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# PERFORMANCE OF *CATHARANTHUS ROSEUS* L. IN DIFFERENT LOCATIONS OF JAIPUR CITY, RAJASTHAN TO FIND THE SUITABILITY OF SOILS FOR CULTIVATION

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**ABSTRACT**

Several elements take part in the growth and development of plants and those absorbed from the soil or water by roots are broadly speaking, plant nutrients. The plant takes up macronutrients like carbon (C), oxygen (O), hydrogen (H), nitrogen (N), phosphorus (P), potassium (K), and iron (Fe) as well micronutrients like, sulphur (S), zinc (Zn), manganese (Mn), copper (Cu), boron (B), molybdenum (Mo), and chlorine (Cl). Soil moisture, pH, and EC values are the physical properties of the soil, and organic carbon, phosphorus, and potassium values are some of the chemical characteristics of soil. Samples taken from three different geographical areas of Jaipur (Rajasthan) have been tested for physical and chemical characteristics with the objective to correlate performance in terms of production of primary metabolites (protein) and secondary metabolites (trigonelline alkaloid) of *Catharanthus roseus* L. Soil testing results showed % soil moisture of all three sites are 2.35, 2.67, and 2.15; pH of soil samples in all the three sites were slightly alkaline and values were 8.4, 7.84, and 7.8, respectively. Electrical conductivity of the three sites were 0.27, 0.37 and 0.28 mmhos $cm^{-1}$ and organic carbon values were 0.16%, 0.24%, and 0.19%, apiece for order of samples. Values of the phosphorus, and potassium were 28, 25, and 22 kg $ha^{-1}$ and 331.5, 280, and 250.9 kg $ha^{-1}$, for respective sample. The physicochemical properties such as soil moisture, pH, EC, organic carbon, phosphorus and potassium in requisite amount is necessary for the growth of the plant. *Catharanthus roseus* L. easily grows up in slightly alkaline soil with electrical conductivity < 1, water deficient area, loamy sand, low organic carbon and medium amount of phosphorous and potassium. Jaipur soils physical and chemical characteristics investigated in present work are found suitable for *Catharanthus roseus* L. Proteins and trigonelline were found higher in plant growing in soils of University of Rajasthan than other two localities.
***Keywords*****:** pH, Electrical Conductivity, Organic carbon, Phosphorus, Potassium, *Catharanthus roseus* L. Trigonelline.

## Introduction

The Latin word "Solum" refers to the earthly substance that plants grow in. Paedology is the study of soil and solum (Wagh *et al*., 2021), Both plants and animals use the soil as a habitat. Soil health refers to the capacity of soil to function as a living ecosystem that sustains plants, animals, and humans and support ecosystem services and agricultural production (Karlen *et al*., 2019, Kibblewhite *et al*., 2008, Lal *et al*., 2021). Water and other nutrients are stored in the soil (Shirsath, 2021) and soil sampling techniques evaluate the nutrients status of soil (Jatti, 2023). Intensive fertilisation, tillage led to negative impacts on soil biodiversity, soil acidity, soil structure and nutrient supply (Young *et al*., 2021). Plants need a variety of components for growth and development, and those that are taken up from the soil are generally referred to as plant nutrients. Air and water that the roots absorb provide the plant with its sources of carbon, oxygen, and hydrogen. Key soil properties include clay content, pH, soil organic carbon and soil nutrients like nitrogen, phosphorus and potassium (Bunemann *et al*., 2018) given their impact on biological, chemical and physical soil processes controlling soil health (Ros, 2012; Lal, 2013; Schlatter *et al*., 2017; Van Doorn *et al*., 2023). According to (Arnon and Stout, 1939), a total of sixteen components have been found and proven to be necessary for plant growth. These are iron (Fe), sulphur (S), zinc (Zn), manganese (Mn), copper (Cu), boron, calcium (Ca), magnesium (Mg), hydrogen (H), oxygen (O), nitrogen (N), phosphorus (P), and potassium (K). These elements serve as raw materials for growth and development of plants and formation of fruits and seeds. Plants absorb a large number of elements, all of them are not essential for the growth of crops. The elements which take active part in the growth and developmental processes of plants are called the essential elements. Some of these are required in large amounts and some in traces. Analysis of soil is carried out for the studies of various parameters like total organic carbon, nitrogen (N), phosphorus ($P_2O_5$) and potassium ($K_2O$), pH, and EC. The fertility of the soil depends on the concentration of N, P, K, organic as well as inorganic nutrients and water conductivity. The physicochemical properties such as moisture content, specific gravity, and essential nutrients are required for the growth of plant (Chaudhari, 2013). Potassium is used for flowering purpose and phosphate is used for growth of roots in plants (Kanimozhi *et al*., 2011; Kordlaghari, 2013; Garba *et al.,* 2013; Sonawane *et al*., 2013; Ali *et al*., 2014). Nitrogen is required by all parts of a plant mainly meristematic tissues and the metabolically active cells. Nitrogen is the major constituent of proteins, nucleic acids, vitamins and hormone, is absorbed as nitrate ion form (Rajasekar, 2017). Phosphorus is absorbed by the plants in the form of phosphate ions is constituent of cell membrane. Certain proteins, and nucleotides are required for all the phosphorylation reactions. Potassium is absorbed as potassium ions. It is required in abundant quantities in the meristematic tissues, buds, leaves, and root tips. Potassium helps to maintain an anion-cation balance in cells and is involved in protein synthesis, opening and closing of stomata, activation of enzymes and maintenance of the turgidity of cells under adverse condition (Jiang *et al*., 2018; Zewdie *et al*., 2021). Deficiency of nitrogen and potassium cause inhibition of cell division and delay in flowering (Malhotra *et al*., 2018). Macronutrients are categorized as Group I (carbon, hydrogen and oxygen; Group II (nitrogen, phosphorus, potassium) and secondary nutrients (calcium, magnesium, sulphur) whereas micronutrients are iron, manganese, boron, zinc, copper, molybdenum and chlorine. Soil testing refers to the chemical, physical, physicochemical analysis of soils and is well recognized as a scientific means for quick characterization of the fertility status of soils and predicting the nutrient requirement of crops. It includes testing of soils for properties like texture, moisture, pH, electrical conductivity and nitrogen, Phosphorus, organic carbon, potassium. One of the objectives of soil testing is to sort out the nutrient deficient areas from non-deficient ones. This information is important for determining whether the soils could supply adequate nutrients for optimum crop production or not, this impacts the development of plant (Pujar *et al*., 2012; Tolambiya and Mathur, 2016A; 2016B; 2017; Tolambiya *et al*., 2023A; B). Soil analysis can improve the crop fertility, productivity and wastage of fertilizers (Sucheta *et al*., 2020). *C. roseus* plant grows in partly shade or partly sunny, soil type clay, loamy, sand, acidic, slightly alkaline and its drought tolerance is high (Gilman *et al*., 2023). The objective of this investigation was to analyse the soil for physical and chemical properties to know its suitability for *C. roseus* for production of primary and secondary metabolites.

## Materials and Methods

### Field Survey

It was done in various region of Jaipur, Rajasthan. Soil samples and plant samples have been collected from the following areas during field survey-

1. University of Rajasthan (UoR), Jaipur
2. Durgapura, Jaipur
3. Sodala, Jaipur

### Sample Processing

Soil samples were collected in thick gauge polythene bags in winter season with location labelling. The use of metal staples, particularly cu-plated staples to close the bags was avoided because metal staples or cu-plated staples can be changed the actual physicochemical properties of soil samples. Paper bags were also avoided in use because it can contain substantial amount of B and Zn which may change the elemental concentration of the soil. Cloth bags were also unsatisfactory in use because they are neither water proof nor dust proof. In Laboratory these samples were analysed to measure various chemical parameters by standard methods (Gupta, 1994). Plant samples have been collected in polythene bags and bring to laboratory and processed further for analysis of proteins and trigonelline.

## Physical parameters

### Soil moisture

Gravimetric method of moisture estimation is mosly used where the soil sample is placed in an oven at 105 °C and dried to a constant weight. Difference in weight is considered to be water present in the soil sample. 10 g of soil samples from each location were collected in aluminium moisture box and kept in the oven at 105 °C for a period of 36 hours. Cooled samples then kept in desiccators. Weight of the cooled moisture samples were taken and moisture content in percent value have been calculated.

### Soil pH

Soil pH is the measure of negative logarithm of the active hydrogen ion ($H^+$) concentration in the soil solution. It is the indicator of soil alkalinity, acidity or neutrality. It is a simple but very authoritative estimation for soils, since soil pH influences to a great extent the availability of nutrients to crops (Bhat, 2011). It also affects microbial population in soils. Most nutrient elements are available to plants in the pH range of 5.5 to 6.5. pH meter was calibrated using buffer solutions with neutral pH (7.0), and acidic as well as alkaline buffers. pH of soil samples was determined using Systronics pH meter as described by (Jackson, 1967).10 g soils from each of the sample was mixed with 20 ml of distilled water in ratio of 1: 2. Suspension were stirred intermittently with glass rod for 30 minutes and kept for the duration of one hour. Electrodes were dipped into the supernatants and pH have been recorded. The electrodes were washed with double distilled water every time to record the pH of new soil sample.

### Electrical Conductivity

Electrical conductivity (EC) is a measure of the ionic transport in a solution between the anode and cathode. This means, the EC is normally considered to be a measurement of the dissolved salts in a solution like a metallic conductor, they obey Ohm’s law. The 0.01M Potassium chloride solution was prepared using 0.7456 g of AR grade potassium chloride kept it at 60 $^0$C for two hours and dissolved in freshly prepared glass distilled water and make volume to one litre. This solution gives has an electrical conductivity of $1411.8 \times 10^{-3}$ i.e. 1.412 mS $cm^{-1}$ at 25 $^0$C. Adding 20 ml of distilled water and 10 g of soil to a 250 ml Erlenmeyer flask, that was sealed and stirred that for an hour using a reciprocating shaker. Use Whatman No. 1 filter papers have been used to filter the aliquots. Conductivity meter electrode was rinsed with a normal KCl solution after washing it with distilled water. After adding KCl solution to a 25 ml beaker and dipping the electrode in it, the conductivity meter's reading was corrected to 25 °C and adjusted to 1.412 mS $cm^{-1}$. After cleaning the electrode with double distilled water, conductivity of soil extracts has been recorded at 25 °C. Electrical conductivity expressed in mS $cm^{-1}$, indicates the salinity condition of this soil and the amount of soluble salt present in the extract. The conductivity can also be expressed as mmhos $cm^{-1}$.

## Chemical parameters

### Organic carbon (C)

Organic matter plays an important role in supplying nutrients and water with good physical conditions to the plants. Quantity of organic carbon of the soil was estimated by the volumetric method (Walkley and Black, 1934) as described by Jackson (1967).1g finely grounded soil sample was passed through 0.5 mm sieve and taken into 500 ml conical flask, to which 5ml of 1 N potassium dichromate and 10 ml concentrated $H_2SO_4$ were added. The content was shaken for a minute and allowed to set aside for exactly half an hour. Then 100 ml distilled water, 5 ml orthophosphoric acid and 1 ml diphenylamine indicator were added. The solution was titrated against standard ferrous ammonium sulphate or ferrous sulphate, till colour flashes from blue violet to brilliant green. Blank titration has also been done. Further calculations were done to estimate the organic carbon of soils.

Spectrophotometer reading = X × 0.0042

$$\%\ \text{Organic carbon (X)} = \frac{10\,(S - T)}{S} \times \frac{0.003 \times 100}{\text{Weight of soil}}$$

Since one gram of soil is used, this equation simplifies to $\frac{3(S-T)}{S}$

Where,

S = ml $FeSO_4$ solution required for blank

T = ml $FeSO_4$ solution required for soil sample

3 = Eq W of C (weight of C is 12, valency is 4, hence Eq W is 12÷4= 3.0)

Here, organic carbon can be categorized in 3 standards as analytical classifications, which are as below-

1. Low - 0 - 0.5
2. Medium - 0.5 - 0.75
3. High > 0.75

### Available phosphorus (P)

Soil available phosphorus found as orthophosphate in several forms and combinations, but only a small fraction of it may be available to plants. Available phosphorus was estimated by Olsen's method (Olsen *et al.,* 1954). The reagent for Olsen's P (0.5 N $NaHCO_3$; pH 8.5) was prepared by dissolving by 1 gm soil and 20 ml $NaHCO_3$ in double distilled water. The flasks were shaken for 30 minutes on the electrical shaker and filtered immediately through Whatman No. 1 filter paper. 5 ml of the filtrate was pipette out into 25 ml of volumetric flask and was neutralized with 5 ml ammonium molybdenite. The volume was made up by adding distilled water. 1 ml of stannous chloride was added to develop colour. The solution was shaken well and optical density of blue colour was recorded using spectrophotometer within 10 minutes.

Spectrophotometer reading = X × 2.29

Where X is reading in apparatus

Phosphorus can be categorized in 3 standards as analytical classifications, which are as below in kg $ha^{-1}$.

| | | | |
|---|---|---|---|
| 1. | Low | - | 0 - 23 |
| 2. | Medium | - | 23 - 56 |
| 3. | High | > | 56 |

### Available potassium (K)

Potassium present in the soil is extracted with neutral ammonium acetate of 1 morality. This is considered as plant available K ($K_2O$) in the soils. It is estimated with the help of flame photometer. This is a well-accepted method (Toth and Prince, 1949). For making molar neutral ammonium acetate solution, 77 g of ammonium acetate ($NH_4C_2H_3O_2$) was dissolved in 1 litre of water. Either ammonium hydroxide or acetic acid have been added to adjust the to the pH 7.0. Five g of each of the soil sample was taken in 100 ml conical flask and 25 ml of the ammonium acetate was added to each of the flask. After a duration of 5 minutes stirring Whatman No.1 filter papers were used to collect the supernatant. Potassium in the filtrate was estimated with the flame photometer.

$$\text{Available K (kg ha}^{-1}) = \frac{C \times A \times 10^6 \times 2.24}{S \times 10^6}$$

Where

C = Flame photometer reading

A = Extraction in g

S = Soil sample in g

OR

$$\text{Available K (kg ha}^{-1}) = \frac{C \times 25 \times 10^6 \times 2.24}{5 \times 10^6}$$

$$= C \times 11.20$$

Potassium can be categorized in 3 standards as analytical classifications, which are as below in Kg/ha.

| | | | |
|---|---|---|---|
| 1. | Low | - | 0 - 142 |
| 2. | Medium | - | 142 -337 |
| 3. | High | > | 337 |

### Quantification of Proteins

After being individually homogenized for 30 minutes in 10 ml of cold 10% trichloroacetic acid (TCA), the test samples leaf, stem ,root and flower (50 mg each) were stored at 4 $^0$C for a full day. The supernatants from the individual centrifugations of these mixes were discarded. 10 ml of 5% TCA was added to each residue and kept for 30 minutes at 80 $^0$C in a water bath. After cooling and centrifuging the samples supernatants from each were discarded followed by addition of 10 ml of 1N NaOH and kept it overnight at room temperature for (Osborne, 1962). Spectrophotometer was used to measure the total protein concentration using the Lowry *et al.* (1951) method. Each of the aforementioned samples (1 ml) was taken and a standard regression curve was prepared. In 1N NaOH (1 mg l-1), a stock solution of BSA (Sigma Chemical Co., St. Louis, USA) was made. Eight concentrations (0.1 to 0.8 mg $l^{-1}$) were set in separate test tubes, and distilled water was added to bring each sample's volume to one ml. Five ml of freshly made alkaline solution (made by combining one ml of 0.5% $CuSO_4.5H_2O$ in 1% sodium potassium tartarate with 50 ml of 2% $Na_2CO_3$ in 0.1 N NaOH) were added to each and allowed to stand at room temperature for 10 minutes. 0.5 ml of the Folin-Ciocalteau reagent (phosphomolybdic/phosphotungstic acid) diluted with an equivalent volume of distilled water shortly before use) was quickly added to each sample and mixed. Using a spectrophotometer, the optical density of each sample was determined at 750 nm after 30 minutes in comparison to a blank (10% TCA solution). To calculate the regression curve, three replicates of each optical density were taken, and the average value was plotted against the corresponding concentrations. Same processing was done for all the samples. Optical density of individual sample was compared to a standard curve in order to determine the concentration of total protein content in each sample.

### Quantification of Trigonelline

Powdered and weighed plant components (leaves, stem roots and flowers) were taken in 100 ml Erlenmeyer flasks with distilled water (50 ml $g^{-1}$). 5 ml of 0.05 N sulphuric acid was added to it. After macerating for three to four hours, the mixture was gently boiled for twenty-five minutes. After adding

12.5 gm of heavy magnesium oxide to the mixture, it was once again gently boiled for 20 minutes. After allowing it to cool to room temperature, the same volume of distilled water was added to compensate for the water that was lost while boiling. Whatman filter paper was used to filter the mixture using vacuum, the filtrate was dried off and then reconstituted with distilled water for additional examination (Kogan *et al.*, 1953).

## Results and Discussion

Soil moisture, pH values, EC values, % organic carbon, phosphorus, and potassium values are some of the physicochemical characteristics of soil. Percent soil moisture of all three sites which are 2.35, 2.67, and 2.15, respectively. pH of soil samples in all the three sites reported as 8.4, 7.84, and 7.8 whereas electrical conductivity of all three site were 0.27, 0.37, and 0.28 mmhos $cm^{-1}$. Organic carbon of soil samples was 0.16%, 0.24%, and 0.19%, respectively for the three localities. Reported values of the phosphorus and the potassium were 28, 25, 22 as well as 331.5, 280, 250.9 kg $ha^{-1}$, respectively. The soil testing results (Tables 1-5) show that *C. roseus* may be cultivated well in slightly alkaline soil for which electrical conductivity <1, water deficient, drought tolerant area, loamy sand, low organic carbon and medium amount of phosphorous and potash. Table-6 shows the protein and alkaloid (trigonelline) amounts in all parts of *C. roseus.* The UoR samples have shown that all the plant sample analysed were higher in protein and trigonelline in comparison to two other localities.

### Physical parameters

### Soil moisture

Table-1and 5 shows that % soil moisture of all three sites is 2.35, 2.67, and 2.15, respectively. Values of soil moisture of all the three sites were approximately same. Hence this would not be having any major impact on biochemical properties of *C. roseus* within the Jaipur city. Bhat (2011) reported higher soil moisture percentage in his studies in comparison to present investigation.

### pH

pH of soil samples was 8.4, 7.84, and 7.8 for the three selected sites, respectively (Table-5). The pH values were found more than pH 7 which indicates alkaline nature of the soils for the above localities. Similar results were also obtained by Joshi and Kumar (2011) in Sanganer region of Jaipur, Rajasthan. At the same time Pujar (2011), Bhat (2011) and Chaudhary (2013) in their studies also observed alkaline nature of the soils in Karnataka's and Maharashtra.

### Electrical Conductivity

Electrical conductivity of all the three sites were 0.27, 0.37 and 0.28 mmhos $cm^{-1}$ (Table-5). Electrical conductivity is a measure of the soluble salt content in the extract and it's an indication of salinity status of this soil. Pujar (2011) also reported similar pattern for the electrical conductivity (i.e. < 1 If EC value is > 1, then there is problem of salinity. Joshi and Kumar (2011) showed variation in EC values in Sanganer region of Jaipur. Bhat (2011) and Chaudhary (2013) also studied EC and observed variable results.

### Chemical Parameters

### Organic carbon

Calculated organic carbon of sampled soils were 0.16%, 0.24%, and 0.19%, respectively (Table-2). As per analytical classifications, results of present investigations indicate that soils are low in organic carbon, because the values are lie in between 0.0% to 0.5%. Similar results have also been noticed by Joshi and Kumar (2011), Bhat (2011), and Chaudhary (2013).

### Phosphorus

Quantities of the phosphorus found in soil samples for the selected sites were 28, 25 and 22 kg $ha^{-1}$ as shown in Table-3. These values are found in the range of 23 to 56 kg $ha^{-1}$and may be placed in the category of medium value. Joshi and Kumar (2011), Bhat (2011), Chaudhary (2013) and Pujar (2011) reported similar trend in their studies.

### Potassium

Hanway and Heidel (1952) method was used to detect soil potassium, reported values were 331.5, 280, and 250.9 kg $ha^{-1}$ (Table-4). The observed values of Jaipur soils are lies in range of between 142-337 kg $ha^{-1}$ may be concluded its analytical category is medium. Similar result is also followed by Joshi and Kumar (2011), Bhat (2011) and Pujar (2011). Chaudhary (2013) reported low amount of potassium in Jalgaon, Maharashtra.

### Proteins and Trigonelline

Leaves of *C. roseus* collected from UoR site, were found to have a highest protein (6.69 mg $g^{-1}$ fw) in comparison to other plant parts during our study (Table-6). Similar trends have also been described by Bhumi *et al*. (2014) and Jain *et al*. (2014). In other two sites also, proteins were highest in leaves. Samples collected from UoR location have shown higher protein levels in all the plant parts comparison to other two sites. Trigonelline quantity was highest in leaves when compared to other tissues. UoR plant samples were showing higher trigonelline than the tissues of other two sites (Table-6). Sharma and Chaudhary (2017); Tolambiya and Mathur (2016A; 2016B; 2017); Tolambiya *et al*. (2023A; B) opined that soil physicochemical properties play important role in production of primary metabolites, and alkaloids in plant species. Soil testing results of present investigation (Table-5) indicate that UoR soils which is alkaline soil with electrical conductivity < 1, low in organic carbon and medium amount of phosphorous and potash are best suited for *C. roseus*. Protein quantity and trigonelline amount was found higher in UoR than the samples collected from other location of Jaipur (Table-6).

**Table 1:** Soil moisture in soil samples collected from three locations of Jaipur city

| Site | W1 (Moisture soil weight in g) | W2 (Dried soil weight in g) | % Soil moisture |
|---|---|---|---|
| UoR | 10 | 9.77 | 2.35 |
| Sodala | 10 | 9.74 | 2.67 |
| Durgapura | 10 | 9.79 | 2.15 |

**Table 2:** Organic carbon in soil samples collected from three locations of Jaipur city

| Site | Soil Sample weight (g) | $FeSO_4$ solution for blank (ml) -S | $FeSO_4$ solution for soil samples (ml) -T | Eq. W of Carbon (g) | Organic Carbon | Organic Carbon% |
|---|---|---|---|---|---|---|
| UoR | 1 | 5 | 4.73 | 0.003 | 0.00162 | 0.16 |
| Sodala | 1 | 5 | 4.6 | 0.003 | 0.0024 | 0.24 |
| Durgapura | 1 | 5 | 4.68 | 0.003 | 0.00192 | 0.19 |

**Table 3:** Phosphorus in soil samples collected from three locations of Jaipur city

| Site | Reading in Apparatus (X) | P (kg $ha^{-1}$) |
|---|---|---|
| UoR | 12.3 | 28 |
| Sodala | 11.0 | 25 |
| Durgapura | 10.0 | 22 |

**Table 4:** Potassium (K) in soil samples collected from three locations of Jaipur city

| Site | Soil Samples (gm) | Ammonium acetate extract (ml) | Reading in Apparatus (C) | Available K in soil samples (kg $ha^{-1}$) |
|---|---|---|---|---|
| UoR | 5 | 25 | 29.6 | 331.5 |
| Sodala | 5 | 25 | 25 | 280.0 |
| Durgapura | 5 | 25 | 22.4 | 250.9 |

**Table 5:** Physicochemical characteristics of soil samples collected from three locations of Jaipur city

| Site | Soil type | % Soil moisture | pH | EC Mmhos $cm^{-1}$ | Organic Carbon % | P (kg $ha^{-1}$) | K (kg $ha^{-1}$) |
|---|---|---|---|---|---|---|---|
| UoR | Loamy sand | 23 | 8.4 | 0.17 | 0.16 | 28 | 331.5 |
| Sodala | Loamy sand | 26 | 7.84 | 0.37 | 0.24 | 25 | 280.0 |
| Durgapura | Loamy sand | 21 | 7.8 | 0.28 | 0.19 | 22 | 250.9 |

**Table 6:** Protein and trigonelline in Wild *Catharanthus roseus* L. growing in soils of Jaipur City

| Site | Plant Part | Protein (mg $g^{-1}$ fw) | Trigonelline (µmol g-1 fw) |
|---|---|---|---|
| UoR | Leaf | 6.69± 0.02 | 19.0±0.50 |
| | Stem | 0.07± 0.03 | 6.2±0.30 |
| | Root | 2.41± 0.25 | 3.8±0.26 |
| | Flower | 0.69± 0.02 | 26.0±0.40 |
| Sodala | Leaf | 6.15± 0.49 | 17.0±0.50 |
| | Stem | 0.08± 0.03 | 5.9±0.03 |
| | Root | 3.14± 0.36 | 3.4±0.23 |
| | Flower | 0.60± 0.06 | 22.0±0.07 |
| Durgapura | Leaf | 5.61 ± 0.22 | 18.0±1.00 |
| | Stem | 0.06 ± 0.02 | 6.1± 0.60 |
| | Root | 2.21 ± 0.67 | 3.7± 0.58 |
| | Flower | 0.59 ± 0.02 | 24.0± 0.60 |

## Conclusion

In order to assist farmers and growers in managing soil nutrients and increasing crop yields, soil analysis is a procedure that looks at the chemical, physical, and biological characteristics of soil. Many previous studies indicate that *C. roseus* can grows and cultivated easily in areas with low soil moisture, an alkaline pH, electrical conductivity less than 1, low levels of organic carbon, and moderate levels of phosphorus and potash. Findings of present study also corroborate with the reports of earlier investigations that soils of University of Rajasthan, Jaipur are appropriate for *C. roseus* farming because extracted of protein and alkaloid (trigonelline) amount was higher than other location. It may be concluded that the water deficit areas may be well used for the cultivation of medicinal plants like *C. roseus* which is an important alkaloid producing plant. The macronutrients that make up fertilizers organic carbon, phosphorus, and potassium are applied in accordance with the requirements. It is clear from this that place with a water shortage may be effectively utilized to grow therapeutic plants like *C. roseus* and that doing so will increase the plants' commercially significant production of alkaloids and protein.

## Future Scope

By performing a soil study, farmers may determine the amount of fertilizer needed and identify factors influencing the soil's ability to provide plants with nutrients. Water shortage can be effectively employed to produce therapeutic plants like *C. roseus*, in addition to raising the primary metabolites, such as carbohydrates, proteins, lipids, and enzymes like peroxidase, polyphenol oxidase, and indole acetic acid, which can be improved and extracted from plant samples. Many methods can also be used to increase and extract secondary metabolites, including phytosterols, alkaloids, and flavonoids. Soil analysis data obtained in the present findings will be useful for investigators working in the same field as well as researchers and farmers for agriculture and cultivating plants appropriate to these soil types with soil amendment practices for better crop yields.

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## Conflict of interest

There is no conflict of interest disclosed by the writer.

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