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ZINC ACCUMULATION PATTERN IN SOME ROADSIDE PLANT ALONG PUNE–KOLHAPUR HIGHWAY

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Abstract:
The quantitative analysis of Zn from the leaves of control and some roadside plants is carried out during summer and rainy season from May 2014 to May2015 using Atomic Absorption Spectrophotometry from selected areas of Pune-Kolhapur Highway.It is noticed that many roadside plant substratum has maximum Zn content than permissible concentration limit. Maximum values recorded at roadside areas in leaves of *Samanea saman* (Jacq.) merr is 468.1mg/lit and minimum values recorded at roadside region is in leaves of *Duranta plumieri* L about 96.0 mg/lit. Our result suggested that the plant species are tolerant to zinc are *Samanea saman* (Jacq.) merr, *Cascabella thevetia* (L.) and *Tecoma stance* L and they can accumulate the maximum level of Zinc in the leaf tissue. The plants species of *Dalbergia sissoo* roxb, *Bougainvilla spectabilis* willd, *Caesalpinia pulcherrima* (L.) Sw. , *Vitex nugundo* , *Duranta plumieri* L and *Nerium oleander* mill. have less ability to tolerate the Zn level. It is observed that concentrations of Zn in the soil are varied. It is noticed that in selected roadside sites the Zn concentration was found to maximum permissible level. The values are found to be increasing in the summer season.
Keywords: Accumulation, Heavy metals, Zinc Tolerance, Roadside plants.

Introduction:

The nature and degree of roadside pollution has been an important subject of road ecological studies during last few decades. It is confirmed that the road traffic is the major reason for the heavy metal contamination in the urban system. It affect the environment quality and the degree of pollution .Heavy metals are continuously accumulate in roadside and vegetations (Marshi etal,2005). Heavy metal tolerance was first reported by the French scientist Prat (1934) which has since been studied extensively by number of scientists in Europe and United States. Tolerance to metal can be demonstrated at different levels of integration. Warren and Delavault (1962) first reported heavy metal contamination of soil vegetation near high ways. Thus roadsides are affected by many metals like pb Zn ,Cu, Ni, which are major heavy metals due to road traffic The average natural levels of zinc in the earth crust are 10 to 300 mg/kg (Malle, 1992). Swaine (1955) reported than Zn is continuously being mobilized and transported in the environment due to natural erosion processes like the weathering of rock, soils and sediments by wind and water. Zinc levels are sometimes increasing in nature due to non-natural conditions like modern agriculture, where zinc has to be supplied and livestock increases to optimum growth. However Zn can be toxic at high concentration. Vegetations on contaminated roadside have highly tolerant species, which may accumulate toxic heavy metals at high amount. According to Hunter (1976) pollution of the air and of the soil through roadside fall out is an increasing hazard to the environment and to health. Marschner (1986) reported that critical deficiency level of Zn are below15-20 mg/lit dry weight of leaves and the critical toxicity levels of zinc in leaves of crop plants are more than 400- 500 mg kg^{-1} dry weight. According to Munson(1998) optimum range of Zn in higher plants are 20ppm (dry weight). Pearson *et al.* (2000) also found the ability of certain mosses to accumulate very high concentration of Zn. Basically metal tolerance is constitutive property present in every living cell, tissue and organs of plant and animals that have received a lot of attention by researchers and planners. In that context, present piece of work will be very useful to study potential of accumulation of metals in roadside plants. The present investigation data provide quantitative information and accumulation pattern of Zinc in the road side plants.

Materials and Methods:

Plants of *Caesalpinia pulcherrima* (L.) Sw. *Tecoma stance* L. *Samanea saman* (Jacq.) merr. *Cascabella thevetia* (L.) *Bougainvilla spectabilis* willd . *Nerium oleander* mill. *Dalbergia sissoo* roxb ,*Vitex nugundo*, *Duranta plumieri* L. were collected at random from various localities of Toll plaza on Pune-Kolhapur highway for both seasons i.e. rainy and summer season. Leaves were washed to remove dirt and dried at room temperature. Samples were then transferred to grinding machine to make powder and this dried powder

was then used for acid digestion. Simultaneously the same species were collected from rural sites of 5km distance away from highway including both sides of road as control. Soil samples of respective plant species were collected and brought to laboratory used for acid digestion.

A)Preparation of acid digests for Plant: The acid digestion method of Toth *et al.* (1948) has been followed for the analysis of zinc accumulation from plant material.

B)Preparation of Acid Digest for soil: Respectively soil samples are also collected along plant material and soil digestion was carried out by using- Simmons (1951)method.

Result and Discussion:

The analysis of zinc (Zn) from the soil substratum and leaves of plants of roadside and control are presented in Table No.1 and 2

Table no.1 shows the Zn content in the soils of roadside and control sites corresponding to the rainy and summer seasons. It is observed that concentrations of Zn in the soil are varied. Maximum concentration of zinc is found in the soil of roadside areas of Pune –Kolhapur highway, where zinc exhausted by the vehicles. It is noticed that in selected roadside sites the Zn concentration was found to maximum permissible level. The values are found to be increasing in the summer season than rainy season in all sites .There is significant difference in roadside and control values which are lower in the control sites than roadsides. A maximum value recorded at roadside area is about 288.1mg/lit. a 1and minimum value recorded at control region is about 87.6 mg/lit. . European Commission prescribed about 200mg Zn mg/lit. is permissible zinc concentration. The concentration exceeded the level above 250 mg/ lit Zn is generally referred as phyto-toxicity level of zinc.

Accumulation of Zn in the leaves of different plants is also varying. Maximum Zn value about 468.1 mg/lit. is recorded in leaves of *Samanea saman* (Jacq.) merr in roadside areas, while minimum values are found in the leaves of *Duranta plumieri* L. about 96.0 mg/lit. from control areas. The concentration is found to be increased in the summer season, as Zn elements do not remain constant throughout the year therefore interpretation of enrichment of Zn is complicated. Depictions in soil and leaves of plant clearly explain the actual inter relationships. Zn in leaves of all plants of 9 species shows significant correlations. It shows that in three plant *Samanea saman* (Jacq.) merr, *Cascabella thevetia* (L.), *Tecoma stance* L.has ability to accumulation of Zn in leaf ,which was significantly higher than that the soils from where they collected. The critical leaf tissue concentration of Zn for toxicity effect on growth in most plant species in the range of 200-300 mg/lit. However Zn According to Xie etal plant tissue can be tolerate 387 to 1221 mg /lit.

Clarkson and Hanson (1980) demonstrated the indispensability of microelement zinc for plant life. In plants zinc is not oxidized or reduced, its functions as a mineral nutrient are based primarily on its properties as a divalent cation with a strong tendency to form tetrahedral complexes. Zinc deficiency is a serious problem worldwide and 30 % of worlds cultivated soils are shown to be zinc deficient.Zinc is part of nature. Most rocks and many minerals contain zinc in varying amounts it exists naturally in air, water and soil. The average natural levels of zinc in the earth crust are 10 to 300 mg/kg (Malle, 1992). Zinc levels are sometimes increasing in nature due to non-natural conditions like modern agriculture, where zinc has to be supplied and livestock increases to optimum growth. However Zn can be toxic at high concentration. Pickering & Pauia (1969) and Briggs (1972) showed that *Marchantia polymorpha* growing in Glasgow, Scotland, were more tolerant than the plants from rural habitats as these metals are transported due to formation of gaseous phase during combustion and so Zn accumulation was found to be more in the traffic and public places. The variation in the metal concentration in the several plant species also indicates that this is due to varying morphological characteristic possessed by different species and to the mechanism by which metal is accumulated (Steinnes, 1977). In present investigation it is found that some plants under study are high ability to absorb and accumulate the high levels of Zn and can tolerate this level. The trend of accumulation of Zn in leaves is *Samanea saman* (Jacq.) merr.. > *Cascabella thevetia* (L.) > *Tecoma stance* L.> *Dalbergia sissoo* roxb> *Bougainvilla spectabilis* willd> *Caesalpinia pulcherrima* (L.) Sw. > *Vitex nugundo*> *Nerium oleander* mill. >*Duranta plumieri* L

Table 1 Zn in soil of both control region and roadside region in two season

Sr No.	Name of Plant Material	Zn in Control region soil		Zn in roadside region soil	
		Rainy Season	Summer season	Rainy Season	Summer season
1	*Caesalpinia pulcherrima*(L.) Sw.	131.0	148.0	143.5	193.5
2	*Tecoma stance* L.	187.0	200.0	141.1	180.1
3	*Samanea saman* (Jacq.) merr.	140.5	155.2	157.9	288.1
4	*Cascabella thevetia* (L.)	148.2	150.0	177.1	253.3
5	*Bougainvilla spectabilis* willd .	135.3	140.5	123.0	183.9
6	*Nerium oleander* mill.	87.6	90.0	123.1	130.4
7	*Dalbergia sissoo* roxb	125.5	130.7	152.6	197.9
8	*Vitex nugundo*	92.4	103.5	127.5	182.1
9	*Duranta plumieri* L.	120.0	127.0	146.0	236.7

*Values in mg/lit.

Table 2 Zn in Plants of both control region and roadside region plants in two season

Sr No.	Name of Plant Material	Zn in Control region Plants		Zn in roadside region Plants	
		Rainy Season	Summer season	Rainy Season	Summer season
1	*Caesalpinia pulcherrima* (L.) Sw.	140,0	153.0	150.8.	195.0
2	*Tecoma stance* L.	387.0	300.0	300.0	370.0
3	*Samanea saman* (Jacq.) merr.	182.0	185.2	357.9	468.1
4	*Cascabella thevetia* (L.)	290.2	250.0	247.7	355.3
5	*Bougainvilla spectabilis* willd .	185.3	180.0	163.0	180.9
6	*Nerium oleander* mill.	137.0	129.0	133.0	140.4
7	*Dalbergia sissoo* roxb	195.5	160.5	185.6	209.9
8	*Vitex nugundo*	122.4	103.5	107.0	120.0
9	*Duranta plumieri* L.	120.0	125.0	96.0	108.0

*Values in mg/lit.

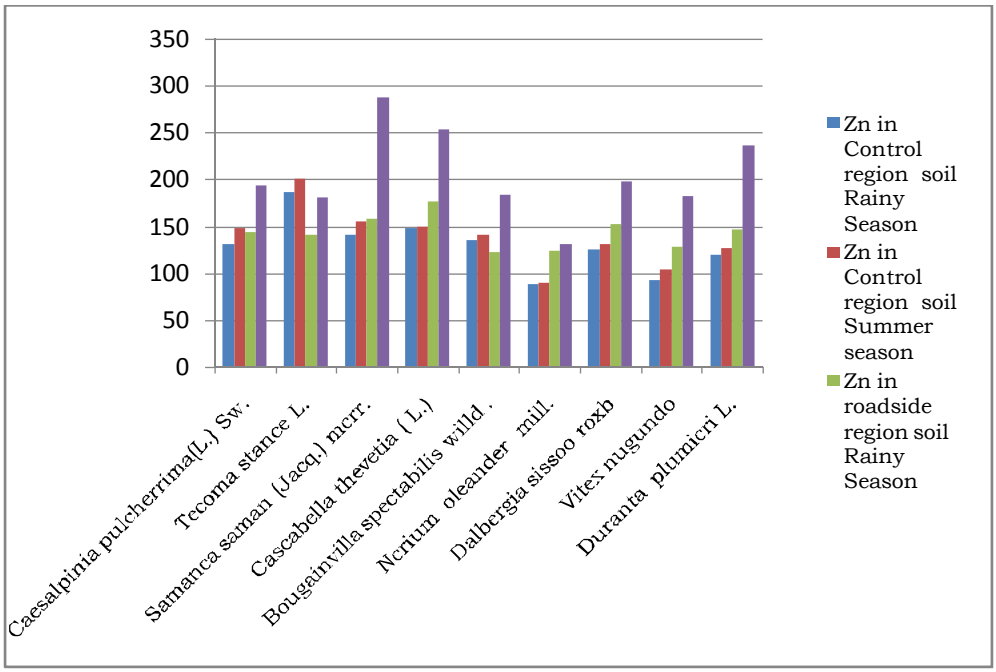

Figure 1 Zn in soil of both control region and roadside region in two season

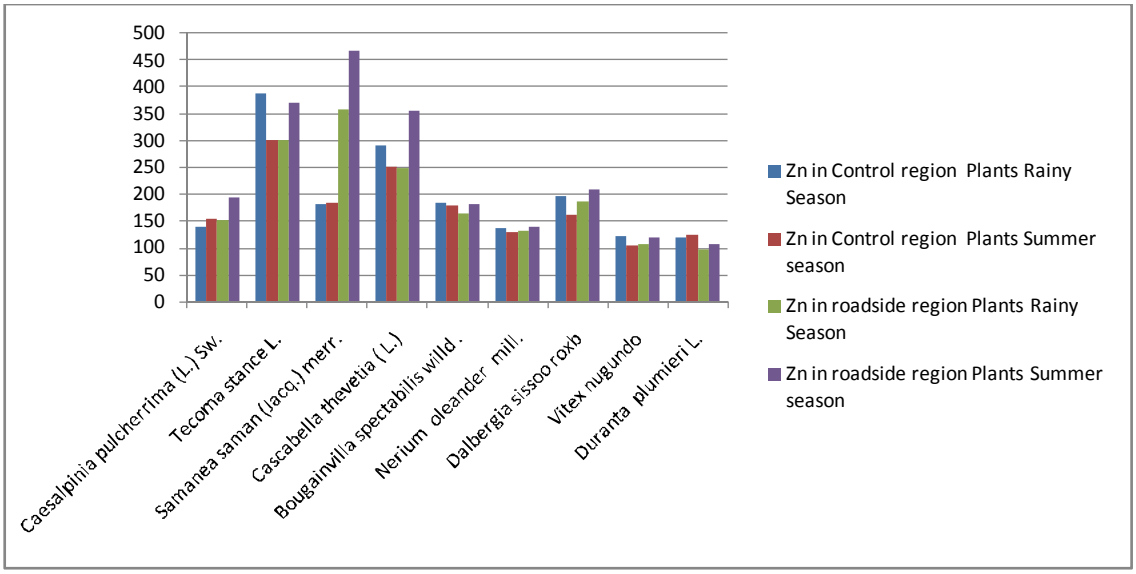

Figure 2 Zn in Plants of both control region and roadside region plants in two season

Conclusion:

It is noticed that many roadside plant substratum has maximum Zn content than permissible concentration limit. Maximum values recorded at roadside areas in leaves of *Samanea saman* (Jacq.) merr is 468.1mg/Kg-1and minimum values recorded at roadside region is in leaves of *Duranta plumieri* L about 96.0 mg/Kg-1. Our result suggested that the plant species are tolerant to zinc are *Samanea saman* (Jacq.) merr, *Cascabella thevetia* (L.) and *Tecoma stance* L and they can accumulate the maximum level of Zinc in the leaf tissue. The plants species of *Dalbergia sissoo* roxb, *Bougainvilla spectabilis* willd, *Caesalpinia pulcherrima* (L.) Sw. , *Vitex nugundo* , *Duranta plumieri* L and *Nerium oleander* mill. have less ability to tolerate the Zn level. It is observed that concentrations of Zn in the soil are varied. It is noticed that in selected roadside sites the Zn concentration was found to maximum permissible level. The values are found to be increasing in the summer season than rainy season in all sites .There is significant difference in roadside and control values which are lower in the control sites than roadsides. In present investigation it is found that some plants under study are high ability to absorb and accumulate the high levels of Znic .

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