouse with five amendments; Biochar "Bc," compost "Cp," black soldier insect frass "If," cow manure "Fb" and phosphogypsum "Pg." Two controls without amendment were adopted consisting of the salinized negative one "T(-)" and the non-salinized positive one "T(+)." After 20 days from sowing, the plants were irrigated with a saline solution of 16 dS/m prepared with NaCl for a period of 60 days. Then plant tolerance was assessed based on agrophysiological parameters. The results showed that salinity stress negatively affected the quinoa plants for all the analyzed agrophysiological parameters in the three varieties compared to their corresponding controls "T(+)." However, most of these parameters were significantly enhanced by the application of soil amendments compared to their negative controls "T(-)." For instance, the biomass was improved by 91.8% and 69.4%, respectively, for Puno and Titicaca varieties amended with "Bc." The total nitrogen amount was increased by 220% for Titicaca and ICBA-Q5 plants cultivated in the soil amended with "If." One of the most important improvements was noted for potassium content in Titicaca amended with "Pg," which was six times higher compared to the negative control. Besides, the plants of Puno amended with "Cp" showed an improvement of 75.9% for the stomatal conductance and 58.5% for nitrate reductase activity. Nevertheless, the pronounced varietal difference was registered between Puno and Titicaca, presenting the highest performances mainly for the soil amended with "If," "Bc," and "Pg."

Keywords : chenopodium quinoa, salinity, soil amendments, growth, nutrients, nitrate reductase
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