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Impact of Enhanced Basalt Rock Weathering Application on Soil Parameters in Arid Regions

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ABSTRACT

This study investigates the impact of Enhanced Basalt Weathering (EBW) combined with compost on soil parameters under the cultivation of eight different crops in the arid conditions of Wahat Baharyia Oasis, Egypt. The experiment was composed of two stages of treatment. In the first stage, two consecutive applications of green manure were made. In the second stage, basalt powder was combined with compost at two different rates. Four treatments were utilized: A, B, C, and D. Treatment A corresponded to basalt/compost at 27/73%, treatment B corresponded to basalt/compost at 5/95%, treatment C corresponded to basalt/compost at 0/100%, and the control plot (sand) was used for treatment D. The present experiment was conducted during the 2023/2024 growing season, employing a central pivot irrigation system. Results from the first stage demonstrated significant improvements in soil salinity (from 0.61 to 0.11 dS/m) and enhancements in available phosphorus and potassium. The second stage further revealed positive effects on soil chemical parameters such as electrical conductivity (EC), nitrogen (N), phosphorus (P), and potassium (K), although pH remained largely unaffected. The study indicates that applying basalt powder and compost improves soil fertility and crop yields, making EBW a viable regenerative agriculture practice in arid environments, while also contributing to carbon sequestration. Future research should focus on optimizing treatment applications and investigating long-term sustainability implications for diverse agricultural systems in similarly stressed regions.

Keywords: Enhanced basalt weathering, soil properties, regenerative practices

INTRODUCTION

Regenerative agriculture (RA) represents a novel farming methodology that focuses on revitalizing soil health, boosting biodiversity, and enhancing the resilience of ecosystems. Unlike conventional practices, which often lead to the degradation of natural resources, RA utilizes a variety of methods aimed at enriching organic matter and capturing atmospheric carbon in the soil. These methods include practices such as cover cropping, reduced tillage, rotational grazing, and agroforestry (Sher *et al.* 2024). Enhanced basalt weathering (EBW) is a noteworthy practice in regenerative agriculture that entails applying finely powdered basalt rock to agricultural soils. This approach speeds up the natural chemical weathering process, as basalt interacts with atmospheric carbon dioxide (CO_2) and water to create stable bicarbonates, thereby effectively sequestering carbon over long periods.

In addition to its potential for carbon capture, Enhanced Basalt Weathering (EBW) provides agronomic advantages, such as enhanced soil fertility and greater crop yields, positioning it as a favorable approach for sustainable farming. Recent agricultural studies have confirmed the effectiveness of EBW in both sequestering carbon and boosting agricultural output. For example, a significant four-year field experiment conducted in the U.S. Corn Belt revealed that applying 50 tons of crushed basalt per hectare each year led to a total carbon removal of roughly 10.5 ± 3.8 tons of CO_2 per hectare. Furthermore, the yields of maize and soybean increased by 12–16%, which is attributed to enhanced soil fertility and the availability of nutrients (Beerling *et al.* 2024). Additionally, combining EBW with organic inputs like compost and biochar has been shown to increase carbon sequestration rates. Research performed in semi-arid rangeland areas indicated that the simultaneous use of these materials led to improved weathering rates of basalt, which in turn fostered better soil health and increased carbon capture efficiency (Almaraz 2025).

As the global community ramps up its efforts to tackle climate change, innovative methods for carbon sequestration as well as soil improvement are becoming more prominent. One such noteworthy technique is enhanced basalt rock weathering (EBRW), which harnesses the natural process of basalt mineral dissolution to effectively capture atmospheric carbon dioxide (CO_2). This method not only captures carbon but can also have a significant impact on soil health, especially in arid areas where soil erosion and lack of nutrients are common issues (Kumar *et al*., 2023). Recent research suggests that using ground basalt rock can improve various soil characteristics, enhancing soil structure, boosting nutrient availability, and fostering microbial activity (Thangarajan *et al*., 2023). For example, incorporating basalt has been demonstrated to enhance soil moisture retention, which is crucial in arid regions where limited water availability hampers agricultural productivity (Hirsch *et al*., 2023). Additionally, the mineral makeup of basalt provides vital nutrients that can boost crop yields while also promoting the long-term capture of carbon (Smith & Chen, 2023). Therefore, enhanced basalt rock weathering presents a dual advantage, tackling both the urgent challenge of climate change and the essential need for sustainable farming practices within dryland ecosystems. The objective of this

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work is to study the impact of basalt powder mixed with compost at different ratios on soil characteristics after one season of cultivation of 8 different crops grown in an irrigated field located in the western desert of Egypt.

MATERIALS AND METHODS

Site description

This work started with a bare sandy soil field of 8.5 ha area (28.222118° N, 29.093145° E) located at Wahat Baharyia Oasis, western desert, Egypt (Fig. 1). Soils in Bahariya Oasis are located under two main soil orders: Aridisols and Entisols. Aridisols represent about 75.05% of the soils in the Oasis, whereas Entisols represent about 15.04% of the soils. Entisols, which are less developed soils, were mainly developed over sand dunes and recently alluvial deposits. Aridisols, which is the major soil order, were developed over relatively old soils in the Oasis (Darwish *et al*. 2008).

The climate in Bahariya Oasis is characterized by hot dry summers and mild winters with very low annual precipitation (1.5 –30 mm). Mean temperature in January and August averaged over 34 years (1983–2016), is 12.6 and 30.4 °C, and relative humidity is 50% and 32% in January and August, respectively (El-Marsafawy *et al*., 2019).

Soil sampling and laboratory work

The soil sampling under this field experiment includes three different sampling rounds, the first one was carried out to characterize the initial soil status before starting the application of treatments. The second round was carried out after mixing the treatments and before planting the crops whereas the last sampling round was carried out after crop harvesting. These three sampling rounds aimed at investigating the impact of applied treatments on soil parameters. In each sampling round and for soil organic carbon (SOC) stock change measurement two soil samples separated by 2 m distance were collected (Ellert *et al*., 2001). Another composite (consisted of 8 subsamples) sample from the whole plot to measure other soil properties rather than SOC.

After collection the soil samples were transported to the laboratory, where they were dried, crushed, and sieved at a 2 mm sieve and then subjected to the following physico-chemical analyses: pH (1:2.5 soil water fraction), electrical conductivity (EC, dSm^{-1}) in 1:5 soil water extract (ECe) and calcium carbonate content were measured according to Jackson (1973). Organic matter (OM) (%) was determined according to Black *et al*. (1965); available nitrogen NH_4-N and NO_3-N were extracted by KCl 2 N and the extracted nitrogen was determined with steam - distillation procedure using MgO - Devarda alloy (it is an alloy of aluminium (44%–46%), copper (49%–51%) and zinc (4%–6%) according to Bremner and Keency methods as described by Black *et al.* (1965); available phosphorus content (P) ($mg.kg^{-1}$) extracted by Olsen *et al.* (1954); the extracted phosphorus was measured calorimetrically using the ascorbic acid method (Watanabe and Olsen, 1965) with UV–vis-NIR spectrophotometer; available potassium (K) ($mg.kg^{-1}$) extracted using 1.0 N ammonium acetate at pH 7.0 and determined using flame photometer method, (Jackson, 1973).

Treatments description

The treatments of the initial soil are divided into two stages as follows:

First stage: aimed at improving soil conditions by cultivating two consecutive green manures i.e. lima bean and chamomile crops during the growing season summer 2022 and winter season 2022/2023.

Second stage:

aimed at investigating the impact of three different treatments containing different mixture ratios of basalt powder to compost on soil properties cultivated with 8 crops. The eight crops were grown under all designated treatments, i.e. A, B, C and D as shown in figure 1.

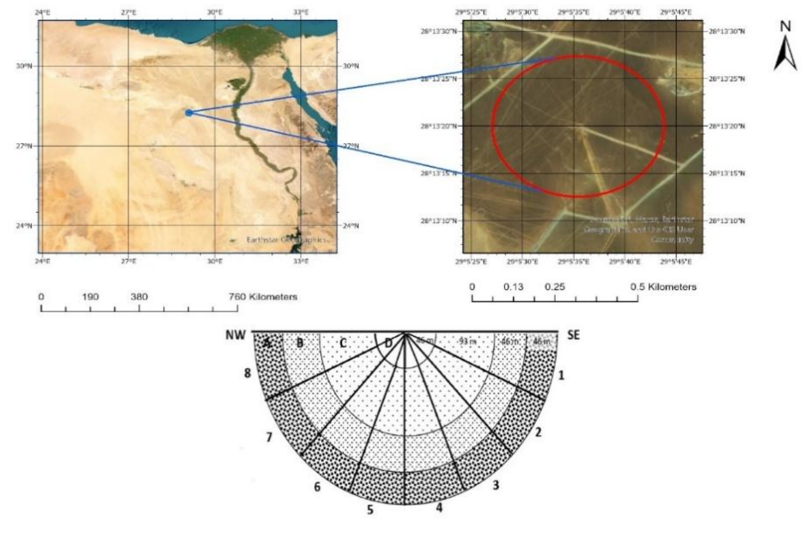

Figure 1. Experimental site geographical settings and plot designations.

These treatments were as follows: A stands for basalt/compost ratio of 27/73 % equals to 12.8 t/ha basalt powder and 35 t/ha compost; B stands for basalt/compost ratio of 5/95 % equals to 2.4 t/ha basalt powder and 45.6 t/ha compost; C stands for basalt/compost ratio of 0/100 % equals to zero t/ha basalt powder and 48 t/ha compost; D stands for blank plot where all crops were cultivated without any treatment considered as control plots.

Analysis of used materials as treatments

Basalt powder analysis

The chemical analysis of the basalt powder is shown in Table 1, which indicates that SiO_2 represents 50% of the basalt powder composition, followed by Al_2O_3 and FeO with values of 13.5% and 10.8%, respectively.

Table 1. Total chemical analysis of the basalt powder used in the second stage of treatment

Element	Result (%)
$Si0_2$	50
TiO_2	1.9
Al_2O_3	13.5
FeO	10.8
MnO	0.13
MgO	8
CaO	8.5
Na_2O	3.8
K_2O	1.4
P_2O_5	0.45

Compost analysis

The chemical analysis of the compost is shown in Table 2, where the compost used in this work has a bulk density of 0.85 Mg/m3. A C:N ratio of 10 is ideal as it promotes nitrogen mineralization rather than immobilization. The phosphorus and potassium contents (0.80% and 0.50%, respectively) are moderate and contribute to a balanced plant nutrition. High levels of organic matter (21.81%) and organic carbon (12.65%) indicate good potential for improving soil structure and microbial health.

Table 2. Analysis of compost used in both stages of treatments.

Properties	Result
Cubic meter weight (kg)	850
Moisture (%)	35
pH (1:10)	8.40
EC (1:10) (dS/m)	2.51
Ammonium nitrogen (NH_4-N) (ppm)	67
Nitrate Nitrogen (NO3-N) (ppm)	83
Total nitrogen (%)	1.3
Organic matter (OM) (%)	21.81
Organic carbon (%)	12.65
Ash (%)	78.19
Carbon:Nitrogen (C:N) Ratio	10
Phosphorus(P_2O_5) (%)	0.80
Potassium (K_2O) (%)	0.50
Weed seeds	not detected

Fertilization program

Since we are testing the impact of basalt powder mixed with compost N fertilization program was only applied to all crops in the form of biogas.

Statistical analysis

Analysis of variance (ANOVA) was carried out to compare the means of different treatments under a complete randomized design calculating the least significant difference (LSD, $p < 0.05$) using the CoStat software version 6.303, Monetery, USA (Fisher, 1936).

RESULTS AND DISCUSSION

Impact of the first stage of treatment

All values in table 3 are average values of 8 geographically representative soil samples collected during the first stage of treatment.

The soil by which this experiment has been started was a bare sandy soil with pH value of 8.66 indicating alkaline conditions which might affect adversely soil nutrient availability when using such soil for crop production. The salinity degree of the initial soil is classified to be highly saline according to FAO (1988) where only tolerant crops yield satisfactorily. Calcium carbonate content indicates a non-calcareous soil since its content is less than 15% (FAO, 2024). With regards to soil organic matter (SOM), available macro elements results showed that the soil is very poor soil properties except the available potassium which considered as sufficient content of this element. Generally, and based on the results shown in table 3 at the initial status (bare soil) it can be concluded that this soil has very low fertility. Figure 2 show the first stage treatment effect on SOM, available P and available respectively. SOM content after the first green manure has increased as compared to the bare soil which might be attributed to a short period of time passed after this addition. However, and after the second green manure the SOM content decreased again which might be due to more biological activity and more time spent in such arid conditions that allow more oxidation of organic material (compost) added to soil.

With regards to available P (Fig. 2) there was a clear trend in its availability from bare soil P content to the first green manure showing an increase percentage of 81%. Whereas higher increase percentage was observed when comparing P content in the first green manure to the second one showing an increase percentage of 75%. Soil salinity considerably decreased from 0.61 dS/m (bare soil) to 0.11 dS/m (second green manure).

Table 3. soil characterization at the first stage of treatment.

Sampling event	pH 1:2.5	EC 1:5 dS/m	$CaCO_3$ %	OC %	OM %	Avai. N (mg/kg)	Avai. P (mg/kg)	Avai. K (mg/kg)
Bare soil	8.66	0.61	8.13	0.04	0.06	15.25	0.57	110
First green manure	8.89	0.17	9.31	0.11	0.19	10.63	3.11	162
Second green manure	8.64	0.11	7.51	0.07	0.12	18.25	12.48	126

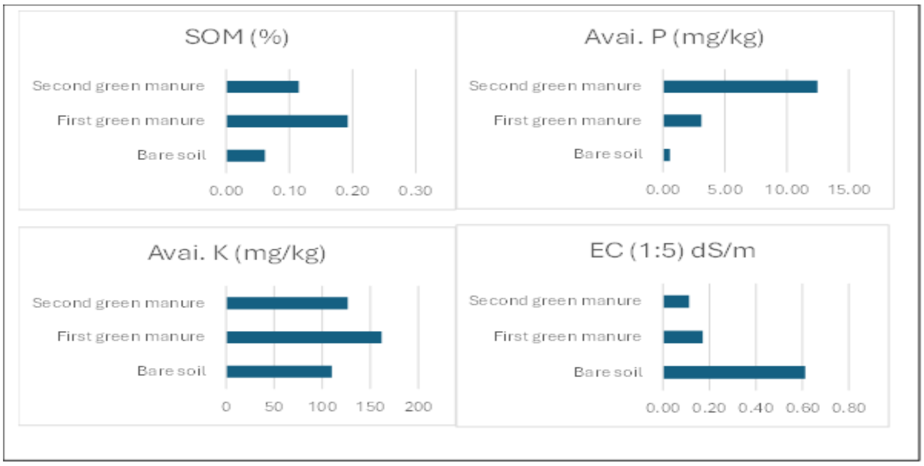

Figure 2. Soil organic matter content, available P, available K and EC during the first stage of treatment

Impact of treatments on soil properties under the 8 crops

This work aimed at investigating the impact of different treatment including basalt and compost at different level on soil properties and plant growth. Furthermore, it is very important to mention that applying an experiment at large scale would contain differences in results as this is affected by the soil spatial variation which is very notable especially when working with large areas.

1- Cotton

The soil reaction and salinity level under the four treatments were found to exhibit no statistically significant differences from one another. However, the soil organic carbon content observed under treatments A, B, C, and D did demonstrate statistically significant differences, with the order C > B > A > D, and average SOC values of 0.62, 0.57, 0.67, and 0.10%, respectively (table 4). The highest available phosphorus value was observed under treatment B, indicating that the basalt/compost ratio of 5/95 was the most suitable condition for P-solubilizing bacteria. Regarding available potassium B treatment surpassed all other treatments, rendering the K more available even after the crop harvest. Overall, the 3 treatments A, B and C were more efficient in terms of SOC, available P and K as compared to the control plot.

Table 4. Effect of soil treatments on soil properties under cotton cultivation

Plot name	pH 1:2.5	EC (1:5) dS/m	$CaCO_3$ %	OC %	OM %	Avai. P (mg/kg)	Avai. K (mg/kg)
A	8.74±0.170 n.s	0.10±0.008	9.99±1.071	0.22±0.020 c	0.38±0.035 c	21.34±4.415 b	232.00±6.000 a
B	8.58±0.317 n.s	0.11±0.005	10.91±3.134	0.33±0.015 b	0.57±0.025 b	33.61±5.755 a	241.00±5.568 a
C	8.18±0.308 n.s	0.09±0.012	7.48±2.229	0.36±0.026 a	0.62±0.047 a	21.29±1.544 b	155.00±12.000 b
D	8.20±0.197 n.s	0.10±0.015	6.66±0.949	0.10±0.021 d	0.18±0.036 d	17.40±4.714 b	168.33±13.614 b
LSD at 0.05	n.s	n.s	n.s	0.0145	0.0255	9.65	21.35

2- Peanut

The soil pH and salinity levels observed under the peanut plots were comparable to those seen under the cotton crop. The highest SOC value was observed under C treatment (table 5) following the same pattern under cotton treatment which is attributed to the relative amounts of compost added to each treatment (Yuan *et al.* 2025). Under peanuts cultivation the highest available P and K values were observed under A treatment indicating that the higher basalt rate was the influencing factor as it contains available K of 330 - 350 mg/kg. It is worth to mention that the 3 treatments were more efficient than the control plot.

Table 5. Effect of soil treatments on soil properties under Peanut cultivation

Plot name	pH 1:2.5	EC (1:5) dS/m	CaCO3 %	OC %	OM %	Avai. P (mg/kg)	Avai. K (mg/kg)
A	8.52±0.144	0.11±0.017	12.39±0.823 a	0.20±0.010 a	0.34±0.015 a	20.79±1.953 a	246.00±2.646 a
B	8.48±0.421	0.10±0.017	8.62±1.204 bc	0.14±0.032 b	0.25±0.055 b	18.10±3.853 a	228.33±9.504 ab
C	8.51±0.056	0.10±0.013	11.22±2.871 ab	0.24±0.010 a	0.41±0.020 a	12.25±1.519 b	227.00±2.000 b
D	8.40±0.121	0.09±0.023	6.66±1.020 c	0.11±0.030 b	0.19±0.050 b	5.78±2.570 c	150.33±17.559 c
LSD at 0.05	n.s	n.s	3.13	0.053	0.090	4.19	18.78

3- Alfalfa

This crop died at earlier growth stage (30 days after cultivation) due to parasitic weed. However, soil samples were also collected and analysed. As shown in table 6 there were no statistically significant differences in soil pH and EC. Similar pattern for SOC was observed as for cotton and peanut crops. However, the available P values were lower than in cotton and peanut crops which might be attributed to the absence of plant that affects the biological activity in the soil. The available K observed in the three treatments were higher than the control plot, however B treatment was the most effective treatment with 305 mg/kg of available K after crop harvesting.

Table 6. Effect of soil treatments on soil properties under alfalfa cultivation

Plot name	pH 1:2.5	EC (1:5) dS/m	$CaCO_3$ %	OC %	OM %	Avai. P (mg/kg)	Avai. K (mg/kg)
A	8.39±0.542	0.11±0.008	7.08±0.272	0.25±0.026 b	0.43±0.047 b	12.38±1.969 a	218.67±13.051 b
B	7.93±0.119	0.28±0.270	8.38±0.899	0.30±0.015 ab	0.52±0.025 ab	8.11±1.652 b	305.67±14.012 a
C	8.05±0.031	0.12±0.024	7.84±0.356	0.38±0.050 a	0.65±0.085 a	15.34±2.057 a	235.33±15.503 b
D	8.33±0.107	0.09±0.027	8.34±0.514	0.11±0.032 c	0.20±0.055 c	6.27±1.636 b	145.33±12.897 c
LSD at 0.05	n.s	n.s	n.s	0.076	0.131	3.94	23.30

4- Basil

There were no considerable changes in soil pH and EC for all treatments cultivated by basil crop as shown in table 7.

The treatments A, B and C surpassed the control plot in SOC content, available P and K. The most effective treatment in terms of SOC content, available P and K were C, B and A respectively. Treatment A can be considered effective in releasing K as it received the highest amount of basalt powder which provide more K when compared to the other treatments. These results are similar to those obtained by (Yuan *et al.* 2025)

Table 7. Effect of soil treatments on soil properties under basil cultivation

Plot name	pH 1:2.5	EC (1:5) dS/m	$CaCO_3$ %	OC %	OM %	Avai. P (mg/kg)	Avai. K (mg/kg)
A	8.04±0.188	0.09±0.003	7.41±1.565	0.27±0.015 b	0.47±0.025 b	24.04±1.728 b	282.00±10.817 a
B	8.07±0.157	0.10±0.035	7.64±0.110	0.31±0.025 b	0.54±0.046 b	32.07±4.258 a	255.33±24.007 a
C	8.26±0.072	0.18±0.120	7.92±0.684	0.45±0.032 a	0.77±0.052 a	18.26±2.811 b	164.00±5.000 b
D	8.36±0.087	0.08±0.003	8.11±0.469	0.16±0.026 c	0.27±0.042 c	9.37±1.750 c	148.67±9.452 b
LSD at 0.05	n.s	n.s	n.s	0.052	0.085	6.34	29.59

5- Fodder beans

No considerable changes were found of soil pH and EC when comparing all treatments with each other (table 8).

Regarding SOC, available P and K, the most effective treatments were C, B and B respectively. Having higher value of available K under B treatment might be attributed to the inaccurate treatment distribution (basalt and compost) when soil preparation is done.

Table 8. Effect of soil treatments on soil properties under fodder beans cultivation

Plot name	pH 1:2.5	EC (1:5) dS/m	$CaCO_3$ %	OC %	OM %	Avai. P (mg/kg)	Avai. K (mg/kg)
A	8.13±0.186	0.09±0.013	7.37±0.813 a	0.17±0.015 c	0.30±0.026 c	14.06±3.121	148.87±1.704 a
B	8.30±0.193	0.08±0.000	7.11±1.337 a	0.23±0.012 b	0.39±0.017 b	16.55±2.112	164.57±26.546 a
C	8.35±0.163	0.09±0.018	7.23±1.519 a	0.31±0.010 a	0.53±0.015 a	9.80±1.054	109.90±9.550 b
D	8.19±0.170	0.08±0.006	4.65±1.427 b	0.11±0.015 d	0.19±0.025 d	11.99±2.708	153.00±20.400 a
LSD at 0.05	n.s	n.s	1.878	0.019	0.032	n.s	31.44

6- Sorghum

The changes in soil pH, EC and $CaCO_3$ can be considered very low within the three treatments as provided in table 9. With regards SOC, available P and K no clear pattern can be shown which might be attributed to the spatial variation of study location.

Table 9. Effect of soil treatments on soil properties under sorghum cultivation

Plot name	pH 1:2.5	EC (1:5) dS/m	$CaCO_3$ %	SOC %	OM %	Avai. P (mg/kg)	Avai. K (mg/kg)
A	8.51±0.108 a	0.08±0.018	6.29±1.235	0.20±0.020 c	0.34±0.035 c	7.58±0.963 b	204.13±0.751 c
B	8.52±0.030 a	0.08±0.008	6.56±0.970	0.26±0.010 b	0.45±0.020 b	8.79±1.276 b	147.80±4.603 d
C	8.53±0.147 a	0.10±0.020	7.74±1.062	0.29±0.015 a	0.50±0.025 a	14.30±1.368 a	312.17±13.851 a
D	8.23±0.147 b	0.09±0.020	6.56±0.205	0.11±0.006 d	0.19±0.006 d	16.34±2.855 a	271.27±12.502 b
LSD at 0.05	0.212	n.s	n.s	0.017	0.034	2.14	19.58

7- Corn

Corn is a heavy nutrient absorber crop; therefore, it is normal to find lower values of available P and K in some plots compared to the control one. Regarding SOC the same trend was found as under all cultivated crops where treatment C surpassed all other treatments due to the higher amount of compost added. The treatment A showed a higher availability of potassium over all other treatments as shown in table 10.

Table 10. Effect of soil treatments on soil properties under corn cultivation

Plot name	pH 1:2.5	EC (1:5) dS/m	$CaCO_3$ %	OC %	OM %	Avai. P (mg/kg)	Avai. K (mg/kg)
A	8.46±0.082	0.08±0.028	8.77±0.312	0.12±0.021 c	0.21±0.036 c	5.11±1.460 c	223.93±10.541 a
B	8.42±0.103	0.10±0.006	8.69±1.483	0.17±0.010 b	0.29±0.015 b	7.38±1.417 c	104.10±4.026 d
C	8.42±0.086	0.34±0.461	7.70±0.663	0.23±0.025 a	0.39±0.040 a	28.41±1.017 a	144.47±8.023 b
D	8.34±0.168	0.08±0.006	7.36±1.019	0.11±0.015 c	0.19±0.025 c	10.53±1.174 b	124.43±9.372 c
LSD at 0.05	n.s	n.s	n.s	0.039	0.066	2.61	19.09

8- Sesame

The four plots A, B, C and D showed no considerable changes in pH, EC and $CaCO_3$ (table 11) providing the same pattern as in all previous crops. The most efficient treatment in SOC, available P and K was C.

The overall impact of the three treatments under the 8 cultivated crops can be synthesized as follows: soil pH did not show much variation under the 3 treatments as well as the control plot (D). The small variation in soil salinity and calcium carbonate content can be attributed to the intrinsic spatial variation present in the study area. The changes in soil organic carbon content are the only soil parameter that varies according to the added amount of compost. Interpretation of available phosphorus and potassium under the three treatments are not clear and needs further analysis and calculations such as nutrient content in the different cultivated plants and computing the nutrient uptake.

Table 11. Effect of soil treatments on soil properties under sesame cultivation

Plot name	pH 1:2.5	EC (1:5) dS/m	$CaCO_3$ %	OC %	OM %	Avai. P (mg/kg)	Avai. K (mg/kg)
A	8.66±0.410	0.10±0.021	5.85±2.332	0.25±0.010 b	0.43±0.020 b	13.00±2.481 a	86.33±3.215 b
B	8.75±0.257	0.12±0.006	7.08±0.591	0.19±0.010 c	0.33±0.015 c	15.51±3.667 a	47.33±2.517 d
C	8.22±0.424	0.08±0.014	7.39±2.170	0.30±0.015 a	0.52±0.025 a	18.79±4.367 a	148.13±14.610 a
D	8.28±0.110	0.10±0.017	5.84±0.513	0.12±0.026 d	0.21±0.047 d	3.33±1.762 b	71.17±2.747 c
LSD at 0.05	n.s	n.s	n.s	0.036	0.062	7.08	12.65

CONCLUSION

The application of enhanced basalt weathering (EBW) mixed with compost in arid regions, specifically within the Wahat Baharyia Oasis of Egypt, has been demonstrated to significantly improve soil parameters and enhance crop productivity. This study highlighted that the addition of finely ground basalt rock enriches soil fertility, evident from increases in soil organic carbon, available phosphorus, and potassium. Various treatment combinations of basalt and compost showed varying impacts on soil health, with certain ratios proving more effective in improving specific nutrient availability. The results underline the potential of EBW as a regenerative agriculture practice that can contribute to sustainable farming in arid ecosystems while mitigating climate change effects through carbon capture. Further research is recommended to refine treatment applications and to explore long-term sustainability and agronomic benefits across diverse climatic conditions and soil types. Overall, this study paves the way for innovative approaches to revitalizing degraded soils and enhancing agricultural resilience in arid environments.

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تأثير استخدام التجوية المعززة للصخور البازلتية على خصائص التربة في المناطق القاحلة

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الملخص

تتناول هذه الدراسة تأثير اضافة مسحوق البازلت مخلوطا مع السماد العضوي بنسب مختلفة على خصائص التربة في ظل زراعة ثمانية محاصيل مختلفة في الظروف القاحلة بمنطقة الواحات البحرية في مصر. تألفت التجربة من مرحلتين من المعالجة. في المرحلة الأولى، تم زراعة موسمين متتاليين من السماد الأخضر. وفي المرحلة الثانية، تم دمج مسحوق البازلت مع السماد العضوي بمعدلين مختلفين. تم استخدام أربع معاملات: المعاملة (أ) و(ب) و(ج) و(د). المعاملة (أ) تقابل البازلت/السماد العضوي بنسبة ٧٣/٢٧٪، والمعاملة (ب) تقابل البازلت/السماد العضوي بنسبة ٩٥/٥٪، والمعاملة (ج) تقابل البازلت/السماد العضوي بنسبة ١٠٠/٠٪، بالأضافة الى المعاملة (د) (الرمل فقط). أجريت التجربة خلال موسم الزراعة ٢٠٢٤/٢٠٢٣، باستخدام نظام الري المحوري المركزي. أظهرت نتائج المرحلة الأولى تحسنًا ملحوظًا في ملوحة التربة (من ٠,٦١ إلى ٠,١١ ديسيسيمنز/متر) وتحسينات في الصورة المتاحة لكل من الفوسفور والبوتاسيوم. وكشفت المرحلة الثانية كذلك عن تأثيرات إيجابية على المؤشرات الكيميائية للتربة مثل درجة التوصيل الكهربي (EC) والنيتروجين (N) والفوسفور (P) والبوتاسيوم (K)، على الرغم من أن الأس الهيدروجيني ظل غير متأثر إلى حد كبير. تشير الدراسة إلى أن استخدام مسحوق البازلت والسماد العضوي يحسن خصوبة التربة وإنتاجية المحاصيل، مما يجعل من الزراعة باستخدام مسحوق البازلت والسماد العضوي ممارسة زراعية متجددة قابلة للتطبيق في البيئات القاحلة، مع المساهمة في عزل الكربون. وينبغي أن تركز البحوث المستقبلية على دراسة تأثير هذه المعاملات على صفات التربة ولكن على المدي الطويل.