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Biochar application reduce ammonia volatilization in a soil-plant system: A closed chamber experiment

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Ammonia (NH3) volatilization is considered as one of the major mechanisms responsible for the loss of nitrogen (N) from soil-plant systems worldwide. About 10-30% of N can be lost as NH3 volatilization, which constitutes a significant economic loss. In recent years carbon-based materials such as biochar have created a great research interest because of their ability to increase soil fertility by reducing nutrient loss and pollutants bioavailability in soil. Most of the studies so far have investigated how biochar addition can reduce NH3 volatilization from soils but less information is available for soil-plant systems. In this research, wheat plants (Triticum aestivum, variety: Calingiri) were grown in a calcareous soil (pH 8, calcarosol) inside a closed chamber system to assess both ammonia volatilization and plant N uptake. In this specialized glass chamber air was passed through an inlet where the flow rate was maintained using an air pump (3.5 L min-1). The air outlet was passed through a sulphuric acid trap which was used to capture the volatilized NH3 from the chamber. Plants were watered using the inlet to maintain 50% field capacity throughout the incubation. Two different biochar samples were used in this study: a poultry manure biochar (PM-BC) and a green waste compost biochar (GW-BC) produced at 250 ˚C. Five different application rates were tested (0, 0.5, 1, 1.5, and 2%). The soil was mixed with biochar samples, water, N, P, K, Ca, Mg, and S for one week before sowing. After one week of germination, plants were transferred to the chamber for further three weeks incubation for NH3 volatilization measurement.
The study identified that biochar application reduced the NH3 volatilization and increase the plant biomass. Biochar application at 0.5 and 2% decreased the NH3 volatilization by 36 and 48% respectively. The N uptake of the plants also increased from 2.9 to 28% at 0.5 and 2% application rates respectively. The dry biomass of the plant also increased with biochar addition. Both biochar sources showed a similar trend. The reduction in NH3 volatilization was due to both the effect that biochar has on soil pH and sorption of NH3 by the biochar. This study confirms the biochar potentiality to reduce NH3 volatilization and at the same time increase plant growth and N uptake efficiency from calcareous soils.