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Comparative study of the Physico-chemical characteristics of Garden soil and Marble Wastes Slurry.

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ABSTRACT:

A study was conducted to assess the soil physicochemical properties of garden soil of Udaipur (Rajasthan) prior to the growth of certain plants like Mustard, Pea and Coriander and these soil characteristics were compared with marble mine waste slurry. The study revealed that marble soil (slurry) poor in nutrient content. During the experiment some commonly growing plants were selected so that their growth in garden soil can be compared with the growth in mine waste slurry. The results of this scientific pursuit depicted a clear difference in the soil quality of garden soil and mine soil by soil analysis and also the quality of soil after growing some common plants. The required level of soil nutrient of minespoil is less than that of the garden soil. Available nutrients (N, P, K)exchangeable cation (Ca, Na, and K) of the garden soil suggest that the open cast mining changes the soil quality. Other physical properties of the mine spoil such bulk density, water holding capacity, moisture content are lower than those of garden soil and it was enhance after growing plants. The present investigation clearly indicate that the mining activity deterioration the soil physicochemical characteristics.

KEYWORDS: Soil quality, Slurry, physicochemical, nutrient, analysis.

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INTRODUCTION:

Marble is one of the solid minerals present in abundance in the outskirts of Udaipur. Udaipur is situated between parallels 23º 26 ', 26º 20' north latitudes and 73º 09', 74º 45' east longitude at average altitudes of about 579.4 meter above mean sea level.The effect of marble mining activities on the properties of soil have already been studied many scientist.[1]Marble is mainly form from limestone which changes the texture of soil in the mining area. Marble mining is a part of industrialization and it also provides employment for hundreds of peoples within in the community, however as marble mining increases the destructions of ecosystem which occurs ultimately causes degradation of the soil quality. Mining is one of the important pathways by which soils are polluted[5]. Mining also results to cleaning of vegetation removal of topsoil and it reduces the organic matter of the soil. It also reduces the biological activity and reduces productivity of the soil.[2] It indirectly affects both living and nonliving components through physical and chemical modification of the soil environment[6]. The present study reveals the comparative study of the physicochemical characteristics of garden soil before and after the growth of three different plants Pea, mustard and Coriander and these characteristics compared with mine dump soil. This paper reports the effect of growing plants on the physicochemical characteristics of the soil as well as the impact of marble mining on soil properties in Udaipur region.

MATERIALS & METHODS:

Five samples were collected from different locations in Udaipur Rajasthan region. Root part and other plant residues were removed from the soil and then these soil samples were air dried at room temperature, sieved with <2.0mm test sieve. For analysis of the soil organic carbon and calcium carbonate, soil samples were further sieved with 0.2 mm test sieve. The pH, EC were determined in 2.0 mm test sieve soil samples. The soil moisture, soil texture, alkalinity, WHC, were estimated by standards methods of S.K. Maiti. The K and Na were measured with flame photometer while the Nitrate and phosphate were estimated by UV spectrophotometer.

RESULT &DISCUSSION:

The results of the present investigation clearly indicate the variation in the physicochemical characteristics of the garden soil prior to plant growth and after growing plants i.e. Mustard (Brasicajuncia), Pea (Pisumsativum) and Coriander (Corindrumsativum) which were compared with the physicochemical characteristics of marble slurry. The average particle size was silt 22.0% in initial garden soil (S-1), 26.56% after growing mustard (S-2), 22.92% after growing coriander (S-3) and 22.0% after pea growth (S-4) whereas 71 % marble wastes slurry (S-5)(shown in the table no. 1

and graph no. 1.1). Clay was found to be 12.5%, 12.88%, 15.2%,16% and 18.01% respectively in the above mentioned samples (shown in the graph 1.2). Fine sand was found to be 26.25, 23.48%, 20.64%, 21.6%, and 18.14% in Sample S-1, S-2, S-3, S-4 and S-5.Percentage of coarse sand 39.52%,37.08%, 40.66%, 40.4% and 0.89%.The bulk density gradually decreased from initial garden soil to marble wastes slurry that is from 1.51 to 1.32% however it was found to be high in soil after the growth of pea plant that is 1.59%. The water holding capacity was maximum in the initial garden soil that is 36.2%, which gradually decreased in the other four samples respectively with the minimum 32.9% after growth of pea plant. The moisture content was 10.3% in the initial garden soil, 15.4% in the soil after growing mustard,15.2 after coriander growth, 14.5% after pea growth, whereas it was least in the marble wastes slurry 0.28. Electrical conductivity was maximum in the initial garden S-1 soil 675µs/cm and it gradually decreased in the soil S-2, S-3, S-4 and it was minimum in marble wastes slurry S-5 362 µs/cm.The chemical characteristics revealed pH value of 6.9 in the initial garden soil (S-1) and it was 7.6 in S-2, 7.3 in S-3 and 7.7 in S-4, while it was 8.9 in marble wastes slurry (S-5). The calcium carbonate was to be found 5.0, 5.5, 5.7, 5.8(S-1, S-2, S-3 S-4 respectively), where as it was 83.5 in marble wastes slurry (S-5). The available potassium was 56 (mg/l) in the soil sample of initial garden soil S-1 and it was found to be 81, 88, 89 in S-2, S-3, S-4 respectively but it was moderately low in marble wastes slurry(S-5) 40. The available phosphorus (mg/l) was 6.0 in initial garden soil which gradually increased in the soil sample after pea growth 18.0. However it was 12.0 in the marble slurry wastes. The available sodium (mg/l) was 165 in initial garden soil S-1, lowest in S-3 145 but in marble wastes slurry S-5 it was only 54. The Nitrate contains (mg/l) was 40 ± 5 in S-1, S-2 and S-3. In marble slurry waste it was only 8.0. The organic carbon was 0.31% in the initial garden soil which gradually increased to 0 35% in S-2, S-3 and S-4 while it was absent in marble wastes slurry.

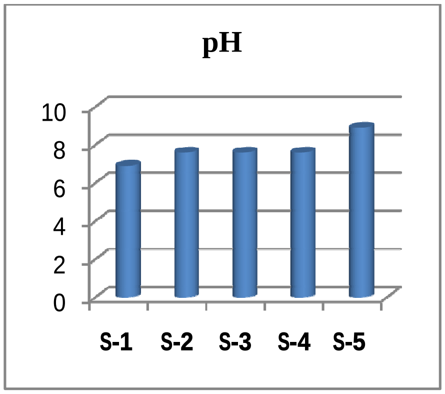
The soil of Udaipur is loamy sand in texturewhereas the texture of marble waste slurry is silt loam which is related to the parent rock material. The silt loam texture of the marble wastes dump may have originated from the parent material which is pink marble slurry pinkish red this color became redder with depth; however this is attributed to the mining activity which is carried out in the area under study. During soil sampling the soil fauna activity was observed of the garden soil but they were no evidence of soil fauna in the mining site[6].

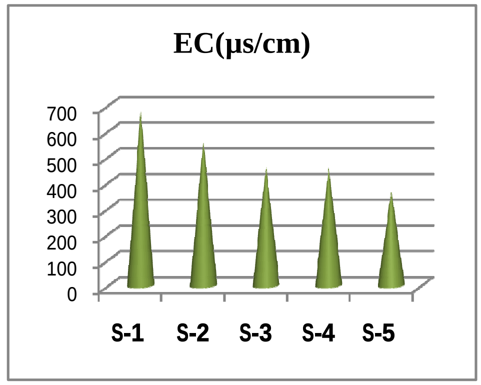
The total amount of soil moisture in the samples from garden soil was 10.3% and +5 in S-2, S-3 and S-4, however, it was only 0.28% in the marble waste slurry S-5 which clearly indicates that the marble waste slurry is completely dry with low water hold in capacity and bulk density.[3]The pH of all samples collected from garden soil was between 6.9 to 7.6 whereas the pH value of mine dump was 8.9, according to kadir et al. and Akhbar et al. the pH of the soil increases with addition of

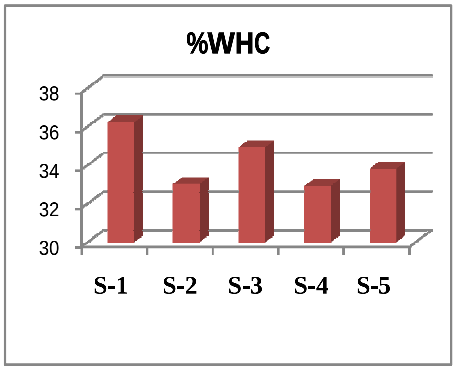
$CaCO_3$ that is why the pH is found to be highest in marble wastes slurry.The EC of all the soil samples was between 675µs/cm to 458 in the soil after pea growth however in the marble wastes slurry it was 362 us/cm, this value of EC is found to be not favorable for plant growth[7] and this value is because of the presence of high amount of calcium and carbonate ions because the value of $CaCO_3$ is significantly high in the marble slurry wastes that is 83.5%. The available sodium (mg/l)is only 54 in marble waste slurry indicate this soil is not fertile enough, to grow mustard, coriander and Pea, this low value of 54 is mainly due to the access of calcium ions and deficiency of sodium ions, sodium is an important nutrient for plant growth and its low concentration in marble waste slurry indicates that this soil cannotbe used for growing plants without the use of sodium fertilizer or the addition of sodium by mixing garden soil into it, similar is the case with potassium and available phosphorus which is also very low in the marble waste slurry.OC which is the most important indicator of fertility of soil was not at all detected in marble waste slurry similar to the study done by Carmona et al., no OC in marble waste slurry is due to removal of top soil in the mining operations which make the soil in fertile.The nitrate content in the initial garden soil was (mg/kg) between 40 to 35 after the growth of mustard, coriander and pea but it was very low only 8 in marble wastes slurry which clearly reveals that the slurry is unfit for plant growth.

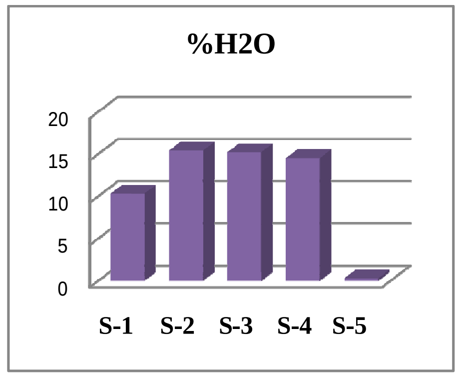
Table: 1physico-chemical characterization of soil.

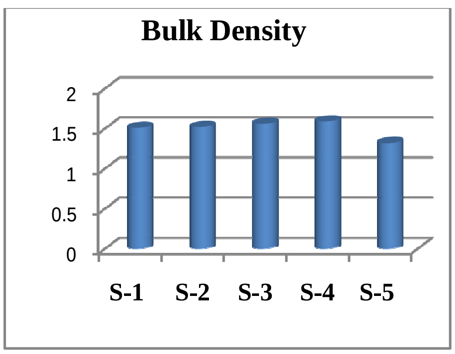
S.no.	**Parameters (unit)**	**Soil samples**				
		S-1 Initial garden soil	**S-2 Garden soil (mustard)**	**S-3 Garden soil (coriander)**	**S-4 Garden soil (pea)**	**S-5 Marble slurry**
1	pH	6.9	7.6	7.6	7.6	8.9
2	EC(us/cm)	675	555	458	458	362
3	%H2O	2.3	15.4	15.2	14.5	0.28
4	%WHC	36.2	33	34.9	32.9	33.8
5	BD Tapped	1.51	1.52	1.56	1.59	1.32
6	%CaCo3	5	5.5	5	5	**83.5**
7	Avai. Na(mg/l)	165	165	160	145	54
8	Avai. K(mg/l)	56	81	88	88	40
9	Avai. P(mg/l)	6	9	9	18	12
10	%NO3	0.004	0.004	0.004	0.0035	0.0008
11	%Org. Carbon	0.31	0.35	0.35	0.35	ND
TEXTURE						
12	%silt	22	26.56	22.92	22	71
13	%clay	12.52	12.88	15.2	16	18.01
14	%fine sand	26.02	23.48	20.64	21.6	18.14
15	%course sand	39.52	37.08	40.66	40.4	0.89

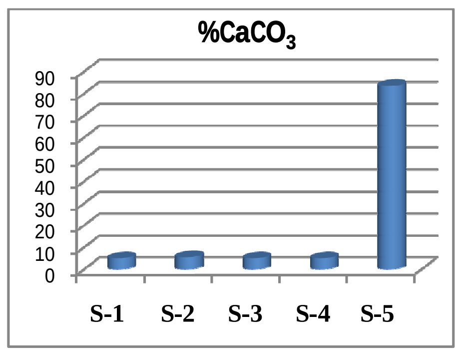

pH
10
8
6
4
2
0
S-1 S-2 S-3 S-4 S-5

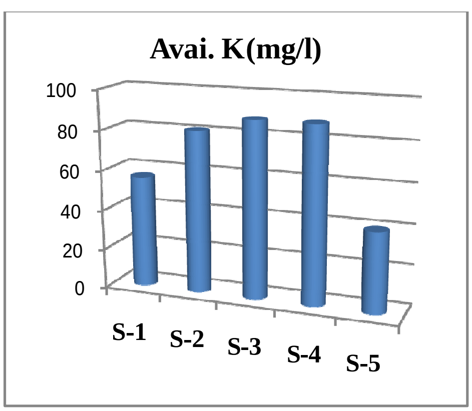

EC(µs/cm)
700
600
500
400
300
200
100
0
S-1 S-2 S-3 S-4 S-5

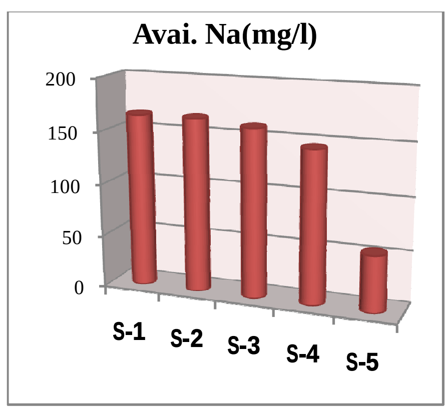

%WHC
38
36
34
32
30
S-1 S-2 S-3 S-4 S-5


%H2O
20
15
10
5
0
S-1 S-2 S-3 S-4 S-5


Bulk Density
2
1.5
1
0.5
0
S-1 S-2 S-3 S-4 S-5


%CaCO3
90
80
70
60
50
40
30
20
10
0
S-1 S-2 S-3 S-4 S-5


Avai. K(mg/l)
100
80
60
40
20
0
S-1 S-2 S-3 S-4 S-5


Avai. Na(mg/l)
200
150
100
50
0
S-1 S-2 S-3 S-4 S-5

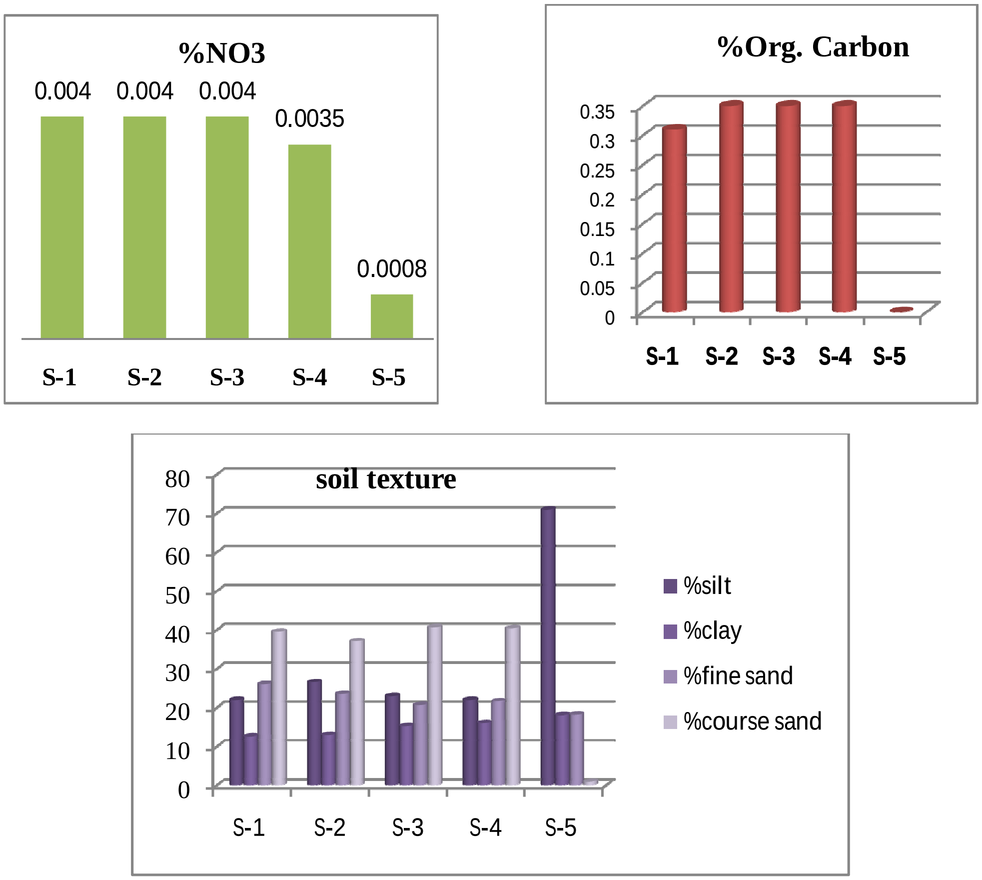


Figure1.Graphical representation of all parameters

The statistical analysis using one way anova test has been depicted in the form of graphs and tables.

Table 2: pH

Location	N	Mean	SD	f	df	Result
Initial Garden Soil	3	6.87	0.06	78.516	4, 10	***
Garden Soil - Mustard	3	7.60	0.10			
Garden Soil - Coriander	3	7.60	0.10			
Garden Soil - Pea	3	7.60	0.20			
Marble Waste Slurry	3	8.90	0.20			

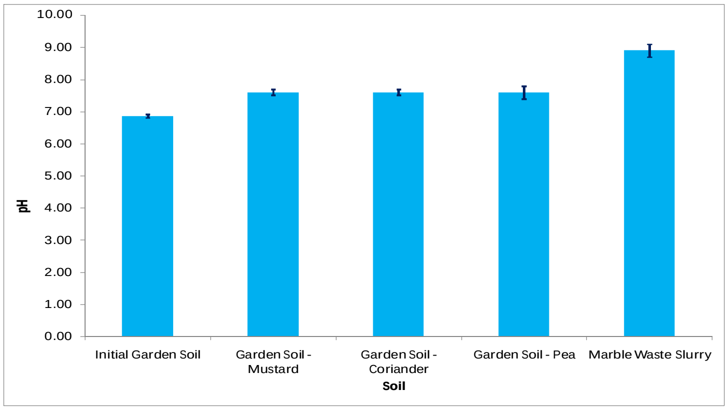


Figure 2 pH

Table 3: EC (µs/cm)

Location	N	Mean	SD	f	df	Result
Initial Garden Soil	3	675.67	12.01	330.327	4, 10	***
Garden Soil - Mustard	3	554.67	14.50			
Garden Soil - Coriander	3	457.33	14.01			
Garden Soil - Pea	3	458.00	9.00			
Marble Waste Slurry	3	362.00	3.00			

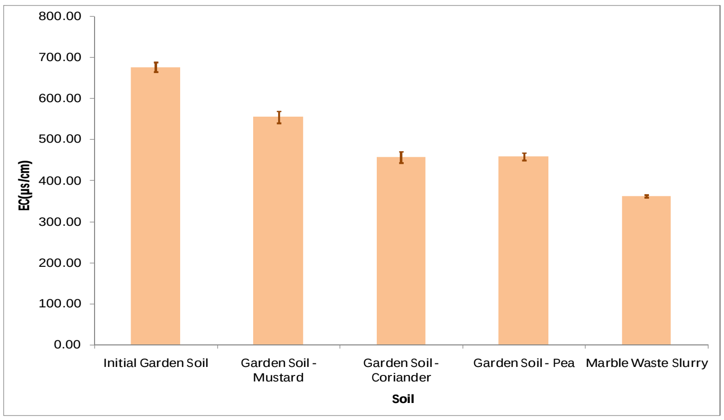


Figure 3 - EC (µs/cm)

Table 4: % H_2O

Location	N	Mean	SD	f	df	Result
Initial Garden Soil	3	10.30	0.20	2046.16	4, 10	***
Garden Soil - Mustard	3	15.40	0.40			
Garden Soil - Coriander	3	15.20	0.10			
Garden Soil - Pea	3	14.50	0.30			
Marble Waste Slurry	3	0.28	0.04			

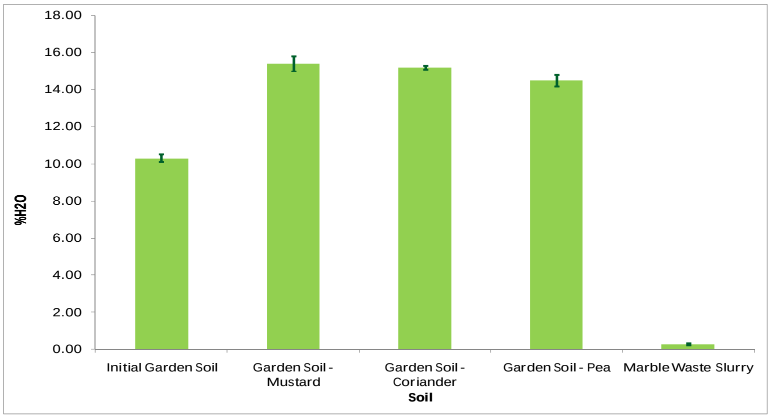


Figure 4 %H_2O

Table 5: % WHC

Location	N	Mean	SD	f	df	Result
Initial Garden Soil	3	36.20	0.20	21.120	4, 10	***
Garden Soil - Mustard	3	33.00	1.00			
Garden Soil - Coriander	3	34.90	0.30			
Garden Soil - Pea	3	32.90	0.40			
Marble Waste Slurry	3	33.80	0.30			

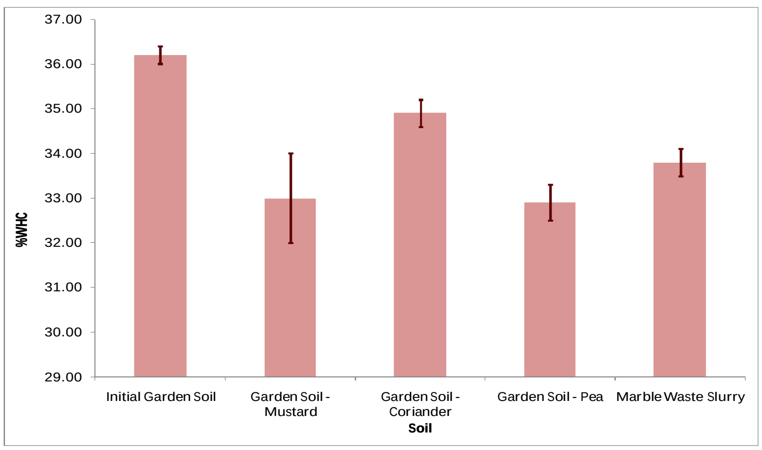


Figure 5 % WHC

Table 6: BD Tapped

Location	N	Mean	SD	f	df	Result
Initial Garden Soil	3	1.51	0.05	26.548	4, 10	***
Garden Soil - Mustard	3	1.52	0.04			
Garden Soil - Coriander	3	1.56	0.03			
Garden Soil - Pea	3	1.59	0.03			
Marble Waste Slurry	3	1.32	0.02			

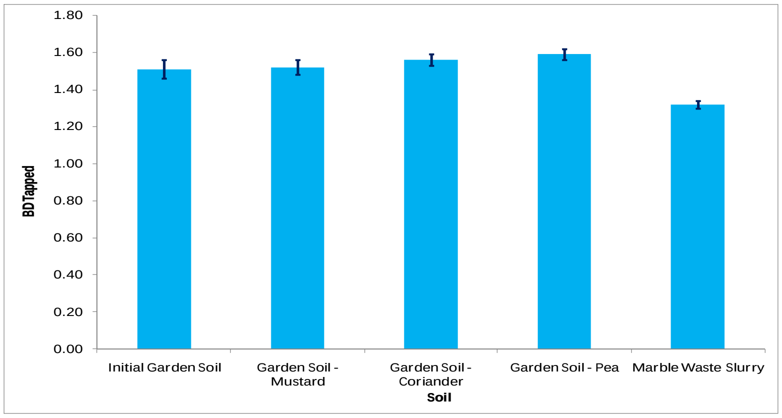


Figure 6 BD Tapped

Table 7: % $CaCO_3$

Location	N	Mean	SD	f	df	Result
Initial Garden Soil	3	5.00	1.00	11663.687	4, 10	***
Garden Soil - Mustard	3	5.50	0.60			
Garden Soil - Coriander	3	5.00	0.20			
Garden Soil - Pea	3	5.00	0.30			
Marble Waste Slurry	3	83.50	0.30			

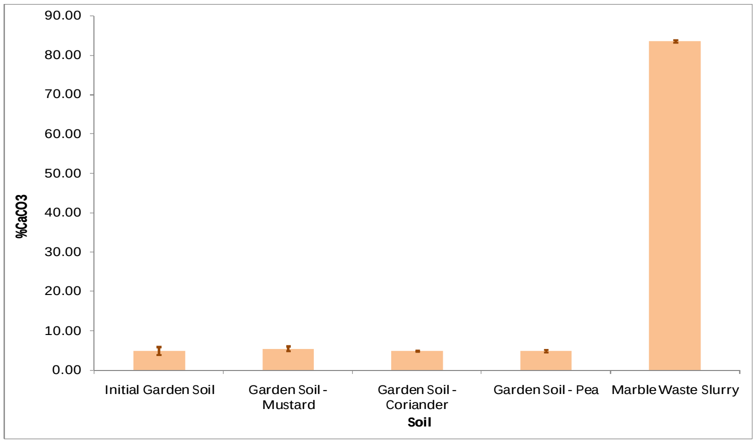


Figure 7 % $CaCO_3$

Table 8: Available Na (mg/l)

Location	N	Mean	SD	f	df	Result
Initial Garden Soil	3	165.00	1.00	2120.34	4, 10	***
Garden Soil - Mustard	3	165.00	2.00			
Garden Soil - Coriander	3	160.00	3.00			
Garden Soil - Pea	3	145.00	1.00			
Marble Waste Slurry	3	54.00	1.00			

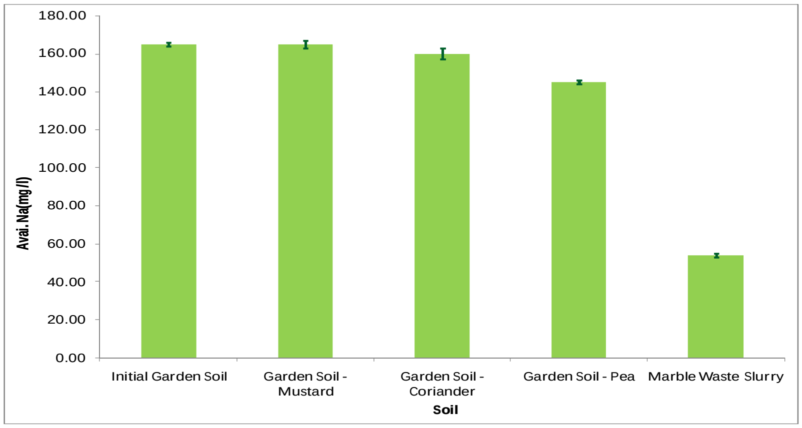


Figure 8 Available Na (mg/l)

Table 9: Available K(mg/l)

Location	N	Mean	SD	f	df	Result
Initial Garden Soil	3	56.00	1.00	656.673	4, 10	***
Garden Soil - Mustard	3	81.00	2.00			
Garden Soil - Coriander	3	88.00	1.00			
Garden Soil - Pea	3	88.00	2.00			
Marble Waste Slurry	3	40.00	0.80			

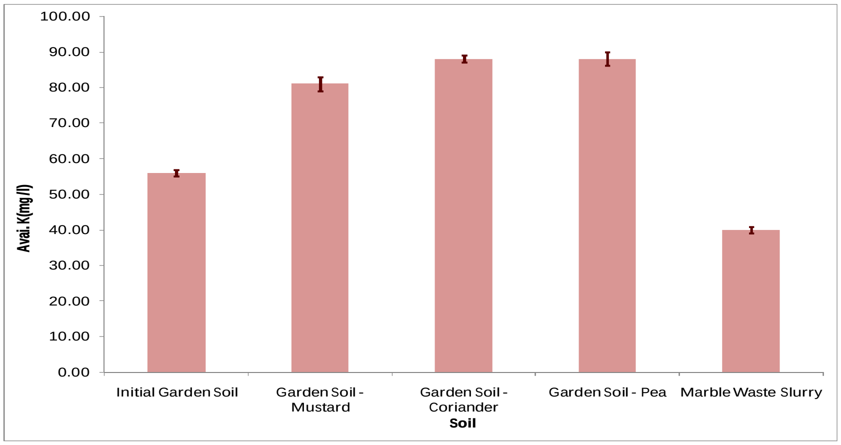


Figure 9 Available K(mg/l)

Table 10: Available P(mg/l)

Location	N	Mean	SD	f	df	Result
Initial Garden Soil	3	3.87	3.35	22.999	4, 10	***
Garden Soil - Mustard	3	9.00	1.20			
Garden Soil - Coriander	3	9.00	0.70			
Garden Soil - Pea	3	18.00	2.00			
Marble Waste Slurry	3	12.00	0.50			

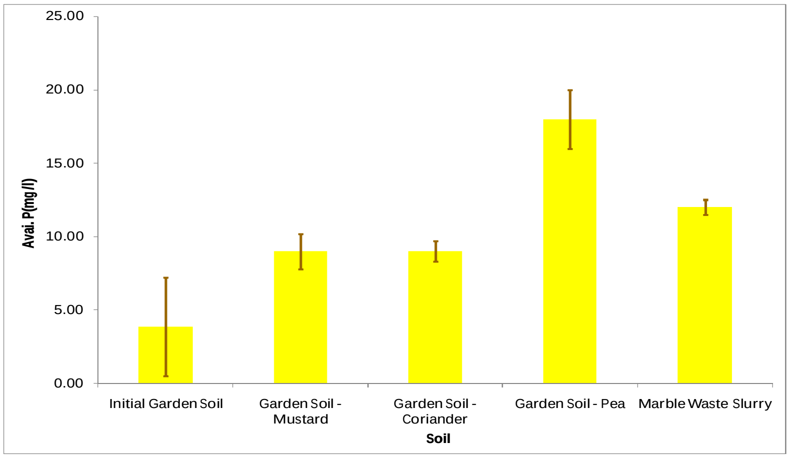


Figure 10 - Available P(mg/l)

Table 11: %NO_3

Location	N	Mean	SD	f	df	Result
Initial Garden Soil	3	40.00	2.00	125.518	4, 10	***
Garden Soil - Mustard	3	40.00	1.00			
Garden Soil - Coriander	3	40.00	3.00			
Garden Soil - Pea	3	35.00	3.00			
Marble Waste Slurry	3	8.00	0.40			

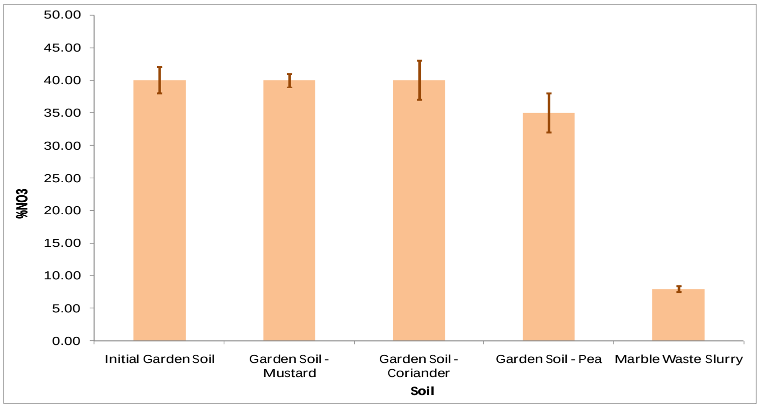


Figure 11 %NO_3

Table 12: % Org. Carbon

Location	N	Mean	SD	f	df	Result
Initial Garden Soil	3	0.31	0.02	195.167	4, 10	***
Garden Soil - Mustard	3	0.35	0.03			
Garden Soil - Coriander	3	0.35	0.02			
Garden Soil - Pea	3	0.35	0.01			
Marble Waste Slurry	3	0.00	0.00			

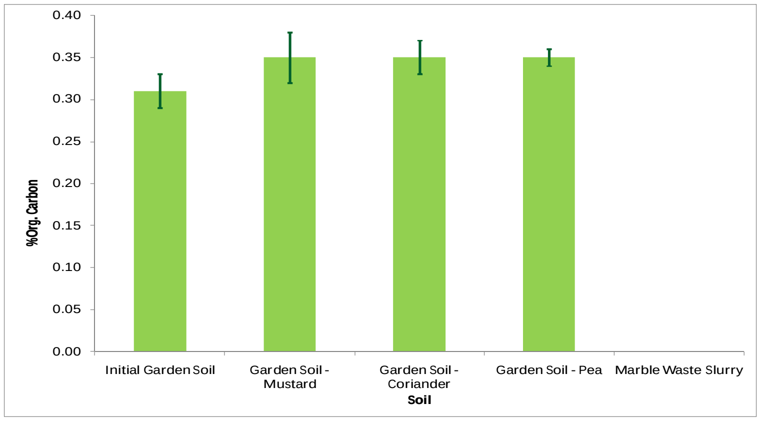


Figure 12 % Org. Carbon

Table 13: % Silt

Location	N	Mean	SD	f	df	Result
Initial Garden Soil	3	22.00	0.40	837.057	4, 10	***
Garden Soil - Mustard	3	26.56	0.14			
Garden Soil - Coriander	3	22.92	0.12			
Garden Soil - Pea	3	22.00	2.00			
Marble Waste Slurry	3	71.00	2.00			

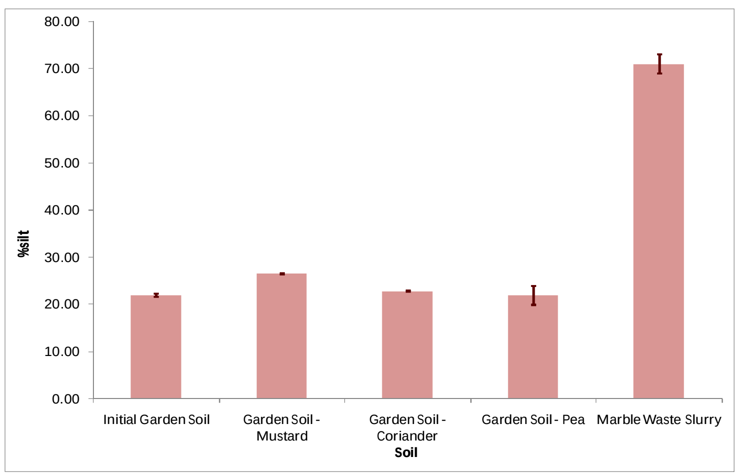


Figure 13: % Silt

Table 14: % Clay

Location	N	Mean	SD	f	df	Result
Initial Garden Soil	3	12.52	0.08	253.523	4, 10	***
Garden Soil - Mustard	3	12.88	0.02			
Garden Soil - Coriander	3	15.20	0.10			
Garden Soil - Pea	3	16.00	0.40			
Marble Waste Slurry	3	18.01	0.36			

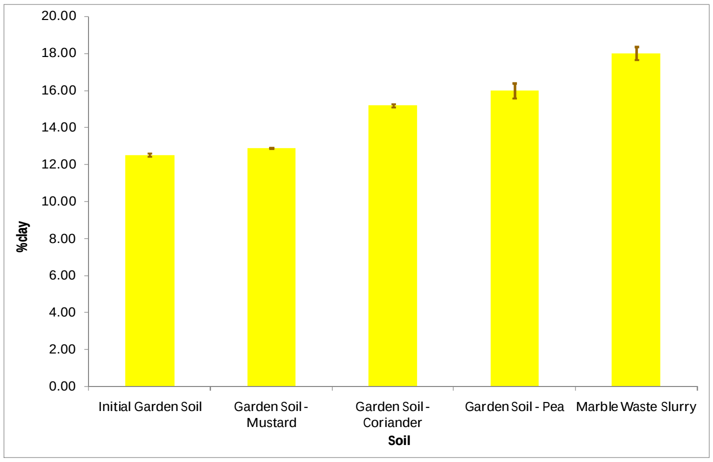


Figure 14: % Clay

Table 15: % Fine sand

Location	N	Mean	SD	f	df	Result
Initial Garden Soil	3	25.90	0.26	579.099	4, 10	***
Garden Soil - Mustard	3	23.48	0.05			
Garden Soil - Coriander	3	20.64	0.16			
Garden Soil - Pea	3	21.60	0.10			
Marble Waste Slurry	3	18.14	0.34			

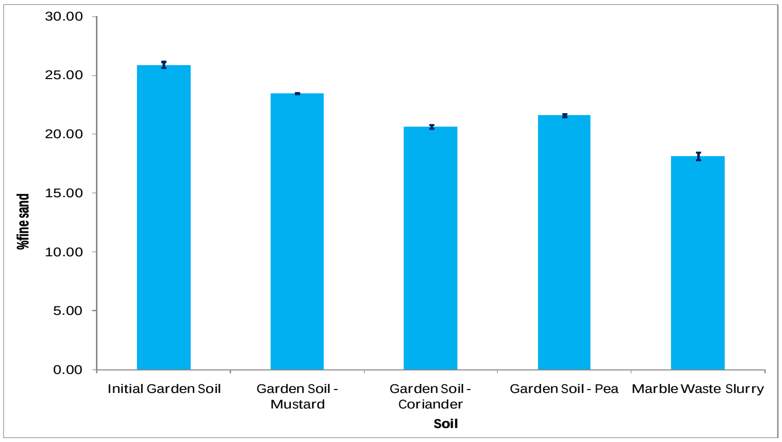


Figure 15: % Fine sand

Table 16: % Corse sand

Location	N	Mean	SD	f	df	Result
Initial Garden Soil	3	39.52	0.12	33652.140	4, 10	***
Garden Soil - Mustard	3	37.08	0.24			
Garden Soil - Coriander	3	40.66	0.14			
Garden Soil - Pea	3	40.40	0.20			
Marble Waste Slurry	3	0.89	0.04			

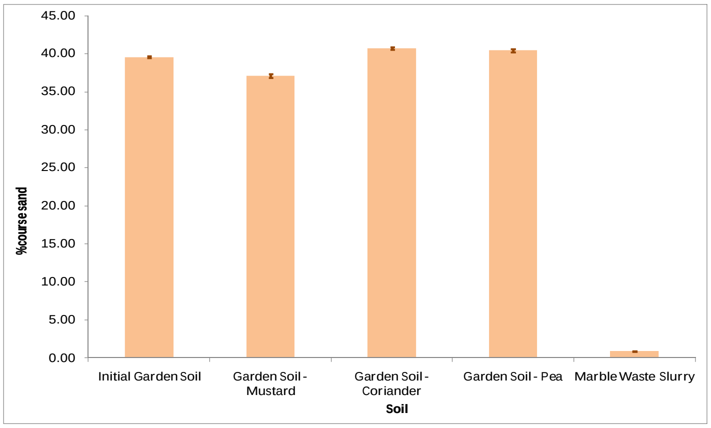


Figure 16: % Corse sand

The statistical analysis clearly shows significant correlation in all the parameters of soil analysis as revealed in the corresponding tables and graphs.

CONCLUSON:

This study indicates that the soil quality is highly destroyed by the mining activity and the alterations are so high that the soil is no more fir for plant growth, therefore some methods have to be suggested to restore this type of soil.

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