β-carotene supply to dill plants grown in sulphur and humic acid-amended soil improves salinity tolerance via quenching the hazard molecules

Remediation and cultivation of salinized soils regarded as a significant solution for increasing the agricultural production. However, crop plants are dramatically injured by salts that accumulate in root zone layer. The current investigation is an attempt to protect dill (*Anethum graveolens* L.) plants from the hazards of salinity via soil amendments (SA), i.e. sulphar (S) and humic acid (HA) or their combinations (SHA) as well as β-carotene (βC). SA involved S at a rate of 500 kg ha^{-1}, HA at a rate of 20 kg ha^{-1}, and SHA **(**10:1 (w/w)**)**, in addition to the control (without amendments). βC was foliar sprayed at concentrations of 50, 150 µM, and distilled water (0.0 µM). SHA×βC practice exhibited the highest increases in all plant pigments contents and shoot dry weight. Soil applied-SHA×150 µM βC reduced hydrogen peroxide and malondialdehyde, and increased aglycone and glycon, compared to the control. Salty-lime soil applied-SHA plus 150 µM βC, generated the highest significant increases in ascorbate peroxidase, catalase, ascorbic acid and glycine. Furthermore, soil treated-SHA×150 µM βC surpassed soil treated-HA×150 µM βC or soil treated-S×150 µM βC combinations for increasing nitrogen, phosphorus, potassium and calcium while decreasing sodium in dill leaf. Under 150 µM βC application, SHA and HA were the potent treatments for improving dill seed yield and oil yield in saline soil. In conclusion, for boosting plant tolerance to salinity while obtaining high yielding and quality, it should perform supply plants with 150 µM βC and amending soil by SHA in dill cultivation practices.