Abstract

Spinach (*Spinacia oleracea* L.) belongs to family "Amarantheceae" which is known to have high contents of iron (Fe). High concentrations of salt (NaCl) and nickel (Ni) in soil cause toxicity in the plant, which effect its growth parameters, cell metabolism and uptake of macro/micro nutrients. To mitigate the toxic effects of Ni and NaCl, iron-nano silicon doped biochar (Fe-NSiDBC) was used. Biochar was prepared by pyrolysis of maize cob, rice husk and wheat straw in the furnance at 500 °C – 600 °C. Iron salts and Si nano particles was added in the biochar and distilled mixture for doping. Doped biochar shows complex interaction with soil health. Properties of biochar depends on the feedstock used, nutrients used in doping and the rate of application. The mechanism and application rate of Fe-NSiDBC in saline and Ni contaminated soil is still a question for some researchers. Two studies were designed to investigate the effects of Fe-NSiDBC prepared by different sources to mitigate the effects of NaCl+Ni contaminated soil on growth of spinach plant. In both studies, sandy loam soil was used to grow spinach cultivar in small pots with 100 mM NaCl, 0.5 mM Ni and 1% w/w of Fe-NSiDBC which was prepared by wheat straw, maize cob and rice husk. First experiment was used to examine the Ni toxicity and salinity effects on the various growth and biochemical parameters of plant. In this study, Ni+NaCl significantly affected the biochemical parameters except total root, leaf and stem phenolic and protein. All types of Fe-NSiDBC enhanced chlorophyll concentration, ascorbate peroxidase concentration and catalase activity while reducing the ion leakage, malondialdehyde production and H_2O_2 activity. Second experiment was conducted to determine the effects of Fe-NSiDBC on macro-micro nutrients uptake by plant in the presence of Ni toxicity and NaCl. The Fe-NSiDBC significantly reduced the concentration of Na^+ and Ni^+ in root, leaf and shoot cells of plant. Fe-NSiDBC significantly enhanced the concentration of Ca^{2+}, Mg^{2+}, K^+ and Fe^{2+} in the presence of Ni and NaCl toxicity. In conclusion, these experiments implied that Fe-NSiDBC treated nickel contaminated saline soil promoted the growth of plant in contrast with non-treated nickel contaminated saline soil.