

Article

Cattle-Urine-Enriched Biochar Enhances Soil Fertility, Nutrient Uptake, and Yield of Maize in a Low-Productive Soil

Naba Raj Pandit ^{1,*}, Pragati Sipkhan ², Shiva Shankar Sharma ², Darmaraj Dawadi ³, Shree Prasad Vista ⁴ and Prashant Raut ²

¹ Nepal Agroforestry Foundation (NAF), Kathmandu 44600, Nepal

² Agriculture Technology Center (ATC), Lalitpur 44705, Nepal; pragati2612@googlemail.com (P.S.); sharma.shivashankar@gmail.com (S.S.); rautprasant@gmail.com (P.R.)

³ Women, Children and Environment Development Center (WOCHEND), Makwanpur 44100, Nepal; dharmarajdawadi@yahoo.com

⁴ National Soil Science Research Center (NSSRC), Nepal Agricultural Research Council (NARC), Lalitpur 44705, Nepal; spvista002@gmail.com

* Correspondence: navraj20@gmail.com

Description S1. Methods soil analysis

Soil texture was analyzed through the hydrometer method [1] and the textural class was identified based on the United States Department of Agriculture (USDA) classification system. Soil pH was measured in 1:2.5 water suspension using a digital pH meter (buffering at pH 7 and 4). Organic carbon was determined following the method of Walkley and Black (1934) [2]. Total N was analyzed through Kjeldahl's method where samples were digested with sulphuric acid and distilled into boric acid solution followed by the titration of borate anions with standardized hydrochloric acid to calculate the nitrogen content. Available P was determined through modified Olsen's bicarbonate method in which phosphate was extracted from the soil by sodium bicarbonate solution adjusted to pH 8.5. The complex formed by reaction between desorbed phosphate ions and molybdate is reduced by ascorbic acid to form blue color and the absorbance of the solution was measured at 880 nm using a spectrophotometer [3]. Available K was determined by Neutral Ammonium Acetate method in which potassium was extracted from soil with ammonium acetate solution in 1:10 (soil: extractant ratio) and measured by a flame photometer.

Citation: Pandit, N.R.; Sipkhan, P.; Sharma, S.S.; Dawadi, D.R.; Vista, S.P.; Raut, P. Cattle-Urine-Enriched Biochar Enhances Soil Fertility, Nutrient Uptake, and Yield of Maize in a Low-Productive Soil. *Nitrogen* **2024**, *5*, 16–27. <https://doi.org/10.3390/nitrogen5010002>

Academic Editor: Jacynthe Dessureault-Rompré

Received: 15 October 2023

Revised: 15 December 2023

Accepted: 25 December 2023

Published: 2 January 2024



Copyright: © 2024 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

Table S1. Two factor ANOVA to assess the effect of biochar and manure on maize yield.

Factor	DF	SSE	MSE	F-value	P value
Biochar	2	2.77	1.38	13.82	0.0025**
Manure	1	0.10	0.01	0.13	0.7275
Residuals	8	0.80	0.10		

Significant. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05.

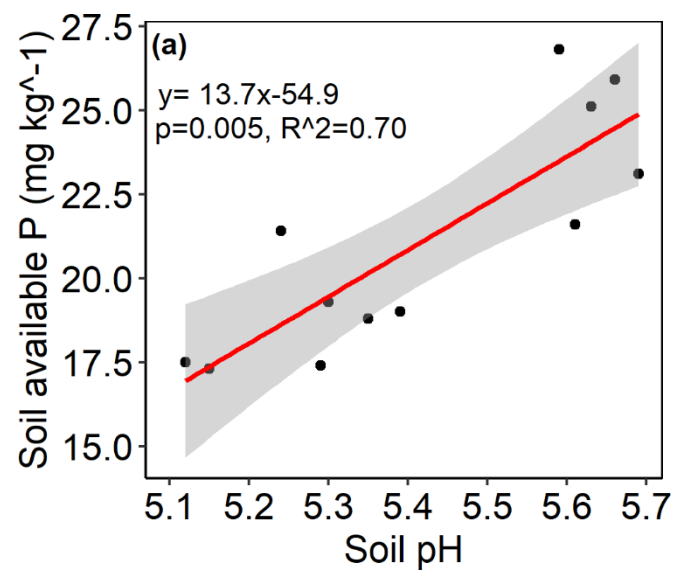


Figure S1. Relationship between soil pH and available P.

References

1. Bouyoucos, G.J. Directions for Making Mechanical Analyses of Soils by the Hydrometer Method. *Soil Sci.* **1936**, *42*, 225–230.
2. Walkley, A.; Black, I.A. An Examination of the Degtjareff Method for Determining Soil Organic Matter, and a Proposed Modification of the Chromic Acid Titration Method. *Soil Sci.* **1934**, *37*, 29–38.
3. Olsen, S.R.; Sommers, L.E. Phosphorus. p. 403–430. AL Page et Al.(Ed.) Methods of Soil Analysis. Part 2. Agron. Monogr. 9. ASA and SSSA, Madison, WI. Phosphorus. p. 403–430. AL Page al.(ed.) Methods soil Anal. Part 2. 2nd ed. Agron. Monogr. 9. ASA SSSA, Madison, WI. **1982**.