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Mineral Uptake Potential of *Commelina Bengalensis, Cyanotis Cerifolia* and *Zebrina Pendula*

Gole K. A., Kadam D. A., Jadhav S. N. and Aparadh V.T.*
Department of Biotechnology, Yashvanrao Chavan Institute of Science, Satara-415001.
golekomal154@gmail.com, vishu1415@gmail.com

Subject: Biochemistry

Abstract

Commelinaceae members grow as cosmopolitan weeds throughout India. The objective of this research was to analyze minerals in leaves of plants, belonging to this family (Viz. *Commelina bengalensis, Cyanotis cerifolia, Zebrina pendula*). Mineral analysis is non-invasive, simple and cheap method. Here these plants were studied for their capacity of both micro and macro elements uptake and is there any role in bioremediation of heavy metals. These minerals were estimated by acid digestion method and on Atomic absorption spectrophotometer.

Keywords: *Commelina bengalensis, Cyanotis cerifolia, Zebrina pendula*

Introduction

Green plants have comparatively simple nutrient requirements and that these are classified as macronutrients (N, P, K, Ca, Mg, S, and Na) and micronutrients (Fe, Mn, Cu, Zn, Mo, B and Cl). Macronutrients are found and needed in plants in relatively higher amounts than micronutrients. But both are essential for almost all metabolic processes. The mineral nutrition is an important aspect of plant growth that governs the productivity of all plants. Most micronutrients are constituents of enzyme molecules dissimilarity, the macronutrients are the constituents of organic compounds. Marschner [1] reported that, the differences in function are imitated in an average concentration of mineral nutrients in plant shoots for adequate growth. The main factor controlling the mineral content of plant material is the specific, genetically fixed nutrient uptake potential for the different mineral nutrients. [2]

Mineral analysis is non-invasive, simple and cheap method. Commelinaceae members viz. *Commelina bengalensis, Cyanotis cerifolia, Zebrina pendula* grow as cosmopolitan weeds throughout India. Here these plants were studied for their capacity of both micro and macro elements uptake.

Materials methods

Various inorganic constituents like Na^{+}, K^{+}, P^{5+}, Mg^{2+}, Fe^{3+}, Mn^{2+}, Ca^{2+}, Cu^{2+}, Zn^{2+} were estimated from the leaves of *Commelina bengalensis, Cyanotis cerifolia, Zebrina pendula*. Oven dried plant material was powdered and 0.5 g of sample was acid digested following the standard method of Toth *et al.* [3].

Plant material samples were taken in a 150 ml clean borosil beaker and to that 10 ml concentrated HNO_3 were added. It was covered with watch glass and kept for an hour till the primary reactions subsided. It was then heated on hot plate till all the material was completely dissolved. It was allowed to cool to room temperature and then 10 ml of Perchloric acid (60%) were added to it and mixed thoroughly. It was then heated strongly on the hot plate until the solution become colourless and reduced to about 2-3 ml. While heating, the solution was not allowed to dry. After cooling, it was transferred quantitatively to 100 ml capacity volumetric flask, diluted to 100 ml with distilled water and kept overnight. Next day it was filtered through Whatman No. 44 filter paper.

The filtrate was stored properly and send for inorganic constituents analysis on atomic absorption spectophotometer. Total nitrogen content in leaves was estimated following the method given by Hawk *et al.* [4]. The nitrate contents in the leaf tissue of commelinaceae species were determined using rapid colorimetric method by nitration of salicylic acid [5].

Result discussion

It was thought that the status of these mineral nutrients may give an idea about adaptability and luxuriant growth of the commelinaceae members. Table 1 gives an idea regarding the status of mineral elements in leaves of different commelinaceae species (*Commelina bengalensis, Cyanotis cerifolia, Zebrina pendula*).

Leaves of *Commelina bengalensis, Cyanotis cerifolia, Zebrina pendula* contain 7.3, 6.2 and 6.65 % sodium (dry wt.) respectively. Which is found very high as compare to adequate level of normal plants. According to Chirputkar [6] adequate level of sodium for glycophytes is 0.6 to 1.4% dry wt. The range of sodium in glycophytes as given by Gauch [7] is 0.1 to 1.4% dry wt. It is evident from results (Table 1) that all Commelinaceae species have high uptake potential for sodium.

Potassium is indispensable for plant growth. Plants require 1% potassium for their optimal growth [8]. It is evident from the results (as shown in Table 1 and Fig 1) that in all Commelinaceae species, potassium level appears to be higher than that of critical level. Same kind of results have been obtained by Karmarkar [9] in *Bryophyllum pinnatum*, by Karadge [10] in *Portulaca oleracea* (1.89%), by Naik [11] recorded 2.4 to 2.6 % potassium in healthy leaves of grape. It is evidence from result that the leaves of *Commelina bengalensis, Cyanotis cerifolia, Zebrina pendula* contain 7.35, 4.1 and 6.4 % potassium respectively.

Usually the level of calcium is higher in the leaves than that in other parts of plant as recorded by Chavan and Karadge [12] in *Arachis hypogeal*. It is evidence from result that the level of calcium in leaves of *Commelina bengalensis, Cyanotis cerifolia, Zebrina pendula* contain 9.85, 6.2 and 8.5 % respectively. Similar type of results have been obtained in various studies on apple [13], Saskatoon [14], in *Cleome* species up to 11.025 % [15] and olive [16], which also accorded with immobile characteristics of Ca in the mature leaves. High levels of calcium in the leaves of all Commelinaceae members may be responsible for their healthiness and fast growth.

In the plants, 2% Mg on dry weight basis has been regarded as critical value by Epstein [8]. The magnesium concentration is the highest in leaves of *Cyanotis cerifolia* as compare to other commelinaceae members (Table 1). Leaves of *Commelina bengalensis, Cyanotis cerifolia, Zebrina pendula* contain 0.89, 0.92 and 0.23 % (dry wt.) of magnesium respectively. Similar to that of *Portulaca oleracea* leaves, 0.3 % (dry wt.) magnesium has been recorded by Karadge [10]. Similar to that in *Cassia* species, Patil [17] recorded 0.37 % (dry wt.) magnesium in *C. obtusifolia* and 0.28 % (dry wt.) magnesium in *C. uniflora*. Khurana *et al.* [18] noticed that deficiency of magnesium reduced biomass, chlorophyll a and b levels and specific activities of catalase, acid phosphatase and ATPase in maize leaves. Although, the magnesium concentration in the leaves of commelinaceae members is lower than that of critical value, the plants do not show any deficiency syndrome.

Manganese plays an important role in the chloroplast membrane system as well as in photolysis of water and O_2 evolution during photosynthesis. According to Marschner [1], it is directly involved as a component of the biotin enzyme in the biosynthesis of fatty acids. Dietary recommendations established by the Food and Nutrition Board of the Institute of Medicine (IOM) [19] suggested that 1.8 to 2.3 mg/day intake of Mn is required daily. Manganese content is the highest in leaves of *Zebrina pendula* (2.13%) as compare to other commelinaceae members (Table 1). Similar kind of result recorded by Patil [17] have recorded 0.8 to 0.9 % manganese in the leaves of *Cassia* species. Leaves of *Commelina bengalensis, Cyanotis cerifolia, Zebrina pendula* contain 1.08, 1.75 and 2.14 % (dry wt.) of manganese respectively.

Copper as a cupric ion is an essential trace element for algae and higher plants [20]. It plays a vital role in reproductive growth as well as another trace element whose requirement is known in photosynthesis. It is associated with enzymes involved in redox reactions of photosynthesis [21]. The leaves of *Commelina bengalensis* have shown the highest concentration of copper while its concentration is the lowest in leaves of *Zebrina pendula* (Table 1). According to Epstein [8] the optimum level of copper is 6 ppm dry wt. and according to Mengel and Kirkby [2] it is about 0.0002 to 0.002 % dry wt. Leaves of *Commelina bengalensis, Cyanotis cerifolia, Zebrina pendula* contain respectively 133.17, 29.03 and 20.43 ppm copper. Similarly Desai [22] has recorded higher levels of Cu (0.0025 – 0.004 % dry weight) in the leaves and ripened fruits of *Morinda*. It can be concluded that commelinaceae members are a rich source of Cu. And thus these plant species can be used in removal of copper from waste water.

Iron in living cells, is required to catalyse a number of enzymatic reactions. It is absorbed by plant roots as Fe^{2+} or as Fe chelate. According to Machold and Stephan [23] , iron has role in the synthesis of common precursors of chlorophyll. Fe is stored in stroma of chloroplast as phytoferritin, which can store about 5000 atoms of Fe^{3+} [1]. Among the studied commelinaceae members, the level of iron is the highest in leaves of *Commelina bengalensis* while, it is the lowest in *Zebrina pendula* (Table 1). Similar observations have been made by Patil [17] in *Cassia obtusifolia and C. uniflora.* The adequate value of iron for optimal growth of plants is 100 ppm (0.01%) [24] [8]. In studied commelinaceae members*;* leaves of *Commelina bengalensis*, *Cyanotis cerifolia*, *Zebrina pendula* contain 13.39, 9.89 and 8.61 % (dry wt.) iron respectively. Iron is essential for various immune systems while its deficiency causes anemia, weakness and depression. Thus, the satisfying population in developing countries with iron nutrition is a serious problem and its recovery after application of allopathic drugs is very slow and time consuming process. It is necessary, therefore, to find herbal source rich in Fe content without side effects. These commelinaceae members may be used as iron rich leafy vegetable in our country.

Zinc is essential for carbohydrate metabolism and regulation of consumption of sugars, nitrogen metabolism, protein synthesis, auxin synthesis, particularly IAA synthesis, as well as for sexual fertilization and development of reproductive parts. The critical deficiency levels of Zn are below 15–20 mg kg^{-1} dry weight of leaves and critical toxicity levels of zinc in leaves of crop plants are more than 400–500 mg kg^{-1} dry weight basis [1]. In commelinaceae members, levels of zinc in leaves is higher than its critical toxicity levels (Table 1). High level of zinc in the leaves has been recorded in *Phaseolus aconitifolius* [25] and *Derris scandensis* [26]. Leaves of *Commelina bengalensis, Cyanotis cerifolia, Zebrina pendula* contain 6948, 1482 and 1206 mg kg^{-1} (dry wt.) zinc respectively. These values are higher than the critical value suggested by Epstein [8] also. Higher level, of zinc in commelinaceae members indicates its tolerance capacity for any kind of environmental stress and also indicates that these species may act as antioxidant.

Among all the mineral nutrients nitrogen is the most important nutrient for the growth of plant. It is very essential for synthesis of many organic compounds. Total nitrogen content in leaves of commelinaceae members is expressed in Table 1. It is evident from the result that the total nitrogen content in leaves of *Cyanotis cerifolia* (3.86%) is highest than other species studied. Gallacher and Sprent [27] reported that total nitrogen reflects total plant growth. Absorbed nitrogen is rapidly converted into amino acids and amides. The weeds generally use twice the amount of nitrogen in comparison to normal crop plants [28]. Leaves of *Commelina bengalensis*, *Cyanotis cerifolia*, *Zebrina pendula* accumulates 3.24, 3.86 and 3.41% (dry wt.) total nitrogen respectively. Similar kind of result in *C. obtusifolia* and that in *C. uniflora* recorded by Patil [17], in *Phaseolus aconitifolius* [25], *Psophocarpus tetragonobolus* [29] (Rajmane, 1984), *Arachis hypogea* var. JL-24 and TMV-10 [30] and *Euphorbia geniculata* [31].

Nitrate is the most abundant nitrogen source available in soil for plants [32]. Nitrate may have a non- specific function as vacuolar osmoticum. Total nitrate content in leaves of commelinaceae members is expressed in Table 1. It observed higher in *Cyanotis cerifolia* than that of *Commelina bengalensis* and *Zebrina pendula.*

In plant nutrition, demand for phosphorus is relatively great. Phosphorus forms integral part of AMP, ADP, ATP and NADP. It is involved in energy transfer metabolism. It is a highly mobile element. So it can be easily translocated from one place to another. It is emerged from the Table 1 that the leaves of *Commelina bengalensis* are rich in phosphorus than other species studied. The optimum concentration of phosphorus is 0.2% dry wt. [24] [8]. Phosphorus content in the leaves of *Commelina bengalensis*, *Cyanotis cerifolia*, *Zebrina pendula* are respectively 0.23, 0.17 and 0.22 g100g-1 of dry wt.. It indicates there is high phosphorus content in the leaves of studied species. Which signifies the high metabolic activities associated within these plant species.

Sulphur is present in plant tissue in minor quantities only; its content varies strongly between species and ranges from 0.03-2 m mol g^{-1} dry weight [33]. In present study, sulphur content in the leaves of *Commelina bengalensis*, *Cyanotis cerifolia*, *Zebrina pendula* are respectively 0.14, 0.15 and 0.17 g100g-1 of dry wt. which is very high than that of its requirement. There are many S-containing compounds, which have been linked, directly or indirectly with the defence of plants against microbial pathogens; these include thionins, defensins, glucosinolates, crucifer phytoalexins, alliin and glutathione [34]. It can be concluded from result that commelinaceae members may act as good source of biocontrol agents against microbial pathogens.

Plants contain Boron both in a water-soluble and insoluble form. In intact plants, the amount of water-soluble boron fluctuates with the amount of boron supplied, while insoluble boron does not. Boron is essential for the growth of higher plants. The primary function of the element is to provide structural integrity to the cell wall in plants. Boron deficiency affects vegetative and reproductive growth of plants resulting in inhibition of cell expansion, death of meristem and reduced fertility [35]. but is required in very small quantities. Although Boron requirements vary among crops, the optimum boron content of the leaves for most crops is 20-100 ppm [36]. It is evidence from result that there is no any kind of deficiency or toxicity of boron in *Commelina bengalensis* (22.77ppm), *Cyanotis cerifolia* (26.75 ppm). While in *Zebrina pendula* (17.98 ppm), it is less than optimum requirement but plant does not show any kind of deficiency syndrome.

Molybdenum is trace element which can exist in several oxidative states. The requirement of molybdenum for plant growth was first demonstrated by Arnon and Stout [37] using hydrophonically grown tomato. The molybdenum content in leaves of *Commelina bengalensis* (0.40 ppm), *Cyanotis cerifolia* (0.78 ppm). While in *Zebrina pendula* (0.67 ppm) are depicted in Table 1. This is higher than that of optimal requirement. Molybdenum content in plant is related to diseases resistance. However, there is little direct evidence to conclude that improvement in plant molybdenum levels results in a decrease of disease [38] [39]. Recently, Graham and Strangoulis [40] reported that molybdenum can improve resistance in tomato against *Verticillium*. Molybdenum is also present within human tooth enamel and may help prevent its decay Curzon *et al.* [41]. From that it can be concluded that commelinaceae members can be used as medicinal purpose in toothpaste.

Table 1: Mineral Uptake Potential in some Commelinaceae members

Sr. No.	Parameters	*Zebrina pendula* mg/100g	*Cyanotis cerifolia,* mg/100g	*Commelina bengalensis,* mg/100g
1.	**Nirogen**	3240	3860	3410
2.	**Nitrate N**	56	55	57
3.	**Phosphrous**	220	170	230
4.	**Potassium**	6400	4100	7350
5.	**Calcium**	8500	6200	9850
6.	**Magnesium**	230	920	890
7.	**Sulphur**	170	150	140
8.	**Sodium**	6650	6200	7300
9.	**Zinc**	120.6	148.2	694.8
10.	**Ferrous**	8610.6	9879.4	13386.4
11.	**Copper**	408.6	580.6	2663.4
12	**Mangenese**	2139.8	1756.2	1082
13.	**Molybdenum**	13.4	15.6	8
14.	**Boron**	359.6	535	455.4

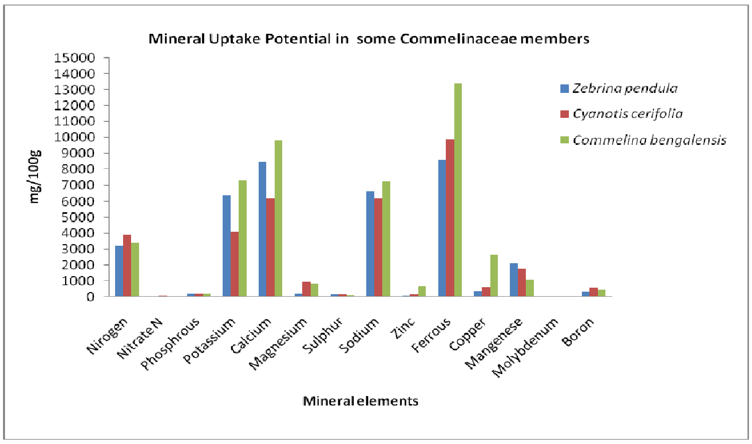

Fig. 1: Mineral uptake potential in some commelinaceae members

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Conclusion

It can be concluded from result that all studied species *Commelina bengalensis, Cyanotis cerifolia, Zebrina pendula* having powerful mineral uptake potential. These species may have potential to tolerate any kind of environmental stress and also having high medicinal potential properties against many pathogens.

"Cite this article"

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