Original Research Paper

Volume-9 | Issue-5 | May-2019 | PRINT ISSN No 2249 - 555X

Engineering

ESTIMATION OF METALS IN PLANTS

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ABSTRACT Accurate monitoring of metal concentration in soils and plants is essential as this plays a very significant role in various physiological processes in plants. Their presence at particular concentration level is a must to complete the life cycles. These roles of various metals are wide ranging from very simple to highly complex and almost all of them are fairly specific for a given nutrient. The beneficial effects of micronutrients stem from their involvement in redox processes, carbohydrate and nitrogen metabolism as well as exchanging the resistance of plants to diseases and adverse environmental conditions. Micronutrients increase the chlorophyll content in leaves, improve photosynthesis and intensify the assimilating activity of the whole plant. Many micronutrients are constituent parts of the active centres of enzymes and vitamins. Deficiency of these micronutrients is responsible for a number of plant diseases and often causes crops to perish. Their deficiency disrupts those processes for which that nutrient is essential, with the result that plant growth, development, yield and quality suffer. In a majority of cases certain characteristic deficiency symptoms occur on various plant parts.

KEYWORDS : Spinacia Oleracea and Trigonila Foenum Graecum

1.0 Introduction:

Soil and plant samples from two industrial areas of Jaipur namely Sanganer industrial area and vishwakarma industrial area have been analyzed for zinc, lead, cobalt and nickel. Results of the Voltammetric study of the reduction of these metals in various supporting electrolytes under different experimental conditions were used for their estimation at levels ranging from micrograms to pictograms per ml. Zinc is an essential trace element which is required by all plants and also by human beings. Its essentiality to plants was established by Sommer and Lipman in 1926. It is essential component of a variety of dehydrogenase, proteinase and peptidases. Lead is a deadly poisonous metal both for plants as well as for human beings. It is used in automobile, exhausts etc in various forms. Lead as such or in the form of its compounds is used in a number of industries and domestic applications. The metal is also used in agriculture in form of pesticide lead arsenate. Cobalt is an essential trace element for plants which is involved in nitrogen fixation and other important physiological processes. It alters the ultras structure of the nitrogen fixing apparatus so that bacteroids remain actively functional for a longer period of time. Capsules around bacteroids take shape earlier and keep longer. Nickel is involved in various physiological processes in plants. Growth of plant, yielded and quality of the food products are affected by this element. It also stabilizes coiled ribosome. At higher concentration nickel causes highly toxic effects. Nickel is involved in various physiological processes in plants. Growth of plant, yielded and quality of the food products are affected by this element. It also stabilizes coiled ribosome. At higher concentration nickel causes highly toxic effects.

Table1:Zinc in dry matter of Spinacia Oleracea

Sample no.	Concentration(ppb)			Concn per gram of soil (ppm)	Percentage standard deviation
	In sample solution	Average	After blank subtraction		
1	0.819 0.823 0.819	0.820	0.811	202.75	0.23
2	1.123 1.107	1.115	1.106	275.50	0.72
3	0.330993 0.330663 0.330334	0.331	0.322	80.50	0.08
4	0.335552 0.348419 0.334639	0.340	0.330	82.55	1.07
5	0.308947 0.312198	0.311	0.301	75.36	0.52

1.1 Estimation of Lead and Zinc in Plant Samples:

Normal levels of lead and zinc in plant samples are range from 0.1 to 150 ppm. In sample solution, they are to be determined at ppb to ppm levels. Leaves of Spinacia Oleracea and Trigonila Foenum Graecum were analyzed for lead and zinc levels in their dry form. The plant leaves were collected from five different agricultural fields of Sanganer area.

Table 2: Lead in dry matter of Spinacia Oleracea

Sample no.	Concentration(ppb)			Concn per gram of soil (ppm)	Percentage standard deviation
	In sample solution	Average	After blank subtraction		
1	59.710 59.780 59.750	59.750	51.95	12.987	0.06
2	26.703 26.690	26.696	18.90	4.725	0.02
3	74.174 74.100 74.026	74.100	66.30	16.575	0.10
4	56.258 59.035 58.049	57.781	49.98	12.495	1.99
5	98.970 98.389 96.980	98.113	90.31	22.578	0.85

1.1.1 Lead and Zinc in Spinacia Oleracea leaves:

1 ml of sample solution, 1 ml of acetate buffer and 8 ml of triple distilled water were taken in the electrolysis cell. The solution was deaerated by passing purified nitrogen gas for 10 mins before carrying out its analysis. Well defined peak voltammograms were obtained for both the metals. Concentrations of Zinc are determined by standard method which is shown in the table 1 given below. Results obtained both for zinc determinations are quite reproducible in all 5 cases are shown in tables. Standard deviations in these determinations were within 2.0%.

Table3: Zinc Concentration in dry matter of Trigonila Foenum Graecum

Sample no.	Concentration(ppb)			Concn per gram of soil (ppm)	Percentage standard deviation
	In sample solution	Average	After blank subtraction		
1	110.241 112.512 111.251	111.335	103.535	25.884	1.67
2	65.239 65.386 65.829	65.485	57.685	14.421	0.38
3	37.716 38.243 37.261	37.740	29.940	7.485	1.06
4	59.376 59.764 59.643	59.594	51.794	12.948	0.54
5	45.783 46.235 45.471	45.830	38.030	9.508	0.68

Results obtained for lead concentration in Trigonila leaves of five different agricultural fields are shown in table 4. Average standard deviation in these experiments ranges from 0.38% to 1.7%.

Table 4: Lead Concentration in dry matter of Trigonila Foenum Graecum

Sample no.	Concentration(ppb)			Concn per gram of soil (ppm)	Percentage standard deviation
	In sample solution	Average	After blank subtraction		
1	363.390 344.282 348.305	351.897	342.597	85.649	2.36
2	567.376 578.732 569.431	571.846	562.546	140.637	0.13
3	375.541 376.243 375.716	375.833	366.533	91.633	0.08
4	286.931 288.317 286.714	287.321	278.021	69.505	0.25
5	439.346 438.431 440.627	439.468	430.168	107.542	0.20

1.2 Estimation of Nickel and Cobalt in Plant Samples: Cobalt and Nickel were also analyzed in leaves of Spinacia Oleracea and Trigonila Foenum Graecum in their dry form. 2 grams of sampled leaves were weighted accurately and digestion was done by adding 5 ml of 1:1 HNO_3-HCI solution. Well defined adsorptive stripping voltammograms were recorded both for cobalt and Nickel.

1.2.1 Cobalt and nickel in Spinacia Oleracea: Cobalt concentrations in the five samples of spinach leaves. These results are evidently very reproducible. Standard deviation is only 0.23 to 1.28% is shown in table5.Adsoptive Stripping Voltammograms of Nickel in the plant leaves of spinach were performed with 5 samples. These results are quite reproducible with an average standard deviation of 0.5% except in one case, it is shown in table 6.

Table5: Cobalt Concentration in dry matter of Spinacia Oleracea

Sample no.	Concentration(ppb)			Concn per gram of soil (ppm)	Percentage standard deviation
	In sample solution	Average	After blank subtraction		
1	24.326 24.085 24.837	24.416	24.116	3.0150	1.28
2	13.225 13.330 12.958	13.170	12.870	1.608	1.27
3	17.293 17.202 17.276	17.257	16.957	2.120	0.23
4	35.268 35.284 36.083	35.545	35.245	4.405	1.07
5	44.261 44.913 44.146	44.440	44.14	5.518	0.76

Table6: Nickel Concentration in dry matter of Spinacia Oleracea

Sample no.	Concentration(ppb)			Concn per gram of soil (ppm)	Percentage standard deviation
	In sample solution	Average	After blank subtraction		
1	92.129 92.037 91.946	92.037	91.187	11.398	0.08
2	48.723 46.342 47.853	47.639	46.789	5.848	2.06
3	134.730 134.595 134.469	134.595	133.745	16.718	0.08
4	73.156 74.011 73.986	73.718	72.868	9.1085	0.54
5	34.265 33.674 33.923	34.287	33.437	4.179	0.89

1.2.2 Cobalt and Nickel in Trigonila Foenum Graecum: Cobalt and Nickel were also determined in leaves of Trigonila by Adsorptive stripping Voltammetry following the same procedure as that for spinach leaves.

Results obtained for Cobalt content in Trigonila leaves is shown in table 7. All the results are quite reproducible with percentage standard deviation of 0.23 to 2.28%.

In analogous manner, Adsorptive stripping voltammetry obtained for Nickel in the plant leaves of Trigonila for 5 plant samples. These values are again reproducible with the average standard deviation ranging from 0.08 to 0.21% shown in table 8.

Table 7: Cobalt Concentration in dry matter of Trigonila Foenum Graecum

Sample no.	Concentration(ppb)			Concn per gram of soil (ppm)	Percentage standard deviation
	In sample solution	Average	After blank subtraction		
1	13.225 13.330 12.958	13.170	12.870	1.61	1.19
2	17.293 17.202 17.276	17.257	16.957	2.12	0.23
3	37.281 37.861 37.345	37.496	37.196	4.65	0.69
4	23.652 23.108 22.369	23.043	22.743	2.84	2.28
5	46.357 48.521 48.376	47.751	47.451	5.93	2.10

Table 8: Nickel Concentration in dry matter of Trigonila Foenum Graecum

Sample no.	Concentration(ppb)			Concn per gram of soil (ppm)	Percentage standard deviation
	In sample solution	Average	After blank subtraction		
1	92.129 92.037 91.946	92.037	91.187	11.398	0.08
2	134.730 134.593 134.471	134.595	133.725	16.716	0.08
3	82.457 82.571 82.164	82.397	81.547	10.193	0.21
4	75.376 74.634 75.887	75.299	74.449	9.306	0.68
5	120.437 120.728 120.837	120.667	119.817	14.98	0.14

2.0Conclusion:

Methods were developed for the analysis of lead, zinc, cobalt and nickel in plant samples Spinacia Oleracea and Trigonila Foenum Graecum. The results for these samples are very reproducible when obtained. On the basis of these results, it may be concluded that Voltammetric techniques are the best in providing the reliable data for plant samples.

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