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Estimation of Soil Constituents Affecting Growth of Medicinal Weed *Ipomoea cairica* (L.) Sweet

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Abstract: The adaptive nature of medicinal plants to their environment is often seen due to their general occurrence. If we consider some wildflower species, they are exceptionally site-specific along with their nature of growth in different soil types and concentrations, so the patchiness of these medicinal plants is often reported in the arable fields. In general occurrence and pattern of space of a medicinal plant is the result of various abiotic factors of the environment among which are soil pH, Bulk density, infiltration rate, and most importantly the nutrient content such as calcium, phosphorous, magnesium, aluminum, iron, etc. which determines the soil type and the rate of growth of vegetation in it. The soil type is important as it determines the water holding capacity of soil which helps the plants to withstand harsh environmental conditions. Thus, the nature of soil affects the growth of medicinal plants in a complex way, while considering it into an account. Thus, it is necessary to identify and quantify the nature of soil required for the growth of medicinal plants luxuriantly, this would in the future help to the cultivation of medicinal plants on a large scale particularly the medicinal plants which has not gained much importance in the past are part of ignorance for human but are very important such as Ipomoea cairica. The current research paper transacts with the purpose of determining how different soil types could affect the nature and growth of medicinal plants i.e., Ipomoea cairica, which is being undomesticated in nature. The research work consists of testing different types of minerals present in both the soil types as well as the pH, Bulk density, Infiltration rate, etc as the determining factor for the growth of a wild Medicinal plant.

Keywords: Soil pH, Minerals in Soil, Growth Rate, Wild Plant, Bulk Density, Percolation Rate of Soil

1. Introduction

Ipomoea cairica commonly referred to as a ‘weed of fallow areas [1]’ due to its distribution near the water ways generally the riparian areas, is a perennial climber reaching up to a height of 5m and sometimes more. It is a weed consisting of slender stems which are glabrous with twining habit, producing nodes at the roots. The leaves have 5-7 narrow lobes which are alternatively arranged, the lobes being palmately lobed. The flowers are funnel shaped purple coloured born on short stalks originating in leaf forks [2].

This species of *Ipomoea* is recognised for its rapid growth covering the trees and understorey plants but can also creep on the ground in the absence of any support but a significant reduction in its biodiversity has been observed due to the infestation of certain pests and certain other biological factors. The growth of the plant has also been noticed to show a certain level of reduction in growth size rate due to the presence of different nature of soil [3]. The soil being the most important investigative tool in determining the nutrient scarcity or needs of the plant by the help of soil testing which helps to determine the productivity rate of plant commercially [4]. The nature and nutrient quantity of the soil are the major factor leading to the rapid growth of the plant, as it is not just the soil but the soil minerals that act as most important element for plant growth as different soils have different attributes [5, 6].

The presence of Phosphorus, Calcium, Magnesium, Aluminium, Iron etc. other mineral nutrient helps the plant to grow in a flourishing manner along with the pH, Bulk density, infiltration rate etc. of the soil. It has been well acknowledged the ill effect of low pH on growth of root as on *Triticum aestivum* L., showing reduction in root length and root mass at a pH between 6.0-4.0 [7]. However exceedingly rare details are provided about the soil nature of *Ipomoea cairica*, a medicinal weed.

The aim of current research is to analyse how the nature of soil affects not only the normal plant but also a medicinal weed which could have been grown anywhere flourishingly but due to the difference in soil composition and the nature or type of soil its growth has been affected. In present research, focus has been made on point how a luxuriantly blooming weed's growth is being affected by the nature and pH of soil with different nutrient quantities.

Figure 1. *Plant Showing Slow Growth Rate.*

Figure 2. *Plant Showing Luxuriant Growth Rate.*

2. Material and Methods

The current research was executed out in the Department of Botany, DDUGU, Gorakhpur. The centre is located in UP Province with a latitude 26.7606° N, and a longitude of 83.3732° E region of India. The growth of wild plant is mainly studied in two types of soil i.e., light textured and dark textured under continuous observation for 60 days. These two soils were analysed for the growth response on the plant *Ipomoea cairica.*

Soil sampling and Analysis:

Both soil samples are collected locally, roots of *Ipomoea cairica* was potted in both the soil samples separately, putting the roots of the plant 15cm deep to carry out assessment of physical and chemical properties of the soil. After 60 days of periodic observation, both soil samples are then air dried (Figure 6), grounded, sieved to less than 2mm pores to find out several characteristics of the soil such as for the determination of chemical properties, tests such as presence of Carbon, Magnesium, Iron, Nitrogen, Calcium, Chloride etc., [8] has been performed and rest for carrying out physical quantities such as Bulk density, pH etc., [9].

Soil pH:

10gm of both the soil samples are taken is two different clean and dry test tubes, each adding a pinch of barium sulphate and 25ml of distilled water. Each test tube is vigorously shaken followed by intermittently shaking for 5 minutes then allowed to withstand for about an hour, Later the clear soil supernatant is decanted in conical flask and the pH of the soil sample is taken by the use of pH meter (Figure 5).

pH = 6.45- 7.5 = Neutral

pH <5 = strongly acidic

pH >8 = strongly alkaline

Soil Moisture

The analysis of soil moisture has been executed out by 'oven dry method' for this 20gm of air-dried soil is weighed and kept on the Petri dish in a hot oven (air oven) for 24hours at 110◦C Later this Petri dish is brought out from oven and kept in a desiccator for about an hour to let it cool, then the sample of soil is again weight (Figure 3).

Initial mass of soil = A gm

Mass of oven dried soil = B gm

Calculation of soil moisture = A-B gm

Table 1. *Details of Moisture Contents in Different Soil Samples.*

Soil Samples	Initial mass of soil (gm)	Mass of oven dried soil (gm)	Soil Moisture (gm)
A	20	19.81	0.19
B	20	18.43	1.57

Bulk density

Mass per unit volume occupied by the pore spaces as well as solids is defined as the soil's bulk-density. In order to determine the bulk density of the soil sample 100gm of soil sample is taken in the measuring cylinder and tapped gently for about 30-35 times later the volume of the sampled soil is measured [5].

A decrease in bulk density has been observed as the soil become fine textured.

Calculation of Bulk density: weight of soil in gm/volume of soil in ml (gm/cc).

Table 2. *Details of Bulk Density in Different Soil Samples.*

Soil Sample	Mass of soil (gm)	Volume of soil (ml)	Bulk density (gm/cc)
A	100	87	1.149
B	100	93	1.07

Water infiltration rate in relation to soil texture:

At one end of the test tube a muslin cloth is tied by help of rubber band and from the other end the same test tube is filled with soil up to half of its length tapping to its known uniform level, a known amount of water is added into the soil sample, time has been noted down, after nearly 20 minutes the length of moistened soil column is measured for both the soils [10, 11].

Table 3. *Details of Water Infiltration Rate in Different Soil Samples.*

Soil sample	Infiltration rate
A	3.7 cm/min
B	4.8 cm/min

Water capillary rise in relation to soil texture:

At one end of the test tube a muslin cloth is tied by help of rubber band and from the other end the same test tube is filled with soil up to half of its length tapping to its known uniform level, now these test tubes are kept over the watch glass filled with water, there the capillary rise in the test tube can be seen, note down the height after a fix duration of 20 minutes. Express the capillary rise in cm [12].

Table 4. *Details of Water Capillary Rise in Different Soil Samples.*

Soil sample	Water capillary rise.
A	1.9 cm/min
B	2.1 cm/min

Chemical Characteristics of the Soil Samples (Figure 4).

Diphenylamine test for Nitrate content:

5gm of each soil is taken in a clean and dry test tube, into this 25ml of 2M KCl was added and shaken intermittently for an hour. After which filtration using a filter paper 2ml of soil extract is taken and later 0.5ml of conc. sulphuric acid along with 0.5ml of 0.2% diphenylamine reagent was added, after shaking it vigorously, the blue colour intensity has been noted down. This blue colour is compared with the standard nitrate solution (Figure 15). The soil sample with less intensity of Blue colour as compared to standard shows nitrate deficiency [13].

Phosphate test analysis:

2-5ml of each soil extract taken in a clean and dry test tube, to it add 1drop of 5% NaOH along with 10 drops of Molybdate solution, shake the solution and then add a piece of metallic tin (Figure 10). Note down the Blue colour intensity [14].

Sulphate test analysis:

To 2ml of each soil extract is added with 1ml of 10% Barium chloride, intensity of white precipitate is noted and compared (Figure 14) [13].

Chloride test analysis:

0.5ml of silver nitrate solution is supplemented to 2ml of each soil extract, intensity of white precipitate is noted down (Figure 9).

Preparation of acid extracts for determination of Iron, Manganese and Aluminium

Into 5gm of each soil, added 25ml of conc. HCl then after boiling it for 10-25 minutes allowed it to cool down and later filer out using filter paper. Then make the final volume of filtrate to 10ml.

Iron analysis test:

Taken 2ml of both the soil acid extract and added 5-10 drop of ammonium sulphocynide solution into it. Bloody red colour was observed (Figure 8).

Manganese analysis test:

5ml of each soil extract is measured in a conical flask of 100 ml and to it add 10ml of HNO_3 along with 2.5ml of orthophosphoric acid and 1ml of conc. Sulphuric acid. The mixture is jiggled and let it boil for 10 min. After cooling add a pinch of potassium periodate then re-boiled, Intensity of Pink colour was observed (Figure 13).

Aluminium analysis test:

In 2ml of each soil acid extract, add 10% of NaOH then filter the solution using filter paper, to the filtrate few amounts of acetic acid and then excess of NH_4OH then boil it, white gelatinous precipitate is observed (Figure 12).

Calcium analysis test:

5ml of each soil extract is poured in a test tube into which added NH_4OH, shaken the solution and added Ammonium oxalate, white coloured precipitate was observed (Figure 11).

3. Results

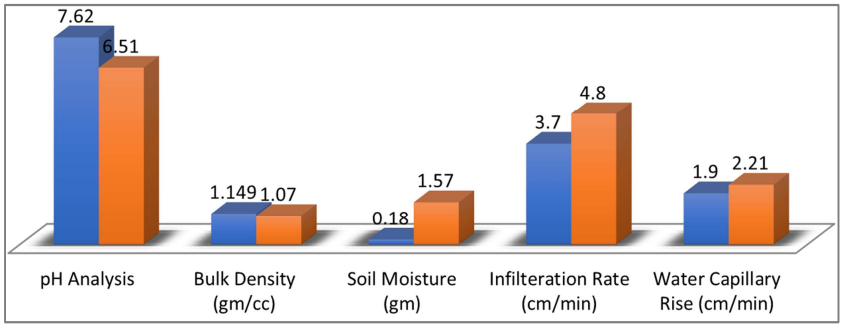

Figure 3. *Graphical Representation for Physical Difference between the Soil Samples.*

Table 5. *Conclusive Differences in Physical Characteristics between both Soil Samples.*

Physical Characteristics	Soil Sample A (Lighter Soil)	Soil Sample B (Darker Soil)
pH Analysis	7.62	6.51
Bulk Density (gm/cc)	1.149	1.07
Soil Moisture (gm)	0.18	1.57
Infiltration Rate (cm/min)	3.7	4.8
Water Capillary Rise (cm/min)	1.9	2.21

Table 6. *Conclusive Differences in Nutritional Characteristics between both Soil Samples.*

Nutrient Characteristics	Standard solution	Soil Type A (Lighter soil)	Soil Type B (Darker soil)
Nitrate	++++	+++++	++++
Phosphate	++++	++	++++
Sulphate	++++	+++	++
Chloride	++++	++	++++
Iron	++++	+++	++++
Manganese	++++	++	+++
Aluminium	++++	++	++++
Calcium	++++	Not present	+++

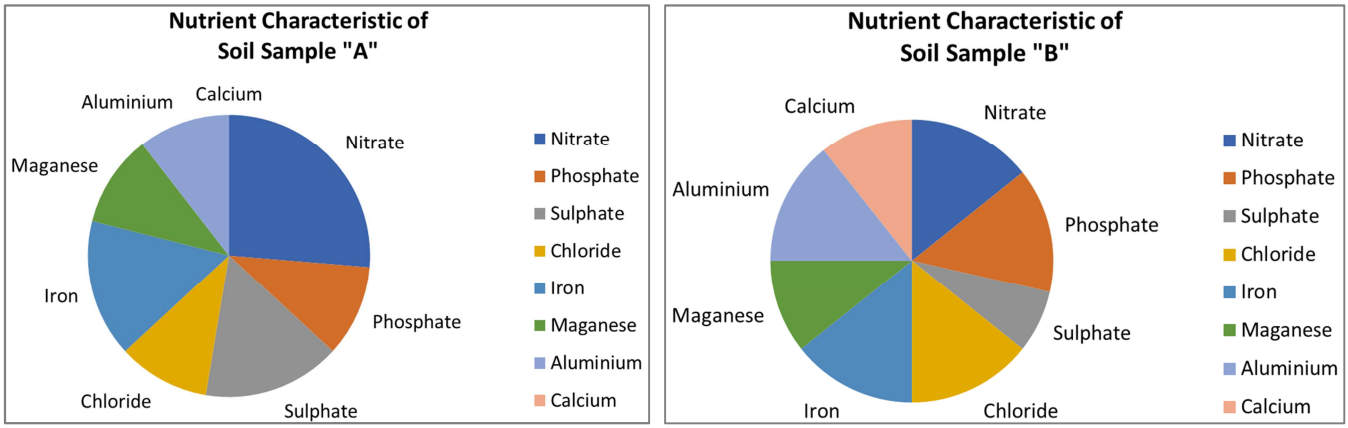

Figure 4. *Graphical Representation for Nutritional Differences between the Soil Samples.*

Figure 5. *pH meter.*

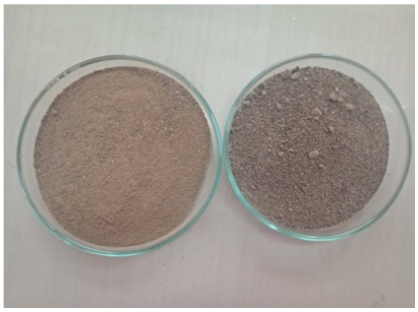

Figure 6. *Oven dried soil sample 'a' and 'b'.*

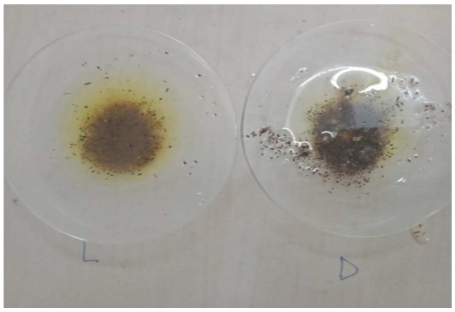

Figure 7. *Calcareousness test for soil sample 'a' and 'b'.*

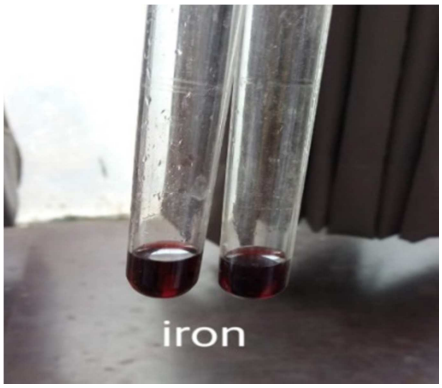

Figure 8. *Test for Iron in soil sample 'a' and 'b'.*

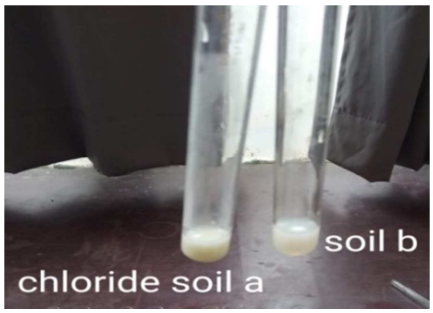

Figure 9. *Test for Chlorine in soil sample 'a' and 'b'.*

Figure 10. *Test for phosphate in soil sample 'a' and 'b'.*

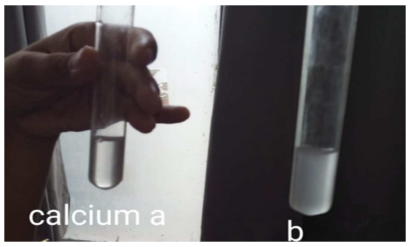

Figure 11. *Test for calcium in soil sample 'A' and soil 'B'.*

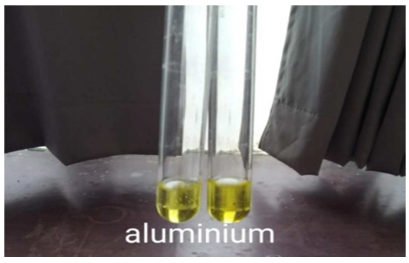

Figure 12. *Test for Aluminium in soil 'A' and 'B'.*

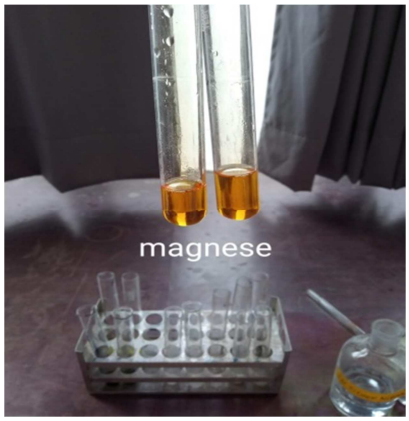

Figure 13. *Test for Manganese in soil 'a' and 'b'.*

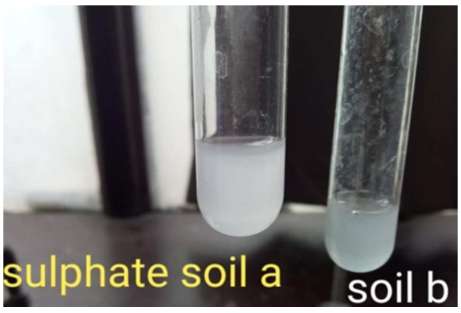

Figure 14. *Test for sulphate in soil 'a' and 'b'.*

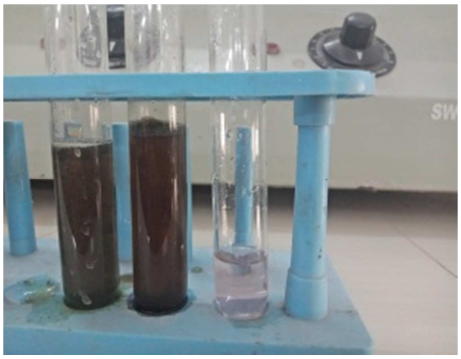

Figure 15. *Nitrate testing in both soil sample.*

4. Discussion

On the basis of above result a conclusion could be drawn that Bulk density, soil moisture, soil pH and calcareousness (Figure 7) are most important physical properties of the soil on which the growth of the plant is based, similarly there is detailed testing for the nutrients available in both the soil types (a and b) playing a significant role in growth, showing corelation to each other. A combined constituent of both physical and chemical nature of the soil make it healthy for its significant ability to sustain growth of any plant [15]. In the above experimental analysis it has been proved by the detailed table with data regarding various test that soil type 'a' which is lighter in colour support growth but due to its deficiency in certain amount of nutrient required at early time of plant growth, the growth rate is very slow in the same time period of 60 days but on the other hand the soil type'b' shows luxurient growth of the same plant due to the richness of all the mineral nutrient which are deficient in soil 'a' and also it has a good pH, to support the growth of plant.

5. Conclusion

A conclusion could be drawn out that the essentiality of Mineral nutrient along with the physical properties, soil pH cannot be ignored even in the case of a weed plant, which should have grown very well in any kind of abiotic stressed environmental condition due to its capability, but here its growth is significantly slow in growth rate due to variability in soil type indicating minimum dataset in assessing soil fertility. Thus in order to sustain important medicinal weed in a good and flourishing manner the soil fertility, soil pH, Bulk

density etc cannot be ignored.

On the basis of above botanical traits discussed in the result section of the paper this medicinal weed *Ipomoea cairica* grows well in soil type 'b' which is darker in texture providing better soil surface cover after 60 days in current study.

Author Contributions

NR designed the study and conducted the field surveys along with certain tests for soil, performed data analysis and wrote the manuscript. DS supervised the research and provided multiple amendment in the early stages of writing. Both author and co-author read and approved the final manuscript.

Conflict of Interest

All the authors do not have any possible conflict of interest.

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References

[1] Srivastava and Shukla, 2015. Ipomoea cairica: a medicinal weed with promising health benefits, International Journal of Information Research and Review, Vol. 2, Issue, 05, pp. 687-694.

[2] Austin, D. F. 1997. Convolvulaceae (Morning Glory Family). Published on www at http://ag.arizona.edu/herbarium/personnel/daustin/convolv.html.

[3] Ngugen, B., Hoa, H. T., Ngo, V. T. H. and Wilson, B. R. 2011. Comparative study of soil properties under various cultivation regimes of different crops. Soil research 49 (7): 595-605.

[4] Kimetu, JM., Lehman, J., Ngoze, SO., Mugendi, DN et al., 2008. Reversibility of soil productivity decline with organic matter of differing quality along a degradation gradient. Ecosystem 11: 726-739.

[5] Wilson, GF., Lal, R., Okigbo, BN. 1982. Effects of cover crops on soil structure and on yield of subsequent arable crops grown under strip tillage on an eroded alfisol. Soil and Tillage 2: 233-250.

[6] Koutika, LS., Hauser, S., Kamga, JGM., Yerima, B. 2004. Comparative study of soil properties under *Chromolaena odorata*, *Pueraria phaseoloides* and *Calliandra calothyrus*. Plant soil 266: 315-323.

[7] Johnson and Wilkinson. 1992. Wheat growth responses of cultivars to H^+ concentration. Plant and soil. 146: 55-59.

[8] Sonikajha and Suneetha, V. 2015. Nutrient analysis of soil samples from various places. Journal of chemical and pharmaceutical Research 7 (3): 291-293.

[9] Agbede, TM. and Adekiya, AO. 2011. Evaluation of Sweet Potato performance and soil properties under tillage methods and Poultry manure levels. Emir. J. Food Agric 23 (2): 164-177.

[10] Hao, X., Ball, BC., Culley, JLB., Carter, MR. and Parkin, GW. 2006. Soil density and porosity In. Soil sampling and methods of Analysis. 749-750.

[11] Sreejani, TP., Abhishek, D., Srinivasa, GVR., Abbulu, Y. 2017. A study on Infiltration characteristics of soils at Andra university campus, Visakhapatnam. International Journal of Environmental Research and Development 7 (1): 29-44.

[12] issuu.com/einsteinworld/docs/experiments_in_biology_milab_version.

[13] Samira, A. Ben Mussa., Hawaa. S. Elferjani., Faiza, A. Haroun., Fatma F. Abdelnabi. 2009. Determination of available Nitrate, Phosphate and Sulphate in soil sample. International Journal of Pharmatech Research 1 (3): 598-604.

[14] Murphy, J., Riley, JP. 1962. A modified single solution method for the determination of phosphate in natural water. Analytica chimica Acta 27: 31-36.

[15] Rauniyar N., Srivastava D. 2020. Dudhikalmi (I. alba)- A less exploited nutritive plant: A Reassessment. International Journal of Pharmacy & Biological Sciences 10 (3): 19-24.