TECNOCHAR: AN ALTERNATIVE TO IMPROVE MOISTURE RETENTION AND OPTIMIZE FERTILIZATION IN SOYBEAN

tecnochar: an alternative for improving moisture retention and optimizing fertilization

summary

Humidity plays a fundamental role in agriculture, as it directly affects the availability of water in the soil, a vital element for the growth and development of crops. Adequate soil moisture facilitates the germination of seeds, the absorption of nutrients by plants and the regulation of their internal temperature. Additionally, balanced moisture promotes beneficial microbial activity in the soil. On the other hand, drought represents a significant threat to agriculture. Low rainfall and lack of soil moisture can cause water stress in crops, resulting in reduced growth, reduced yields and, in extreme cases, total crop loss. Additionally, drought can increase plants' susceptibility to diseases, pests, and other environmental stressors. In the 2023-2024 summer campaign there was a considerable decrease in soybean production due to extreme drought conditions, with an estimated loss of 800 thousand tons and was reflected in 60,000 hectares of soybeans not planted in the northern area. integrated of the department of Santa Cruz, This drought episode highlights the importance of adopting sustainable agricultural practices. The implementation of TecnoChar is an innovative measure of regenerative agriculture to mitigate the adverse effects of drought on crops. This agricultural amendment has an outstanding capacity to retain moisture and can store 5 times its weight in water, which constitutes one of the its main characteristics.

Keywords: TecnoChar, Yield, Regenerative Agriculture, drought, humidity, organic amendment

abstract

Moisture plays a fundamental role in agriculture, as it directly affects the availability of water in the soil, a vital element for crop growth and development. Adequate soil moisture facilitates seed germination, plant nutrient uptake and internal plant temperature regulation. In addition, balanced moisture promotes beneficial microbial activity in the soil. On the other hand, drought poses a significant threat to agriculture. Low rainfall and lack of soil moisture can cause water stress in crops, resulting in reduced growth, reduced yields and, in extreme cases, total crop failure. In addition, drought can increase plant susceptibility to diseases, pests and other environmental stressors. During the recent drought in the summer season, many growers faced significant challenges; low rainfall in many cases proved insufficient. As a result, significant crop losses and negative economic impacts were observed and reflected in 60,000 hectares of unplanted soybeans in the northern integrated zone of the department of Santa Cruz. This drought episode highlights the critical importance of effectively managing water resources in agriculture and adopting sustainable and climate-resilient agricultural practices. The implementation of disruptive water conservation techniques, such as the implementation of TecnoChar, are innovative regenerative agriculture measures to mitigate the adverse effects of drought on agriculture.

Key words: TecnoChar, yield, regenerative agriculture, drought, moisture, organic amendment

INTRODUCTION

Humidity is a crucial component in agriculture, determining the optimal development of crops. The adequate availability of water in the soil is essential for the germination of seeds, the efficient absorption of nutrients by plants and the maintenance of their internal water balance. However, effective moisture management in agriculture faces challenges such as drought and loss of soil moisture due to unsustainable agricultural practices, deforestation and soil degradation.

Drought in the summer campaign

During the 2023-2024 summer campaign, the Santa Cruz region faced significant challenges due to drought. This period was characterized by low rainfall and a pronounced lack of soil moisture, which caused a marked limitation on agricultural production. These adverse conditions were reflected in sowing, which barely reached 40% until December 2023.

The world. (2023, December 26). The sowing of the "Summer 2023-2024" campaign is 40%

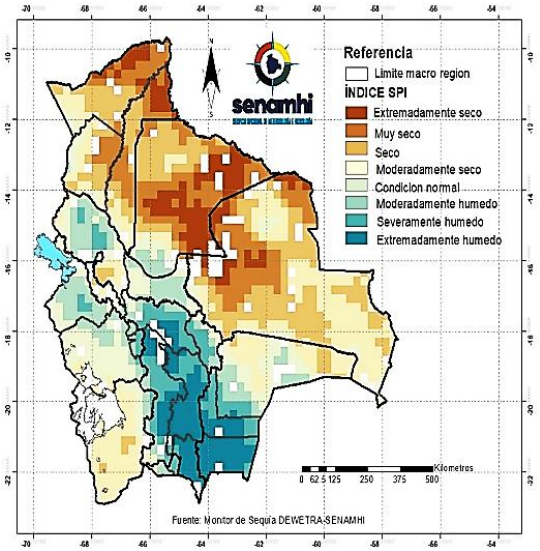

Figure 1. Standardized Precipitation Index (SPI), Monitoring for the month of December 2023, SENAMHI

In the case of the golden grain, only 1,156,600 hectares of the 1,214,000 hectares initially projected were cultivated. This was precisely due to the lack of moisture in the soil, caused by the considerable delay in rains. This delay even influenced successive planting failures in November and December.

The world. (2024, April 2). El Niño leaves its marks on the 2023-2024 summer campaign.

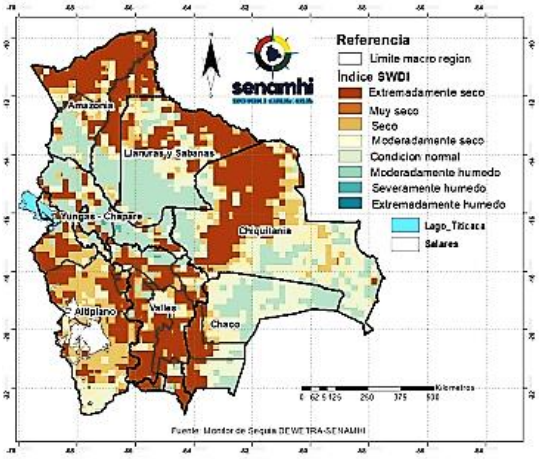

Figure 2. Soil water deficit index (SWDI), Monitoring for the month of January 2024 - SENAMHI

Absence of precipitation in Concepción

Agriculture in Chiquitania was significantly affected by the marked drought during the 2023-202 summer campaign, which represented an unprecedented challenge for agricultural producers in the region. The lack of water, derived from low rainfall, negatively impacted crops, compromising their development and yield.

The 2023-2024 summer campaign was strongly marked by the El Niño phenomenon, bringing with it a severe drought that had a strong effect on the sowing at the beginning of the campaign. In Concepción, rainfall was scarce during the month of November, reaching only 236.6 mm, and in December it dropped to 83.4 mm, thus beginning one of the campaigns with the highest water shortages.

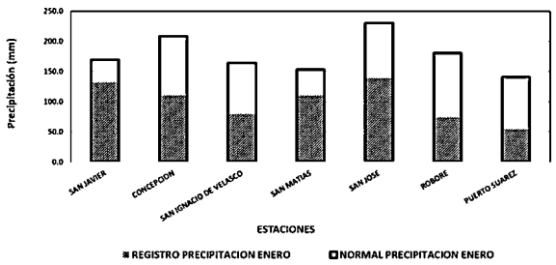

Figure 3. Rainfall record for the month of January in the macroregion of Chiquitania - SENAMHI

In the record for the municipality of Concepción we can see that there is a record of approximately 100 mm of rain in the month of January, where there is a normal rainfall of more than 200 mm of rain. These data reveal an alarming situation, since the region experienced only half of the usual rainfall.

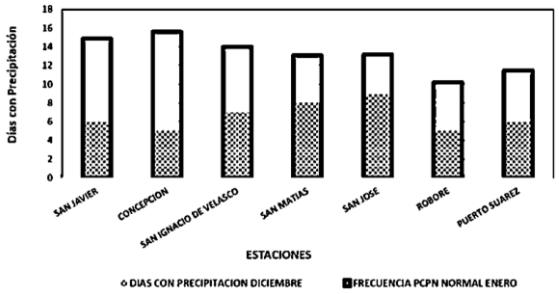

Figure 3. Frequency of days with precipitation in the month of January in the macroregion of Chiquitania - SENAMHI

For the frequency of rainy days in the municipality of Concepción, 5 days with precipitation are shown out of the 16 days of the normal frequency for the month of January, representing only 31.25% of the total days with precipitation.

Humidity

In this context, TecnoChar emerges as an innovative and promising solution in regenerative agriculture, by offering an effective way to improve moisture retention in the soil, acting like a sponge in the soil, absorbing and retaining water and nutrients. Its unique porosity allows it to retain water in its porous structure, gradually releasing it for absorption by plant roots.

This is of vital importance since it is a scarce and indispensable natural resource for the survival of all ecosystems and essential for producing food. For this, different practices can be implemented.

RuralNet. (2024, March 30). Agricultural productivity depends up to 80% on water.

MATERIALS AND METHODS

In the 2023-2024 summer campaign, trials were carried out in soybean crops with the application of Tecnochar to improve soil conditions, seeking to improve and optimize nutrition in crops, in the same way contribute to the improvement of the physical qualities of the soil, providing porosity which translates into better structure. This is due to the honeycomb structure that TecnoChar has, which provides significant moisture to the soil because the pores act as moisture storage.

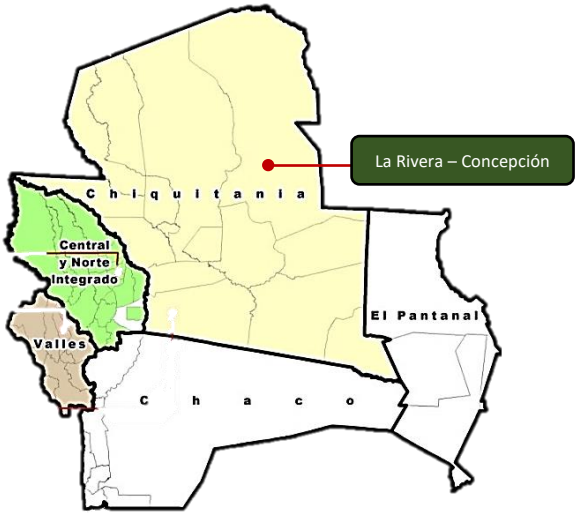

Figure 4. Location of the trials with TecnoChar in Chiquitania

For this trial in the area, the limitations of the previous campaign were also taken into account, where the producer expressed the challenges he presented on his farms, where he obtained an average yield of 0.8 tn ha-1 in soybeans.

The limitation experienced in the previous campaign is attributed to soil degradation, which leads to the loss of nutrients and a decrease in productive capacity. However, for the 2023-2024 summer campaign, a marked drought occurred that represented another challenge for the producer. This situation further marked the adverse conditions for soybean agricultural yields in the region.

The brook

The present test was carried out on the La Rivera property, it was carried out on an area of 10ha in which the corresponding technical assistance was carried out for a dosage of 4.5 tn ha $^{-1}$. The material was collected on the property where the application was carried out.

Figure 5. TecnoChar collection on the La Rivera property

After having the material required for the treatment, its application was carried out by boling with an organic fertilizer spreader. This equipment allows us to uniformly apply the TecnoChar to the soil, as well as have better control in the dosage of the test area.

Figure 6. Loading the organic fertilizer spreader

The application of TecnoChar was carried out in detail, following a rigorous protocol to guarantee its uniformity throughout the field. This process was carried out 30 days prior to sowing the soybeans, for incorporation with rowplow, thus allowing an adequate period for the TecnoChar to be completely integrated into the soil. This incorporation strategy was carried out to maximize its effectiveness, also in this way we can avoid wind and water erosion depending on the recommendation indicated for each particular case.

Figure 7. TecnoChar application

Sowing

Soybean planting on the La Rivera property was carried out on December 1, 2023, with a planting density of 65 kg ha $^{-1}$ of seed and a distance of 40 cm between furrows.

Table 1. Initial state of the soil prior to the application of TecnoChar

Parameter	Units	Rehearsal
PH (H_2O)	-	5.2
Acidity (Al)	mmolc dm ^{3}	3
H+Al	mmolc dm ^{3}	36
Nitrogen (N)	%	0.068
Phosphorus (P)	mg dm ^{3}	3
Potassium (K)	mmolc dm ^{3}	1.8
Sulfur (S)	mg dm ^{3}	5
Subject Org.	mg dm ^{3}	fifteen
Copper (Cu)	mg dm ^{3}	0.5
Zinc (Zn)	mg dm ^{3}	0.7
Iron (Fe)	mg dm ^{3}	33
Boron (B)	mg dm ^{3}	0.35
Sand	%	65.32
Clay	%	22.12
Silt	%	12.56
Texture	-	FYA

Source: Laboratory analysis (BRAZIL)

Fertilization

Sampling of the properties was carried out prior to the application of TecnoChar to carry out an analysis of the state of the property. The results in the analyzed samples helped us to have an initial record of the soil and provided the necessary data to carry out the necessary fertilization.

It is important to highlight that the fertilization applied in the trial was carried out in both the control group and in the treatment with TecnoChar. This measure was taken in order

to equitably evaluate the crop yield in both cases. Fertilization constitutes a fundamental factor in agricultural production, and by applying it uniformly in all test conditions, a fair and accurate comparison of the results obtained in each experimental group is guaranteed.

It was dosed with 150 kg ha $^{-1}$ with the following base formula adjusted to its respective soil analysis: 7.5 N-36P-11K + 1S +Micro

Monitoring and tracking

Soil monitoring was carried out to study its behavior and response to treatment, taking into account the evolution of the crops and the soil.

Figure 8. Soil monitoring (0 – 20cm)

Figure 8 shows the progressive incorporation of TecnoChar into the soil profile. In addition, an adequate level of humidity was observed in the soil, despite the low rainfall. This finding demonstrates that the tests with TecnoChar show higher humidity levels compared to the control without TecnoChar.

Figure 9. Soil samples without TecnoChar compared to soils with TecnoChar

During the campaign, soil moisture monitoring was also carried out, highlighting the main characteristics and benefits of TecnoChar, for which in situ measurements were made with a soil moisture sensor. Where the soils treated with TecnoChar showed greater moisture retention compared to the control as can be seen in figure 9.

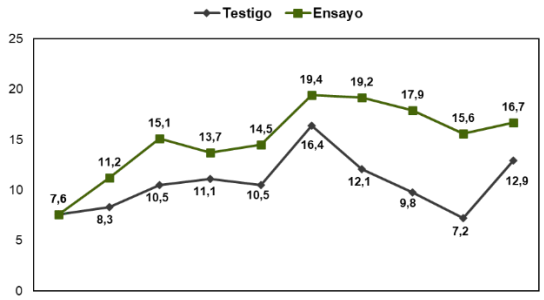

Figure 10. Humidity monitoring in tests carried out with TecnoChar

The graph presented in Figure 10 shows the moisture levels in the soil during the monitoring carried out between December 2023 and February 2024 to compare the treatments applied in the trials. Greater moisture retention was observed in the soil after rains in the area. Although the control group also received the same amount of moisture from rainfall, it failed to retain moisture from the rain during the campaign.

Harvest

The harvest of this trial in soybean crops was carried out on April 2, 2024. To complete the evaluation of the crop to improve performance.

From the results obtained, a clear improvement can be observed compared to the control control, however, it is also worth mentioning that an increase was observed compared to the last campaign.

Figure 10. Soybean crop harvest

RESULTS AND CONCLUSIONS

Table 2 Yield Results in Soybean Trials in the Summer Campaign

Rehearsal	Luvia (mm)	Height (cm)	Yield in (kg ha $^{-1}$)
T0	1280	39.65	896
T1	470	58.52	1305
T2	470	71.18	1983

T0 witness 2022; Control T1 + Fertilization + Microelements; T2 TecnoChar + Fertilization + Microelements

We observed an improvement in the yield of the soybean crop compared to the control and a greater increase compared to the previous campaign. This significant increase between T0 and T2 is due to unfavorable soil conditions, which hindered the availability of nutrients. During the current campaign, in addition to the agricultural inputs added to the soil, the application of TecnoChar was included for the trial. It should be noted that both the treatment with TecnoChar and the control group were subjected to the same management throughout the campaign.

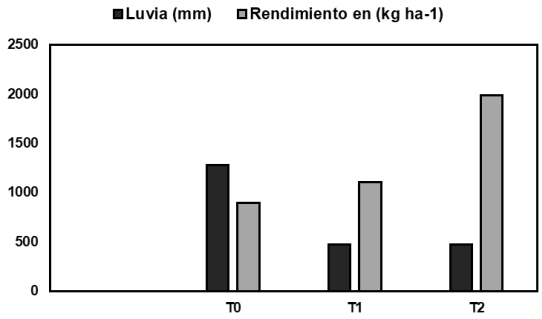

Figure 11. Yield in soybean crops

In the results presented in Table 7, an increase in yield is observed during the current soybean campaign, going from 896 kg ha $^{-1}$ to 1305 kg ha $^{-1}$ in our control group with an increase of 409 kg between T1 and T2 . In addition, a significant increase is recorded from 896 kg ha $^{-1}$ to 1983 kg ha $^{-1}$ between T0 and T2, with an increase of 1087 kg, more than double compared to the previous campaign. It is important to highlight a notable fact, despite the atypical conditions in the campaign characterized by drought and low rainfall in the region, with only 470 mm of rain in the current campaign in contrast to the 1,280 mm of the previous campaign. That is, approximately a third less precipitation and despite this we obtained an improvement in performance.

CONCLUSION

The application of TecnoChar helps us as an innovative alternative to mitigate drought and stress problems. It demonstrated favorable results compared to our control control. The development of the crop was more favorable in terms of growth and vigor with the use of TecnoChar, which was reflected in a higher yield during harvest.

Despite being a recent amendment to Bolivian agriculture in general, TecnoChar emerges as a promising innovation for regenerative agriculture. We will be able to observe more significant and notable improvements in degraded soils, and in those that maintain adequate conditions, it will contribute to preventing future degradation.