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Opportunities of Biochar in Kanchanpur District of Nepal

Janak Pant[1], Prava Dawadi[2]
[1, 2]*Department of Soil and Agri engineering, Agriculture and Forestry University (AFU), Chitwan, Nepal*

Abstract: ***The soil fertility and production were observed to be poor and declining in the district. So, an experiment was conducted to determine the opportunity of innovative and sustainable biochar in soil properties and crop production. The experiment was laid out in Randomized Complete Block Design (RCBD). The research was conducted during November 2022 to May 2023 in Kanchanpur district of Nepal. Six different treatments namely, sheep manure, rice husk, poultry manure, farmyard manure and wood including one control was applied in the research. Tomato crop was selected for the research crop. Rice husk was found most effective in crop attributes and yield. The average numbers of leaves after 20 and 40 days of transplantation of tomato were 9, 7, 6, 6, 5, 4 and 9, 8, 6, 6, 5, 4 by the application of rice husk, poultry manure, farmyard manure, sheep manure, wood, and control respectively. The average yield (kg/plant) was 14, 12, 11, 11, 10 and 7 through the treatments of rice husk, poultry manure, farmyard manure, sheep manure, wood, and control respectively. The soil pH in poultry manure and wood were significantly similar and higher than other biochar treatments. Sheep manure biochar was a highly significant and effective source of nitrogen which was followed by poultry manure, rice husk/wood and control. Organic matter content was higher in sheep manure biochar followed by poultry manure, rice husk/wood, farmyard manure and control. Rice husk, sheep manure and poultry manure were effective sources of biochar, though other sources have equal importance in soil properties and crop yield or yield attributes. All the biochar sources found with their own benefits and scope in soil enhancement and crop production in the district.***

Keywords: Chemical, fertility, production, soil, yield

I. INTRODUCTION

According [1] Biochar is any source of biomass heated in the absence or at low concentrations of oxygen with the purpose of application to the soil. The technologies that produce biochar as the main product or byproduct of a pyrolysis process are the only ones, among the available biofuel tolls, that may contribute to the enhancement or maintenance of soil properties, and, therefore, to the sustainable production of energy and food. Although it may take until 2020 for pyrolysis technologies to reach a large scale as per [2], they have the potential to impact sustainable soil management on regional levels. The contribution of biochar as a soil amendment is currently being assessed as to two main aspects. One is related to its potential to enhance the productivity of agricultural systems and to combat land degradation by improving soil physical, biological, and chemical properties [3]. The other is its contribution to carbon sequestration, as it contains carbon in stable forms and, consequently, with a longer permanence in the soil as per [4]. The agricultural use of biochar as the result of deliberate wood pyrolysis or as a by-product of cooking, has a history of more than 150 years in the Western World or much longer if its use in animal husbandry is considered.

The increasing problem of decreasing soil fertility in many developing nations such as, Nepal has brought forward the importance of technologies that are locally available, economically feasible and environment friendly. Cropping system of most developing nation such as, Nepal is mostly chemical based. Their heavy use has led to other harmful effects like poor soil structure, nitrate in the ground water, adulteration of food materials, eutrophication, and thus leading to decline in crop productivity. High agricultural inputs are doubtful to be sustainable for long run unless the inputs are judged appropriately in terms of both their quality and quantity. Unavailability of irrigation facility and dependence on monsoon is the bitter truth of our country. A few studies of biochar application on crops suggest that biochar may enhance soil moisture retention. This attribute of biochar may lessen the effects of drought on crop productivity in drought-prone areas, according to [5]. Biochar is best option due to its ability to attract and retain water owing to its porous structure and high surface area. According to a source [6, 7] In Nepal, majority of the soils are acidic in nature with low fertility status, having low to medium quantity of organic carbon, total nitrogen, available phosphorous, potassium and other exchangeable bases. Decreased soil fertility and nutrient stresses are one of the main reasons leading to lower crop production. Thus, it is critical to identify the efficient soil fertility management method to improve farm productivity per unit of land.

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One of the sustainable approaches could be the use of biochar, which has shown improved crop production and productivity by enhancing soil fertility status and alleviating nutrient stress in a low fertile nutrient deficit acidic soil [8, 9]. In this study, the scope of biochar in crop production and soil enhancement has been analyzed in context of Kanchanpur, Nepal.

II. MATERIALS

The research was conducted during November 2022 to May 2023 in Kanchanpur district of Nepal. The experiment was carried in vegetable crops, i.e., tomato. The experiment was laid out in Randomized Complete Block Design (RCBD). Six treatments of research were selected, i.e., five with biochar inputs (sheep manure, rice husk, poultry manure, farmyard manure and wood) and one was control as per Table 1. The samples were kept and dried in shade to eradicate excess moisture. Locally made stainless-steel drum (for making biochar) was used to combust biomass excluding oxygen after some time.

Table no 1 Detail of Treatment used in Experiment

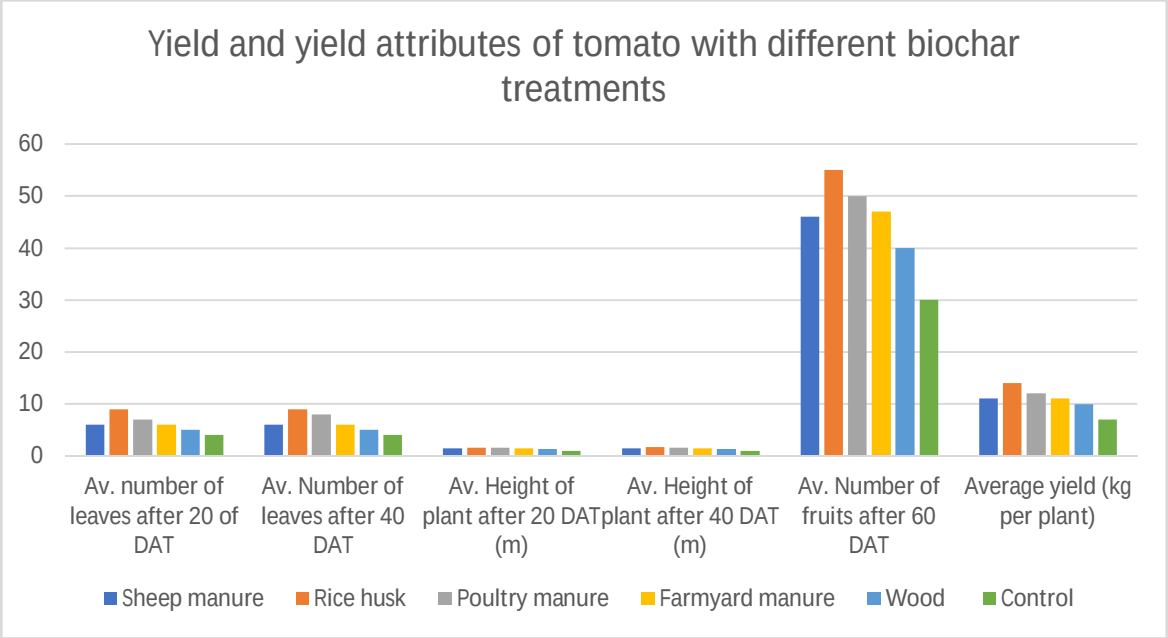
Number of Treatment	Treatments
T1	Sheep manure
T2	Rice husk
T3	Poultry manure
T4	Farmyard manure
T5	Wood
T6	Control

Notes T: Treatments

The study carried to determine soil pH, Nitrogen, and organic matter. 24 samples taken for soil test were shade-dried for some time. Plants phenological attributes (numbers of leaves, plant height, numbers of fruits) and yield were assessed.
The recorded data were all tabulated and systematically arranged using MS- Excel which were subjected to Analysis of Variance (ANOVA) and Duncan's Multiple Range Test (DMRT-0.05 level) for mean separations using Gen stat software.

III. BIOCHAR OPPORTUNITY, RESULTS AND DISCUSSION

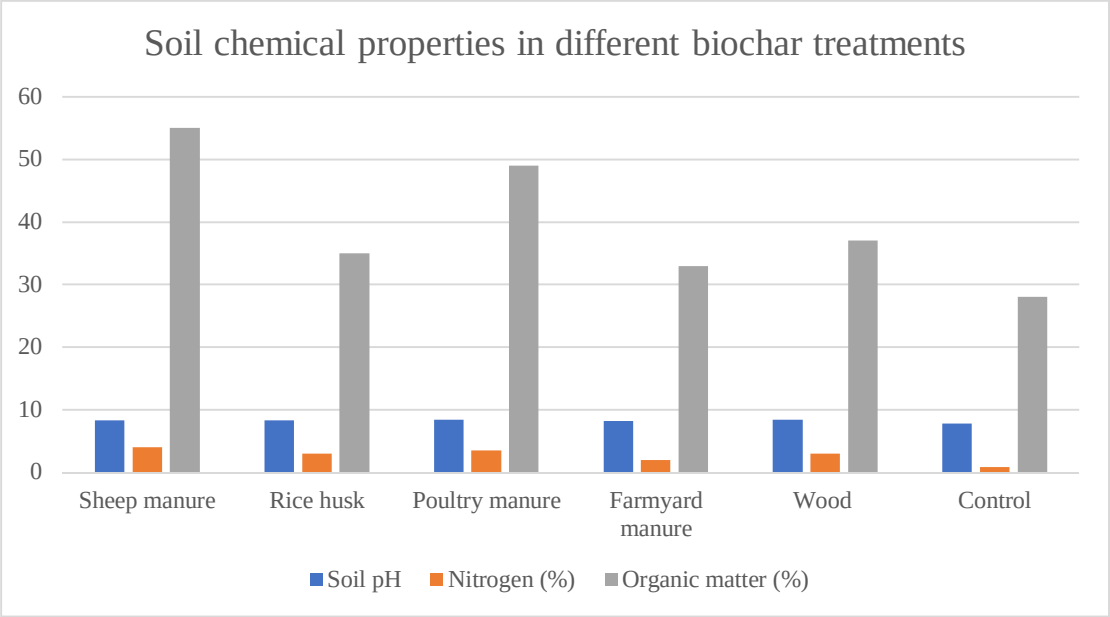
A. Effects Of Biochar In Plant Attributes



Note DAT: Days after transplantation, m:meter, kg: Kilogram
Graph No 1 Effect of biochar in plant attributes

It was observed that average numbers of leaves after 20 and 40 days of transplantation of tomato were 9, 7, 6, 6, 5, 4 and 9, 8, 6, 6, 5, 4 by the application of rice husk, poultry manure, farmyard manure, sheep manure, wood, and control respectively. Similarly, average height of tomato plant (in meter) after 20 and 40 days of transplantation were observed to be 1.6, 1.6, 1.4, 1.4, 1.3, 1 and 1.7, 1.6, 1.4, 1.4, 1.3, 1 through the treatments of rice husk, poultry manure, farmyard manure, sheep manure, wood and control respectively. It was recorded that average numbers of tomato fruits (per plant) after 20 and 40 days of transplantation of tomato were 55, 50, 47, 46, 40 and 30 through the treatments of rice husk, poultry manure, farmyard manure, sheep manure, wood and control respectively. Finally, the average yield (kg/plant) was recorded to be 14, 12, 11, 11, 10 and 7 through the treatments of rice husk, poultry manure, farmyard manure, sheep manure, wood and control respectively as shown in Graph 1. The study of [10] found that rice husk and poultry manure have highest effect in crop phenology, whereas farmyard manure and sheep manure at par with each other (though effective after rice husk and poultry manure). Biochar prepared from wood have least effect in yield or yield attributes compared with other treatments of biochar. The control treatment found poorly enhancing plant attributes and yield.

B. Effects of Biochar In Chemical Properties of Soil



Note %: Percentage, pH: Potential of hydrogen
Graph No 2 Effects of biochar in chemical properties of soil

The soil pH found in poultry manure and wood were significantly similar and higher than other biochar treatments. Sheep manure and rice husk have similar soil pH effect in the soil after poultry manure and wood. Thirdly the farmyard manure has implication in soil pH which was followed by control plot. Sheep manure biochar was found highly significant and effective source of nitrogen which was followed by poultry manure, rice husk/wood and control. Organic matter content was found higher in sheep manure biochar followed by poultry manure, rice husk/wood, farmyard manure and control as shown in Graph 2. Similar study was found in [11] where the soil pH was found highest in poultry manure/wood biochar resources. [12] found that biochar has lower nitrogen ratio, though within the available source's sheep manure have good amount of nitrogen in comparison with others. Most of the previous research support the findings of organic matter percentage in different biochar sources as per the above study.
The study clearly shows that each treatment of biochar has their own advantage and effect in the soil or crop attributes.

IV. CONCLUSIONS

The research was conducted during November 2022 to May 2023 in Kanchanpur district of Nepal. The experiment was carried out in vegetable crops, i.e., tomatoes. The experiment was laid out in Randomized Complete Block Design (RCBD). Six different treatments including one control were applied in the research. Rice husk was found most effective in crop attributes and yield. All the biochar sources found with their own benefits in soil productivity and crop production.

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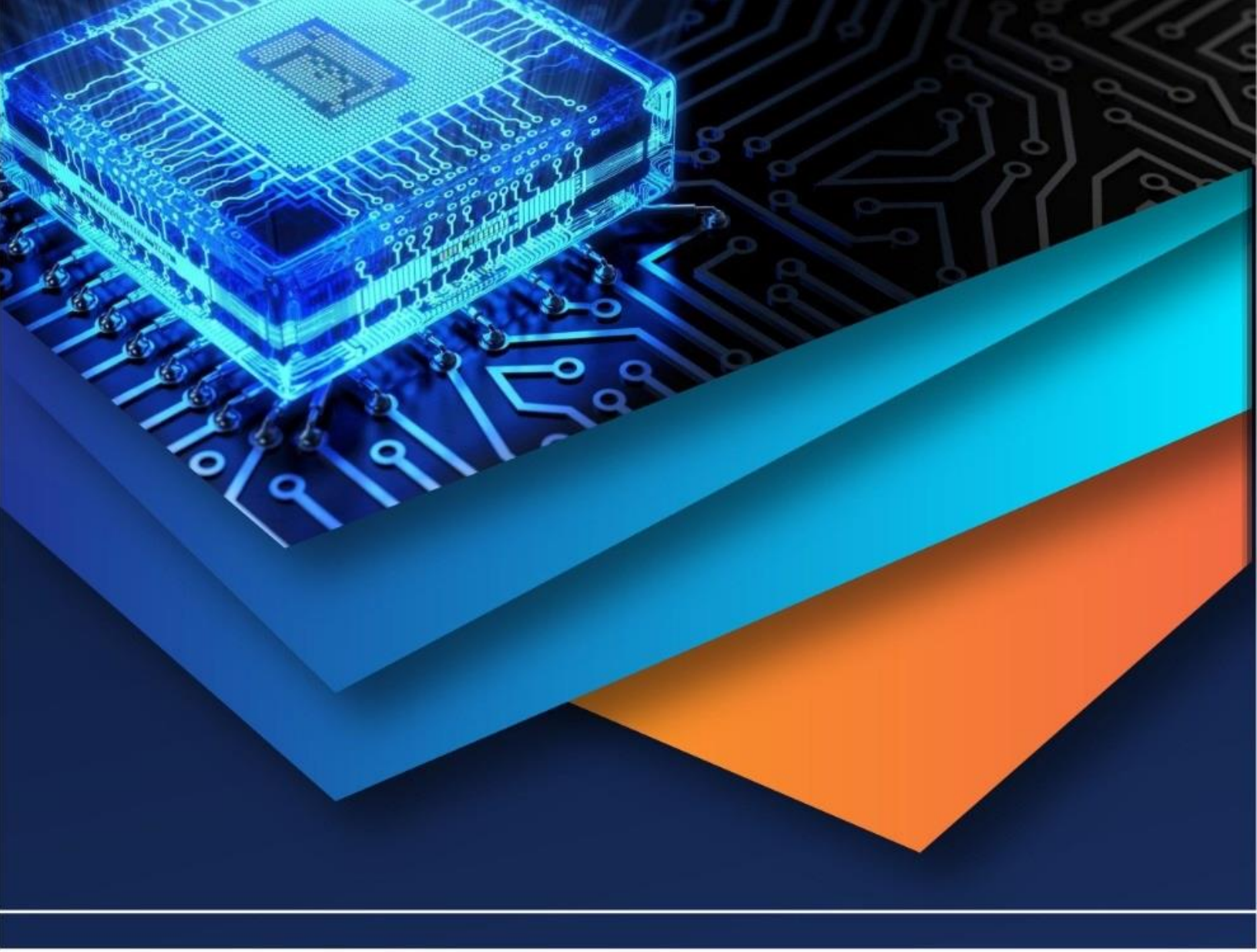
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