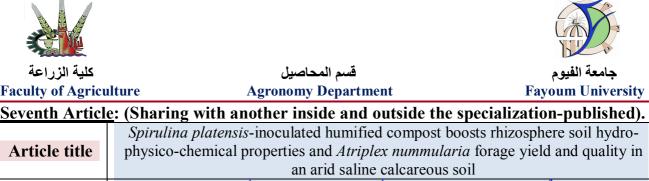


Article title

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	an arid saline calcareous soil
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ABSTRACT

In arid and semi-arid climates, soil salinization and calcareousness are increasingly serious problems, threatening agricultural sustainability. Using bio-organic amendments to improve rhizosphere hydro-physico-chemical properties of saline calcareous soils is necessary to hasten restoration processes. This study aimed to explore the impact of bio-organic amendments on rhizosphere hydro-physico-chemical properties and nutrient status of saline calcareous soil along with oxidative stress biomarkers, antioxidant capacity, morpho-physiological attributes, nutritive value, and forage yield of multi-stressed Atriplex nummularia. A two-field experiment (2020 and 2021), comprising of five treatments replicated thrice, was conducted in a completely randomized block design. The treatments were un-amended control, leguminous compost (LCt), LCt supplemented with humic acid (HA), LCt inoculated with Spirulina platensis (SP), and LCt supplemented with HA+SP. Each bio-organic amendments, with a rate of 20 t ha⁻¹, were applied to amend saline calcareous soil characterized by electrical conductivity of saturated soil past extract (ECe=8.5 dS m⁻¹), 32.5% CaCO₃, and poor organic matter for growing Atriplex nummularia. Applying bio-organic amendments, particularly Spirulina platensis-inoculated humified leguminous compost, ameliorated soil defects through improvement of hydro-physicochemical properties by lowering soil reaction (pH), ECe, CaCO₃ content, and exchangeable Na⁺ and Ca²⁺, increasing cation exchange capacity, organic matter, and water retention at field capacity, thus maintaining higher nutritional status. These findings were positively reflected in morpho-physiological attributes, forage yield, and nutritive value (increased soluble protein and nutrients). B-group vitamins (e.g., thiamin, riboflavin, niacin, pyridoxine, folic acid, and cyanocobalamin) of multi-stressed Atriplex nummularia forage were also improved. Further, this treatment significantly boosted non-enzymatic and enzymatic antioxidants, detoxifying reactive oxygen species (i.e., superoxide and hydrogen peroxide), nitrite and nitrate contents, and reducing malondialdehyde and electrolyte leakage, associating with greater stress tolerance in Atriplex nummularia. Overall, application of Spirulina platensis-inoculated humified leguminous compost is a promising sustainable approach in amending rhizospheric soil properties, nutrient availability, and exchangeability of Na⁺ and Ca²⁺, thus maximizing forage yield and quality of Atriplex nummularia in saline calcareous arid region.