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PTERIDOPHYTES OF RAJASTHAN—A STUDY OF SOIL IN RELATION TO OCCURRENCE

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On the basis of the study of soil samples collected from the hills and plains throughout Rajasthan, relationship has been established with the occurrence of these plants. Both physical and chemical analyses have been made of the soil samples using standard techniques. Gravel soils possessing enough moisture and minimum amount of mineral like Na^+, K^+ and Ca^{++} are very suitable for the growth of pteridophytes. Water holding capacity, pH, EC and salts of various elements also play important role on the growth of pteridophytes.

Keywords : Soils; Hills; Plains; Pteridophytes.

Introduction

Terrestrial plants need soils as they get all essential inorganic chemicals required for the growth of the plants from it. Kline (1969) stated that the ultimate reservior of plant nutrient is the soil which they absorb through root system. Indeed, the environment of roots is a soil complex consists of the mineral matter, organic matter, soil solution and the living organisms. The nature of soil confines the growth of plant species in a particular area.

The major portion of western Rajasthan is covered by the Thar desert and the climatic conditions are not very congenial for the growth of plants specially for the pteridophytes which grow generally in moist and shady places. However, some of them survive in wide range of ecological conditions (Page, 1979). In Rajasthan the pteridophytes occur mostly in the Aravalli Hills and in the Chambal ravines during rainy season. Some of the pteridophytes however, may survive year round (Sharma and Bohra, 1977) e.g. *Actiniopteris radiata*, *Adiantum incisum*, *Cheilanthes farinosa*, *Cyclosorus dentatus* etc. The North and North-West portions of the state are poor in pteridophytic vegetation, as these areas are full of sand-dunes. However, at some places in the Arid zone along the banks of ponds, a few species of *Marsilea* e.g. *M. aegyptiaca* at Jodhpur, *M. rajasthanensis* at Kolayat (Bikaner) and ferns like *Actinio-*

pteris radiata and *Adiantum incisum* are also found growing in the area. In the present investigation an attempt has been made to study soil in relation to the growth of pteridophytes.

Materials and Methods

Soil samples have been collected from various places througout Rajasthan and all sites are categorised into two types i.e. sites situated hilly regions and the sites situated in plains. Hilly sites include Mt. Abu, Nagpahar (Ajmer), Goramghat (Udaipur) and Menal (Chittorgarh) where as Atru, Dausa, Kolayat and Jodhpur are included as plain sites Samples of surface soils (upto 10 cm. depths) have been collected, during and after the rainy season from all the sites and physical and chemical properties are studied.

Physical properties include soil texture, soil moisture, water holding capacity whereas, chemical properties include pH, E. C. soluble ions (CO_3^-, HCO_3^- and Cl^-) and mineral elements (Na^+, K^+ and Ca^{++}). The procedure followed are based on Pandey et al., (1968)(soil texture and soil moisture), Piper (1944) (water holding capacity), USDA Hand Book No. 60, 1954, (pH and E. C.), Reitmer (1943) (soluble ions) and Allen *et al.* (1975) (mineral elements).

Results and Discussion

During investigation, along with the soil samples, plants of pteridophytes were also collected. A large number of pteridophytes were collected from different hilly sites e.g. *M. rajasthanensis, Ophioglossum reticulatum, O. petiolatum, O. costatum, Actiniopteris radiata, Adiantum incisum, A. lunulatum, A. capillusveneris, Pteris vittata, Cheilanthes farinosa, Dryopteris cochleata, Athyrium pectinatum, Tectaria macrodonta, Ampelopteris prolifera, Hypodematium crenatum, Asplenium pumilum* var. *hymenophylloides, Marsilea minuta* etc. whereas few pteridophytes were also collected from the sites situated in plains e.g. *Isoetes reticulata, I. tuberculata, I. Coromandelina, Ophioglossum costatum, Actiniopteris radiaia, Adiantum incisum, Marsilea minuta, M. aegyptiaca* and *M. rajasthanensis.*

Data presented in the Table-1 shows that soil texture at different localities varies according to the climatic conditions. The soil samples collected from hilly sites show coarse sand to coarse-gravel soil texture whereas, soil samples from plains are gravel and alluvial. Soil moisture and water holding capacity (WHC) are higher in the hilly soils in comparison to those of plains. The percentage of soil moisture ranges 8.8 in hills (Goramghat) to 2.9 in plains (Jodhpur) Exceptionally soil sample from Kolayat shows from maximum WHC i. e. 92%, whereas samples from Jodhpur shows the minimum WHC (40 5%).

Table 1 : Showing soil texture and other properties at different localities.

Sites	Soil texture	Soil moisture %	WHC %	pH	EC mmhos/ sec.	Soluble ions			Mineral elements mg/ 100 gm dry soil		
						CO_3 m.eq/lt	HCO_3 m.eq/lt	Cl %	Na^+	K^+	Ca^{++}
Mt. Abu	Coarse-sand	6.6	78.2	7.4	2.01	0.52	0.98	0.019	72.0	22.5	18.5
Nagpahar	Coarse-sand	6.1	57.5	7.7	3.42	0.75	1.40	0.026	112.0	45.0	21.5
Goramghat	Coarse-gravel	8.8	64.0	7.4	2.50	0.61	1.00	0.027	86.0	28.0	18.5
Menal	Coarse-gravel	7.6	62.6	7.9	3.79	0.59	1.25	0.022	98.0	38.5	25.0
Atru	Gravel	4.8	54.0	8.0	3.79	0.85	1.50	0.036	115.5	44.5	31.5
Dausa	Alluvial	4.0	48.0	7.8	3.30	1.00	1.68	0.029	118.5	49.0	54.0
Kolayat	Clay	3.7	92.0	8.7	4.64	1.58	2.50	0,078	140.5	68.5	125.0
Jodhpur	Clay-sand	2.3	40.5	8.5	4.10	1.10	2.20	0.057	130.0	55.0	88.0

pH and Electrical conductivity (E.C.) are recorded higher in the soil samples from plains in comparison to those from hilly soils. Generally pH and EC ranges from 7.4 to 8.7 and 2.01 to 4.64 mmhos/sec. respectively. However, the maximum values of pH (8.7) and EC (4.64 mmhos/sec) are noticed in the soil samples from Kolayat and the minimum pH (7.4) and EC (2.01 mmhos/sec) noticed in the soil sample from Mt. Abu.

Soluble ions of carbonates,bicarbonates & chlorides do not show significant differences. The hilly soils from Mt. Abu, Nagpahar (Ajmer), Goramghat and Menal show lesser amount of these soluble ions in comparison to those from plains e. g. Atru, Dausa, Kolayat and Jodhpur. The maximum values of $CO_3^{=}$, HCO_3^{-} and Cl^{-} are recorded in the soil sample from Kolayat i.e. 1.58 m.eq/lt 2.50 m eq/lt. and 0.078% respectively and the minimum values in the soil sample from Mt. Abu i.e. 0.52 m.eq/lt, 0.98 m.eq/lt. and 0.019% respectively.

Mineral elements are also recorded in lesser amount in the soil samples from hills in comparison to these from plains. The value of Na^{+} is generally higher than other elements while the value of Ca^{++} is generally recorded lower. The maximum value of these elements (Na^{+}, K^{+} and Ca^{++}) have been recorded in a soil sample from Kolayat i.e. 140.5, 68.5 and 125.0 mg/100 g dry soil respectively, and the minimum from Mt. Abu i.e. 72.0, 22.5 and 18.5 mg/100 g dry soil respectively.

Rajasthan forms a part of the Thar desert of India. The annual average rainfall is comparatively low and the area faces scorching heat during summers. Similarly, the dry the cold winters effect the growth of plants adversely (Sharma *et al*., 1981). Ferns and fernallies are generally moisture and shade loving plants, yet quite a good number of pteridophytes are found growing luxuriantly during rainy season at several places in Rajasthan (Sharma and Bohra, 1977; Bohra et al., 1980; Bhardwaja et al., 1979, 1987; Sharma et al. 1988).

Majority of pteridophytes regenerate through their rhizomorphs or rhizomes which remain embedded in the soil for quite a long time. The rhizome in a majority of ferns has a dense growth of fibrous roots which require sufficient amount of oxygen for respiration. In hills the soil texture is coarse-sand to coarse-gravel and thus sufficient air spaces are present in the soil. The hilly soils also possess more soil moisture and WHC than those of plains and both those factors favour the growth of pteridophytes better at hills. Soluble ions do not cause significant difference in the growth of pteridophytes, except some plants, *Marsilea rajasthanensis* which grow at Kolayat, a place with quite

high percentage of Cl^- ions comparison to *M. aegyptiaca* (Jodhpur) or *M. minuta* (Mt. Abu). Mineral elements like Na^+, K^+ and Ca^{++} are minimum at Mt. Abu and other hilly places in places in comparison to those at plains. This suggests that higher concentrations of these elements is inhibitory in the growth of pteridophytes.

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