ABSTRACT

Brackish water (BW) remains a major environmental stress causing the soil salinity which leads to the poor crop growth; however, the impact of brackish water on crops could be reduced by applying biochar/ minerals enriched contrasting biochars (MECBs). This dissertation was designed to assess the potential of MECBs to adsorb toxic elements such as Na^+ and Cl^- from BW and to determine the mitigating effects of BW on soil quality and wheat growth by the use of MECBs in five independent studies. Simple biochar (SBc) was prepared from rice husk and then enriched with different minerals to prepare iron enriched biochar (FeBc), zinc enriched biochar (ZnBc) and manganese enriched biochar (MnBc). Firstly, the ability of MECBs to adsorb the cations from BW and its effect on physicochemical properties of BW at different time intervals were determined. Most efficient enriched biochar such as FeBc decreased EC (82%) and Na^+ concentration (61%) of BW and increased the concentration of essential minerals in BW when it was passed through filter columns filled with MECBs. Then, MECBs were applied to soil (irrigated with BW) to check their elemental adsorption ability at different time intervals. Maximum reduction (23 and 27%) in Na^+ and Cl^- was noted with the application of 40 dSm^{-1} BW + 0.5% ZnBc when compared with 40 dSm^{-1} BW + 0.5% SBc at 16th day of incubation in soil. In the pot experiment, maximum increase in fresh weigh (40, 53%) of wheat root and shoot, chlorophyll contents (75%) and photosynthetic rates (34%) was achieved by FeBc application under BW application. Similarly, improvement in the growth of wheat plants was also observed in hydroponic conditions by MECBs application in saline environment. FeBc application played a vital role to prevent oxidative damage by controlling the shoot CMP (40%) in *T. aestivum* L. and by efficiently triggering the activities of shoot antioxidant enzymes such as APX (57%) and CAT (46%). In field trials, the best selected enriched biochar such as FeBc (from previous studies) was applied to *T. aestivum* L. plants under BW application and saline-sodic soils conditions on field scale to check the effects of FeBc on growth, crop yield and grain quality improvement under BW irrigation. Application of FeBc significantly increased the grain yield (48.4%) and total biomass (37.86%) of wheat crop. A significant increase in the concentration of essential minerals Fe (150.8%), Mg (25.13%), Ca (90.66%), and K (81.9%) in grains was also noted with FeBc application as compared to control treatment.

Our results indicated that although all MECBs showed promising results for adsorption of toxic elements from soil irrigated with BW and reduced the impacts of BW applications on wheat growth; however, FeBc (0.1%) remained the best treatment to enhance the wheat growth and its grain yield on field scale under saline-sodic conditions.