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Effect of Sugarcane Bagasse Made Biochar on Maize Plant Growth, Grown in Lead and Cadmium Contaminated Soil

M. Biria[1]- A. A. Moezzi[2*]- H. AmeriKhah[3]
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Introduction: Among wide variety of soil pollutants including heavy metals, acidic precipitation and other toxicants, the importance of heavy metals due to their pollution capacity has received growing attention in recent years. These metals enters into soil through municipal and industrial sewage as well as direct application of fertilizer and pesticides. High cadmium and lead concentration in soil lead to severe environmental pollution. Such pollution not only has a destructive effect on crop yield but also endangers human being and other creatures' health after entering in their food chain. Several physical, chemical and biological methods used to reduce the adverse effect of high concentration of heavy metals in soil. In spite of the hight cost, these methods are not always suitable for reclamation of small area and mostly have side effect on physico-chemical and biological characters of soil, after application. Biochar produced by thermal decomposition of biomass in the absence or presence of low oxygen. These material due to their high spacific surface area and high cation exchange capacity may have great ability to absorb charged material including heavy metals. Therefore in this study attempt is made to evaluate the effect of sugarcane bagasse –derived biochar in improving maize plant growth in cadmium and lead contaminated soils.

Material and methods: This study was carried out during the year 2014 in two separate experiments in Shahid Chamran university. The treatments in each case consisted of two levels of sugarcane bagasse made biochar (0 and 4 percent by weight) in combination with each soil, properly contaminated with 50 and 100 mg cadmium per kg soil in first experiment and 500 and 1000 mg lead per kg soil in the second. The treated soils were applied to pot and arranged in a complete randomized block designe and replicated 3 times. Prior to introduction of soil to pots, the heavy metal contaminated soils with moisture content around 70 percent of F.C. were incubated for 30 days. During incubation period sugarcane bagasse was dried, milled, sieved, compacted and subjected to traditional furnace at 550 ^{o}c for 3 hours on low pyrolysis. The furnace temperature was controlled manually using lesser thermometer. The furnace cooled down and the collected sugarcane bagasse made biochar sieved again. The incubated soil mixed with proper amount of sugarcane bagasse made biochar and incubated under previous condition for 45 days. The treated soils were poured to the labeled pots and 3 maize seeds were sown in each pot and two weeks after emergence thinned to one plant per pot. Nineteen days after sowing, the height of the plants and chlorophyll index were recorded and plants were harvested and leaf area of each plant was recorded, maize root content of each pot were carefully separated from soil and along with shoot property washed, dried, weighed and after milling subjected to chemical analysis. Prior to sowing maize seeds some of physic- chemical properties of untreated soil were estimated. Furthermore few charactoristics of sugarcane bagasse made biochar including pH and EC in 1 : 10 solution of biochar to water recorded. N, C, H, O concentration were estimated by elementary analyzer. Cation exchange capacity of sugarcane bagasse made biochar was measured by ammonium acetate method. Moreover its functional group determined by FT-IR method. Specific surface area estimated as per Branuar Emmet Teller (BET) method. Sugarcane bagasse made biochar image was obtained from scanning electron microscope. Cadmium and lead concentration in root and shoots were estimated by atomic absorption spectrometer after wet digestion. SAS software was used for statistical analysis data which fallowed by Duncan test to compare the mean values.

Results and discussion: The results showed that implementation of cadmium and lead led to decrease in chlorophyll index, leaf area, height of plant and root and shoot dry weight significantly. But the sharp decline in the concentration of cadmium and lead in root and shoot after sugarcane bagasse made biochar application improved chlorophyll index, leaf area, height of plant, root and shoot dry weight. Application of 4% Sugarcane bagasse made biochar, decreased transfer factor (TF) and bioaccumulation factor (BF) of these elements compared to control. The results showed high capability of sugarcane bagasse made biochar to absorb cadmuim and lead and reduce their availability to plant respectively. In fact application of sugarcane bagasse made biochar

1, 2 and 3 - M.Sc. Graduate, Associate Professor and Instructor, Soil Science Department, Shahid Chamran University of Ahvaz
(*-Corresponding Author Email: moezzi251@gmail.com)

dwindled cadmium and lead absorption as well as their transfer factor and bioaccumulation factor, and hence improved plant growth.

Conclusion: The results obtained after sugarcane bagasse made biochar application mainly initiated due to high cation exchange capacity of which eventually was created by large number of functional groups in its high specific surface area (table 2) to stabilize cadmium and lead and render them unavailable to plant and hence improve its growth.

Keywords: Bioaccumulation, Biomass, Fixation, Heavy metal, Transfer Factor