International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2022): 7.942

Prognostication of Minerals in the Soil through Analysis of Parts of the Plant and Grass

Dr. Sanjiv Tyagi[1], Mansi Dimri[2], Rinku Patel[3]

[1]IFS; FRSC London; Director GFRF & APCCF, Research & Training (Corresponding Author)

[2]Project Assistant, Gujarat Forestry Research Foundation, TRO Bhavan, Gandhinagar, Gujarat, India

[3]Junior Research Fellow, Gujarat Forestry Research Foundation, TRO Bhavan, Gandhinagar, Gujarat, India

Abstract: ***Mineral Prognostication in soil has been carried out through a detailed scientific method by use of appropriate technologies this traditional method has stood the test of time. However, the new technique of soil mineral prognostication by use of various part of plants and grasses could become a well-known norm in time to come. Trees, plants and grasses act as an indicator for various environment commodities such as water & its quality, air & its quality etc. This study is effort to include plant& grasses that would indicate the quality of soil as well.***

Keywords: ICP OES, ICP-AS, Prognostication, tree, grass, indicator

1. Introduction

1.1 Defining Prognostication

Prognostication is in a broad sense, the theory and exercise of forecasting. In narrower sense, it implies the science of the rules and techniques for elaborating a forecast. The improvement of prognostication as the theory of forecasting has been steady with the development of theories of scientific prediction, programming, projecting, and management. Its fundamental premise is the elaboration of a particular method of forecasting, so as to enhance the effectiveness of the strategies and techniques in making forecasts.

There are branches of prognostication: General (theoretical) and specific (applied). The specific (applied) approach is a part of unique scientific disciplines (medical, biological, economic, and demographic forecasting).

1.2 Soil quality

There are two ways in which soil quality is generally defined. One is based on the inherent properties of soil and the other on the basis of outcomes of human activity and management. Mausel (1971) was the earliest to define it in scientific literature- "*Soil quality is the capability of soil to yield corn, soyabean and wheat on the basis of high level management".* Thus, the choice of crops and their poor or overwhelming performance was to define the soil quality. In short, this definition based on inherent properties was given in SSSA (1987; noted in Doran and parkin, 1994) as *"inherent attributes of soils which can be inferred from soil traits or oblique/indirect observations".*

A Comprehensive soil quality definition would therefore include intrinsic potential of any soil to contribute to environment systems and environment services that it provides together with Biomass production. The latter definition based on inherent and static soil properties is actually related to soil taxonomy. Larson and Pierce (1991) sought to sift total productivity from agriculture productiveness of the soil. While Doran and Parkin (1994) felt that soil quality included its capability to function sustainability. Thus, focus on production is considered to be too restrictive. The Broad definition of soil quality is therefore thought to be the one that, besides productiveness, contributes to environmental sustainability and thereby promotes plant, animal and human health.[1]

1.3 Minerals in the soil

Minerals in the soil have a definite role to play in determining its fertility. The soil surface, especially the top soil has an ability to function as a nutrients garage. However, the capability of soil to hold and retain differing amounts as such can help one predict the degree to which such a soil can not only hold such nutrients but also supply them to the plants. The numerous minerals in the soil vary in size and chemical composition in the different type of soil that are available.

1.4 Particle size of soil Minerals

In order to differentiate between different kinds of soil and its minerals; the particle size is an essential criteria. The soil may include particles ranging from massive boulders to minutes ones, which may even be invisible to bare eye.

Table 1: Description of sand, silt, and clay classes

The Fine Earth Fraction			
Classes	Size	Texture	Characteristics
Sand	2.0 mm to 0.05 mm	Gritty	The Sand particle can be seen by the naked eye. It has low surface area and easily allows excessive drainage.
Silt	0.05 mm to 0.002 mm	Buttery	Not seen by the naked eye, but has increased water holding capacity.
Clay	Less than 0.002 mm	Sticky	Has high surface area and high water holding capacity. The small pores, may possess charged surfaces that attract and hold nutrients.

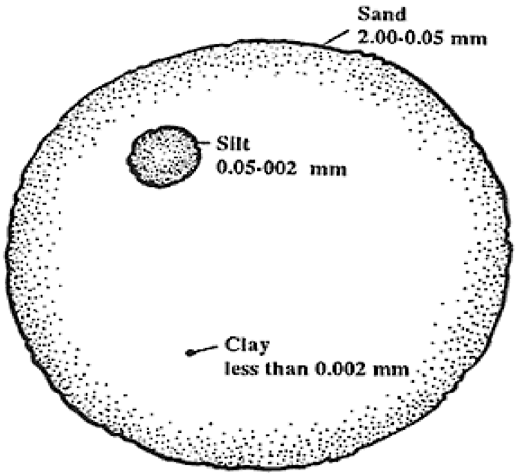


Figure 1: Relative size comparison between sand, silt, and clay of the fine earth fraction. (Source: http://www.cst.cmich.edu/users/Franc1M/esc334/lectures/physical.htm)

Based on the size, the particle can be classified into two categories: - The Coarse fraction and the finer ones.

1.5 Coarse Fraction

All soil particles with sizes greater than 2mm are grouped into the coarse fraction. This group consist of boulders, stone, gravels and coarse sand. They are generally rocky fragments and therefore, an aggregate of multiple mineral types. Weathering in such soil minerals leads to smaller shapes of soil particle and finer particle that is called as "Soil "in common parlance. Weathering is an important process for nutrient control and management and such a process significantly makes plant nutrient available. As the weathering process accelerates the size of the particle decreases, while the nutrient availability in the soil decreases. Such nutrients may be lost due to leaching of soil if proper care is not taken. Weathering is generally of two types - Physical and Chemical

The Chemical weathering generally takes place in tropics as the climate around the earth is normally warm and moist, which is quite appropriate for continuous chemical weathering to happen. Thus, sufficient amount of rainfall coupled with warm temperature causes mineral particle to weather into smaller and smaller size of particles of soil.[2][3]

1.6 Mining of Minerals

Mining is broadly classified into two categories:
A) Surface Mining
B) Underground Mining.

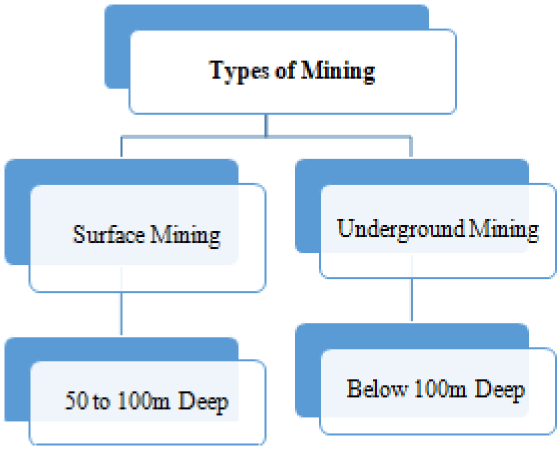


Figure 2: (**Source: -** R.N.P Arogyaswamy (1996), "Courses in Mining Geology", 4th Edition, Oxford and IBH Publishing Co. pvt. Ltd.)

Though, there are numerous variation in all sorts of mining, yet surface mining is generally resorted to as it is more advantageous in terms of recovery of ores, ease of operation, production, safety and values. All non-metallic minerals (almost 95%) and most metallic minerals (more than 90%) are mined by surface method (Hartman, 1987). Underground Mining may become inevitable when the ground resources are exhausted.

1.7 Modern Technologies employed in prognostication/ Soil Sampling

ICP-MS (Inductively Coupled Plasma–Mass- Spectrometry) determines low concentrations (inppm range) and ultra-low-concentrations (*i.e.*, ptt). The sample solution is introduced into the tool viaa peristaltic pump. After nebulization in the spray chamber, the aerosol is injected into an argon-plasma, which is at 6 to 8 K (Kelvins).

ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry) is a method, wherein the composition of factors in (mainly water-dissolved) samples can decide the use of plasma and a spectrometer. The technique has been used since 1974. [4]

1.8 The Underlying Principle in the use of grass and plants in prognostication of minerals in the soil

Soil Concentration are crucial for the growth of the plant, making the plant uptake of minerals an important element for measuring such growth. Elemental estimation of trace metal therefore, becomes an important aspect. Elemental evaluation and concentration of trace metal in extracted solutions of the soil samples are analysed using ICP-OES or ICP-MS. [5]

2. Material and methodology

The present research was carried out at Gujarat Forest Research Foundation (GFRF), Gujarat Forestry Research and Training Institute Campus behind conference hall in approximately 50 acre of forested area. Samples were collected and analyzed for of each mineral of different parts of plant such as root, stem, and leaves and in Grassroot, tuft and soil around plant and in Grass root, tuft and soil. Analysis of minerals was done at Gujarat Environment Management Institute Laboratory, Gandhinagar.

Material used during the exercise, especially to carry out Soil Sampling was as follows:
1) Measuring tape;
2) Sterile Collection bags;
3) Marker pen;
4) Recorded Book;
5) Labels; and
6) Scabbard.

2.1 About the Present Study

The elemental and parameter analysis for soil and each part of the plant i.e., Roots, Stem and Leaves was done. The result has been tabulated below the diagram. Diag- 1 Makrol -1, Diag- 2 Makrol- 2, Diag- 3 Neem Diag-4 Karanj and Diag- 5 Grass, Diag-1 to Diag-5show the concentrations in plants and grasses respectively in mg/kg except for unit less pH and for soil parameters such as Available phosphors and Potassium, which are in kg/hector; Bulk Density in mg/m^3 and Available nitrogen, Organic Carbon and Water content in %.

The Diagram, Diag-1 Ato Diag-5 A show the Biomagnification/ Bioaccumulation in different part of the plants and grasses respectively as compared to the corresponding value in the soil.

Diagram showing Assimilation of Elements in a Tree

Diagram 1: Makrol -1 (*Diospyros montana*)

Legends

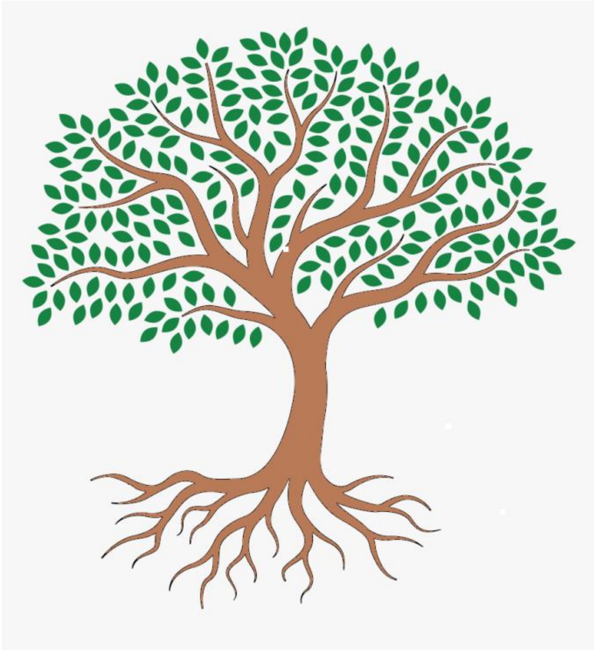
Abbreviation	Full Form	Unit
pH	Potential of Hydrogen	-
B	Boron	mg/kg
Mn	Manganese	mg/kg
Mo	Molybdenum	mg/kg
Fe	Iron	mg/kg
Cu	Copper	mg/kg
Zn	Zinc	mg/kg
Cd	Cadmium	mg/kg
Cr	Chromium	mg/kg
Pb	Lead	mg/kg
Ni	Nickel	mg/kg
As	Arsenic	mg/kg
Co	Cobalt	mg/kg

Values	pH	B	Mn	Mo	Fe	Cu	Zn	Cd	Cr	Pb	Ni	As	Co
Leaves	7.56	21.66	145.27	0.1	639.90	8.14	68.36	0.05	2.58	3.37	3.57	0.17	4.76
Stem	6.28	17.33	102.82	0.1	1480.07	15.94	91.66	0.17	8.96	5.38	3.78	0.19	0.99
Root	5.86	10.40	30.61	0.1	536.80	6.08	64.76	0.07	3.14	3.72	1.17	0.1	0.58
Soil	7.91	0.13	19.68	0.02	6.68	0.34	0.77	0.1	31.21	1.99	10.03	6.75	4.93

- Values of pH, Boron, Manganese, Molybdenum, Iron, Copper Zinc etc. are shown for the different parts of the tree. The values are in mg/kg except for pH.
- The Sample was collected from the forest area in GFRTI campus behind Conferences Hall, Nr. Akshardham, Sector 30, Gandhinagar.
- The analysis of elements / parameters was carried out in GEMI's laboratory, Gandhinagar using ICP-OES.

Diagram showing assimilation of elements in a tree

Diag.1 A (*Diospyros montana*)



Legends

Abbreviation	Full Form	Unit
pH	Potential of Hydrogen	-
B	Boron	mg/kg
Mn	Manganese	mg/kg
Mo	Molybdenum	mg/kg
Fe	Iron	mg/kg
Cu	Copper	mg/kg
Zn	Zinc	mg/kg
Cd	Cadmium	mg/kg
Cr	Chromium	mg/kg
Pb	Lead	mg/kg
Ni	Nickel	mg/kg
As	Arsenic	mg/kg
Co	Cobalt	mg/kg

Values	pH	B	Mn	Mo	Fe	Cu	Zn	Cd	Cr	Pb	Ni	As	Co
Leaves	1.0 X	167.0 X	7.0 X	5.0 X	96.0 X	25.0 X	89.0 X	0.5 X	0.1 X	1.69 X	0.4 X	0.0 X	1.0 X
Stem	0.8 X	133.0 X	5.0 X	5.0 X	222.0 X	47.0 X	119.0 X	2.0 X	0.3 X	3.0 X	0.4 X	0.0 X	0.2 X
Root	0.7 X	80.0 X	1.55 X	5.0 X	80.0 X	18.0 X	84.0 X	0.7 X	0.1 X	2.0 X	0.1 X	0.0 X	0.1 X
Soil	7.91	0.13	19.68	0.02	6.68	0.34	0.77	0.1	31.21	1.99	10.03	6.75	4.93

- X represents Biomagnification/Bioaccumulation in different parts of plant as compared to the corresponding values in soil.
- The values in the box reflect the number of times the assimilation of pH, Boron, Manganese, Molybdenum, Iron, Copper Zinc etc. as compared to values in soil.

Diagram Showing Assimilation of Elements in a Tree

Diag.2 Makrol -2 (*Diospyros montana*)

Legends

Abbreviation	Full Form	Unit
pH	Potential of Hydrogen	-
B	Boron	mg/kg
Mn	Manganese	mg/kg
Mo	Molybdenum	mg/kg
Fe	Iron	mg/kg
Cu	Copper	mg/kg
Zn	Zinc	mg/kg
Cd	Cadmium	mg/kg
Cr	Chromium	mg/kg
Pb	Lead	mg/kg
Ni	Nickel	mg/kg
As	Arsenic	mg/kg
Co	Cobalt	mg/kg

Values	pH	B	Mn	Mo	Fe	Cu	Zn	Cd	Cr	Pb	Ni	As	Co
Leaves	5.93	66.87	188.96	0.1	1778.20	7.12	35.91	0.1	6.13	3.46	3.07	0.5	8.01
Stem	5.64	12.91	63.39	0.1	654.67	8.18	18.93	0.1	4.83	1.48	0.1	0.1	0.79
Root	6.12	11.63	78.90	1.17	2572.45	12.51	10.07	0.1	38.52	3.13	3.52	0.59	1.56
Soil	7.79	34.12	283.92	0.1	12155.74	8.67	27.56	0.1	47.13	5.30	18.12	5.01	7.71

- Values of pH, Boron, Manganese, Molybdenum, Iron, Copper Zinc etc. are shown for the different parts of the tree. The values are in mg/kg except for pH.
- The Sample was collected from the forest area in GFRTI campus behind Conferences Hall, Nr. Akshardham, Sector 30, Gandhinagar.
- The analysis of elements / parameters was carried out in GEMI's laboratory, Gandhinagar using ICP-OES.

Diagram Showing Assimilation of Elements in a Tree

Diag.2 A Makrol – 2 (*Diospyros montana*)

Legends

Abbreviation	Full Form	Unit
pH	Potential of Hydrogen	-
B	Boron	mg/kg
Mn	Manganese	mg/kg
Mo	Molybdenum	mg/kg
Fe	Iron	mg/kg
Cu	Copper	mg/kg
Zn	Zinc	mg/kg
Cd	Cadmium	mg/kg
Cr	Chromium	mg/kg
Pb	Lead	mg/kg
Ni	Nickel	mg/kg
As	Arsenic	mg/kg
Co	Cobalt	mg/kg

Values	pH	B	Mn	Mo	Fe	Cu	Zn	Cd	Cr	Pb	Ni	As	Co
Leaves	0.8X	1.0X	0.66X	1.0X	0.15X	1.0X	1.30X	1.0X	0.13X	0.65X	0.17X	0.1X	1.03X
Stem	0.72X	0.37X	0.22X	1.0X	0.05X	0.94X	0.68X	1.0X	0.10X	0.27X	0.005X	0.001X	0.102X
Root	0.8X	0.34X	0.27X	11.7X	0.21X	1.44X	0.37X	1.0X	0.82X	0.60X	0.20X	0.11X	0.20X
Soil	7.79	34.12	283.92	0.1	12155.74	8.67	27.56	0.1	47.13	5.30	18.12	5.01	7.71

- X represents Biomagnification/Bioaccumulation in different parts of plant as compared to the corresponding values in soil.
- The values in the box reflect the number of times the assimilation of pH,Boron, Manganese, Molybdenum, Iron, Copper Zinc etc. as compared to values in soil.

Diagram Showing Assimilation of Elements in a Tree

Diag.3 Neem (*Azadirachta indica*)

Legends

Abbreviation	Full Form	Unit
pH	Potential of Hydrogen	-
B	Boron	mg/kg
Mn	Manganese	mg/kg
Mo	Molybdenum	mg/kg
Fe	Iron	mg/kg
Cu	Copper	mg/kg
Zn	Zinc	mg/kg
Cd	Cadmium	mg/kg
Cr	Chromium	mg/kg
Pb	Lead	mg/kg
Ni	Nickel	mg/kg
As	Arsenic	mg/kg
Co	Cobalt	mg/kg

Values	pH	B	Mn	Mo	Fe	Cu	Zn	Cd	Cr	Pb	Ni	As	Co
Leaves	5.29	92.79	34.90	0.1	542.69	3.36	20.86	0.1	1.83	2.21	0.1	0.1	0.4
Stem	5.42	11.18	19.31	0.1	460.52	9.655	25.90	0.1	3.44	2.87	0.1	0.1	0.2
Root	6.10	16.72	78.44	0.49	2430.36	15.36	19.56	0.1	30.81	1.95	1.76	0.68	1.56
Soil	7.60	26.73	228.24	0.1	9885.14	8.11	23.6	0.1	38.62	4.05	15.12	3.87	6.18

- Values of pH, Boron, Manganese, Molybdenum, Iron, Copper Zinc etc. are shown for the different parts of the tree. The values are in mg/kg except for pH.
- The Sample was collected from the forest area in GFRTI campus behind Conferences Hall, Nr. Akshardham, Sector 30, Gandhinagar.
- The analysis of elements / parameters was carried out in GEMI's laboratory, Gandhinagar using ICP-OES.

Diagram showing assimilation of elements in a tree

Diag.3 A Neem (*Azadirachta indica*)

Legends

Abbreviation	Full Form	Unit
pH	Potential of Hydrogen	-
B	Boron	mg/kg
Mn	Manganese	mg/kg
Mo	Molybdenum	mg/kg
Fe	Iron	mg/kg
Cu	Copper	mg/kg
Zn	Zinc	mg/kg
Cd	Cadmium	mg/kg
Cr	Chromium	mg/kg
Pb	Lead	mg/kg
Ni	Nickel	mg/kg
As	Arsenic	mg/kg
Co	Cobalt	mg/kg

Values	pH	B	Mn	Mo	Fe	Cu	Zn	Cd	Cr	Pb	Ni	As	Co
Leaves	0.69X	3.47X	0.15X	1.0X	0.05X	0.41X	0.88X	1.0X	0.05X	0.77X	0.006X	0.02X	0.06X
Stem	0.71X	0.42X	0.08X	1.0X	0.04X	1.19X	1.09X	1.0X	0.08X	0.70X	0.006X	0.02X	0.03X
Root	0.80X	0.63X	0.34X	4.9X	0.24X	1.89X	0.82X	1.0X	0.79X	0.48X	0.12X	0.17X	0.25 X
Soil	7.60	26.73	228.24	0.1	9885.14	8.11	23.6	0.1	38.62	4.05	15.12	3.87	6.18

Diagram showing assimilation of elements in a tree

- X represents Biomagnification/Bioaccumulation in different parts of plant as compared to the corresponding values in soil.
- The values in the box reflect the number of times the assimilation of pH,Boron, Manganese, Molybdenum, Iron, Copper Zinc etc. as compared to values in soil.

Diag.4 Karanj *(Pongamia pinnata)*

Legends

Abbreviation	Full Form	Unit
pH	Potential of Hydrogen	-
B	Boron	mg/kg
Mn	Manganese	mg/kg
Mo	Molybdenum	mg/kg
Fe	Iron	mg/kg
Cu	Copper	mg/kg
Zn	Zinc	mg/kg
Cd	Cadmium	mg/kg
Cr	Chromium	mg/kg
Pb	Lead	mg/kg
Ni	Nickel	mg/kg
As	Arsenic	mg/kg
Co	Cobalt	mg/kg

Values	pH	B	Mn	Mo	Fe	Cu	Zn	Cd	Cr	Pb	Ni	As	Co
Leaves	7.71	77.75	55.71	0.2	941.02	13.57	48.60	0.1	5.68	3.46	1.44	0.38	0.77
Stem	6.35	18.50	24.64	0.1	861.86	10.78	24.54	0.1	6.33	3.36	0.1	0.2	0.5
Root	6.06	12.41	38.82	0.2	916.08	13.50	18.27	0.1	12.51	1.6	0.1	0.3	1.1
Soil	8.12	36.48	245.1	0.1	10500.87	10.4	28.74	0.1	58.06	3.63	21.87	5.2	8.63

- Values of pH, Boron, Manganese, Molybdenum, Iron, Copper Zinc etc. are shown for the different parts of the tree. The values are in mg/kg except for pH.
- The Sample was collected from the forest area in GFRTI campus behind Conferences Hall, Nr. Akshardham, Sector 30, Gandhinagar.
- The analysis of elements / parameters was carried out in GEMI's laboratory, Gandhinagar using ICP-OES.

Diagram showing assimilation of elements in a tree

Diag.4 A Karanj*(Pongamia pinnata)*

ISSN: 2319-7064
SJIF (2022): 7.942

Legends

Abbreviation	Full Form	Unit
pH	Potential of Hydrogen	-
B	Boron	mg/kg
Mn	Manganese	mg/kg
Mo	Molybdenum	mg/kg
Fe	Iron	mg/kg
Cu	Copper	mg/kg
Zn	Zinc	mg/kg
Cd	Cadmium	mg/kg
Cr	Chromium	mg/kg
Pb	Lead	mg/kg
Ni	Nickel	mg/kg
As	Arsenic	mg/kg
Co	Cobalt	mg/kg

Values	pH	B	Mn	Mo	Fe	Cu	Zn	Cd	Cr	Pb	Ni	As	Co
Leaves	0.21X	2.13X	0.22X	1.92X	0.08X	1.30X	1.69X	1.0X	0.09X	0.95X	0.06X	0.07X	0.08X
Stem	0.78X	0.50X	0.1X	1.0X	0.08X	1.03X	0.85X	1.0X	0.11X	0.92X	0.004X	0.03X	0.05X
Root	0.74X	0.34X	0.15X	2.0X	0.08X	1.29X	0.6X	1.0X	0.21X	0.44X	0.004X	0.05X	0.12 X
Soil	8.12	36.48	245.1	0.1	10500.87	10.4	28.74	0.1	58.06	3.63	21.87	5.2	8.63

Diagram showing assimilation of elements in a tuft of grass

- X represents Biomagnification/Bioaccumulation in different parts of plant as compared to the corresponding values in soil.
- The values in the box reflect the number of times the assimilation of pH,Boron, Manganese, Molybdenum, Iron, Copper Zinc etc. as compared to values in soil.

Diag.5 Dharo*(Cynodon dactylon)*

Legends

Abbreviation	Full Form	Unit
pH	Potential of Hydrogen	-
B	Boron	mg/kg
Mn	Manganese	mg/kg
Mo	Molybdenum	mg/kg
Fe	Iron	mg/kg
Cu	Copper	mg/kg
Zn	Zinc	mg/kg
Cd	Cadmium	mg/kg
Cr	Chromium	mg/kg
Pb	Lead	mg/kg
Ni	Nickel	mg/kg
As	Arsenic	mg/kg
Co	Cobalt	mg/kg

Values	pH	B	Mn	Mo	Fe	Cu	Zn	Cd	Cr	Pb	Ni	As	Co
Tuft	**7.09**	3.32	18.96	0.1	844.27	17.78	68.36	0.03	4.29	5.86	2.73	0.19	0.58
Root	7.26	13.93	247.10	0.1	7668.69	21.0	121.09	0.1	29.24	4.90	14.52	2.15	5.10
Soil	8.62	0.06	16.08	0.05	6.06	0.80	0.58	0.1	29.69	3.01	11.53	2.71	5.58

- Values of pH, Boron, Manganese, Molybdenum, Iron, Copper Zinc etc. are shown for the different parts of the tree.The values are in mg/kg except for pH.
- The Sample was collected from the forest area in GFRTI campus behind Conferences Hall, Nr. Akshardham, Sector 30, Gandhinagar.
- The analysis of elements / parameters was carried out in GEMI's laboratory, Gandhinagar using ICP-OES.

Diagram showing assimilation of elements in a tuft of grass

Diag.5 A Dharo*(Cynodon dactylon)*

Paper ID: SR211126172614 DOI: 10.21275/SR211126172614

Legends

Abbreviation	Full Form	Unit
pH	Potential of Hydrogen	-
B	Boron	mg/kg
Mn	Manganese	mg/kg
Mo	Molybdenum	mg/kg
Fe	Iron	mg/kg
Cu	Copper	mg/kg
Zn	Zinc	mg/kg
Cd	Cadmium	mg/kg
Cr	Chromium	mg/kg
Pb	Lead	mg/kg
Ni	Nickel	mg/kg
As	Arsenic	mg/kg
Co	Cobalt	mg/kg

Values	pH	B	Mn	Mo	Fe	Cu	Zn	Cd	Cr	Pb	Ni	As	Co
Tuft	**0.82 X**	**55 X**	**1.17 X**	**2.0 X**	**139.31 X**	**22.22 X**	**117.8 X**	**0.3 X**	**0.14 X**	**1.94 X**	**0.2X**	**0.0 7X**	**0.10 X**
Root	**0.84 X**	**232.0 X**	**15.36 X**	**2.0 X**	**1265.4 X**	**26.25 X**	**208.7 X**	**1.0 X**	**0.98 X**	**1.6 X**	**1.25 X**	**0.79 X**	**0.91 X**
Soil	8.62	0.06	16.08	0.05	6.06	0.80	0.58	0.1	29.69	3.01	11.53	2.71	5.58

- X represents Biomagnification/Bioaccumulation in different parts of plant as compared to the corresponding values in soil.
- The values in the box reflect the number of times the assimilation of pH,Boron, Manganese, Molybdenum, Iron, Copper Zinc etc. as compared to values in soil.

Results and its analysis

Table 1: Analysis of Soil, Roots, Stem and Leaves Parameter of Plant (Makrol 1)

Sr. No	Parameter	Unit	Actual Values (in mg/kg)			
			Soil value (mg/kg)	Root value (mg/kg)	Stem value (mg/kg)	Leaves value (mg/kg)
1	pH	-	7.91	5.86	6.28	7.56
2	Boron as B	mg/kg	0.13	10.40	17.33	21.66
3	Manganese as Mn	mg/kg	19.68	30.61	102.82	145.27
4	Molybdenum as Mo	mg/kg	0.02	BDL	BDL	BDL
5	Iron as Fe	mg/kg	6.68	536.80	1480.07	639.90

6	Copper as Cu	mg/kg	0.34	6.08	15.94	8.14
7	Zinc as Zn	mg/kg	0.77	64.76	91.66	68.36
8	Cadmium as cd	mg/kg	BDL	0.07	0.17	0.05
9	Chromium as Cr	mg/kg	31.21	3.14	8.96	2.58
10	Lead as Pb	mg/kg	1.99	3.72	5.38	3.37
11	Nickel as Ni	mg/kg	10.03	1.17	3.78	3.57
12	Arsenic as As	mg/kg	6.75	BDL	0.19	0.17
13	Cobalt as Co	mg/kg	4.93	0.58	0.99	4.76
14	Conductivity	µs/cm	362			
15	Available Nitrogen	%	0.030			
16	Organic Carbon	%	0.849			
17	Water Content (Water Moisture)	%	7.69			
18	Bulk Density	mg/m^3	1.19			
19	Available Phosphorous	Kg/ Hectare	BDL			
20	Available Potassium	Kg/ Hectare	457.7			

(Analysis done by Gujarat Environment Management Institute's Laboratory)

Table 2: Analysis of Soil, Roots, Stem and Leaves Parameter of Plant (Makrol 2)

Sr. No	Parameter	Unit	Actual Values (in mg/kg)			
			Soil value (mg/kg)	Root value (mg/kg)	Stem value (mg/kg)	Leaves value (mg/kg)
1	pH	-	7.79	6.12	5.64	5.93
2	Boron as B	mg/kg	34.117	11.634	12.914	66.877
3	Manganese as Mn	mg/kg	283.924	78.901	63.387	188.959
4	Molybdenum as Mo	mg/kg	BDL	1.173	**BDL**	0.098
5	Iron as Fe	mg/kg	12155.744	2572.448	654.672	1778.195
6	Copper as Cu	mg/kg	8.673	12.514	8.182	7.123
7	Zinc as Zn	mg/kg	27.563	10.070	18.927	35.912
8	Cadmium as cd	mg/kg	BDL	**BDL**	**BDL**	**BDL**
9	Chromium as Cr	mg/kg	47.127	38.521	4.830	6.133
10	Lead as Pb	mg/kg	5.300	3.128	1.478	3.462
11	Nickel as Ni	mg/kg	18.118	3.519	**BDL**	3.066
12	Arsenic as As	mg/kg	5.011	0.586	**BDL**	0.494
13	Cobalt as Co	mg/kg	7.710	1.564	0.788	8.013
14	Conductivity	µs/cm	444			
15	Available Nitrogen	%	0.031			
16	Organic Carbon	%	0.947			
17	Water Content (Water Moisture)	%	3.12			
18	Bulk Density	mg/m^3	1.47			
19	Available Phosphorous	Kg/ Hectare	1.88			
20	Available Potassium	Kg/ Hectare	407.5			

Table 3: Analysis of Soil, Roots, Stem and Leaves Parameter of Plant (Neem)

Sr. No	Parameter	Unit	Actual Values (in mg/kg)			
			Soil value (mg/kg)	Root value (mg/kg)	Stem value (mg/kg)	Leaves value (mg/kg)
1	pH	-	7.60	6.10	5.42	5.29
2	Boron as B	mg/kg	26.733	16.725	11.185	92.788
3	Manganese as Mn	mg/kg	228.244	78.442	19.31	34.903
4	Molybdenum as Mo	mg/kg	**BDL**	0.489	0.0956	**BDL**
5	Iron as Fe	mg/kg	9885.140	2430.359	460.516	542.692
6	Copper as Cu	mg/kg	8.112	15.356	9.655	3.365
7	Zinc as Zn	mg/kg	23.598	19.561	25.90	20.865
8	Cadmium as cd	mg/kg	**BDL**	0.097	**BDL**	**BDL**
9	Chromium as Cr	mg/kg	38.624	30.809	3.441	1.826
10	Lead as Pb	mg/kg	4.056	1.956	2.868	2.211
11	Nickel as Ni	mg/kg	15.117	1.760	**BDL**	**BDL**
12	Arsenic as As	mg/kg	3.871	0.684	**BDL**	0.096
13	Cobalt as Co	mg/kg	6.176	1.564	0.191	0.384
14	Conductivity	µs/cm	573			
15	Available Nitrogen	%	0.037			
16	Organic Carbon	%	1.674			
17	Water Content (Water Moisture)	%	3.53			
18	Bulk Density	mg/m^3	1.31			
19	Available Phosphorous	Kg/ Hectare	2.90			
20	Available Potassium	Kg/ Hectare	660.0			

Table 4: Analysis of Soil, Roots, Stem and Leaves Parameter of Plant (Karanj)

Sr. No	Parameter	Unit	Actual Values (in mg/kg)			
			Soil value (mg/kg)	Root value (mg/kg)	Stem value (mg/kg)	Leaves value (mg/kg)
1	pH	-	8.12	6.06	6.35	7.71
2	Boron as B	mg/kg	36.484	12.410	18.503	77.752
3	Manganese as Mn	mg/kg	245.096	38.820	24.638	55.715
4	Molybdenum as Mo	mg/kg	**BDL**	0.198	**BDL**	0.192
5	Iron as Fe	mg/kg	10500.873	916.079	861.864	941.020
6	Copper as Cu	mg/kg	10.396	13.502	10.785	13.568
7	Zinc as Zn	mg/kg	28.736	18.268	24.539	48.595
8	Cadmium as cd	mg/kg	**BDL**	**BDL**	**BDL**	**BDL**
9	Chromium as Cr	mg/kg	58.061	12.509	6.332	5.677
10	Lead as Pb	mg/kg	3.628	1.588	3.364	3.464
11	Nickel as Ni	mg/kg	21.871	**BDL**	**BDL**	1.443
12	Arsenic as As	mg/kg	5.198	0.297	0.197	0.384
13	Cobalt as Co	mg/kg	8.630	1.092	0.494	0.769
14	Conductivity	µs/cm	320			
15	Available Nitrogen	%	0.029			
16	Organic Carbon	%	0.022			
17	Water Content (Water Moisture)	%	2.45			
18	Bulk Density	mg/m^3	1.47			
19	Available Phosphorous	Kg/ Hectare	1.92			
20	Available Potassium	Kg/ Hectare	494.4			

Table 5: Analysis of Soil, Roots and Tuft Parameter of Grass

Sr. No	Parameter	Unit	Actual Values (in mg/kg)		
			Soil value(mg/kg)	Root value(mg/kg)	Tuft value(mg/kg)
1	pH	-	8.62	7.26	7.09
2	Boron as B	mg/kg	0.06	13.93	3.32
3	Manganese as Mn	mg/kg	16.08	247.10	80.69
4	Molybdenum as Mo	mg/kg	0.05	BDL	BDL
5	Iron as Fe	mg/kg	6.06	7668.69	844.27
6	Copper as Cu	mg/kg	0.80	21.00	17.78
7	Zinc as Zn	mg/kg	0.58	121.09	175.65
8	Cadmium as cd	mg/kg	BDL	BDL	0.03
9	Chromium as Cr	mg/kg	29.65	29.24	4.29
10	Lead as Pb	mg/kg	3.01	4.90	5.86
11	Nickel as Ni	mg/kg	11.53	14.52	2.73
12	Arsenic as As	mg/kg	2.71	2.15	0.19
13	Cobalt as Co	mg/kg	5.58	5.10	0.58
14	Conductivity	µs/cm	322		
15	Available Nitrogen	%	0.017		
16	Organic Carbon	%	0.308		
17	Water Content (Water Moisture)	%	7.96		
18	Bulk Density	mg/m^3	1.25		
19	Available Phosphorous	Kg/ Hectare	2.26		
20	Available Potassium	Kg/ Hectare	835.8		

(Analysis done by Gujarat Environment Management Institute's Laboratory)

3. Inferences

3.1 About Tree

Makrol 1

From the analysis of various parts of the plant and grass, the following inferences can be drawn: -

1) The pH in the soil is more than that in root, stem and leaves
2) The low pH in the roots of plant (5.86) causes a good absorption of Boron, Mn, Iron, Copper, Zinc, Lead etc.
3) The roots, the stem and leaves of the plant show lower value of Chromium as compared to that in the soil. The value infact are 70 To 90% lower in roots, stems and leaves
4) The uptake of nickel is also 70 to 90 % low in roots, stems and leaves.
5) Arsenic levels are recorded to be very low in root, stems and leaves as compared to that in the soil
6) Cobalt also witnessed reduction in root and stem though quite substantial amount was found in leaves.

From the above it is clear that due to lower value of pH in the root, stem and leaves as compared to soil, the absorption of trace metals is quite substantial.

- The value of Boron goes up from 10.40 in root to 17.33in stem and to 21.66 in leaves.

- The value of Mn goes up from 30.61in root to 10.82 in stem and to 145.27 in leaves.
- The value of Molybdenum remains same as in from 0.1in root to 0.1in stem and to 0.1 in leaves.
- The value of Iron goes up from536.80 in root to 1480.07 in stem and comes down to 639.90 in leaves.
- The value of Copper goes up from 6.08 in root to 15.94 in stem and comes down to 8.41 in leaves.
- The value of Zinc goes up from 64.76 in root to 91.66 in stem and comes down to 68.36 in leaves.
- The value of Cadmium goes up from 0.07 in rootto 0.17 in stem and comes down to 0.05 in leaves.
- The value of Chromium goes up from 3.14 in root to 8.96 in stem and to 2.58 in leaves.
- The value of Lead goes up from 3.72 in root to 5.38 in stem and comes down to 3.37 in leaves.
- The value of Nickel goes up from1.17 in root to 3.78 in stem and to 3.57 in leaves.
- The value of Arsenic goes up from 0.1 in root to 0.19 in stem and comes down to 0.17 in leaves.
- The value of Cobalt goes up from 0.58 in root to 0.99 in stem and to 4.76 in leaves.

Interesting aspect is that the plant rejects uptake of Chromium, nickel, arsenic and cobalt (to some extent). This is due to the fact that the four trace metal turn toxic at certain levels. Since they are not of utility to the plant for growth, the plants reject them.

From the above it is clear that to determine the content of various trace metals in the soil, the analysis of leaves alone is enough and sufficient.

Makrol 2

From the analysis of various parts of the plant and grass, the following inferences can be drawn: -

1) The pH in the soil is more than that in root, stem and leaves
2) The low pH in the roots of plant (6.12) causes a good absorption of Boron, Mn, Iron, Copper, Zinc, Lead etc.
3) The roots, the stem and leaves of the plant show lower value of Chromium as compared to that in the soil. The value in fact are 70 To 90% lower in roots, stems and leaves
4) The uptake of nickel is also 70 to 90 % low in roots, stems and leaves.
5) Arsenic levels are recorded to be very low in root, stems and leaves as compared to that in the soil
6) Cobalt also witnessed reduction in root and stem though quite substantial amount was found in leaves.

From the above it is clear that due to lower value of pH in the root, stem and leaves as compared to soil, the absorption of trace metals is quite substantial.

- The value of Boron goes up from 11.6 in root to 12.9in stem and to 66.8in leaves.
- The value of Mn goes up from 78.9in root and comes down to63.38in stem and goes up from 188.9in leaves.
- The value of Molybdenum comes down from 1.173 in root to 0.1in stem and to 0.09in leaves.
- The value of Iron goes up from 2572.4 in root and comes down to 654.6in stem goes up to1778.19in leaves.
- The value of Copper comes down from 12.51 in root to 8.18in stem to 7.12in leaves.
- The value of Zinc goes up from 10.07 in root to 18.92in stem to 35.91in leaves.
- The value of Cadmium remains same as in from 0.1 in root to 0.1 in stem and comes down to 0.1in leaves.
- The value of Chromium comes down from 38.5 in root to 4.83 in stem and goes up to 6.13in leaves.
- The value of Lead comes down from 3.12 in root to 1.47in stem and goes up to 3.46 in leaves.
- The value of Nickel goes up from 1.17 in root to 3.78 in stem and to 3.57 in leaves.
- The value of Arsenic comes down from 0.58 in root to 0.1in stem and goes up to 0.4in leaves.
- The value of Cobalt comes down from 1.5 in root to 0.78in stem and goes up to 8.01in leaves.

Interesting aspect is that the plant rejects uptake of Chromium, nickel, arsenic and cobalt (to some extent). This is due to the fact that the four trace metal turn toxic at certain levels. Since they are not of utility to the plant for growth, the plants reject them.

From the above it is clear that to determine the content of various trace metals in the soil, the analysis of leaves alone is enough and sufficient.

Neem

From the analysis of various parts of the plant and grass, the following inferences can be drawn: -

1) The pH in the soil is more than that in root, stem and leaves
2) The low pH in the roots of plant (6.10) causes a good absorption of Boron, Mn, Iron, Copper, Zinc, Lead etc.
3) The roots, the stem and leaves of the plant show lower value of Chromium as compared to that in the soil. The value in fact are 70 To 90% lower in stems and leaves

The uptake of nickel is also 70 to 90 % low in roots, stems and leaves.

4)

5) Arsenic levels are recorded to be very low in root, stems and leaves as compared to that in the soil
6) Cobalt also witnessed reduction in root and stem though quite substantial amount was found in leaves.

From the above it is clear that due to lower value of pH in the root, stem and leaves as compared to soil, the absorption of trace metals is quite substantial.

- The value of Boron comes down from 16.7 in root to 11.18in stem and goes up to 92.78in leaves.
- The value of Mn comes down from 78.4in root to 19.31in stem and goes up to 34.90in leaves.
- The value of Molybdenum comes down from 0.4in root to 0.09in stem and goes up to 0.1 in leaves.
- The value of Iron comes down from 2430.35 in root to 460.51in stem and goes up to 542.69in leaves.
- The value of Copper comes down from 15.35 in root to 9.65in stem and to 3.36in leaves.
- The value of Zinc goes up from 19.56 in root to 25.90in stem and comes down to 20.86in leaves.
- The value of Cadmium goes up from 0.09 in root to 0.1 in stem to 0.1in leaves.
- The value of Chromium comes down from 13.80 in root to 3.44in stem and to 1.82in leaves.
- The value of Lead goes up from 1.95 in root to 2.86in stem and comes down to 2.2in leaves.
- The value of Nickel comes down from 1.76 in root to 0.1in stem and to 0.1in leaves.
- The value of Arsenic goes up from 0.1 in root to 0.19 in stem and comes down to 0.17 in leaves.
- The value of Cobalt goes up from 0.58 in root to 0.99 in stem and to 4.76 in leaves.

Interesting aspect is that the plant rejects uptake of Chromium, nickel, arsenic and cobalt (to some extent). This is due to the fact that the four trace metal turn toxic at certain levels. Since they are not of utility to the plant for growth, the plants reject them.

From the above it is clear that to determine the content of various trace metals in the soil, the analysis of leaves alone is enough and sufficient.

Karanj

From the analysis of various parts of the plant and grass, the following inferences can be drawn: -

1) The pH in the soil is more than that in root, stem and leaves
2) The low pH in the roots of plant (6.06) causes a good absorption of Boron, Mn, Iron, Copper, Zinc, Lead etc.
3) The roots, the stem and leaves of the plant show lower value of Chromium as compared to that in the soil. The value infact are 70 To 90% lower in roots, stems and leaves
4) The uptake of nickel is also 70 to 90 % low in roots, stems and leaves.
5) Arsenic levels are recorded to be very low in root, stems and leaves as compared to that in the soil
6) Cobalt also witnessed reduction in root and stem though quite substantial amount was found in leaves.

From the above it is clear that due to lower value of pH in the root, stem and leaves as compared to soil, the absorption of trace metals is quite substantial.

- The value of Boron goes up from 12.41 in root to 18.5in stem and to 77.7in leaves.
- The value of Mn comes down from 38.8in root to 24.6in stem and goes up to 55.71in leaves.
- The value of Molybdenum remains same as in from 0.19 in root to 0.1in stem and to 0.19in leaves.
- The value of Iron comes down from 916.07 in root to 861.86in stem and goes up to 941.02in leaves.
- The value of Copper comes down from 13.50 in root to 10.78in stem and goes up to 13.56in leaves.
- The value of Zinc goes up from 18.26 in root to 24.53in stem and to 48.59in leaves.
- The value of Cadmium remains same as in from 0.1 in root to 0.1 in stem and comes down to 0.1in leaves.
- The value of Chromium comes down from 12.50 in root to 6.33in stem and to 5.67in leaves.
- The value of Lead goes up from 1.58 in root to 3.36in stem and comes down to 3.46in leaves.
- The value of Nickel goes up from 0.1 in root to 0.1in stem and to 1.44in leaves.
- The value of Arsenic comes down from 0.29 in root to 0.19 in stem and goes up to 0.38in leaves.
- The value of Cobalt comes down from 1.09 in root to 0.49in stem and goes up to 0.76in leaves.

Interesting aspect is that the plant rejects uptake of Chromium, nickel, arsenic and cobalt (to some extent). This is due to the fact that the four trace metal turn toxic at certain levels. Since they are not of utility to the plant for growth, the plants reject them.

From the above it is clear that to determine the content of various trace metals in the soil, the analysis of leaves alone is enough and sufficient.

The values so obtained from the analysis of different parts of plants including Leaves may be determined by the following rounded factor: -(Makrol 1)

Sr. No	Parameter	Unit	Magnification (No of Times)			
			Soil value(mg/kg)	Root value (mg/kg)	Stem value (mg/kg)	Leaves value (mg/kg)
1	pH	-	8.0	0.7 X	0.8 X	1.0 X
2	Boron as B	mg/kg	0.1	80.0 X	133.0 X	167.0 X
3	Manganese as Mn	mg/kg	20.0	155.0 X	5.0 X	7.0 X
4	Molybdenum as Mo	mg/kg	0.0	5.0 X	5.0 X	5.0 X
5	Iron as Fe	mg/kg	7.0	80.0 X	222.0 X	96.0 X
6	Copper as Cu	mg/kg	0.3	18.0 X	47.0 X	25.0 X
7	Zinc as Zn	mg/kg	0.8	84.0 X	119.0 X	89.0 X
8	Cadmium as cd	mg/kg	0.1	0.7 X	2.0 X	0.5 X

Paper ID: SR211126172614 DOI: 10.21275/SR211126172614

9	Chromium as Cr	mg/kg	31.0	0.1 X	0.3 X	0.1 X
10	Lead as Pb	mg/kg	2.0	2.0 X	3.0 X	3.0 X
11	Nickel as Ni	mg/kg	10.0	0.1 X	0.4 X	0.4 X
12	Arsenic as As	mg/kg	7.0	0.0 X	0.0X	0.0 X
13	Cobalt as Co	mg/kg	5.0	0.1 X	0.2 X	1.0 X

* X in above table implies, the number of times the value gets magnified.

The values so obtained from the analysis of different parts of plants including Leaves may be determined by the following rounded factor: - (Makrol 2)

Sr. No	Parameter	Unit	Magnification (No of Times)			
			Soil value(mg/kg)	Root value (mg/kg)	Stem value (mg/kg)	Leaves value (mg/kg)
1	pH	-	7.79	0.8X	0.72X	0.8 X
2	Boron as B	mg/kg	34.12	0.34X	0.37X	1.0X
3	Manganese as Mn	mg/kg	283.92	0.27X	0.22X	0.66 X
4	Molybdenum as Mo	mg/kg	0.1	11.7X	1.0X	1.0 X
5	Iron as Fe	mg/kg	12155.74	0.21X	0.05X	0.15 X
6	Copper as Cu	mg/kg	8.67	1.44X	0.94X	1.0 X
7	Zinc as Zn	mg/kg	27.56	0.37X	0.68X	1.30 X
8	Cadmium as cd	mg/kg	0.1	1.0X	1.0X	1.0 X
9	Chromium as Cr	mg/kg	47.13	0.82X	0.10X	0.13 X
10	Lead as Pb	mg/kg	5.30	0.60 X	0.27X	0.56 X
11	Nickel as Ni	mg/kg	18.12	0.20X	0.005X	0.17 X
12	Arsenic as As	mg/kg	5.01	0.11X	0.01X	0.1 X
13	Cobalt as Co	mg/kg	7.71	0.20X	0.10X	1.03 X

* X in above table implies, the number of times the value gets magnified.

The values so obtained from the analysis of different parts of plants including Leaves may be determined by the following rounded factor: - (Neem)

Sr. No	Parameter	Unit	Magnification (No of Times)			
			Soil value(mg/kg)	Root value (mg/kg)	Stem value (mg/kg)	Leaves value (mg/kg)
1	pH	-	7.60	0.80X	0.71X	0.69X
2	Boron as B	mg/kg	26.73	0.63X	0.42X	3.47X
3	Manganese as Mn	mg/kg	228.24	0.34X	0.08X	0.15X
4	Molybdenum as Mo	mg/kg	0.1	4.9X	1.0X	1.0X
5	Iron as Fe	mg/kg	9885.14	0.24X	0.04X	0.05X
6	Copper as Cu	mg/kg	8.11	1.89X	1.19X	0.41X
7	Zinc as Zn	mg/kg	23.6	0.82X	1.09X	0.88X
8	Cadmium as cd	mg/kg	0.1	1.0X	1.0X	1.0X
9	Chromium as Cr	mg/kg	38.62	0.79X	0.08X	0.05X
10	Lead as Pb	mg/kg	4.05	0.48 X	0.70X	0.77X
11	Nickel as Ni	mg/kg	15.12	0.12 X	0.006X	0.006X
12	Arsenic as As	mg/kg	3.87	0.17X	0.02X	0.02X
13	Cobalt as Co	mg/kg	6.18	0.25X	0.03 X	0.06 X

* X in above table implies, the number of times the value gets magnified.

The values so obtained from the analysis of different parts of plants including Leaves may be determined by the following rounded factor: - (Karanj)

Sr. No	Parameter	Unit	Magnification (No of Times)			
			Soil value(mg/kg)	Root value (mg/kg)	Stem value (mg/kg)	Leaves value (mg/kg)
1	pH	-	8.12	0.74X	0.78X	0.21X
2	Boron as B	mg/kg	36.48	0.34X	0.50X	2.13X
3	Manganese as Mn	mg/kg	245.1	0.15X	0.1X	0.22X
4	Molybdenum as Mo	mg/kg	0.1	2.0X	1.0X	1.92X
5	Iron as Fe	mg/kg	10500.87	0.08X	0.08X	0.08X
6	Copper as Cu	mg/kg	10.4	1.29X	1.03X	1.30X
7	Zinc as Zn	mg/kg	28.74	0.6X	0.85X	1.69X
8	Cadmium as cd	mg/kg	0.1	1.0X	1.0X	1.0X
9	Chromium as Cr	mg/kg	58.06	0.21X	0.11X	0.09X
10	Lead as Pb	mg/kg	3.63	0.44X	0.92 X	0.95X
11	Nickel as Ni	mg/kg	21.87	0.004X	0.004 X	0.06X
12	Arsenic as As	mg/kg	5.2	0.05X	0.03X	0.07X
13	Cobalt as Co	mg/kg	8.63	0.12X	0.05 X	0.08X

* X in above table implies, the number of times the value gets magnified.

3.2 About Grass

- The value of Boron comes down from 13.93 in root to 3.32 in Tuft of Grass.
- The value of Mn comes down from 247.10 root to 80.69 in Tuft of Grass.
- The value of Molybdenum remains same as in from 0.1in root to 0.1 in Tuft of Grass.
- The value of Iron comes down from 7668.89 in root to 844.27 in Tuft of Grass.
- The value of Copper comes down from 21.00 in root to 17.78 in Tuft of Grass.
- The value of Zinc goes up from 121.09 in root to 175.65 in Tuft of Grass.
- The value of Cadmium comes down from 0.1 in root to 0.03 in Tuft of Grass.
- The value of Chromium comes down from 29.24 in root to 4.29 in Tuft of Grass.
- The value of Lead goes up from 4.90 in root to 5.86 in Tuft of Grass.
- The value of Nickel comes down from 14.52 in root to 2.73 in Tuft of Grass.
- The value of Arsenic comes down from 2.15 in root to 0.19 in Tuft of Grass.
- The value of Cobalt comes down from 5.10 in root to 0.58 in Tuft of Grass.

In grass analysis, as in tree, the interesting aspect is that the grass rejects uptake of chromium, iron, nickel, arsenic, boron, copper, cadmium, and cobalt (to some extent). This is due to fact that this trace metal turn toxic at certain levels and since they are not of utility to the grass for growth, the grass reject them.

From the above analysis also, it is clear that in grass as well the analysis of tuft of grass alone is enough and sufficient to determine amount of trace metals in soil.

The values so obtained from the analysis of root and tuft of grasshave been tabulated below after rounding off.

Sr. No	Parameter	Unit	Magnification (No of Times)		
			Soil value (mg/kg)	Root value (mg/kg)	Tuft value (mg/kg)
1	pH	-	9.0	0.9 X	0.8 X
2	Boron as B	mg/kg	0.0	232.0 X	55.0 X
3	Manganese as Mn	mg/kg	16.08	15.0 X	1.2 X
4	Molybdenum as Mo	mg/kg	0.0	2.0 X	2.0 X
5	Iron as Fe	mg/kg	6.06	1265.0 X	139.0 X
6	Copper as Cu	mg/kg	0.8	26.0 X	22.0 X
7	Zinc as Zn	mg/kg	0.6	209.0 X	118.0 X
8	Cadmium as cd	mg/kg	0.1	1.0 X	0.3 X
9	Chromium as Cr	mg/kg	30.0	1.0 X	0.1 X
10	Lead as Pb	mg/kg	3.0	2.0 X	2.0 X
11	Nickel as Ni	mg/kg	12.0	1.3 X	0.2 X
12	Arsenic as As	mg/kg	2.7	0.8 X	0.1 X
13	Cobalt as Co	mg/kg	5.6	0.9 X	0.1 X

4. Conclusion

The plant and grass uptake minerals which are beneficial to their parts and eliminates the minerals which cause toxicity to them. The concentration of minerals present in the soil is minimum, average in the root and stem and then increases about 100 times in leaves, except for the minerals that are toxic to the plants such as Arsenic, Nickel, Chromium and Cadmium. And for grasses, the concentration of minerals present in root is maximum and then decreases in tuft of the grass except for the mineral that are toxic to grass such as lead and Zinc.

Feasibility of use of plant technique for prognostication of minerals in soil

While mineral prognostication is carried out in the field of mining for ascertaining the amount of mineral present in soil. Especially, for surface mining, only the Laboratory analysis of leaves or different part of the plants is sufficient for carrying out such prognostication and the benefit of such exercise would be as follows.

1) It saves time required for carrying out detailed analysis and investigation of soil.
2) Tree and its various plant would act as an indicator for the mineral quantity present in the soil and even rock.
3) It would be a cheaper exercise saving one a lot of money.
4) Does not employ expensive technologies except those required in laboratory analysis. It can be carried out at different location, which may be representative area of larger locations.

The use of this methodology of prognostication using tree, grass tuft as an indicator may therefore, save time, energy and money. The methodology has a scope to be used as a method for prognostication of minerals in soil.

References

[1] Bünemann EK, Bongiorno G, Bai Z, Creamer RE, De Deyn G, de Goede R, Fleskens L, Geissen V, Kuyper TW, Mäder P, Pulleman M. Soil quality–A critical review. Soil Biology and Biochemistry, 2018, **120,** 105-125.

[2] Blatt, Harvey; Middleton, Gerard; Murray, Raymond, Origin of sedimentary rocks, (1980), **2** 245–246.

[3] Blatt, H., Middleton, G.V. and Murray, R.C, Origin of sedimentary rocks, 1972

[4] 4.Wilschefski SC, Baxter MR, inductively coupled plasma mass spectrometry: introduction to analytical aspects. The Clinical Biochemist Reviews, 2019, 40**(3),** 115–133.

[5] Takeda, A., Tsukada, H., Takaku, Y., Hisamatsu, S.I., Inaba, J. and Nanzyo, M., 2006. Extractability of major and trace elements from agricultural soils using chemical extraction methods: application for phytoavailability assessment, Soil Science & Plant Nutrition**,** 52**(4)**, 406-417.