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PROSPECTS OF SOIL AND SAND CULTURE STUDIES OF *TEPHROSIA PURPUREA* IN VINDHYAN REGION

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ABSTRACT

Tephrosia purpurea is a commonly occurring weedy plant in the ecosystem, where there is competition for water. It is a plant found in open spaces in rocky and barren grounds a weed. The xerophytic leaves differ from mesophytic ones in thickness. The stomata have been arranged irregularly throughout the length of lamina and are anisocytic type. The area of the present work extends through various startigraphic terrains belonging to a wide span of geological events. The geological age of the various rocks that occur within the periphery of the region some of these rocks are ranging in age from 2500 m.yr. or more while the rocks of volcanic origin formed nearly 60 m.yr. ago are also found. The present investigation showed that plants have adopted themselves according the soil characters. Mostly plants adapt themselves morphologically, anatomically, phonologically and ecologically to the availability of the water. Effect of different types of soil on growth performance and effect of Fe, K and Ca deficiency on plant growth of *Tephrosia purpurea* is also shown in the study.

KEY WORDS: *Tephrosia purpurea*, Soil culture, water, plant growth etc.

INTRODUCTION

The plant *Tephrosia purpurea* (L) Pers is an important source of medicinal drugs and has a well recognized place in the indigenous system of medicine. It has been mentioned in both the Ayurvedic and Unani systems of medicine.[1] Different plant parts are known to be used for various ailments effectively.[2] Watt, 1889 described the dried plant as useful in bronchitis and diseases of liver, spleen and kidney. The plant is also recommended as a blooded in the treatment of boils and pimples.[3] Applied with the leaves of *Cannabis sativa* L., the plant is said to be a remedy for bleeding piles and with black paper as diuretic useful in gonorrhea.

The whole plant is uprooted as soon as the flowers begin to appear and are dried. The dried plants are then bundled and sold in the market.[4] Kirtikar and Basu, 1935 have also mentioned similar properties of this plant. The leave act as a good general tonic and are said to be useful in diseases of the lungs and chest, piles, syphilis and gonorrhea. The root is bitter and is given in chronic intestinal disorder like diarrhea.[5]

The fresh root bark pounded and rolled as pills with black pepper is given in cases of obstinate colic. The plant has found use as an anthelmintic for children. The seeds are useful in cases of poisoning due to rat bite.[6] In French Guina, the root is used in cases of fish poison. Kirtikar et al., 1935 and Nadkarni, 1954 has described that the plant parts with the combinations of other medicines can work as an antidote for snake bite.[7,8]

Tephrosia purpurea (L) Pers known as Kuchiki' in Distt. Koraput (Orissa State) and 'Uvadhoo' in Bastar (Madhya Pradesh) and it is used as a cure for poisonous snake bite. The root of the mature plant is grounded to make a paste. Slaked lime soaked in water is then mixed in the paste in the ratio of 2:1. Half teaspoon full of turmeric powder is then added in to the mixture. This mixture is then heated over a low flame for a few minutes, then applied over the injured part and bandaged. The patient is not allowed to sleep. The drug is said to have the sucking effect on the poison which is sucked out of the system.[9,10]

The leaves of the plant are made into a paste with half a seed of *Strychnos nuxvomica* L. The paste is well grounded, then mixed with honey and ghee or vegetable oil. Three doses at the intervals of two hours each, the medicines is given to the patient. This miracle-working medicine is said to tone up the nervous, respiratory and intestinal systems. It has a 'poison killing' and stimulating effect. The patient is said to recover within 12 to 18 hours time. The oil of the seeds is also used as a specific remedy for itch and scabies. Benzene extract of the whole plant has been shown to exhibit a depressant effect on the central nervous system.[11,12,13]

Some researchers have mentioned that fresh juice of the plant can cause hypoglycemic activity. Oral administration of the aqueous extract of seeds of *Tephrosia purpurea* (L) led to a marked lowering glucose levels in the blood of normal and alloxan induced diabetic rabbit.[14] The hypoglycemic effect of the extract was comparable to that of tolbutamide in normal rabbits. In diabetic rabbits the extracts exerted 60 to 70 percent hypoglycemic effect as compared to tolbutamide. Hypoglycemic activity of the whole plant extract is any much

lower than of the seed.[15] Upadhyaya *et al*., 1964 reported on the basis of a clinical trial that the extract improves the liver functions with no adverse effects.[16]

The area of the present work extends through various startigraphic terrains belonging to a wide span of geological events. The geological age of the various rocks that occur within the periphery of the region some of these rocks are ranging in age from 2500 m.yr. or more while the rocks of volcanic origin formed nearly 60 m.yr. ago are also found. Thus, almost all the important stratigraphic columns of the Indian shield are represented here. Geomorphologically the whole are can be divided into three major sectors: The Rewa plateau sector, the Sidhi sector and the Shadol sector.

The northern part of the area comprises part of the vast Vindhyan plateau. So far as the topographic expression of the whole region is concerned it assumes the form of an elongated saucer shaped land form. Its edges consist of steep scarpland, while the interior area constitutes an extensive bench having an average height about 325 M. above sea level. The upland of the plateau is bounded by the Kaimur highland in the south of Rewa.

The Sidhi sector shows lineated topographic expressions of Bijawars and Vindhyans. In fact the river Son lineament has been dominant in deciding the evolution of the geomorphology of this area. The Shahdol sector has an undulating and hilly topography. The southernmost part of the district is hilly and forms part of the Maikal range. There is a continuous drop in elevation from south to north and it reaches its lowest level in the extreme north where the river son forms the boundary of the district. The Amarkantak region forms the major watershed of Central India.

MATERIALS AND METHODS

Soil Culture Studies

Vegetative growth of the plant was studies on different soils

1. Control soil was collected from natural habitat of the plant.
2. Murum soil was collected from murum rocks.
3. Alluvial soil was collected from bed of a river
4. Mannured soil is the mixture of ordinary soil and cow dung manure.

Equal quantity of each type of soil was taken in earthen pots and five replicates of each soil was prepared. Seedling of equal size was planted in each pot. 500 ml of water was supplied to

each of the pot. All plants were placed in open. Necessary measurements were taken periodically.

For the growth of terrestrial plants soil is an important factor. According to Krammer (1944) soil characters depends chiefly on the texture, mineral particles and organic matter and properties of soil influences the plant growth.[17] The plants have adopted themselves according the soil characters. Mostly plants adapt themselves morphologically, anatomically, phonologically and ecologically to the availability of the water. Water is an important source to sustain life. Soil water depends upon its water holding capacity. The water holding capacity of a soil depends on the texture of the soil. When there is severe water scarcity, as the soil does not have the capacity to hold water for a longer period the plant shortens its life cycle. Various plants show wide differences in their growth performances in different types of soil. Even the same plant species change its morphological, physiological phonological character in different types of soil. They are known as ecads and ecotypes. Alternanthera sessile has been reported to grow best in sand and black cotton soil.[18]

Sand Culture Studies

Silica sand from a local river was obtained for experiments purpose. The sand was thoroughly in running tap water to remove the dust and finer particles. It was then bleached with 4% cold HCL for 5-7 days in polythene containers as described by Hewitt, 1952 to get the sand free from minerals elements.[19] After bleaching from cold HCL the sand was again washed in running tap water with continuous mechanical stirring till the supernatant solution was found to be acid free. After that the sand was washed with distilled water till it was found to be free of chloride and then transferred to polythene pots for experiments.

RESULTS AND DISCUSSIONS

According to Pirice, 1979 there are six factors to effect the plant growth are.[20]

1. Water supply
2. Air supply
3. Temperature
4. Supply of plant nutrients
5. Various injurious factors
6. Depth of soil.

Jorden, 1985 gave importance to chemical constituents of soil. According to him the localization of plants is mainly due to different chemical composition of Soil. He said that relations between plant and soils are chiefly determined by soil solutions which are immediate contact with root hairs.[21]

Soil plant relations of *Tephrosia purpurea* (L) pers with different types can be shown with growth is affected with different types of soil; plant was grown in five types of soil i.e.

1. Control soil.
2. Alluvial soil.
3. Manured soil.
4. Murrum soil.
5. Garden soil.

Control soil is brought from the place where plant grows luxuriantly and the growth performances of the plant given in the following **table-1** with the effect of types of soil.

Table: 1 Effect of different types of soil on growth performance of *Tephrosia purpurea* L.

S. No.	Growth Parameters	Control soil	Alluvial soil	Manure soil	Morrum soil	Garden soil
1.	Average length of root (cms.)	18.2	7.6	7.9	17.0	4.7
2.	No. of leaves per plant	256	52	12	200	13
3.	No. of roots per plants	8	4	3	6	3
4.	No. of flowers per branch	22	10	7	14	6
5.	No. of seeds per pod.	6	4	5	6	6

Each of the essential elements plays an important role in the development of plant. Many specific functions of majority of essential elements with respects to green plants in general are known in the absence of essential elements a plant shows morphological abnormalities and distortion which are called deficiency Symptoms characteristics deficiency symptoms are the key to the diagnosis of critical mineral element shortage in a given plant (Kenchington, 1885).[22] The present study deals with the vegetative growth performance of *Tephrosia purpurea* in Ca, K, Fe deficient sand culture medium respectively.

Goreau, 1986 established the phenomenon of essentiality of elements using sand and water culture techniques, similarly sand culture solutions were prepared.[23] The solution was

supplied with all the macro and micro nutrients while other sets were kept devoid of Ca, K, Mg, Fe respectively. Five replicates for each set of treatment were maintained. Samples of the same age plants were transplanted in these culture pots on the same day, and the plants were analyzed in terms of some important morphological features under these deficiencies. The results are tabulated in the following table-2.

Table: 2 Effect of Fe, K and Ca deficiency on plant growth of *Tephrosia purpurea.*

S. No.	Para meters	Control with Fe, Mg, K and Ca	Fe deficient culture	Mg. deficient culture	K deficient culture	Ca deficient culture
1.	Plant height cm.	44.5	42.6	25.1	32.3	30.1
2.	Root	18.2	18.3	11.1	14.2	12.8
3.	Shoot length cm.	26.3	24.3	14.0	18.1	17.3
4.	No. of leaves	258	101	38	62	60

The soil environment influences the germination, growth and distribution pattern of plants. Soil is the normal environment for roots. Besides getting a foot hold in the soil, plants also get nourishment in the form of mineral and water from it. Due to this close intimacy of contact plant and soil are strong influence by each other. For healthy growth of plant the influence of soil may itself act as one of the master factor. The various characteristics of soil such a texture, mineral composition, water holding capacity, pH organic matter exchangeable bases, etc. influence the plants studies on soil plant relationships have been made by many investigators.

It was observed that *Tephrosia purpurea* can grow well in control soil. The sequence of growth was like this.

1. Plant grows best in control soil than any other type of soil. The control soil was brought form its habitat area.
2. Significant growth was seen in murum soil than in manured soil and garden soil.
3. The growth was better in manured soil than alluvial soil.
4. The plant showed very poor growth in alluvial soil.

The soil culture experiments showed that plant does not need much organic matter. The plant in its natural environment grows mostly in watershed area, or the areas where moisture does not remain for a longer period. The soil is very poor in organic matter and extremely less clay percentage. The luxuriant growth of the plant can be seen in control soil. As the murum soil

has less water holding capacity and little amount of organic matters so the plant grows best in this kind of soil than in all the other experimental soils. The garden soil shows fair growth of the plant. But manured and alluvial soils show very poor growth of the plant in comparison to control soil (table-1).

The chemical analysis of soil in which plant is grown luxuriantly shows sandy loam soil. As the approximate percentage of gravel was 5.3, coarse sand 45.3, fine sand 23.11, slit 19.2, clay 6.0, water holding capacity was 27.3. The pH value of soil was 7.56, cation exchange capacity was 9.90 and Electerical conductivity 0.36 micro hos/cm. (table3 and 4)

Table: 3 Mechanical analysis soil samples and fine sand% of the four districts for *Tephrosia purpurea.*

Name of the place	Soil Sample	Gravel %	Coarse	Fine Sand %	Silt %	Clay %	Water holding capacity
	A1	4.6	47.0	23.9	20.4	7.1	27.1
REWA	A2	4.9	47.0	24.1	20.8	7.0	30.1
	A3	5.8	48.0	24.0	19.9	6.8	29.0
Mean		5.1	47.3	24	20.3	6.9	28.7
	B1	6.0	48.3	22	18.0	5.0	26.30
SATNA	B2	6.1	48.0	22	18.0	5.0	26.00
	B3	5.8	46.0	21	19.7	5.4	28.0
Mean		5.9	46.7	21.6	18.5	5.1	26.84
	C1	6.3	48.0	22.2	18.0	5	26.28
SIDHI	C2	5.9	46.0	22.0	19.0	5.1	30
	C3	5.7	47.0	23.1	19.1	5.3	29.3
Mean		5.9	47	22.4	18.7	5.1	28.52
	D1	4.9	47	24.0	19.9	7.2	28.8
SHAHDOL	D2	4.8	45	23.3	20.0	6.8	29.3
	D3	6.0	48	22.1	18.1	5.1	26.18
Mean		5.2	33.16	23.13	19.3	6.3	28.09

Exchangeable cations in the soils of Rewa, Satna, Sidhi and Shahdol were very less variation. The approximate exchangeable cations me/100gm as following, sodium 0.012, potassium 0.299, calcium 0.2212, phosphorus 0.023 and magnesium 0.51.The total nitrogen content of the soil was 0.054% and available nitrogen was 0.023. The percentage of organic matter was very less i.e. 0.52. (table 4 and 5)

Table: 4 pH, C.E.C. and E.C. in soil Sample of the four districts for *Tephrosia purpurea.*

Name of the Place	Soil Sample	Ph	C.E.C.	E.C. in micro hos/cm
	A1	7.6	9.89	0.38
REWA	A2	7.5	9.18	0.38
	A3	7.6	10.1	0.37
Mean		7.56	9.72	0.37
	B1	7.6	9.49	0.36
SATNA	B2	7.5	9.50	0.38
	B3	7.8	9.90	0.37
Mean		7.6	9.63	0.37
	C1	7.5	10.02	0.36
SIDHI	C2	7.8	10.22	0.31
	C3	7.4	10.01	0.35
Mean		7.56	10.14	0.34
	D1	7.8	9.89	0.37
SHAHDOL	D2	7.4	9.80	0.34
	D3	7.6	9.88	0.38
Mean		7.6	9.85	0.36

Notations: CEC = Cation Exchange capacity

EC = Electrical Conductivity.

Table: 5 Nitrogen and organic matter in soil sample of the four districts for *Tephrosia purpurea.*

Name of place	Soil Sample		NITROGEN			Organic matter %
				Available N 2		
		%	Kg/hac	%	Kg/hac	
	A1	0.052	1164.8	0.0104	234	.87
REWA	A2	0.057	1276.8	0.0117	264	.97
	A3	0.051	1142.4	0.0112	252	.21
Mean		0.053	1194.6	0.0111	250	0.68
	B1	0.55	1232	0.0108	244	.29
SATNA	B2	0.54	1209.6	0.0119	268	.50
	B3	0.55	1232	0.0112	251	.42
Mean		0.054	1224.5	0.0113	181.1	0.40
	C1	0.058	1299.2	0.0105	236	.55
SIDHI	C2	0.052	1164.8	0.0113	254	.89
	C3	0.053	1187.2	0.0113	255	.10
Mean		0.054	1217.0	0.042	248.3	0.51
	D1	0.053	1187.2	0.0120	269	.46
SHAHDOL	D2	0.052	1164.8	0.0118	265	.49
	D3	0.057	1276.8	0.0118	265	.21
Mean		0.054	1209.6	0.0118	266.3	0.38

Sand Culture

Soil is a natural root environment for plant. Plants not only get a foot-hold in the soil but they also get nourishment in the form of minerals and water from it. The influence of soil may act as one of the master factor responsible for healthy growth of plants. These minerals are present in the form of ions. Soil solutions contain a mixture of nutrient ions. The metabolic machinery of plant has to cope with the chemical environment as they have to selectively acquire essential elements. Therefore the soil solution is the primary source for inorganic nutrients for plant of root and in the case of the more important cations, the concentrations of this solution represents equilibrium with the cations adsorbed on the exchange complex. Thus for many cations, the soluble exchangeable components is a good index of availability for plant growth.[25]

Natural soil contains much more potassium than phosphorus of nitrogen. Black cites value between 0.3 and 2.51 % as Potassium in soils which is generally derived from alumino-silicate minerals. Fine textured soils with high silt and clay contents tend to have a higher percentage of potassium. In soil only a very small proportion of the K is soluble or exchangeable, the remainder is a non-exchangeable component of the soil matrix, black reports a mean figure of 99.6 % of the total K in the latter form and, 0.003-0.02 me/100gm were in solution. The potassium ion is indispensible for the existence of protoplasm, in the living substances. Its chief role is to provide ion atmosphere. Potassium deficient sand culture study on *Tephrosia purpurea* shows, general retardation in growth behavior of plant, number of roots are reduced and number of leaves are also reduced.[26]

The calcium content of soils is widely variable. In rich soil some 70-80% of the cations exchange complex may carry ions and in non-carbonate soils this may be a relatively large proportion of the total soil Ca. the equilibrium concentration of Ca in the soil solution is also high compared to other cations such as K. Calcium deficient sand culture study on Tephrosia purpurea shows, effects mostly on morphological features. Ca deficiency changes the activity of enzymes which helps in elongation of underground parts and retards growth of above ground portion.

CONCLUSION

For the growth of terrestrial plants soil is an important factor. The plants have adopted themselves according the soil characters. Mostly plants adapt themselves morphologically, anatomically, phonologically and ecologically to the availability of the water. Water is an

important source to sustain life. Soil water depends upon its water holding capacity. The water holding capacity of a soil depends on the texture of the soil.

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