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Study of selected physicochemical parameters of soils used for cultivation of sadabahar (*Catharanthus roseus* L.)

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Abstract
Assessment of numerous selected physicochemical characteristics in soil samples was examined in Rangwasa, Bijalpur, Bhorasla, and Machal, four agricultural regions of Indore. Along with measuring the soil's cation exchange capacity (CEC), organic carbon (OC), electrical conductivity (EC), and moisture content, potassium, sodium, calcium, and magnesium were also assessed (MC). A flame photometer was used to measure Na and K in the soil samples, an atomic absorption spectrophotometer was used to measure Ca and Mg, and standard analytical methods were used to measure the remaining physicochemical parameters. The results showed that the concentrations of physicochemical parameters in the soil samples ranged from 7.35 to 11.01% for MC, 6.53 to 7.64 for pH, 0.09 to 0.34 mS/cm for EC, 1.25 to 3.44% for OC, 2.16 to 5.93% for OM, 30.75 to 41.83 cmol/kg for CEC, 845 to 1014 mg/kg for Na, 1980 to 6065 mg/kg for K, 952-2 It was discovered that the pH ranged from neutral to slightly alkaline. According to the EC readings, none of the soil samples are salinized. The values of the physicochemical characteristics in the soil samples collected from all the sampling locations did not differ significantly (P>0.05) according to the statistical test of significance using ANOVA. The link between the various metrics in the soil samples was also investigated using correlation analysis. The information will assist farmers in fixing problems with soil nutrients, including how much fertilizer should be used to boost crop output, as the soil under study may be deemed a good supplier of critical nutrients.

Keywords: soil, physicochemical parameters, *Catharanthus roseus*, flame photometer, FAAS

Introduction

The unconsolidated mineral matter in soil, which functions as a thin layer of the earth's crust and provides a natural habitat for plant development, is controlled by both genetic and environmental influences [1]. It is a naturally occurring body made up of layers (soil horizons) of mineral components that are different from the parent materials in terms of their morphological, physical, chemical, and biological characteristics [2-3]. One of nature's most significant and priceless resources is soil. It is made up of fractured rock fragments that have undergone chemical and mechanical processes including weathering and erosion. For daily requirements, every living creature is directly or indirectly dependent on soil, and 95% of human nourishment comes from the land. Humans and other living things benefit from the various functions of soil. It serves as a filter, buffer, storage, and transformation mechanism, preventing the harmful impacts of environmental contaminants on the world's ecology [2]. For the growth of plants and soil management, agricultural chemists value the research of soil physicochemical properties. The physicochemical characteristics necessary for plant development include moisture content, specific gravity, and nitrogen as a fertilizer. In addition to being utilized for blooming, potassium is also necessary for the synthesis of proteins, photosynthesis, fruit quality, and the prevention of disease. Plant cell walls must have calcium for proper transport and retention of other elements [4].

One of the most important ecological variables is soil, which plants rely on for their supply of nutrients, water, and minerals [5]. Only via soil testing can we evaluate the level of accessible nutrients in the soil and come up with particular fertilizer recommendations. The capacity of the soil to deliver mineral nutrients is determined by the results of physical and chemical testing [6]. An essential factor in the context of sustainable agricultural production is soil characterization in connection to evaluation of the fertility state of the soils of an area or region. Four essential soil components—nitrogen, phosphorus, potassium, and sulfur—control the fertility of the soil and agricultural production [7]. Madagascar, an island in the Indian Ocean, is the original home of *Catharanthus roseus.* It is discovered to be an endangered plant in the wild, and habitat degradation by slash-and-burn agriculture is the major factor contributing to its decline. Despite this, it is now widespread in many tropical and subtropical locations throughout the world, including the Southern United States. [8]. Both culinary and therapeutic uses of *Catharanthus roseus* have been documented throughout recorded history. The physicochemical characteristics of agricultural soil have a significant impact on its production. Because soil is a universal substrate for plant growth and a source of vital nutrients for plants, its quality is significant. Today, a lot more fertilizers than manures are utilized in India, which causes crop output to rise quickly but soil quality to deteriorate. Therefore, it is crucial to examine the physicochemical properties of soil because, as chemical fertilizer is used on more and more soil, it is getting harder to regulate its negative effects on the soil, plants, animals, and people. There is little available information on the physicochemical characteristics of the soil in the studied region. In order to learn more about the physicochemical

characteristics of the soils used to grow *Catharanthus roseus* in East Zone, India, the current study was undertaken. An effort was also made to link the nutrient levels of the soils with other soil attributes.

Materials and methods

Sample Collection

Soil samples were taken using a soil auger at a depth of 0–20 cm from four agricultural locations where *Catharanthus roseus* was grown. Five sub-sites were selected at random from each of the four major sites. In order to create a composite sample, five soil samples were randomly selected from each of the four agricultural regions' five sub-sites. Four bulk soil samples, one from each of the aforementioned regions, were then placed in plastic bags and sent to the laboratory at SAGE University for additional examination.

Sample Preparation

The soil samples were mashed using a clean porcelain mortar and pestle and put through a 2.0 mm sieve after being air dried for a week. For further examination, the soil samples were stored in polythene containers.

Calibration Standard and Spiking Standard Preparation

Five calibration standard solutions were created by serially diluting 1000 ppm stock standard solutions in order to calibrate the flame atomic absorption spectrophotometer (FAAS) and flame photometer. 100 ml of a standard solution combination comprising 50 mg/L of Ca and Mg and 50 mg/L of each of Na and K were produced for the spiking procedure.

Determination of Some Physicochemical Parameters of the Soil Samples

The following physicochemical characteristics of soil samples were examined: moisture content, pH, electrical conductivity, organic carbon, organic matter, and Cation exchange capacity.

Moisture Content

The oven drying method was used to measure the moisture content of the soil [9]. A composite soil sample weighing 10 g was obtained. The samples were dried in an oven for 24 hours at 105°C. The sample's dry weight was measured up until a consistent weight was apparent. The weight loss is correlated with the amount of water in the soil sample. The percentage of moisture content in each of the soil samples was determined using the formula below [10].

$$\text{Moisture content (MC)}(\%) = \frac{Loss\ in\ weight\ on\ drying\ (g)}{100 Initial\ sample\ weight} * 100$$

When calculating the amount of sample to be weighted in for analysis, the moisture correction factor (MCF) or multiplication factor is determined as follows:

$$\text{Moisture correction factor (MCF)} = \frac{100 + \%\ \text{moisture}}{100}$$

pH

According to the instructions in, the pH of the soil samples was assessed in water suspension (1:2.5) [9]. A 20 g portion of air dried soil was placed in a beaker, and 50 ml of water was then added. The liquid was swirled for 10 minutes with a glass rod, then let to stand for 30 minutes. Using a standard buffer solution with pH values of 4.0, 7.0, and 10.0, the pH meter (ELMETRON, CPI-501) was calibrated. The pH reading was then obtained by inserting the electrode of the pH meter into the supernatant solution.

Electrical Conductivity

The soil samples' electrical conductivity (EC) was measured in accordance with [9]. A 20 g portion of air dried soil was placed in a beaker, and 50 ml of water was then added. The liquid was swirled with a glass rod for 10 minutes before being left undisturbed for 30 minutes. After allowing the soil to settle, the electrical conductivity (EC) value was determined by inserting a SCHOTT handylab LF11 electrical conductivity meter into the supernatant solution.

Organic Carbon and Organic Matter

By using the [11] technique, the soil samples' organic carbon content was calculated. A 500 ml conical flask was filled with a 1 g of finely crushed soil sample that had been passed through a 0.5 mm screen without loss. A measuring cylinder was then used to add 10 ml of 1 N potassium dichromate and 20 ml of concentrated H_2SO_4. The mixture was mixed for a minute before being let to stand for 30 minutes. Next, 1 ml of diphenylamine indicator, 10 ml of ortho phosphoric acid, and 200 ml of distilled water were added. The solution was titrated with 0.5 N ferrous ammonium sulphate until a flash of blue-violet to green colour occurred. At first, there was no soil used in the blank titration. The following formulae were used to compute the findings:

$$\text{Organic carbon \%} = N \times (V1 - V2)\ S \times 0.39 \times mcf / S$$

Where: N = Ferrous Ammonium Sulfate Normality (FAS).
10 ml of 1 N $K_2Cr_2O_7$ need 10 ml of 0.5 N FAS to neutralize it, or a blank reading (ml).
V_2 is the amount of 0.5 N FAS that is required to titrate the soil sample (ml).
S = Sample weight when dry to the air (g).
0.39 = 0.003 x 100% x 1.31 (0.003 is the milliequivalent weight of carbon in g) (0.003 is the milliequivalent weight of carbon in g). Since only 77% of the organic stuff is thought to be oxidized, a proportion of 100/77 = 1.31 is used.
Organic matter (%) = Organic carbon (%) x 1.724.
1.724 = average content of carbon in soil organic matter is equal to 58%.

Cation Exchange Capacity

The technique was used to estimate Cation exchange capacity (CEC) [12]. We placed 1.3 g of dirt in the centrifuge tube. In the centrifuge tube, 11 ml of a 1 N sodium acetate solution were added. It was centrifuged and well shook. The liquid supernatant was decanted. Isopropyl alcohol in the amount of 11 ml was put into the centrifuge tube. The centrifuge tube was agitated vigorously before being spun up. The liquid supernatant was decanted. In the centrifuge tube, 11 ml of a 1 N ammonium acetate solution were added. The centrifuge tube was agitated vigorously before being spun up. The 100 ml flask was filled with the supernatant liquid. The solution was diluted to fill the 100 ml standard measuring flask. In order to calibrate the flame photometer, standard sodium solution was used. The

instrument was filled with the prepared solution, and a reading was obtained [12]. The formula was then used to determine CEC value [13].

$$\text{CEC, cmol}(+)\ \text{kg} - 1\ \text{soil} = \frac{10 * \text{Na concentration in meq L} - 1}{\text{Mass of sample (g)}}$$

Determination of Metal Concentrations

The air-dried, ground, and sieved soil samples totaled 0.5 g each, which was precisely weighed into a digestive tube. The digestive tube was filled with 6 ml aqua regia and 1.5 ml H_2O_2, which were added as directed and gently swirled to combine the sample substance. After that, the digestion tubes were put on a digestive furnace (Model: KDN-20C) and cooked for three hours at 180°C. All the digests were chilled and put into a 50 ml volumetric flask after being filtered with Whatman No. 42 filter paper. The filtrate was mixed with lanthanum chloride solution (1%), and the filtrate's container flask was filled to the proper level with double-distilled water. Five replicas of each sample were digested before being transferred to an acid-washed glass container with a stopper, labelled, and maintained for metal analysis. Utilizing a flame atomic absorption spectrophotometer (Model: AA-320N) to measure the concentrations of Ca and Mg in the filtrate and a flame photometer to measure the concentrations of Na and K (ELICO, CL-378, India). The element's final concentration in soil samples was determined to be:

$$\text{Concentration of the element in soil (mg/kg)} = \text{Conc .(mg /L)x V(ml)/ W(g)}$$

Where Conc. is the element's acquired concentration in milligrammes per litre, V is the digested solution's final volume (50 ml), and W is the soil sample's weight (0.5 g).

Method Validation and Quality Control for Metal Analysis

The following method validation parameters, including analysis and determination of continuous calibration standard, limit of detection, limit of quantification, precision and accuracy studies through the analysis of method blank, laboratory control sample, matrix spike and matrix spike duplicate analyses, were carried out in order to validate the analytical method.

Continuing Calibration Standards

Every analytical run was followed by a calibration accuracy check using continuing calibration standards (CCS). The first calibration standard's midway, which is 4 mg/L for Na and K, 0.5 mg/L for Mg, and 8 mg/L for Ca, was used to produce the CCS. For each analyte CCS was checked every 10 readings.

Limit of Detection

The smallest concentration of analyte that can be detected but not always measured with a reasonable degree of error is known as the limit of detection (LOD) [14]. Seven duplicates of technique blanks that were digested using the same digestion process as the real samples were analyzed to determine the LOD for each metal. LOD was determined to be three times the blank's standard deviation.

Limit of Quantification

The lowest concentration of an analyte that can be measured with a reasonable amount of uncertainty is known as the limit of quantification (LOQ) [14]. Seven technique blanks that were digested using the same manner as the real samples were analysed in triplicate to determine the LOQ. The LOQ was estimated as 10 times the blank's standard deviation.

Precision and Accuracy

Repeatability and recovery tests of matrix spike (MS), matrix spike duplicate (MSD), and laboratory control samples were used to evaluate the analytical method's precision and accuracy (LCS). Five replicate soil samples were spiked with a known concentration of metal standard solution to conduct a recovery investigation (mid-range calibration concentration). The identical digestion process used for the original sample was then applied to the spiked samples. The five duplicate findings' relative standard deviations (RSD) were used to express precision.

RSD = (standard deviation/mean value) x 100

Was used to calculate the sample's relative standard deviations. The following equation was used to determine the percent recovery outcomes and represent accuracy as matrix spike recovery [15].

$$\%\text{Recovery} = \text{conc .in spiked sample} - \text{conc .in un spiked sample / actual spike conc .} * 100$$

Analysis of Matrix Spike and Matrix Spike Duplicate

Two aliquots of the same environmental sample are used for matrix spike (MS) and matrix spike duplicate (MSD) samples, to which known amounts of the method analytes are added in the lab [14]. Both MS and MSD were created by adding 2 cc of a combination of spiking standards to 0.5 g of soil samples to create spike levels of 4 mg/L of Na, K, and each of those elements, as well as 2 mg/L of Ca and Mg. All of them underwent the same digestion and analytical procedures as the unspiked sample. The following equation was used to compute the relative percent differences (RPD) between the MS and MSD findings [14] are applied to samples of soil [15].

Laboratory Control Samples (LCS)

For the soil sample, five replicates of 0.5 g lithium carbonate (method blank) were prepared and digested similarly to the sample, including exposure to all glassware, digestion media, apparatus, solvents, and reagents that were less affected by matrix specific variability, and the data generated was in the acceptable quality range. The spike level for the soil sample was 4 mg/L of each Na and K; 2 mg/L of Ca and Mg. These outcomes show how accurate the suggested strategy was.

Statistical Analysis

The significant variations in the mean values of physicochemical characteristics among groups of soils were assessed using one-way analysis of variance (ANOVA). Additionally, Pearson's correlation analysis was used to examine the relationship between the physicochemical characteristics of soil samples. P 0.05 was used as the cutoff point for statistical significance. The Windows version of SPSS version 16.0 was used to conduct all statistical analyses. Five duplicate trials' data were reported as mean standard deviation (SD).

Results and Discussion

Detection Limit, Precision and Accuracy

Results of the metals' analysis's limits of detection (LOD), limits of quantitation (LOQ), recovery, and RSD are shown in Table 1. The table shows that for the metals under consideration, the LOD is 0.510 and the LOQ is 1.698. These demonstrate that the LOD and LOQ were both low enough to detect the target metal concentrations. The tested metals' percentage recoveries ranged between 93 and 97%, which was within the allowed range of 80 to 120% for metal analysis [16]. The RSD values fell within the allowed range (10%), ranging from 3.09 to 8.96%. The approach demonstrates that it has the necessary accuracy and precision of the analytical method through both recovery and RSD.

Table 1: For the determination of metals: Limit of detection (LOD), limit of quantification (LOQ), accuracy (%R) and precision (%RSD) of soil matrix spike sample

Metal	LOD (µg/g)	LOQ (µg/g)	Recovery (%)	RSD (%)
Na	0.405	1.349	97 ± 6.48	6.68
K	0.510	1.698	94 ± 8.43	8.96
Ca	0.283	0.942	95 ± 5.30	5.58
Mg	0.109	0.363	93 ± 2.87	3.09

Matrix Spike and Matrix Spike Duplicate Results

To gauge the accuracy, the matrix spike and matrix spike duplicate results were converted into relative percent difference (RPD) values. Table 2 shows that the relative percent difference between the matrix spike and the duplicate matrix spike varied from 0.82 to 5.04, which was within the permitted limits of 10%. This demonstrated that matrix-specific variability had a less impact on the entire analytical process and that the data provided was of acceptable quality. These outcomes show how accurate the suggested strategy was.

Table 2: Relative percent difference (RPD) results of Matrix spike and matrix spike duplicate analysis

Element	Na	K	Ca	Mg
RPD	0.82	1.13	5.04	4.00

Contamination Control

Method blanks were used to find and fix systematic mistakes brought on by contamination of the glassware, instruments, and reagents. The results of the research showed that there were no values over the metals' technique detection limits. Therefore, it may be said that there was no general laboratory contamination of the analytical procedure.

Calibration Control/Continuing Calibration Standard

As can be observed from Table 2, the relative percent difference between the matrix spike and the duplicate spike ranged from 0.82 to 5.04, which was within 10% of the permissible range. This proved that the entire analytical procedure was successful. To ascertain the background signal and set the baseline of an instrument, a calibration blank (2% HNO_3) was created. The same digestion process utilized for the soil samples' materials was employed to create 0.5 g of Li_2CO_3 as a matrix for the technique blank, but no additional sample was added.

Laboratory Control Samples Results

For each analyte, LCS recoveries and RSD were computed. Table 3 provides an overview of the associated outcomes. The RSD values varied from 2.95 to 7.14%, whereas the percent recovery values of the LCS findings ranged from 91.22% to 94%. All of the readings were determined to be within the 80–120% LCS recovery and 10% RSD suggested control ranges [16]. These findings demonstrated that the analytical technique had the necessary precision and accuracy.

Table 3: Recovery and precision test results for the laboratory control samples.

Element	Amount Added (µg/g)	Conc. in Spiked Sample[a] (µg/g)	Recovery[a] (%)	RSD (%)
Na	400	370.64±0.92	92.56±3.81	4.12
K	400	365.16±0.74	91.22±6.51	7.14
Ca	200	186.45±0.28	93.07±2.75	2.95
Mg	200	188.00±1.13	94.00±5.14	5.47

[a]Mean ± SD, n = 5

Each analyte deviates by 10% from the predicted value, according to an analysis of the metal standard solution of the mid-point calibration curves after every 10 samples and at the conclusion of the sample run. The sample analysis is within the control limits, according to this indication.

Physicochemical Characteristics of the Soils

Table 4 and Figure 1 display the findings of the determination of a few chosen physicochemical soil properties.

Moisture Content

The moisture content (MC), which directly relates to the soil's ability to retain water, ranged from 7.35 to 11.01%. (Table 4). Comparatively more moisture is present in the soil from the Bhorasla site than at the other research locations. The soil samples collected from the four regions had significantly different moisture content levels, according to a statistical test of significance using an ANOVA (p 0.05).

pH

The hydrogen ion activity in the soil solution is gauged by soil pH. It is a key element in plant development and expresses the soil's acidity and alkalinity. It is a highly significant soil characteristic since it affects the soil's physical state, microbial activity, and availability of nutrients. The four locations' soil pH ranges from 6.53 to 7.64% (Table 4). The soil sample from Bijalpur had a lower pH than that of Machal, which had a higher pH. All of the farming soils investigated were neutral, with the exception of the Machal soil, which has a mild alkaline pH. The pH values in the soil samples collected from the four sites showed statistically significant variations (p 0.05) when tested using an ANOVA. Studies by [17] have demonstrated that adding bio solids like compost and animal dung to acidic soils significantly raises the pH of the soil.

Electrical Conductivity

A good understanding of the soluble salts present in the soil may be obtained through electrical conductivity (EC), which represents the ion concentrations in solution and determines the current carrying capacity. The range of electrical

conductivity values is 0.09 to 0.34 mS/cm (Table 4). In comparison to other locations, the soil in Bijalpur has a higher electrical conductivity, which may be caused by the overuse of fertilizers like P and K. Electrical conductivity, a typical indicator of salinity, is used to calculate the quantities of soluble salts in soil. When the soil's EC is below 0.4 mS/cm, it is referred to as moderately or non-salty, and when it is beyond 0.8 mS/cm, it is referred to as highly saline [18]. The research revealed that the soils weren't salty. The values of EC in the soil samples taken from the four sites showed significant differences (P 0.05) when subjected to a statistical test of significance using an ANOVA. The variations in the soluble salt content of the soils may be the cause of the variations in the electrical conductivity values.

Organic Carbon and Organic Matter

Organic matter is crucial for giving plants adequate physical conditions as well as nutrients and water. Table 4 shows that the organic matter (OM) ranges from 2.16 to 5.93% while the organic carbon (OC) ranges from 1.25 to 3.44%. The soil samples taken from the Bijalpur and Machal regions did not show any statistically significant changes ($p > 0.05$) in the levels of OC and OM. According to [16], soil OM concentration ranges from 2.0% as low, 2.1–3.0% as medium, and > 3.1% as high. According to this categorization, the agricultural soil examined showed high OM in the Bijalpur and Machal soils and medium OM in the Rangwasa and Bhorasla soils. The application of animal dung may be the cause of the elevated levels of OM found.

Cation Exchange Capacity

The amount of readily exchangeable cations in the soil that can neutralize negative charge is measured by something called the cation exchange capacity, or CEC. An important indicator of the soil's capability to store and provide nutrients is its cation exchange capacity. The tested soils' cation exchange values varied from 30.75 to 41.83 cmol/kg. Rangwasa soil has the lower CEC, whereas Machal soil has the greater CEC (Table 4). There were no statistically significant variations between the CEC values in the soil samples taken from the Rangwasa and Bijalpur locations, according to an ANOVA statistical test of significance ($P>0.05$).

Sodium (Na)

The findings showed that the soil analysed had a total sodium concentration of 1014 mg/kg in Machal dirt, 868 mg/kg in Rangwasa soil, 855 mg/kg in Bhorasla soil, and 845 mg/kg in Bijalpur soil (Table 4). For irrigation, the quality of the water's sodium level is crucial since salts eventually have an impact on the health of the soil and plant development [19].

Potassium (K)

At the study locations of Rangwasa, Bijalpur, Bhorasla, and Machal, the concentrations of potassium in the chosen soil samples were 1980, 5060, 3540, and 6065 mg/kg, respectively (Table 4). The vast majority of physiological processes, including protein synthesis and the maintenance of the plant-water balance, depend on potassium for plant development. Although potassium is a fairly soluble cation in solution, soil does not move potassium very quickly. As the K ions are taken up by the colloids, other ions like Ca, Mg, or Na are displaced. The capacity of soils to absorb and retain potassium is crucial because it reduces leaching and increases the amount of continuously accessible potassium [19].

Calcium (Ca)

When soil passes over deposits of lime stones, gypsum, etc., calcium is produced. It has a significant impact on how cell walls and protoplasm are made. It has been linked to several organic acids and carbohydrates [18]. vTable 4 shows that Bhorasla soil has the greatest calcium content (2118 mg/kg), followed by Machal dirt (1793 mg/kg), Rangwasa soil (1670 mg/kg), and Bijalpur soil (952 mg/kg). Magnesium (Mg) (Mg) Magnesium is a cation that is water soluble and is required for the green plants' chlorophyll pigment [21]. Magnesium concentrations ranged from 1751 to 4288 mg/kg in all of the samples, with the sample sites of Bijalpur and Bhorasla having the lowest and highest values, respectively. Rangwasa and Machal soil have Mg concentrations of 3293 and 3917 mg/kg, respectively (Table 4).

Correlation Analysis

The findings of using Pearson's correlation coefficient to examine the connections between the concentrations of various physicochemical characteristics are displayed in Table 5. A high correlation coefficient indicates a strong relationship between two variables (around +1 or -1) and it Concentration around zero indicates there is no association between them; if r>0.7, there may be a high correlation; r values between 0.5 and 0.7, however, indicate a moderate correlation between the two parameters [22]. We can see from Table 5 that there is a significant positive association between the parameters of OC and (OM and K), OM and K, pH and (Ca and Mg), and Ca and Mg.

Table 4: Results of physicochemical parameters of the soils (mean ± SD, n = 5)

Parameters	Sites			
	Rangwasa	Bijalpur	Bhorasla	Machal
MC (%)	7.35 ± 0.18^a	9.22 ± 0.13^b	11.01 ± 0.29^c	7.95 ± 0.20^d
pH (H2O)	7.13 ± 0.04^a	6.53 ± 0.08^b	7.41 ± 0.06^c	7.64 ± 0.04^d
EC (mS/cm)	0.09 ± 0.01^a	0.34 ± 0.06^b	0.11 ± 0.01^c	0.14 ± 0.01^d
OC (%)	1.25 ± 0.11^a	3.42 ± 0.14^b	1.71 ± 0.05^c	3.44 ± 0.12^b
OM (%)	2.16 ± 0.18^a	5.89 ± 0.24^b	2.95 ± 0.08^c	5.93 ± 0.21^b
CEC (cmol/kg)	30.75 ± 0.06^a	31.14 ± 0.09^a	37.49 ± 0.09^b	41.83 ± 0.07^c
Na (mg/kg)	868 ± 45.49	845 ± 11.18	855 ± 50.25	1014 ± 18.16
K (mg/kg)	1980 ± 50.99	5060 ± 15.81	3540 ± 51.48	6065 ± 37.42
Ca (mg/kg)	1670 ± 43.15	952 ± 30.09	2118 ± 34.65	1793 ± 41.78
Mg (mg/kg)	3293 ± 74.02	1751 ± 35.42	4288 ± 38.98	3917 ± 90.23

Mean values in the same column with different alphabets are significantly different ($P<0.05$).

MC=Moisture content; EC=Electrical Conductivity; OC= Organic Carbon; OM= organic carbon; CEC=Cation Exchange Capacity.

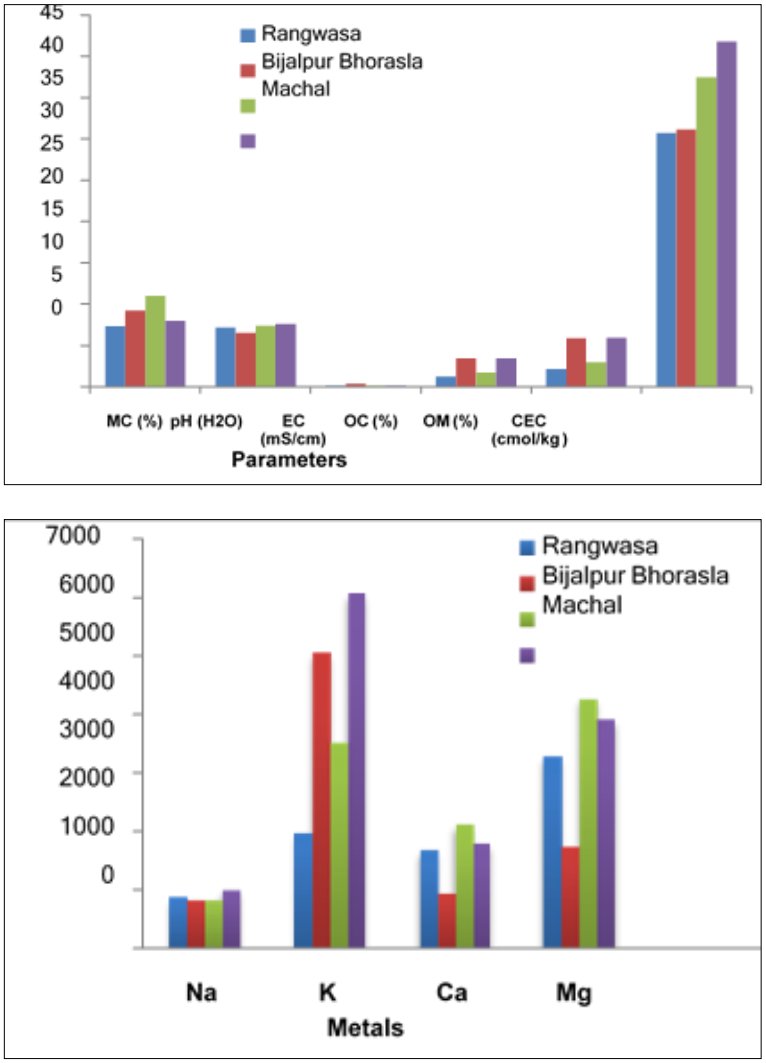

Fig 1: Relative study of mean concentrations of physicochemical parameters (n = 5)

Table 5: Pearson's correlation coefficients between soil physicochemical factors

	MC	pH	EC	OC	OM	CEC	Na	K	Ca	Mg
MC	1									
pH	-0.042	1								
EC	0.088	-0.807**	1							
OC	-0.036	-0.160	0.683*	1						
OM	-0.036	-0.161	0.683*	1.000**	1					
CEC	0.333	0.330	-0.147	0.104	0.103	1				
Na	-0.092	0.684*	-0.278	0.479	0.478	0.294	1			
K	0.033	0.102	0.486	0.950**	0.950**	0.236	0.605*	1		
Ca	0.147	0.852**	-0.896**	-0.561	-0.561	0.230	0.237	-0.288	1	
Mg	0.105	0.933**	-0.883**	-0.417	-0.418	0.287	0.409	-0.136	0.979**	1

*Correlation is significant at the 0.05 level (2-tailed) **Correlation is significant at the 0.01 level (2-tailed)

Since the parameters are strongly positively correlated, it is possible that they have a same origin. There were somewhat favourable relationships between EC and (OC and OM), pH and Na, and Na and K. There was a significant inverse relationship between EC and (pH, Mg and Ca). Ca and have a somewhat negative association with each other (OC and OM). Other connections are with the week.

Conclusions

The physicochemical properties of the soil utilized for growing *Catharanthus roseus* in India's East Zone Indore were examined. The findings show that the soil pH ranges from neutral to slightly alkaline, and that it is one of the key elements influencing the mobility and solubility of metals in the soil environment. The soils' electrical conductivity measurements were non-saline, despite the fact that they had a significant quantity of organic matter and Cation exchange capacity. For the growth of plants and soil management, agricultural chemists value the physicochemical analysis of factors. These investigations provide information on the kind of soil and its nutrient content. Farmers may use this information to determine the quantity of fertilizers and nutrients that the soil needs to raise the percentage yield of crops. The physicochemical examination of the soil samples under investigation reveals that different locations have varied concentrations of various factors. Analysis of

variance (ANOVA) findings revealed that there was statistically significant (p 0.05) variation between physicochemical parameters. Future research should be conducted to examine the concentrations of heavy metals and other physicochemical characteristics of the soils in the study region.

References

1. Manimegalai K, Sukanya S. Assessment of physicochemical parameters of soil of Muthannan Kulam wetland, Coimbatore, Tamilnadu, India. International Journal of Applied Sciences & Biotechnology,2014:2(3):302-04.
2. Sumithra S, Ankalaiah C, Janardhana RD, Yamuna RT. A case study on physicochemical characteristics of soil around industrial and agricultural area of Yerraguntla, Kadapa district, A.P, India. International Journal of Geology, Earth and Environmental Sciences,2013:3(2): 28–34.
3. USEPA. National functional guidelines for inorganic superfund: Data Review. USEPA-540-R10-011, Washington, DC, 2010.
4. Chaudhari KG. Studies of the physicochemical parameters of soil samples. Advances in Applied Science Research,2013:4(6):246-248.
5. Shaikh PR, Bhosle B. Heavy metal contamination in soils near Siddheshwar Dam Maharashtra, India. Research Journal of Chemical Sciences,2013:3(1):6–9.
6. Ganorkar RP, Chinchmalatpure PG. Physicochemical assessment of soil in Rajura Bazar in Amravati district of Maharastra (India). International Journal of Chemical, Environmental and Pharmaceutical Research,2013:4(2&3):46-49.
7. Singh RP, Mishra SK. Available macronutrients (N, P, K and S) in the soils of Chiraigaon block of district Varanasi in relation to soil characteristics. Indian Journal of Scientific Research,2012:3(1):97-100.
8. Diriba SG, Kebede W, Nigussie DR, Getachew T, Sharma JJ. Postharvest quality and shelf life of garlic bulb as influenced by storage season, soil type and different compound fertilizers. Journal of Postharvest Technology,2013:1(1):69-83.
9. Jackson ML. Soil chemical analysis. New Delhi: Prentice Hall of India, Pvt. Ltd, 1967, 205–498.
10. Joel OF, Amajuoyi CA. Determination of selected physicochemical parameters and heavy metals in a drillin cutting dump site at Ezeogwu-Owaza, Nigeria. Journal of Applied Sciences and Environmental Management,2009:13(2):27-31.
11. Walkey A, Black IA. An examination of Degtjareff method for determining soil organic matter and a proposed modification of the chromic acid titration method. Soil Science,1934:37:29-38.
12. Raman N, Sathiyanarayanan D. Physicochemical characteristics of soil and influence of cation exchange capacity of soil in and around Chennai. Rasayan Journal of Chemistry,2009:2(4):875-885.
13. Herk AV. Physicochemical parameters in soil and vegetable samples from Gongulon agricultural site, Maiduguri, Borno State, Nigeria. International Journal of Chemistry,2012:1(1):21–36.
14. Prichard E, Barwick V. Quality assurance in analytical chemistry. New York: John Wiley and Sons, 2007.
15. Javed I, William AC, Shelly LC, Chandra ST. Metals determination in biodiesel (B100) by ICPOES with microwave assisted acid digestion. The Open Analytical Chemistry Journal,2010:4:18-26.
16. USEPA, Method 200.9, Trace elements in water, solids, and biosolids by stabilized temperature graphite furnace atomic absorption Spectrometry, 2001. revision 3.0, EPA-821-R-01-011. Washington, DC.
17. Harvey D. Modern analytical chemistry. Depauw University, United States of America: McGraw-Hill, 2000.
18. Odoemelam SA, Ajunwa O. Heavy metal status and physicochemical properties of agricultural soil amended by short term application of animal manure. Current World Environment,2008:3(1):21-26.
19. Wagh GS, Chavhan DM, Sayyed MG. Physicochemical analysis of soils from Eastern Part of Pune city. Universal Journal of Environmental Research and Technology,2013:3(1):93-99.
20. Mahajan S, Billore D. Assessment of physicochemical characteristics of the soil of Nagchoon pond Khandwa, MP, India. Research Journal of Chemical Sciences,2014:4(1):26-30.
21. Sumithra S, Ankalaiah C, Janardhana RD, Yamuna RT. A case study on physicochemical characteristics of soil around industrial and agricultural area of Yerraguntla, Kadapa district, A.P, India. International Journal of Geology, Earth and Environmental Sciences,2013:3(2):28–34.
22. Rakesh SM, Raju NS. Correlation of heavy metal contamination with Soil properties of industrial areas of Mysore, Karnataka, India by cluster analysis. International Research Journal of Environment Sciences,2013:2(10):22–27.