BIOCHAR IN REGENERATIVE AGRICULTURE PRACTICES: AN ORGANIC AMENDMENT TO BOOST YIELDS

Biochar in regenerative agriculture practices: an organic amendment to enhance yields

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Summary

Biochar, a carbonaceous product derived from the pyrolysis of biomass, has emerged as a promising technology to improve agricultural productivity and optimize crop yields. Its positive impact on moisture retention, nutrient optimization, improvement of soil structure and promotion of microbial activity make it a key component for agricultural sustainability. However, Exomad Green has taken this technology a step further by using wood waste as raw material, giving rise to this improved variant that not only retains the beneficial qualities of conventional Biochar, but also expands its potential and benefits. For this reason, the objective of the research is to evaluate the improvement in agricultural performance in corn and bean crops with the implementation of Biochar as an organic amendment in regenerative agriculture practices in different regions of the department of Santa Cruz. The evaluation methodology consisted of a soil analysis prior to the trial, dosage recommendation, technical evaluations during the campaign and soil monitoring. The results show us that with Biochar, optimization of nutrient availability, better moisture retention, as well as improved crop vigor is achieved, which is reflected in better crop yields.

Keywords: Biochar, Biochar, optimization, performance, regenerative agriculture, organic amendment,

Abstract

Biochar, a carbonaceous product derived from biomass pyrolysis, has emerged as a promising technology for improving agricultural productivity and optimizing crop yields. Its positive impact on moisture retention, nutrient optimization, soil structure improvement and promotion of microbial activity make it a key component for agricultural sustainability. However, Exomad Green has taken this technology a step further by using hardwood residues as raw material, giving rise to what we call Biochar. This improved variant not only retains the beneficial qualities of conventional Biochar, but also expands its potential and benefits. For this reason, the objective of the research is to evaluate the improvement in agricultural yields in corn, and bean crops with the implementation of Biochar as an organic amendment in regenerative agricultural practices in different regions of the department of Santa Cruz. The evaluation methodology consisted of a soil analysis prior to the trial, dosage recommendations, technical evaluations during the campaign and soil monitoring. The results show that Biochar optimizes nutrient availability, improves moisture retention, and improves crop vigor, which is reflected in better crop yields.

Key words: Biochar, Biochar, optimization, yield, regenerative agriculture, organic amendment,

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INTRODUCTION

Soil degradation is a growing challenge that threatens the productivity and sustainability of agriculture, a vital activity for food security. The loss and deterioration of soil quality due to unsustainable agricultural practices, erosion, compaction and loss of nutrients, among Other factors contribute to degradation. These problems have a direct impact on crop yields, decreasing soil fertility and limiting its ability to retain water and nutrients essential for the proper growth and development of crops.

Regenerative agriculture is positioned as a promising response to increasing soil degradation. This practice focuses on restoring and improving soil health, in order to promote biological diversity and strengthen the resilience of agricultural systems. However, soil degradation remains a crucial challenge that impacts the productivity and sustainability of agriculture. In this scenario, different practices and tools emerge. These initiatives range from the adoption of soil conservation techniques to the use of organic amendments and innovative technologies.

The main objective is to counteract the negative effects of erosion, soil compaction, as well as the loss of moisture and nutrient retention, which are some of the main causes of soil degradation, These practices and tools seek to restore soil fertility and create optimal conditions for crop development.

In the constant search for sustainable and efficient agricultural practices, Biochar has emerged as an innovative tool that promises to revolutionize productivity and sustainability in agriculture. This carbonaceous product, derived from the pyrolysis of biomass, has captured the attention of the scientific and agricultural community due to its notable benefits in moisture retention, nutrient optimization, improvement of soil structure and promotion of microbial activity.

The implementation of Biochar in regenerative agriculture contemplated certain challenges that had to be addressed to maximize its effectiveness and benefits. Such as the availability and accessibility of Biochar to farmers, the understanding of its long-term effects on different types of soil and crops. However, with the Exomad Green project to produce Biochar on an industrial scale under its own Biochar brand, the availability of the amendment for agricultural producers is guaranteed. The tests carried out and those that are ongoing allow us to demonstrate the effects of Biochar on different types of soils and crops, supporting its effectiveness and viability in regenerative agriculture.

Biochar

Despite the notable progress made in the implementation of Biochar, Exomad Green has taken this technology one step further by using wood waste as raw material, giving rise to an improved variant that not only retains the beneficial qualities of conventional Biochar, but It also expands its potential by improving the qualities of its porosity, managing to retain 5 times its weight in water in addition to its stability over time, further optimizing its effectiveness in regenerative agriculture.

Figure 1. Porosity in a Biochar chip

In the present study it is proposed to evaluate the impact of Biochar as an agricultural amendment. We seek to understand existing limitations in performance and highlight how Biochar can overcome these barriers. Seeking to not only measure improvements in crop yields, but also understand how Biochar can help improve soil health and mitigate soil degradation in modern agriculture.

MATERIALS AND METHODS

Location of the study area

The tests carried out with Biochar for the evaluation of performance optimization were carried out in different areas of the department of Santa Cruz. Cañada Larga in the Chiquitania area, Saavedra (EEAS) in the North area and (CRI) Mairana in the valley area. A dose of 4 tn ha $^{-1}$ was applied in all the Biochar trials carried out with (CIAT).

Treatments

In the different areas of the department, 4 treatments were carried out simultaneously for evaluation. Treatment 1 as Witness; Treatment 2 single application with Biochar; Treatment 3, Biochar + NPKS application and Treatment 4, Biochar + NPKS + Microorganisms application.

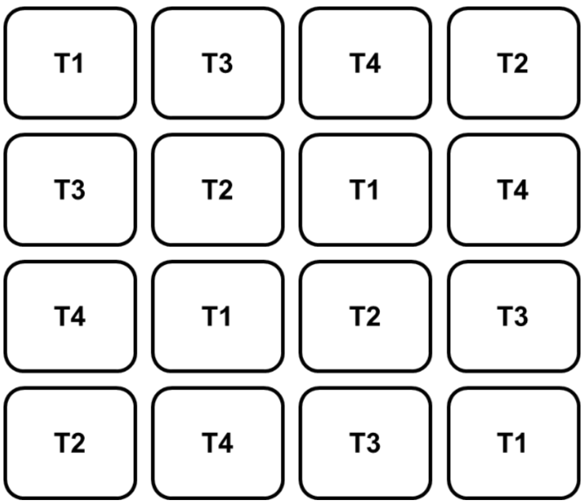

Figure 2. Distribution of treatments in the Biochar trials

During the winter agricultural campaign, trials were carried out on bean crop plots. Planting was scheduled on different dates: June 2 in Mairana, June 5 in Saavedra and June 20 in Cañada Larga. Each location was subjected to the aforementioned treatments, with four repetitions per treatment to guarantee the statistical validity of the results obtained.

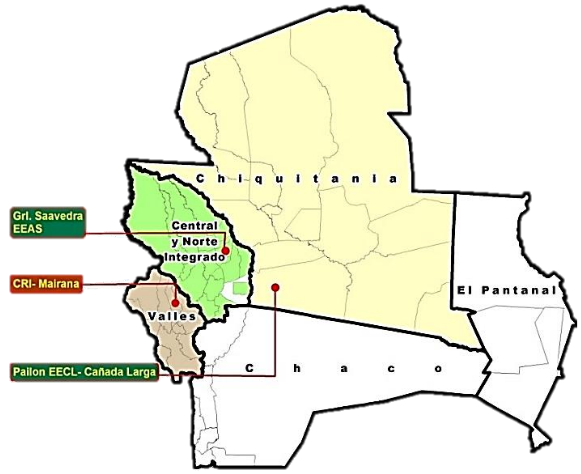

Figure 3. Location of trials with Biochar in beans

When the trials for the winter campaign began in June 2023, a soil analysis was carried out in the trial plots to record the initial state of the soils in the treatments to be carried out. 30 subsamples were collected at a depth of 0 to 30 cm to carry out the corresponding soil analysis.

Table.1 Initial characteristics of the soils in the winter campaign in bean crops

Parameter	Unit	CRI	CL	EEAS
PH	-	6.08	6.4	6.3
CICE	:mol $_c$ kg $^{-1}$	6.54	10.1	4.9
N	%	0.04	0.18	0.1
Q	ppm	16	47	18
K	neq 100g $^{-1}$			
M.O.	%	1.08	2.8	1.7
Sand	%	76	twenty-one	49
Clay	%	22	61	16
Silt	%	2	19	35
Texture	-	FYA	F.L.	FA

CRI: Regional Research Center (Mairana), CL: Cañada Larga, EEAS: Saavedra Experimental Station. Source: Water, Soil and Plant Laboratory (CIAT)

Fertilization and planting

Soil analyzes played a critical role in the agricultural planning process. These evaluations contributed to the calculation of the fertilization requirements in the soils where the tests were carried out.

Table 2. Fertilization of the bean crop

P_2O_5 Kg ha $^{-1}$	K_2O Kg ha $^{-1}$	OS_4 Kg ha $^{-1}$	Zn – B – Cu L ha $^{-1}$
18.32	66	fifteen	1

Seed Inoculation: 1 L 100kg $^{-1}$ of seed
Inoculation in Culture: 10 mL ha $^{-1}$

Source: Fertilization carried out by the Soil Department (CIAT)

For sowing, a quantity of seeds of 50 kg per hectare was used, with a sowing density of 60 per 20 cm, 4 seeds per stroke. The vegetation period spanned 110 to 120 days. Furthermore, it is relevant to note that the crop of the previous campaign was a grass.

Evaluations of the trials with Biochar in the Winter campaign – Bean Cultivation

During the winter campaign, the trial was monitored, collecting important data and parameters to carry out its evaluation of the different treatments at the end of the trial in the different areas of the department.

During crop monitoring, a preliminary evaluation of growth was carried out 58 days after sowing, recording the height of the plants in the different treatments. Greater development was observed in the Biochar treatments, having an average height of 35 cm in the control T1, an average height of 40cm in T2, an average height of 50cm in T3 and an average height of 60cm in T4.

Figure 6. Effect of Biochar on the bean crop at 58 days – Saavedra Experimental Station.

Table 3. Evaluation of the bean crop

essays	Height (cm)	º N of Flores	Yield in kg ha $^{-1}$
T1	44.55	21.60	1189.10
T2	47.05	22.30	1365.94
T3	51.58	24.40	1484.66
T4	56.98	25.15	1595.48
CV.%	17.32	28.9	23.47
p-value ANOVA	<0.0001	0.3002	0.4481

* T1: Witness; T2: Biochar; T3: Biochar + NPKS; T4: Biochar + NPKS + Microorganisms

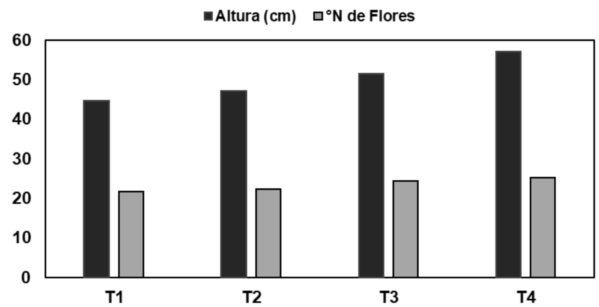

Figure 4. Evaluation of the development of the bean crop

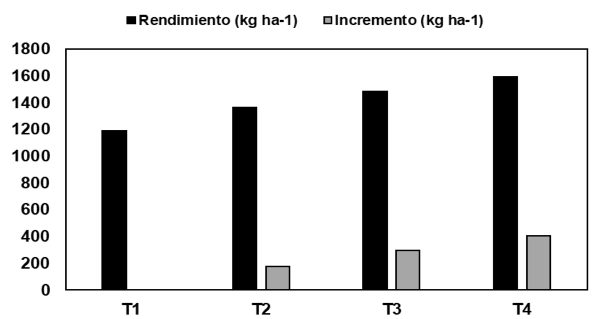

Figure 5. Evaluation of bean yield

For the evaluation of the optimization of performance in the winter campaign with bean cultivation. The best results obtained were in those tests where the Biochar was treated with microorganisms, better optimizing performance. In Table 3 you can see an increase of 12.94% between T1 and T2 which shows us that only with the use of Biochar, an increase of 19.90% between T1 and T3 applying fertilization and an improvement of up to 25.47% between T1 and T4 for a complete treatment in our trials.