Fulvic acid mediates chromium (Cr) tolerance in wheat (*Triticum aestivum* L.) through lowering of Cr uptake and improved antioxidant defense system

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Proliferation of population triggers the scarcity of food worldwide. The intensive agricultural practices reduced the fertility of soil and introduced a number of organic and inorganic pollutants in soil and water biota. Among different inorganic pollutants heavy metals are gaining more attention due to their disastrous effects on vegitables, food and cash crops. Chromium (Cr) stress is one of the most adverse environmental factors that affect plant growth and cause food chain contamination. Fulvic acid (FA) is known to enhance the growth and production of crops, but the studies are scare regarding the application of FA on metal tolerance in plants. The effects of FA application on alleviating Cr phytotoxicity in wheat plants were investigated in a pot experiment conducted in sand- and soil-grown plants. Three Cr (0, 0.25, and 0.50 mM) treatments in the form of $K_2Cr_2O_7$ were applied in both soils with or without foliar application of 1.5 mg L^{-1} FA. Plants were harvested after 4 months of treatments, and data regarding growth characteristics, biomass, photosynthetic pigments, and antioxidant enzymes were recorded. Fig A & B shows the Cr concentration alone and in combination with FA in wheat grain, leaf, stem and root. Cr stress significantly reduced the plant growth and biomass by significantly reducing its gas exchange attributes, photosynthetic rate and antioxidant enzymes. Similar results were found in plants grown in sand media. FA application increased plant biomass, photosynthetic pigments, and antioxidant enzymes while it decreased Cr uptake and accumulation in plants as compared to Cr treatments alone. We concluded that FA application contributes to decreased Cr concentrations in wheat grains and could be used as an amendment when aiming for decreased metal concentration in plants.