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BIOGEOCHEMICAL STUDIES OF COCONUT TREES FROM THE ASBESTOS MINING AREA, ANDHRA PRADESH, INDIA.

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Abstract

Coconut trees occurring in and around asbestos mining area are selected. From these trees, roots, bark, midrib of the leaf, and leaflets were collected. Biogeochemical studies of coconut trees in the asbestos mining area of Brahmanapalli, Cuddapah District, Andhra Pradesh has been carried out. Organs of coconut trees, consisting of roots, bark, midrib of the leaf, and leaflets were analyzed for various elements viz., K, Mg, Fe, Na, Ba, Sr, Pb, Zn, Cu, Co, Ni, Al, Mn, Ti, Mo, B, Be, and Cd on ash weight basis. The concentration of Mg is consistently high in all parts of trees. It is noted that some elements are not detected. The concentration of Mg is consistently high in the organs of coconut tree, compare to the concentration of other elements reflecting mineralization. It may be noted that basipetal trend is found in the case of Mg in asbestos mining area. Similarly Fe, Na, and Al are also high concentration in tree organs next to K and Mg concentrations. The variations in the concentration of trace elements may be attributed to the influence of organic matter. Coconut tree organs (leaflets) show maximum accumulation capability for K and Mg, and this organ may be used for biogeochemical reconnaissance surveys and may also useful as a tool for their possible application in mineral exploration.

Key Words: Biogeochemistry, Coconut tree organs, Trace elements, Asbestos mine.

1. Introduction

Biogeochemical exploration involving soil plant relationship and consists of the chemical analysis of plants to get tangible proof of mineralization in the substrate. Biogeochemical province (Vinogradov, 1964) is influenced by local enrichment of metals due to the existence of ore bodies and their associated dispersion halos. In such provinces plants conspicuously exhibit indicator characteristics which may be morphological or physiological. Many workers find application in mineral exploration (Malyuga, 1964; Kovalevskii, 1979; Rose *et al;* 1979; Brooks; 1983; Thornton, 1983). Biogeochemistry dealing with chemical analysis with emphasis on trace elements in various biological materials for application regional geochemical reconnaissance applied to agriculture (Joyce,1975) and in applied to environmental geochemistry to tackle various problems of practical importance (Thornton,1983). Significance of coconut tree in biogeochemical exploration has studied by Prasad and Niranjan Prasad (1991). Trace elements play an important role in biological activities and therefore, their deficiency or excess in human beings can lead a number of disorders (Underwood, 1971). Earlier biogeochemical studies on coconut trees (Cocus nucifera) were carried out from Pollution (Fazeli *et al.*, 1991), exploration and (Prasad and Niranjan Prasad, 1991).

2. Study area

Asbestos deposit of Brahamanapalli area is located in Pulivendla of Cuddapah District, Andhra Pradesh, and is included in the Survey of India toposheet No. 57J/3. The NW-SE trending Pulivendla asbestos belt forms a small segment in the S-W part of the Cuddapah Basin. This area is primarily consists of quartzites, shales, limestones and dolomites. The mineralized zone comprising yellow, green, black serpentine and talc. Earlier workers have carried out geological (Prasad and Prasannan, 1976), mineralogical (Prasad and Prasannan, 1976).

3. Materials and methods

Several coconut trees (Cocus nucifera) individually or assemblages are distributed in the asbestos mining area of Brahmanapalli and of their adjoining agricultural lands. About 15 healthy and mature coconut trees occurring in different parts of the mining area were selected. From these trees, different organs consisting of roots, bark, midrib of the leaf, and leaflets were collected.

4. Sample Collection

From each tree, 5-6 leafs developed in the lower part of the crown in different directions are cut into pieces. Leaflets on either side of the midrib are plucked along the length of the leaf and midrib was cut into pieces. Roots are collected at the ground level and from the depth about 5 inches below the ground level around the base of the tree. Bark is collected at breast height from the ground level by chiseling out the trunk to about one inch in depth at a few places around the trunk of the tree. All the samples of the individual organs of coconut trees were separately combined to obtain the composite samples of the particular organ. All these samples were burnt in a large vessel individually. The samples were analyzed following the methods of Brooks *et al.*, (1995).The samples were oven dried at 110^0C over night. These samples were ashed by ignition at 450^0C in a muffle furnace and were dissolved in 2 M HCl. These samples were analyzed by atomic absorption spectrometry for K, Mg, Fe, Na, Ba, Sr, Pb, Zn, Cu, Co, Ni, Al, Mn, Ti, Mo, B, Be, and Cd on ash weight basis.

Moisture, Organic matter and Ash

The physical properties, moisture, organic matter and ash content were determined for the coconut tree organs (Table 1) .From the data the following observations are made.

1. Moisture is recorded as high (62.25%) in leaflets and low (12.10%) in bark of asbestos mining area.
2. Organic matter is recorded as high (80.40%) in bark and low (29025%) in leaflets.
3. Ash content is recorded as high (8.50%) in leaflets and low (4.82%) in midrib.

Table 1. Moisture, organic matter and ash content of coconut tree organs

S.No	Name of the organ	Moisture %	Organic matter %	Ash content %
1	Roots	13.25	79.72	7.03
2	Bark	12.10	80.40	7.50

3	Midrib	40.12	55.06	4.82
4	Leaflets	62.25	29.25	8.50

5. Results and discussion

Elemental distribution in different organs of coconut tree

In the present work an attempt has been made to study the distribution of elements in different parts of coconut trees .In order to study the distribution and behavior of elements in different parts of coconut trees in Brahmanapalli asbestos mining area, the samples of the individual organs of the coconut tree were analyzed for 19 elements consisting of K, Mg, Fe, Na, Ba, Sr, Pb, Zn, Cu, Co, Ni, Al, Mn, Ti, Mo, B, Be, and Cd on ash weight basis by AAS (Table 2). From the data some of the following important observations are made.

1. It is noted that some elements are not detected.
2. A very minute concentration of Ba is found in the parts of coconut tree. Ba, and Sr is not detected in root. Be is present in some of the organs of the coconut tree
3. Cr, Ti, Be, Cd is not detected in both roots and bark.
4. Mo is not detected in bark and midrib. Pb is not detected in midrib.
5. Cr, Ti, and Mo is not detected in bark and midrib
6. Ti is not at all detected in any parts of coconut tree organs

Table 2. Multi element analysis (in ppm and in % where the ppm level exceeds 10,000) on ash weight basis in different organs of coconut tree

S.No	Element	Root	Bark	Midrib	Leaflets
1	K	4.70%	6.20%	6.24%	6.53%
2	Mg	5.95%	6.15%	6.63%	6.71%
3	Fe	6200	5840	3200	3000
4	Na	3975	3400	2850	2260
5	Ba	ND	50	25	80
6	Sr	ND	40	10	50
7	Pb	10	60	ND	90
8	Zn	15	19	12	16
9	Cu	60	75	90	125
10	Cr	ND	ND	ND	150
11	Co	50	70	120	600
12	Ni	15	12	9	7
13	Al	2250	2475	2800	3020
14	Mn	50	40	26	15
15	Ti	ND	ND	ND	ND
16	Mo	27	ND	ND	94

17	B	60	45	42	20
18	Be	ND	ND	18	225
19	Cd	ND	ND	12	19

Trends of Elemental Distribution in Different organs of Coconut tree

1. In the study area, right from the topmost leaf to the lower most root the distribution of Mg, K, Cu and Al is basipetal striking showing a trend; L>M>B>R. in contrast to this a reverse trend; B>M>L>F is shown by Ni, Mn, Fe, and Na which are acropetal.

2. The concentration of Mg is consistently high in all parts of tree

In plant biogeochemistry, the selection of plant organ is very important. The distribution of elemental concentrations in different organs of a plant varies due to complex processes of metabolism. Different organs show wide variations in respect of accumulation of different elements. Each plant species has its own requirement and tolerance to element uptake and retention. Thus, the composition of an individual plant varies substantially among its various tissue types i.e., roots, wood, bark, twigs, needles, leaves, fruits and flowers (Dunn *et al.,* 1993).The different plant organs show wide variations in respect of accumulation of different elements (Tiagi,1990).

Elemental Sequences in Different Organs of Coconut Tree:

On the basis of elemental analysis, different workers have suggested different 'orders' or 'sequences' of the elements under different physico-chemical or biological conditions. Irwing and Williams (1953); and Basolo and Pearson (1958) proposed an order of stability of metal complexes with organic matter for divalent cations, monovalent cations, and trivalent cations. Such sequences are found to give valuable information regarding the elemental behavior in geological/biological materials. From the Table 2, the elemental sequences of coconut tree organs based on absolute concentrations are arranged in decreasing order as follows:

Root: Mg>K>Fe>Na>Al>B=Cu>Co>=Mn>Mo>Zn=Ni>Pb,Ba*,Sr*,Cr*,Ti*,Be*,Cd*

Bark: K>Mg>Fe.>Na>Al>Cu>Co>Pb>Ba>B>Sr=Mn>Zn>Ni>Cr*, Ti*, Mo*, Be*,Cd*

Midrib: Mg>K>Fe>Al>Na>Co>Cu>B>Mn> Ba>Be> Cd = Zn>Sr>Ni,* Pb*, Cr*, Ti* Mo*

Leaflets: Mg>K>Al>Fe>Na>Co>Be>Cr>Cu>Mo>Pb>Ba>Sr>B>Cd>Zn>Mn>Ni,Ti*

* = Not detected

Wide variations are found in the elemental sequences of different organs of coconut trees. From these sequences some of the important following observations are made:

1. Among the trace elements, Mg occupies first position in the sequences of elemental concentration in all the organs of coconut tree except in bark.

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2. The concentration of Mg is consistently high in the organs of coconut tree, reflecting mineralization.

3. It may be noted that basipetal trend is found in the case of Mg in asbestos mining area

4. Coconut tree organs of leaflets show maximum accumulation capability for K and Mg and this organ may be used biogeochemical reconnaissance surveys. Similarly Fe, Na, and Al are also high concentration in tree organs next to K and Mg concentrations.

5. There is no significant accumulation in the case of elemental concentrations in different organs of tree.

6. Conclusions

The present study reveals that the variations in the concentration of trace elements are attributed to the influence of organic matter. Because of unusual properties of organic matter, it has generally effects on the chemistry of trace elements. The movement of inorganic constituents into the coconut tree organs is selectively controlled in such a way that some elements are freely admitted while others impeded to a greater or lesser degree by the coconut tree. Shacklettee *et al;* (1980) are of the opinion that the available amounts of elements, rather than total amounts determine the uptake of an element by a plant from the soil and that available amount changes with the change in chemistry of environment. The soil organic matter as a source of nutrients. The concentration, rate of release and the amount of elements absorbed by plants are dictated by the level of soil organic matter (Akinola *et al.,* 1973). Further, in the study area all the coconut tree organs consisting of high concentration of magnesium and therefore coconut trees may ideally be used as tools for their possible application in mineral exploration. Further these investigations are also useful in biogeochemical orientation surveys.

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