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Assessment of soil quality for seedlings of some medicinal plants of Tripura, India

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Abstract
Conservation of medicinal plants is an alarming issue now days. If medicinal plant are identified in their early life cycle stage and are provided with favourable growing condition then conservation process becomes easy. To provide favourable growing conditions to seedling, soil analysis plays a critical role. In this investigation soil tests (such as determination of pH, electrical conductivity, SOC, available phosphorus and potassium) for seedling of 35 medicinal plants had been carried out.

Keywords: soil, seedling, medicinal plants, conservation

Introduction

In recent times we have seen growing shift toward natural and herbal products as they are considered safer than the synthetic products for humans and environment. This in effect has led to kind of herbal renaissance going all over the world. Plant drugs constitutes approx. 80% of total drugs in fast developing countries like India (Joy *et al,* 1998) [4]. There are many advantages associated with the herbal medicine like effectiveness with chronic conditions, lower cost and widespread availability along with reduced risk of side effects etc. So, medicinal plants are economically important for the countries like India. Tripura, a small hilly state of northeast India, is rich in floral diversity and represents the western fringe of Indo-Burma biodiversity hotspot of tropical Asia (Myers *et al,* 2000) [5]. Medicinal Plants are at risk from destruction of their habitats, bio prospecting for new sources, and overharvesting of known medicinal plants. (CBD, 2008). So conservation of medicinal plants is an alarming issue now days. If medicinal plant are identified in their early life cycle stage and are provided with favourable growing condition then conservation process becomes easy. To provide favourable growing conditions to seedling, soil analysis plays a critical role. Soils have become one of the most vulnerable resources in the world due to climate change, land degradation and biodiversity loss. To assess plant nutrient needs soil testing is an important tool. It is also useful to formulate nutrient recommendation for plants. In soil testing, tests such as determination of texture, pH, electrical conductivity, mineralisable nitrogen, available phosphorus and potassium are routinely carried out.

Materials and Methods

Tripura is the third smallest state of the country. It is located in North East region of India between 22˚56’ N to 24˚ N, and 91˚09’ E to 92˚20’ E, covering an area of 10,491.69 Km^2. Seedling samples of 35 medicinal plants (in (para)cotyledonary stage) were located from different locations and soil sample were collected. Seedlings of *Stephania japonica* (Thunb.) Miers., *Tinospora sinensis* (Lour.) Merr., *Argemone mexicana* L., *Portulaca oleracea* L., *Abroma augusta* (L.) L., *Abutilon indicum* (L.) Sweet, *Hibiscus surattensis* L., *Melochia corchorifolia* L., *Sida acuta* Burm.f., *Sida cordata* (Burm.f.) Borss.Waalk., *Sida cordifolia* L., *Sida rhombifolia* L., *Triumfetta rhomboidea* Jacq., *Urena lobata* L., *Glycosmis pentaphylla* (Retz.) DC., *Abrus precatorius* L., *Bauhinia acuminata* L., *Caesalpinia bonduc* (L.) Roxb., *Caesalpinia pulcherrima* (L.) Sw., *Cajanus scarabaeoides* (L.) Thouars, *Calopogonium mucunoides* Desv., *Canavalia gladiata* (Jacq.) DC., *Clitoria ternatea* L., *Crotalaria spectabilis* Roth, *Crotalaria pallida* Aiton, *Crotalaria verrucosa* L., *Desmodium gangeticum* (L.) DC., *Desmodium heterocarpon* (L.) DC., *Desmodium triflorum* (L.) DC., *Mimosa pudica* L., *Mucuna pruriens* (L.) DC., *Pueraria montana* var. chinensis (Ohwi) Sanjappa & Pradeep, Pueraria phaseoloides (Roxb.) Benth., *Phyllodium pulchellum* (L.) Desv., *Tephrosia purpurea* (L.) Pers. were considered during this study.

Soil samples were collected from depth of 0-10 cm from each site for each species. (Table 1)

a. pH by Soil water suspension method: 10g of soil sample was taken in 50 or 100 ml beaker. 20-25 ml of distilled water was mixed and pH was measured by pH meter. (Soil survey, 2004) [8].
b. Electrical conductivity: 20 g of soil sample was taken in beaker. 40 ml of distilled water was mixed and EC was measured by pH meter. (Soil Survey, 2004) [8].
c. Soil organic carbon: 1g (0.2mm) of soil was taken and 10 ml 1N $K_2Cr_2O_7$ and 20 ml conc. H_2SO_4 was mixed with 200 ml distilled water. 10 ml ortho phosphoric acid and 1 ml diphenylamine indicator was mixed and mixture was titrated against ammonium sulphate till green color. (Walkley and Black, 1934) [9].
d. Available phosphorus: Two types of extraction methods were followed. For acidic soil, Bray and Kurtz (1945) [1] and for alkaline soil Olsen’s method (1982) [6] had been followed. For acidic soil, 5g of soil was mixed with 50 ml Bray’s P1 extractant. 5 ml of ammonium molybdate along with distilled water was mixed with the mixture. 1ml $SnCl_2$ was added and intensity was measured at 660 nm. For alkaline soil, 2.5 g soil was mixed with Darco G60 and 50 ml Olsen’s agent. 5 ml

of ammonium molybdate along with distilled water was mixed with the mixture. 1ml $SnCl_2$ was added and intensity was measured at 660 nm.

e. Available potassium: 5 g of soil was mixed with 25 ml 1N ammonium acetate and concentration was measured using flame photometer. (Hanway and Heidel, 2017) [3].

Result

Table 1: Showing soil characteristics where seeding grown.

S. No.	Species	pH	EC (ds/m)	Organic carbon (%)	Available nutrients	
					Phosphorus (kg/ha)	Potash (kg/ha)
1.	*Stephania japonica*	±4.80-4.90	±0.17-0.18	±0.84-0.87	±9.59-9.60	±228-230
2.	*Tinospora sinensis*	±5.05-5.1	±0.14-0.16	±0.53-0.56	±1.58-1.60	±185-190
3.	*Argemone mexicana*	±4.52-4.56	±0.44-0.48	±0.27-0.30	±5.12-5.20	±48.3-49.5
4.	*Portulaca oleracea*	±4.25-4.30	±0.23-0.25	±0.60-0.80	±10.2-11.0	±320-325
5.	*Abroma augusta*	±7.00-7.1	±0.09-0.096	±0.38-0.40	±8.51-8.56	±321-324
6.	*Abutilon indicum*	±5.01-5.2	±0.14-0.16	±1.04-1.05	±18.5-18.8	±331-335
7.	*Hibiscus surattensis*	±6.45-6.5	±0.22-0.23	±0.97-0.98	±7.62-7.70	±427-430
8.	*Melochia corchorifolia*	±4.90-4.94	±0.14-0.16	±0.64-0.66	±1.73-1.76	±330-340
9.	*Sida acuta* Burm.	±7.07-7.2	±0.06-0.08	±1.12-1.14	±25.1-25.6	±289-296
10.	*Sida cordata*	±4.97-4.99	±0.18-0.19	±0.40-0.45	±6.14-6.2	±329-340
11.	*Sida cordifolia*	±6.01-6.2	±0.10-0.2	±0.70-0.8	±18.4-19.0	±113-116
12.	*Sida rhombifolia*	±5.48-5.55	±0.12-0.14	±0.73-0.75	±7.18-7.2	±166-175
13.	*Triumfetta rhomboidea*	±4.13-4.2	±0.25-0.28	±0.62-0.70	±10.9-11.0	±323-325
14.	*Urena lobata*	±4.84-4.87	±0.13-0.16	±0.54-0.57	±1.72-1.75	±328-335
15.	*Glycosmis pentaphylla*	±4.64-4.78	±0.27-0.26	±0.70-0.75	±27.7-28.0	±513-525
16.	*Abrus precatorius*	±4.51-4.60	±0.11-0.12	±0.82-0.88	±23.1-24	±305-325
17.	*Bauhinia acuminata*	±5.18-5.5	±0.35-0.38	±0.83-0.86	±6.91-6.97	±234-240
18.	*Caesalpinia bonduc*	±5.37-5.8	±0.10-0.2	±0.67-0.8	±3.07-3.8	±85.9-89
19.	*Caesalpinia pulcherrima*	±4.55-4.7	±0.09-0.10	±0.34-0.36	±3.32-3.35	±253-256
20.	*Cajanus scarabaeoides*	±7.71-7.78	±0.16-0.18	±0.58-0.60	±5.04-5.1	±137-140
21.	*Calopogonium mucunoides*	±7.24-7.3	±0.14-0.16	±0.58-0.60	±9.41-9.5	±199-205
22.	*Canavalia gladiata*	±4.6-4.8	±0.17-0.18	±1.21-1.25	±17.9-18.0	±509-525
23.	*Clitoria ternatea*	±7.40-7.8	±0.32-0.40	±0.860.88	±26.7 -26.9	±212-221
24.	*Crotalaria spectabilis*	±5.20-5.6	±0.40-0.45	±0.88-0.9	±15.1-16	±420-425
25.	*Crotalaria pallida*	±7.75-7.8	±0.17-0.19	±0.50-0.60	±3.07-4.0	±277-280
26.	*Crotalaria verrucosa*	±4.20-4.3	±0.09-0.10	±1.34-1.40	±36.137.0	±780-785
27.	*Desmodium gangeticum*	±5.44-5.46	±0.14-0.16	±0.89-0.90	±6.44-6.50	±310-314
28.	*Desmodium heterocarpon*	±4.34-4.36	±1.12-1.15	±0.53-0.56	±3.33-3.37	±369-375
29.	*Desmodium triflorum*	±4.86-4.9	±0.05-0.06	±0.41-0.6	±1.34-1.4	±392-396
30.	*Mimosa pudica*	±5.37-5.8	±0.10-0.2	±0.67-0.8	±3.07-3.8	±85.9-89
31.	*Mucuna bracteata*	±4.80-4.9	±0.12-0.16	±0.54-0.56	±1.63-1.67	±325-345
32.	*Pueraria montana*	±4.80-4.9	±0.12-0.16	±0.54-0.56	±1.63-1.67	±325-345
33.	*Pueraria phaseoloides*	±6.44-6.5	±0.27-0.28	±0.86-0.89	±6.14-6.5	±171-175
34.	*Phyllodium pulchellum*	±4.42-4.7	±0.25-0.30	±0.89-0.95	±15.6-16.0	±119-225
35.	*Tephrosia purpurea*	±6.38-6.7	±0.16-0.18	±1.07-1.09	±6.72-6.89	±150-165

pH (<6.5 acidic soil; >8.5 Alkaline soil); Organic carbon (%): (<0.5: Low; 0.5-0.75: Medium; >0.75: High); Available phosphorus: (<10: Low; 10-25: Medium; >25: High); Available Potassium: (<120: Low; 120-280: Medium; >280: High); EC: (<1.0: Normal; >1.0: Saline)

Discussion

Herbal products are considered safer than synthetic products. These products are extracted from medicinal plants. But due to anthropogenic activities medicinal plants are at risk of extinction. Sometimes seeds of these plants grow but cannot survive due to environmental conditions. So, if these plants are identified in their early stage and are shifted to the favourable conditions then it will be helpful in conservation of medicinal plant. Soil is one of the important component of environment which affect growth and development of plant. If soil characteristics were analysed then it will be easier to provide favourable conditions to the plants.

The most common range of soil pH is 4 to 8 pH. The optimal availability for most plant is 6.0 to 7.5 (www.qld.gov.au). If pH is below 6.0 some nutrients, such as nitrogen, phosphorus, and potassium, are less available. When pH exceeds 7.5, iron, manganese, and phosphorus are less available. In this investigation most of the seedling had been found to be growing in acidic soil (*Triumfetta rhomboidea, Portulaca oleracea, Crotalaria verrucosa* etc.) and rest were found in neutral pH conditions (*Hibiscus surattensis, Pueraria phaseoloides, Tephrosia purpurea*, etc.). (Figure 2).

SOC (soil organic carbon) is indispensable for enhancing soil physical, chemical, and biological processes and properties. An increase in SOC can increase soil aggregate stability, water retention capacity, water infiltration, plant available water, soil microbial and macrofauna biomass and activity, and cation exchange. Four plants (*Argemone mexicana, Caesalpinia pulcherrima, Abroma augusta, Sida cordata*) were found to be in low organic carbon condition while 18 plants (*Portulaca oleracea, Sida cordifolia, Caesalpinia bonduc, Mimosa pudica*, etc.) were found in high SOC condition and rest were in medium SOC condition. (Figure 3).

Phosphorus is a major element and performs vital functions for sustenance, growth and development of plants. Four plants (*Sida acuta, Clitoria ternatea, Glycosmis pentaphylla, Crotalaria verrucosa*) were found in high available phosphorus condition while 23 plants (*Desmodium triflorum, Tinospora sinensis, Mucuna bracteata*, etc.) were found in low available phosphorus condition. (Figure 4).

Potassium is essential for photosynthesis, for protein synthesis, for nitrogen fixation in legumes, for starch formation, and for the translocation of sugars. 19 plant (*Sida acuta, Desmodium gangeticum, Abroma augusta* etc.) were found in high available potash condition while 4 plants (*Argemone mexicana, Caesalpinia bonduc, Mimosa pudica, Sida cordifolia*) were found in low available potash condition and rest were in medium available potash condition. (Figure 5).

Conclusion

This study may help in providing better environment to seedlings after their transfer from area having threat to plants to a safe place and thus will be helpful in conservation of medicinal plants.

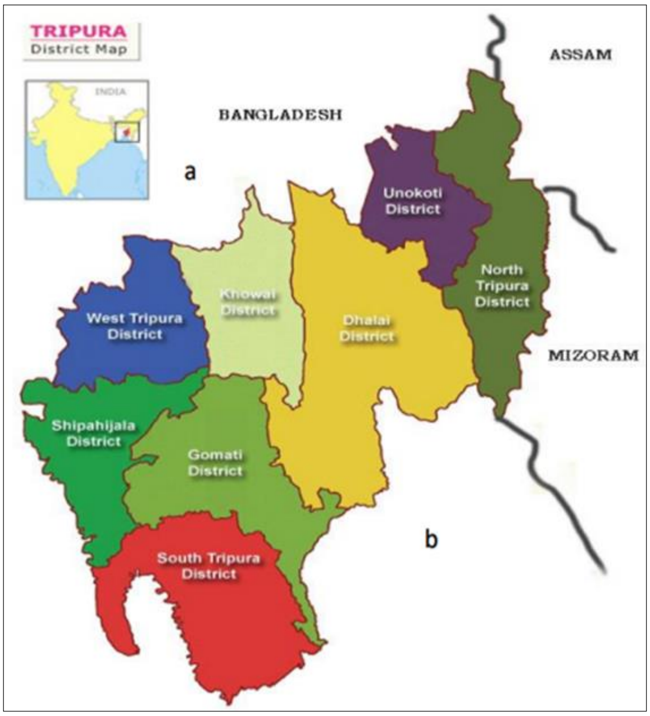

Fig 1: Location of study area. 1a. Location of Tripura in India. 1b. Districts of Tripura

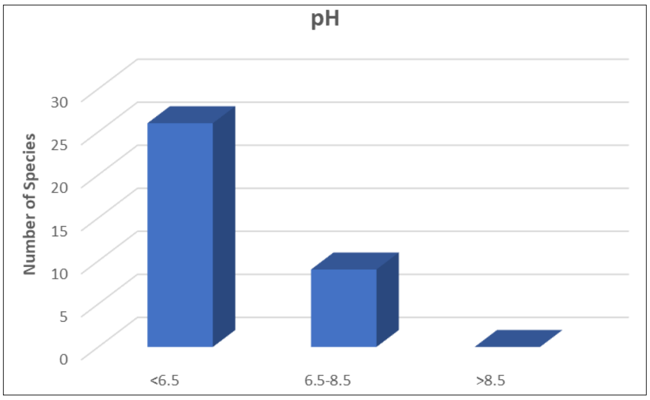

Fig 2: Graph showing soil pH in which seedlings are found

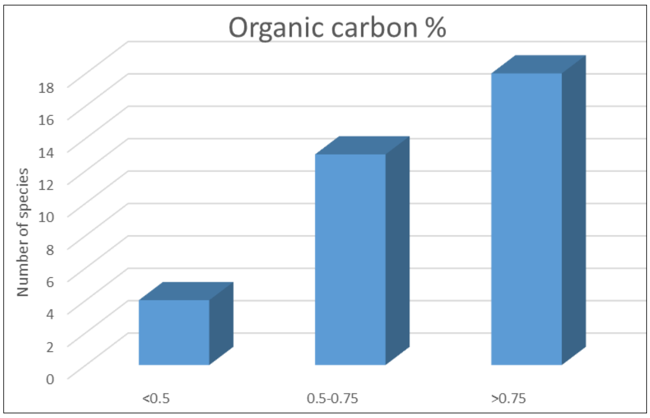

Fig 3: Graph showing soil organic carbon (%) in which seedlings are found

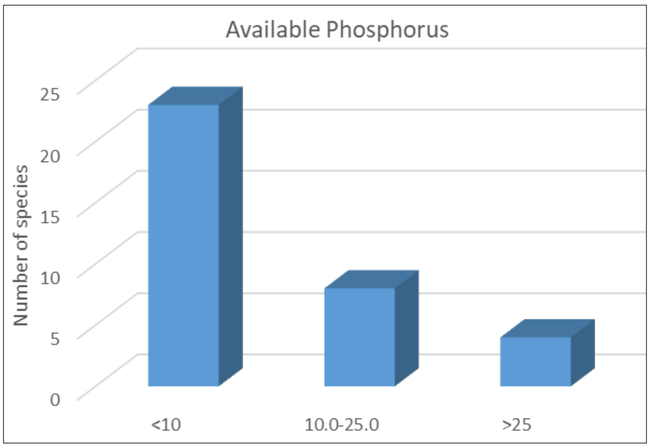

Fig 4: Graph showing soil available potassium in which seedlings are found.

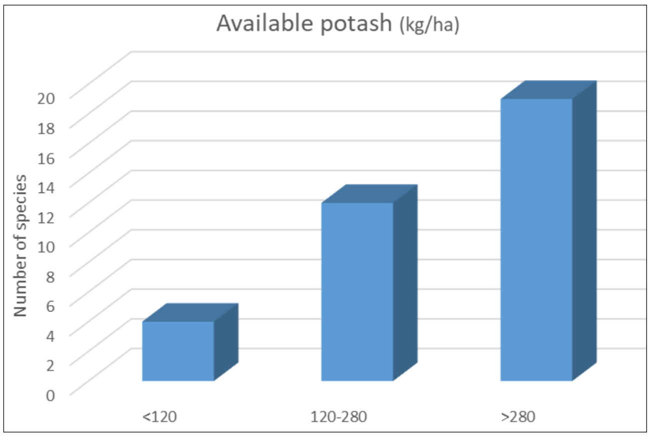

Fig 5: Graph showing soil available potassium in which seedlings are found

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