



## Soil P, Arbuscular mycorrhizal spore count and root colonization of cowpea in biochar amended soils under maize/cowpea cropping systems

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### Abstract

Cowpea, a food and nutrition security crop is being threatened by decline in soil fertility especially in small holder farmstead. The natural arbuscular mycorrhizal fungi in the soil could improve its ability to acquire and retain nutrients thereby leading to higher yield. This irrigated field research was conducted to determine the effect of biochar rates and cropping systems on selected soil chemical properties, soil microbial biomass carbon (SMBC), nitrogen (SMBN), phosphorus (SMBP), and vesicular-arbuscular mycorrhizal (VAM) spore count and mycorrhizal fungi colonization (AMF) of cowpea. Experimental design was 3 x 3 factorial in randomized complete block design (RCBD). Factor A was three cropping systems; sole cowpea, intercropping and intra-cropping, while factor B was three biochar rates; control (biochar at 0 t ha<sup>-1</sup> (B<sub>0</sub>)), biochar at 2.5 t ha<sup>-1</sup> (B<sub>1</sub>) and biochar at 5 t ha<sup>-1</sup> (B<sub>2</sub>). These were replicated in three blocks to constitute 27 plots. The entire plot was cleared, ploughed and demarcated into beds with hoes and diggers. Cowpea sole or inter- or intra-cropped with maize were planted in a spacing distance of 25cm by 75cm, with intercropped cowpea being in-between the interrow spacing (75 cm), while the intracropped cowpeas was planted between the intrarow spacing (25 cm). Biochar soil amendment were applied two weeks after planting by making a groove in-between the rows in the soil and covering them with soil. The result showed that biochar soil amendment and interaction of biochar with cropping system significantly ( $p < 0.05$ ) affected SMBN, SMBC, total VAM spore count and AMF colonization by cowpea, whereas cropping system significantly affected only total VAM spore count and AMF colonization by cowpea. B<sub>2</sub> amended soil had the highest SMBC content (0.028 mg kg<sup>-1</sup>) while the least was from control plot (0.021 mg kg<sup>-1</sup>), SMBN was highest in B<sub>1</sub> amended soil (0.004 mg kg<sup>-1</sup>), followed by control plot (0.002 mg kg<sup>-1</sup>). Control had higher AMF and total VAM spore count while biochar amended soil had higher soil microbial properties. Considering the cropping systems,

inter and intra-cropping had higher microbial biomass and total VAM spore count than sole cowpea whereas sole cowpea had higher AMF infection of cowpea than the intercropped cowpea. Biochar at 5  $\text{t ha}^{-1}$  had the highest available P. Generally, this study showed superiority of the interaction of biochar with cropping systems over sole cropping in the improvement of soil properties in degraded soils of North-West province of South Africa.

Key words: Cropping systems; Chromic Luvisol; Microbial properties; Soil fertility; Soil amendment