Journal of Medicinal Plants Studies
www.PlantsJournal.com

ISSN (E): 2320-3862
ISSN (P): 2394-0530
https://www.plantsjournal.com
JMPS 2023; 11(2): 112-115
© 2023 JMPS
Received: 02-01-2023
Accepted: 08-02-2023

Parul Bhatt Kotiyal
Scientist-E, Division of Forest Ecology and Climate Change, Forest Research Institute Dehradun, Uttarakhand, India

Ruchita Tiwari
Scientist-E, Division of Forest Ecology and Climate Change, Forest Research Institute Dehradun, Uttarakhand, India

Corresponding Author:
Parul Bhatt Kotiyal
Scientist-E, Division of Forest Ecology and Climate Change, Forest Research Institute Dehradun, Uttarakhand, India

Response of some important medicinal plants of Uttarakhand to different soil amendments

Parul Bhatt Kotiyal and Ruchita Tiwari

DOI: https://doi.org/10.22271/plants.2023.v11.i2b.1546

Abstract
In this study, the effect of various treatment combinations on the growth parameters of medicinal plants and and soil properties under medicinal plants was studied. The experiment was conducted at Forest Research Institute, Dehradun to study the growth parameters of the selected medicinal plant species *viz*, *Withania somnifera* (Ashwagandha) *Ocimum africanum* (Lemon tulsi) Ocimum *tenuiflorum* (Kapoor tulsi) *Andrographis paniculata* (Kalmegh) under different treatments using soil "soilization" technique. In this technique commercially available sand made productive and fertile by applying various treatment combination SAND + COMPOST, SAND + COMPOST + CMC SAND + COMPOST + CMC + NPK, CONTROL (Sand). With the results obtained, it was evident that the media with only sand was not sufficient for the optimum growth of the vegetation. The yields of three species i.e. Ashwagandha, Lemon Tulsi, Kapur Tulsi were much higher by using soil "soilization" technique which was used in three other treatment pots. Only Kalmegh species deferred by failing to grow in the sand and the NPK rich media. Out of the four treatments, the best results were obtained in the Sand+CMC+Compost media.

Keywords: Medicinal plants, carboxymethyl cellulose (CMC)

Introduction
There are some 240,000 species of higher plants (medicinal and non-medicinal) and not all of those species will have the same mineral needs, at the same scale. Some will require a specific element in much higher concentration than others, and others will be able to tolerate a much higher concentration of an essential element that would, be toxic, to a different species. Medicinal and aromatic plants are use for healing various ailments in all the civilization around the world since time immemorial. Approximately 80% of the World population depends on medicinal plants for their health and healing Aliyu 2003 [1]. Societal motivations to use herbs are increasing due to concern about the side effects of synthetic drugs. Many botanicals and some dietary supplements are good sources of antioxidants and anti-inflammatory compounds Balasubramanian and Palaniappan 2001 [2]. Monitoring changes in soil physic-chemical properties with respect to field management strategies including soil management practices and plant species offers promise for better understanding and measurement of soil quality. Soil amendments and fertilizers are a wide array of materials could be added to topsoil to improve plant growth. It can be organic and inorganic. Inorganic fertilizer such as NPK is essential nutrients that must be supplied to the plants to increase growth, vigour, and yield and maintain the health of plants. It is also, suggested that there should be a complete or partial substitution of mineral fertilization (NPK) by using of organic and biofertilizers which are sure and economical for farmers (Dahmardeh, 2012) [4]. Boroomand and Grouh 2012 [7] reviewed that with adequate supply of N, P and K utilization by various spice crops are enhanced. Macro elements caused increase the number of traits such as plant height, leaf area, yield seed, and oil content. Some of traits of medicinal plants such as basil, turmeric, black pepper, cardamom, fennel, fenugreek, and *Aloe vera* with used potassium were changed.

Methodology
The study was carried in Forest Research Institute (FRI), Dehradun. FRI is located between 77°52'12"E, and 30°20'40" N at an altitude of 640.08 amsl. It is spread over 450 hectares in the outer Himalayas in its backdrop, provides the habitat for the flora and fauna. FRI has humid subtropical to tropical climate with heavy precipitation during May to September and received annual rainfall approximately 1898 mm.

In general temperatures goes up to maximum 40 °C in May and lowest minimum temperatures drops up to 2 °C in January.

Plant species used in the experiment

Medicinal plant species were procured from the NTFP Division of the Forest Research Institute in the form of seeds, each weighing 20g. The following NTFP plant species were used in the pot experimentation:

a) Kalmegh (Andrographis *paniculata)*
b) Lemon Tulsi (*Ocimum africanum*)
c) Kapoor Tulsi (Ocimum *tenuiflorum*)
d) Ashwagandha (*Withenia somnifera).*

The river sand was collected from a nearby construction site of Dehradun having the properties listed in table-1. The compost was collected from the central nursery situated at Institute itself.

Surface sterilized seeds (with 0.1% HgCI2) were sown in the pots plastic pots of 5 x 6 inches dimension with the following treatment.

Treatments

1. Control (sand only)
2. Sand+ Compost,
3. Sand+ Compost +CMC,
4. Sand+ Compost +CMC+NPK

Collection, Processing and analysis of soil samples

About 20 g soil was collected from each pots as per the desired depth. The collected soil was mixed thoroughly and the gravels were taken out. The 20g of soil samples were kept in polythene bags and tightly closed with thread. Collected samples from field were brought to the laboratory immediately.

Moist, well-mixed samples were transferred and spread on a brown paper or newspaper in the laboratory were shade dried and were crushed in mortar and pestle, after removing all stony material from the soil. Soil pH was determined by using calomel electrode by 1:2.5 soil water ratios. Soil organic carbon (SOC) was determined by (Walkley and Black Method, 1934) [1]. Bulk density of every sample was estimated by standard core method (Wilde *et al*., 1964) [6]. Soil available nitrogen was analyzed Subbiah and Asija (1956) [13]. Potassium by (Hanway and Heidel, 1952) [14], Determination of available phosphorus is by the Olsen method (Olsen, *et al*., 1954) [9].

Statistical analysis

The obtained experimental data were statistically analyzed by applying analysis of variance (ANOVA) technique (Panse and Sukhatme, 1978).The differences among treatments were compared by applying 'F' test of significance at 5 per cent level of probability.

Result and Discussion

Table 1: Soil properties in pot experiment on medicinal plants under various treatment combination

Treatments		pH	Organic Carbon (%)	Nitrogen (%)	Phosphorus (%)	Potassium (%)
Sand/control	Kalmegh	6.92	0.1	0.0028	0.0013	0.05
	Ashwagandha	6.91	0.12	0.0028	0.0013	0.05
	Lemon Tulsi	6.86	0.06	0.0028	0.0013	0.05
	Kapur Tulsi	6.76	0.1	0.0028	0.0013	0.05
Sand + compost	Kalmegh	6.98	0.36	0.0154	0.0018	0.175
	Ashwagandha	6.99	0.38	0.0154	0.0018	0.25
	Lemon Tulsi	6.92	0.46	0.0154	0.0018	0.175
	Kapur Tulsi	6.99	0.42	0.0154	0.0018	0.25
Sand +compost+ CMC	Kalmegh	8.39	0.28	0.0252	0.0018	0.2
	Ashwagandha	8.04	0.26	0.0252	0.0018	0.225
	Lemon Tulsi	8.35	0.32	0.0252	0.0018	0.2
	Kapur Tulsi	8.46	0.24	0.0252	0.0018	0.225
Sand + compost+ CMC+NPK	Kalmegh	7.68	0.54	0.021	0.004	0.175
	Ashwagandha	7.60	0.2	0.021	0.004	0.25
	Lemon Tulsi	7.30	0.26	0.021	0.004	0.175
	Kapur Tulsi	7.85	0.24	0.021	0.004	0.25

Soil pH is a key indicator because it correlates directly with nutrient availability/solubility such as nitrogen, calcium, magnesium, phosphorus, potassium iron, sulphur, zinc, copper, molybdenum, boron and also affects microbial activity. Soil organic carbon in the soil was comparatively low ranging from 0.1 to 0.54 (table: 2). Soil organic carbon generally correlates positively with crop yield. Carbon is the primary component of the soil organic matter. It affects important functional processes in soil like the storage of nutrients, mainly N, water holding capacity, and stability of aggregates. The nitrogen percent in the soil ranged from 0.0028 to 0.0052%. Nitrogen is the most required plant nutrient, which is found in several chemical forms in soil resulting in a very dynamic behavior. Soil nitrogen has been assessed mainly as mineral N, especially nitrate, organic N or potentially mineralizable N, as stored in the soil organic matter. It is an essential constituent of protein and is present in many compounds of physiological importance in plant metabolism like nucleotide, phosphatides, alkaloids, enzymes etc. Phosphorus content in the soil ranges from 0.0018% to 0.004%. Phosphorus is also a key nutrient for agricultural yields and is essential in assessments of soil quality. The available P in the soil solution is present as orthophosphates, but the microbial P and organic-P are also stocks that can rapidly become available. Potassium content in the soil ranges from 0.05% to 0.25% The Potassium function is primarily catalytic in nature. It provides the osmotic pull that draws water into the plant roots. It also regulates opening and closing of stomata during photosynthesis process.

Table 2: Medicinal plants height in pot experiment under various treatments

	Plant height under various treatments (Mean values in cm)			
Species	**Sand**	**Sand +Compost+ CMC**	**Sand +Compost**	**Sand +Compost +CMC +NPK**
Lemon Tulsi	8.00	34.00	30.00	7.33
Ashwagandha	8.33	12.67	7.67	5.67
Kalmegh	0.00	3.00	2.67	
Kapur Tulsi	5.33	20.33	13.33	

Factors	C.D.	SE(m)
Factor(A)	5.369	1.855
Factor(B)	5.369	1.855

Table 3: Number of leaves under various treatments

	Number of leaves under various treatments			
Species	**Sand**	**Sand +Compost + CMC**	**Sand +Compost**	**Sand +Compost +CMC +NPK**
Lemon tulsi	16.75	20.583	20.917	6.667
Ashwagandha	8.333	19.167	17.25	11
Kalmegh	0	3.167	3.167	0
Kapur tulsi	5	23.833	27.917	0

Factors	C.D.	SE(m)
Factor(A)	5.339	1.845
Factor(B)	5.339	1.845

Growth performance of the medicinal plants under different treatments

Sand/Control Media

Sand typically is made up of Quartz. Organic matter content of sand is very low. Sand is susceptible to dispersion and is less permeable. However sand contains little amount of phosphate and nitrate which makes it fertile to support scanty vegetation. The sand media could not provide the needs of the planted species for their optimum growth due to lack of nutrients and organic matter. In sand media Ashwagandha species surpassed the others in terms of growth. Lemon Tulsi was next in line which was followed by Kapur Tulsi. Kalmegh species gave no output in this media.

Sand + Compost Media

The sand and compost media provided the planted species with all the necessary inputs for optimum growth which the previous media lacked. The compost when mixed with the sand provide the plants with organic matter and all the essential nutrients which are basis for life process of the plant. In this media Lemon Tulsi outnumbered the other species in terms of height, followed by Kapur Tulsi, Ashwagandha and Kalmegh. In terms of no. of leaves Kapur Tulsi surpassed the other species followed by, Lemon Tulsi, Ashwagandha and Kalmegh.

Sand + Compost + CMC Media

The third media was a mixture of sand, compost and a chemical i.e. CMC in the ratio of 1:1:0.15. Sand, as it is defined in geology or engineering exists in a discrete state, and the constraint that acts among its granules is a contact constraint. When CMC paste was added to and mixed with sand granules, then an omni-directional integrative (ODI) constraint (with omni-directionality and restorability) was formed among the granules instead, and the sand was be transformed into a rheological state (wet "soil"). After the evaporation of the water content in the paste, the ODI constraint was transitioned into a fixed constraint, and the sand was transformed into a solid state (dry "soil"). "Soilized" sand possessed the mechanical properties of natural soil, which can continuously transform between the rheological state and the solid state. Thus, such "soilized" sand possessed the same eco-mechanical attributes as those of soil. Because the necessary constraint was imposed on the sand granules by means of a water-soluble CMC paste, this "soilized" sand also possessed a strong capacity to retain water, nutrients, and air. Clearly, there was no significant difference between the "soilized" sand and natural soil in terms of their mechanical properties and ecological attributes. Yi has found that once sands "soilized," it becomes suitable for the growth of plants, thus making it an ideal habitat for the planted speies. In the CMC mixed media Lemon Tulsi outnumbered the other species in terms of height, followed by Kapur Tulsi, Ashwagandha and Kalmegh. In terms of no. of leaves Kapur Tulsi surpassed the other species followed by Lemon Tulsi, Ashwagandha and Kalmegh.

Sand + Compost + CMC + NPK media

This treatment Constituted the same ingredients as the previous one with an addition i.e. NPK mixture at the rate of 0.75g per pot. The basic requirement for plant growth was met by compost and CMC but NPK gave a boost to the rate of growth being primary nutrients. Nitrogen is used by plants for lots of leaf growth and good green color. Phosphorous is used by plants to help form new roots, make seeds, fruit and flowers. It's also used by plants to help fight disease. Potassium helps plants make strong stems and keep growing fast. Lemon Tulsi showed maximum growth in terms of height followed by Ashwagandha. In terms of no. of leaves Ashwagandha was more potent than Lemon Tulsi. Kalmegh and Kapur Tulsi failed to show any output in this media.

Conclusion

The experiment was conducted to analyze the soil and growth parameters of the selected plant species under different treatments using soil "soilization" technique to combat desertification. With the results obtained, it was evident that the media with only sand was not suffice for the optimum growth of the vegetation. Hence soil "soilization" technique reflect a beacon of hope to combat world's desertification problem by simply altering the physical composition of the sand.

The selected species were planted for full three months i.e. March to May, the plants survived this period of continuous change in temperature. The plants were appropriately watered at different intervals with no further addition of the supplements. For comparison with the results of the above experiment, the following plant species with three replication were planted in the only sand media. In sharp contrast to the "soilized" sand, although the same methods of sowing and watering were used, plants only in the sand pots showed very little growth. As the sand does not possess the eco-mechanical attributes of soil. The yields of three species i.e. Ashwagandha, Lemon Tulsi, Kapur Tulsi were much higher

by using soil "soilization" technique which was used in three other treatment pots. Only Kalmegh species deferred by failing to grow in the sand and the NPK rich media.

Out of the four treatments, the best results were obtained in the Sand+CMC+Compost media as it furnished the best results by using Completely Randomized Design (CRD) method.

Natural soil usually takes thousands of years to form. However, by means of sand "soilization," sand can be turned into "soil" such that it instantly becomes an ideal habitat for plants. Desert "soilization, "which offers a solution to various problems commonly encountered in desert control, such as sand drifting, poor water retention, and the consequent hostility to plant species, has been achieved through interdisciplinary studies combining mechanics, ecology, soil science, and phytology. It is believed that the extensive implementation of desert "soilization" for desert control in the near future may foster many new disciplines and industries. Soil degradation has resulted in various global environmental problems. The large-scale application of sand "soilization" for planting has the potential to enable the establishment of a thriving desert ecosystem, which may offer a solution to several global environmental problems, such as deforestation, bio-diversity loss, and climate change.

References

1. Aliyu L. Effect of manure type and rate on growth, yield and yield components of pepper. J Sustain. Agric. Environ. 2003;5:92-98.
2. Balasubramanian P, Palaniappan SP. Principles and practices of agronomy; Tata McGraw-Hill Publishing Co. Ltd.: New Delhi, India; c2001.
3. Bower CA, Wilcox LV. Soluble Salts. In: Black, C.A., *et al*., Methods of Soil Analysis, American Society of Agronomy, Madison; c1965. p. 933-940.
4. Dahmardeh M. Effect of mineral and organic fertilizers on the growth and calyx yield of roselle (*Hibiscus sabdariffa* L.). Afr. J Biotechnol. 2012;11(48):10899-10902.
5. Walkley AJ, Black IA. An examination of the Degtjareff method for determining soil organic matter and a proposed modification of the chromic acid titration method. Soil Sci. 1934;37:29-38.
6. Wilde SA, Voigt GK, Iyer JG. Soil and plant analysis for tree culture. Oxford Publishing House, Calcutta, India; c1964.
7. Ravindranath NH, Ostwald M. Carbon Inventory Methods: Handbook for Greenhouse Gas Inventory, Carbon Mitigation and Round wood Production Projects. Springer Publishers; c2008.
8. Naser Boroomand, Mohammad Sadat Hosseini Grouh. Macroelements nutrition (NPK) of medicinal plants: A review Journal of Medicinal Plants Research. 2012;6(12):2249-2255. DOI: 10.5897/JMPRx11.019
9. Subbiah BV, Asija GL. A rapid procedure for the determination of available nitrogen in soils. Curr. Sci. 1956;25:259-260.
10. Olsen SR, Cole Watanable FS, Dean LA. Estimation of available phosphorus in soils by extraction with sodium bicarbonate. Circ. U.S. Dep. Agric; c1954. p. 939.
11. Hanway JJ, Heidel H. Soil Analysis Methods as Used in Iowa State College Soil Testing Laboratory. Iowa Agric. 1952;57:1-31.
12. Walkley AJ, Black IA. An examination of the Degtjareff method for determining soil organic matter and a proposed modification of the chromic acid titration method. Soil Sci. 1934;37:29-38.
13. Subbiah BV, Asija GL. A rapid procedure for the determination of available nitrogen in soil. Curr. Sci. 1956;25:259-260.
14. Hanway JJ, Heidal H. Soil analysis methods as used in Iowa State College Soil Testing Laboratory. Iowa State College of Agriculture Bulletin. 1952;57:1-31.
15. Olsen SR, Cole Watanable FS, Dean LA. Estimation of available phosphorus in soils by extraction with sodium bicarbonate. Circ. U.S. Dep. Agric; c1954. p. 939.