Environmental Engineering and Management Journal xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
http://www.eemj.icpm.tuiasi.ro/; http://www.eemj.eu

"Gheorghe Asachi" Technical University of Iasi, Romania

PHOSPHORUS RELEASE CHARACTERISTICS AND GEOCHEMICAL FRACTIONS IN A CALCAREOUS SOIL AMENDED WITH BIOCHAR AND LEONARDITE

Arian Labbafzadeh, Majid Hejazi-Mehrizi*, Majid Fekri

Soil Science Department, Faculty of Agriculture, Shahid Bahonar University of Kerman, Pajoohesh Sq., 76169-14111, Kerman, Iran. P.O. Box: 76169-133

Abstract

Valorization of solid wastes by employing them as effective soil conditioners can be considered as a promising approach towards sustainable soil management. In this way, understanding the role of different soil amendments on phosphorus (P) dynamics especially in calcareous soils is of great importance. This study aimed to investigate the bioavailability, geochemical fractions, and release characteristics of P in soil as affected by biochars derived from spent coffee grounds (SCGs) at 300 and 600 ºC temperatures in comparison with leonardite as a natural biochar rich in humic substances. The amendments were applied at 1 and 3 % w/w and the P extractability was measured at 1, 7, 14, 28, 56, and 90-day time-steps. Results revealed a biphasic release pattern for P in amended soils in which the most P was extracted in the first 240 minutes. In this time period, the B600-3 treatment increased the available P up to 212 mg kg^{-1} in comparison with 23 mg kg^{-1} which was found for un-amended soil control. The geochemical P fractions in control soil were distributed as: HCl-P (89%) > $NaHCO_3$-P (6.4%) > NaOH-P (3.1%) > H_2O-P (1.3%) > residual P (0.2%). The contribution of H_2O-P and $NaHCO_3$ as the bio-available P fractions increased while HCl-P (the stable P fraction) decreased after soil amendments. These changes were more intense in B600 amended soil in comparison with B300 and leonardite amended ones. Biochar and leonardite showed the capability to improve P availability in calcareous soils through changing soil P dynamics.

Key words: biochar, humic substances, nutrients management, phosphorus dynamics, sustainable agriculture

Received: June, 2024; Revised final: April, 2025; Accepted: June, 2025

* Author to whom all correspondence should be addressed: e-mail: mhejazi@uk.ac.ir; Phone: +983433257442, Fax: +983433257443