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Effect of Maize Straw-Derived Biochar on Imidacloprid Adsorption onto Soils Prior to No-Tillage and Rotary Tillage Practices

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Abstract : Although pesticides are used in crop productivity, their use is highly harming the soil environment, and measures must be taken in the future to eradicate soil and groundwater pollution. The primary aim was to determine the effect of biochar addition on the imidacloprid adsorption on soil prior to no-tillage (NT) and rotational tillage (RT) conditions. In the laboratory, batch tests were conducted to determine the imidacloprid adsorption on soil using equilibrium and kinetic modelling with the addition of biochar. The clay level of the soil was found to be more significant when no-tillage was applied (22.42) than when rotational tillage was applied (14.27). The imidacloprid adsorption equilibrium was significantly shortened to 25 min after biochar addition. The isotherms and kinetic findings confirmed that the adsorption occurred according to Freundlich and pseudo-second-order kinetic models, respectively. The adsorption capacity of imidacloprid (40<35<25 °C) increased with decreasing temperature, indicating an exothermic adsorption behaviour, whereas negative Gibbs free energy (G) values of -6980.5 and 5983.93 Jmol-1, respectively, for soil prior to NT and RT at 25 °C, asserted spontaneous adsorption. The negative values of entropy (ΔS); -22.83 and -38.15 Jmol-1K-1, prior to NT and RT applications, respectively, described a lowered randomness process. The enthalpy was greater when RT was applied (-17533 J mol-1) than when NT was applied (-450 J mol-1). Lastly, it was shown that NTtreatment enhanced imidacloprid adsorption capacity more than RT treatment and that biochar addition enhanced pesticide adsorption in both treatments.

Keywords : adsorption, biochar, imidacloprid, soil, tillage
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