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THE GREAT BANYAN TREE (*FICUS BENGHALENSIS* L.), INDIAN BOTANIC GARDEN, HOWRAH—THE PERIODICAL VARIATION IN ITS SOIL FERTILITY STATUS

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ABSTRACT

Under the present investigation, for preserving the Great Banyan Tree (*Ficus benghalensis* L.) of religious, tourism and botanical significance,—its root environment has thoroughly been investigated which was not yet been explored. From the results it is clear that the entire soil which is supporting nearly 95-98% soil-proproot system is quite low in organic carbon content and consequently resulting into its unfavourable physico-chemical properties. A few important physico-chemical properties have been tabulated and at the end some valuable suggestions are given.

INTRODUCTION

The legendary "Great Banyan Tree",—one of the valuable assets of the Indian Botanic Garden, Shibpore, Howrah, attracts hundreds of tourists and visitors day in and day out perennially. Regarding actual age of this oldest tree of the garden, there is no conclusive opinion. On the basis of the recorded history, it has been presumed that it is more than two hundred years old. The peculiarity of this tree is that it has lost its main trunk in the year of 1925 but even to-day, it is still surviving with its about 1200 proproot system. Each root looks itself like an individual tree. At present this tree has begun to show some deteriorating signs as evidenced from its physical appearance and breakage of a portion of its proproot system in the recent years despite of its best horticultural upkeeping in terms of several aerial treatments for food, fungicides and insecticides, etc. Undoubtedly the shoot portions of the tree has been receiving the aforesaid care since long but its root environment has not yet been taken care of. In view of this negation, an attempt has been made to assess the periodical variation in the fertility status of plant's soil system.

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METHODS AND MATERIALS

The total circumference of the tree canopy is 410 metres which has been demarcated and cemented all along. In this investigation, the entire land inside the cemented periphery and some portion beyond the periphery and up to the extent where a few proproots overhung the cemented circle have been taken into account. For collecting soil samples horizontally and vertically the abundance of existing prop roots was kept as a criterion. The entire area was divided into 4-circles accordingly, as has been shown in Fig. 1.

The first circle is in the centre, covering mainly those parts where main trunk existed. The second circle, having approximately 16 metres width, is rolling around the first circle with a few proproots. The third circle covers those parts which lie in between cemented periphery and outerline of the second circle, consists major number of proproots. The fourth circle is beyond the cemented periphary and covers an area as far up to the extent where some proproots are getting their foothold.

From each circle 5 composite soil samples

were collected from varying depths, (0-22 cm, 22-44 cm, 44-66 cm, 66-88 cm and 88-110 cm) where the aerial proproots penetrate and spread in the soil. The soil samples were collected in the same pattern thrice a year: August 1975, December 1975 and May 1976. The collected soil samples were analysed

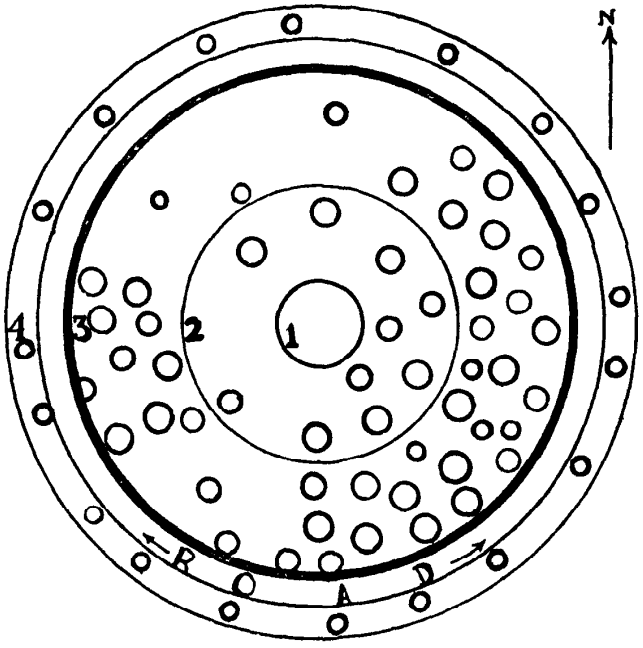

Fig. 1 : A diagrammatic presentation of the location of soil sampling sites within Banyan tree area (1—4); approximate proproot positions have also been shown by smaller configurations.

for their important physico-chemical characteristics according to the methods described by Jackson (1958) and Piper (1966).

RESULTS AND DISCUSSION

The mechanical composition of the surface and soil profile is presented by table no. 1. From the data mentioned in this table, it is quite clear that fine sand and silt are the main mechanical constituents of the entire soil constituting approximately 75% of the total composition. Coarse sands are very negligible and present below 1% throughout the soil. But at the surface it is comparatively higher. The amount of clay portions is varying from 22.65% minimum at the surface to 27.87% maximum at the lowest depth sampled.

The other physico-chemical properties of the soil depth-wise and period-wise have been condensed into circle-wise periodical variation of important physico-chemical characteristics showing mainly range and mean of the constituents which have been recorded in the table nos. 2 and 3. A perusal of the results obtained indicates that the organic carbon content (a vital constituent) of the soil in all the circles and at all time is low. It's mean value is ranging from 0.216% in circle no. 1 in month of May to 0.481% in circle no. 4 in month of August. It has been observed that organic carbon content is decreasing with the increasing of the depth in all the circles and at all times.

In general the soil under Great Banyan tree is deficient in organic matter. Though there is no such well defined parameter of this constituent which could depict the nutrient status in terms of low, medium and high, particularly for preserving very deep-rooted tall trees of either evergreen or deciduous type, as it is available for cultivated lands but it can not be utilized here to evaluate the fertility status because of being superficial layer; 0-15 cm in depth. However, in the lack of such a parameter the observation in this context is based upon the comparison of its status to the tree lands where fertility is maintained by the nature. Yadav *et al.* (1970) while investigating the depth-wise (0-193 cm deep) soil of evergreen forest of Western Ghat have recorded this constituent ranging from 0.55% to 6.09% with mean 2.52%. Working on soil characteristics of varying depths of Brahmaputra valley of evergreen forest in Assam, the same author (1969) has described the soil as moderate in organic matter content ranging from 0.35% to 2.48% with the mean of 1.01%, having a total depth of 183 cm. Certainly range and mean values recorded for this constituent in this investigation are low and are affecting the other physico-chemical properties of the soil. Waksman (1926) and (1938) stated that the physical,

chemical, biological and mechanical properties of the soil are improved by organic matter.

It is very evident that porosity is minimum in the month of August and maximum in the month of December in all the circles. It has been noticed with much interest that in the month of August the surface porosity is lesser than the bottom, as evident by its range 38.9%, lowest in the surface of second circle to 46.2% highest at the bottom of third circle. But in the months of December and May the porosity of the soil is significantly higher than August ranging from 48.6% minimum to 58.5% maximum. The lowest value of porosity in the month of August may be due to high precipitation which fill-up the pore spaces by muddy water and secondly, the reduction in the porosity, particularly at the surface, is caused by the constant trampling of visitors.

It is quite apparent that the periods and the circles are showing significant influence on the electrical conductivity values of the soils. It is very explicit from its mean values that circle nos. 1 and 2 are more saline than circle nos. 3 and 4 with the exception of circle no. 3 in the month of August.

The analyses of available nutrients *viz.* N.P.K., their circle-wise range and mean values have been recorded in the same table no. 2. From the scrutiny of their results, it is clear that the soil of the banyan tree in general, is very poor in available nitrogen and phosphorus but in comparison to these two available nutrients it is rich in available potash. It has also been observed that all these three major nutrients have the same trends of decreasing order of their contents with the increase of the depths. The periodical fluctuations have been noticed to be little for these constituents.

The range and mean values of the HCl extract analyses along with pH have been shown by table no. 3. From the pH values recorded in this table, it is very apparent that soil is feebly acidic to neutral in reaction. The range of its mean values is 6.1 to 6.9 which is showing an insignificant fluctuation with the change of the time. But the pH of surface soil of the 4th circle has been recorded moderately to an extent. It has also been noticed that pH is slowly increasing with the increase of the depth. From the data of sesquioxide and iron oxide, it is quite obvious that the amount of these constituents is present in fair quantities in all the circles and at all times. The values recorded for total phosphorus, it appears that soil possesses very good reservoir of this constituent, but it is very interesting to note that it's availability is very low. It may be due to the presence of high amount of sesquioxides and low content of organic matter. Dalton *et al.* (1952) reported that organic substances free from phosphorus were effective in increasing soil phosphorus.

From scanning of the observations taken for calcium oxide and magnesium oxide of all the circles depth-wise and period-wise, it is clear that their contents for circle nos. 1 and 2 are homogeneous althrough their profile and comparatively higher than other circles. Circle nos. 3 and 4 are showing different trends of retention of these constituents. In these circles both the cations in question are present in lesser quantities at the surface but as the depth increases their quantities are also increased. Particularly this trend of retaining calcium and magnesium in the circle nos. 3 and 4 is the same for all the periods.

CONCLUSION

From the results so far achieved after investigating the soils under the great Banyan tree for their important physico-chemical properties, it may be concluded that the entire soil underneath the tree is poor in organic matter content. It is not only poor in organic matter content but poor in avail-

TABLE No. 1

Mechanical composition of the soil under great Banyan tree

Depth in cm.	Coarse sand %	Fine sand %	Silt %	Clay %
0-22	0.427	51.00	25.47	22.65
22-44	0.285	49.43	24.50	22.95
44-66	0.110	48.50	24.95	23.86
66-88	0.108	45.69	25.64	26.85
88-110	0.094	44.83	25.76	27.89

TABLE No. 2

Circle-wise periodical variation of important physico-chemical characteristics of the soil under great Banyan tree

		August 1975		December 1975		May 1976	
Constituents	Circle No.	Range	Mean	Range	Mean	Range	Mean
Organic Carbon %	1	0.135-0.427	0.292	0.187-0.510	0.353	0.105-0.265	0.216
	2	0.120-0.397	0.271	0.202-0.630	0.392	0.277-0.472	0.356
	3	0.165-0.855	0.394	0.270-0.712	0.448	0.240-0.673	0.406
	4	0.090-1.463	0.481	0.187-0.772	0.424	0.112-0.735	0.392
Porosity %	1	41.2-44.6	42.2	53.9-58.5	56.3	50.5-54.1	52.5
	2	38.9-46.1	42.7	52.7-54.9	54.2	51.3-54.7	53.6
	3	39.0-46.2	41.9	49.8-55.2	52.7	50.9-52.9	52.0
	4	42.8-45.7	43.9	49.9-56.7	54.3	48.6-53.9	50.9
Electrical conductivity in m. mhos/cm. at 25°C.	1	2.7-4.7	3.3	4.1-4.9	4.5	3.2-4.7	3.8
	2	0.8-3.4	2.3	2.8-4.6	3.9	1.6-4.0	3.1
	3	0.9-4.0	3.04	0.4-3.4	2.2	1.1-3.1	2.4
	4	0.5-2.8	1.18	0.17-1.40	0.76	0.5-3.0	2.1
Available N. %	1	0.0084-0.0137	0.0101	0.006-0.014	0.010	0.006-0.0151	0.012
	2	0.0047-0.0109	0.009	0.006-0.014	0.009	0.007-0.016	0.014
	3	0.0059-0.0175	0.0116	0.007-0.015	0.012	0.008-0.017	0.013
	4	0.0073-0.0381	0.0146	0.005-0.022	0.013	0.006-0.0224	0.014
Available P_2O_5%	1	0.0018-0.0021	0.002	0.0019-0.0023	0.002	0.0017-0.0025	0.002
	2	0.0017-0.0023	0.002	0.0018-0.0024	0.002	0.0021-0.0028	0.002
	3	0.0018-0.0042	0.003	0.002 -0.005	0.003	0.0025-0.0046	0.003
	4	0.0017-0.0064	0.003	0.0019-0.006	0.004	0.0019-0.0059	0.004
Available K_2O%	1	0.0195-0.0285	0.024	0.020-0.029	0.026	0.0197-0.0298	0.027
	2	0.0183-0.0294	0.025	0.020-0.030	0.026	0.0187-0.0297	0.025
	3	0.0195-0.0319	0.027	0.021-0.032	0.028	0.0215-0.0328	0.027
	4	0.019-0.035	0.025	0.027-0.037	0.030	0.0195-0.0340	0.025

TABLE No. 3

Circle-wise periodical variation of HCl extract analyses and pH of the soil under Great Banyan tree

		August 1975		December 1975		May 1976	
Constituents	Circle No.	Range	Mean	Range	Mean	Range	Mean
Sesquioxide %	1	7.83-8.96	8.29	5.99-9.25	7.54	6.48-10.25	8.55
	2	6.95-8.13	7.72	6.20-9.16	7.68	5.97-10.02	8.75
	3	6.59-8,15	7.71	7.88-9.10	8.33	8.76-10.28	9.53
	4	8.65-9.89	8.82	7.32-9.15	8.19	7.95-9.80	9.18
Fe_2O_3%	1	4.01-4.28	4.12	3.48-5.80	4.42	3.28-6.60	4.93
	2	3.40-4.84	4.24	3.28-5.48	4.30	3.0 -6.28	5.04
	3	3.08-4.16	3.72	3.92-5.12	4.44	4.72-6.85	5.56
	4	4.36-5.20	4.78	3.92-5.0	4.18	4.48-5.25	5.02
CaO%	1	1.16-1.29	1.24	1.24-1.27	1.25	1.26-1.29	1.27
	2	0.98-1.69	1.53	1.09-1.26	1.21	0.99-1.29	1.14
	3	0.87-1.38	1.20	0.99-1.29	1.22	0.99-1.29	1.20
	4	0.68-1.24	0.89	0.67-1.27	0.88	0.88-1.25	1.05
MgO %	1	0.86-0.92	0.90	0.83-0.88	0.86	0.78-0.93	0.86
	2	0.74-0.99	0.89	0.89-0.91	0.89	0.72-0.94	0.84
	3	0.65-0.93	0.85	0.69-0.86	0.79	0.72-0.86	0.82
	4	0.68-0.86	0.75	0.49-0.73	0.61	0.74-0.84	0.79
Total P_2O_5 %	1	0.232-0.283	0.266	0.193-0.278	0.240	0.238-0.285	0.26 7
	2	0.198-0.228	0.213	0.185-0.265	0.222	0.195-0.235	0:212
	3	0.264-0.303	0.279	0.193-0.286	0.247	0.198-0.287	0.255
	4	0.265-0.291	0.280	0.190-0.301	0.243	0.189-0.295	0.261
pH	1	6.7-7.2	6.8	6.5-7.0	6.7	6.2-7.1	6.6
	2	6.2-7.2	6.9	6.3-7.2	6.7	5.7-7.1	6.2
	3	6.2-7.1	6.6	5.9-6.5	6.1	6.2-6.9	6.6
	4	5.5-7.6	6.8	5.8-6.8	6.1	5.2-7.4	6.7

able nitrogen and phosphorus too. The circle no. 4 is showing superiority over other circles for these constituents only for surface soil. It is very interesting to note that soil possesses a good reservoir of total phosphorus but its availability is extremely low mainly due to presence of high amount of sesquioxide and small amount of organic matter. Regarding porosity of the soil, it may be stated that it is very satisfactory in

the months of December and May but in August it decreases very remarkably.

The overall pH of the soil is neutral to feebly acidic except the pH in the 4th circle (surface) where acidity is moderate. The concentration of soluble salts has been presented by electrical conductivity values. From its observations, it is quite apparent that circle nos. 1, 2 and partially 3 possess higher concentration of soluble salts than circle no. 4, may naturally be higher for their solute pressure. After a study of the results recorded in the said tables, it may safely be concluded that circle nos. 1, 2 and partially 3 show the characteristics of exhausted soils.

From the above discussion it may be suggested that the entire soil under the Great Banyan tree supporting nearly 95% to 98% of total proproots system deserves to be quickly treated for replenishing organic carbon. The natural sources of this vital constituent for the said soil are mainly some tropical grasses growing underneath the tree and the leaves dropped by the tree. But it has been noticed in fact that the natural sources of the organic matter are being cleared off with a view to beautifying the area without artificially inducing this constituent. Hence it's acute shortage upsets the important physico-chemical properties in the soil root system. While taking soil samples vertically at an approximate depth of one and a half feet in the circle nos. 1 and 2, it has been noticed the presence of a considerable amount of small chips of bricks. It is recommended that the brick chips should be removed gradually without injuring the existing root systems. For preserving the good porosity especially in the month of August when high precipitation is observed; it has already been suggested that the status of soil organic matter be raised. It is advisable therefore, that in addition to the total reserves of the other major plant constituents *viz.* available nitrogen, phosphorus etc. of the soil which otherwise are lost to the nutrient cycle of the plant, addition of organic matter in the form of some fairly decomposed manure might augment the fertility status of soil.

Moreover, the free movement of the visitors in the area should also be restricted. Visitors not only cause the compaction of the surface soil but a few of them also impart physical injury to the tree by etching their names on the aerial parts of the plant which later on suffers from pathogens' invasion.

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