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Sustainable salinity management: Biochar boosts sweet potato growth and antioxidant responses in coastal agroecosystems

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Abstract

Soil salinity severely limits sweet potato production in the coastal regions of Bangladesh, so sustainable soil improvements are needed. In this study, integrated fertilisation with biochar (Biochar+FRG (Fertiliser Recommendation Guide, Bangladesh 2018)) was evaluated in salt-tolerant (BARI SP 16) and salt-sensitive (BARI SP 18) sweet potato genotypes under saline conditions. In a randomised block design (RCBD) with three replicates, three treatments were tested: FRG (control), IPNS, and Biochar+FRG. The results showed that Biochar+FRG increased yield in BARI SP 16 by 15 % and in BARI SP 18 by 5 compared to FRG alone. Antioxidant activity increased strongly in both genotypes, with GR (20 %), POX (10 %), APX (20 %) and proline (40 %) increasing in the tolerant variety, while the sensitive genotype showed even higher increases (GR 35 %, POX 40 %, APX 30 %, proline 50 %). It is noteworthy that ascorbate remained unchanged in BARI SP 16, while it increased by 15 % in BARI SP 18, indicating genotype-specific responses to oxidative stress. The K/Na ratio improved by 50 % (BARI SP 16) and 35 % (BARI SP 18), indicating improved ion homeostasis under salinity. Biochar also improved soil organic matter and nutrient retention, which contributed to better root development. These results show that biochar in combination with FRG mitigates salt stress by improving antioxidant defenses, soil quality and nutrient balance, especially in salt-tolerant varieties. The study advocates biochar+FRG as a scalable strategy for sweet potato cultivation in saline coastal soils, with greater efficacy in adapted genotypes.

Keywords: Antioxidants, biochar, coastal agriculture, K/Na ratio, oxidative stress, salinity tolerance, soil amendment, sweet potato