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Copper and Nickel Concentrations in *Alternanthera Philoxeroides* (Mart.)Griseb. From *Nambul* River, Imphal West District, Manipur, India

KEYWORDS: Alternanthera philoxeroides, copper, nickel, stem, root, Nambul river

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ABSTRACT *Concentrations of copper (Cu) and nickel(Ni) in stem and root of Alternanthera philoxeroides Griseb. collected from three sites of Nambul river in Imphal West District of Manipur were analyzed with the help of ICP-MS during the wet (June - October) and dry (November - February) seasonsof 2012 and 2013. One way ANOVA reveals significant variations among Cu concentrations in the shoot and root of the plant in the three sites. Ni concentrations in stem were also significantly differentbetween Thong Nambonbi (TN) and Wangoi (WN) (p = 0.022). In contrast, there was no significant variation among Ni concentrations in root. Both Cu and Ni absorbed by the plants growing in the river may be attributed to various anthropogenic sources including chemical fertilizers, pesticides and fungicides used in agriculture.*

Introduction

Heavy metals are generally defined as those metallic chemical elements having relatively high density and toxicity at low concentrations. According to Tam and Wong (2000), heavy metals are one of the serious pollutants in our natural environment due to their toxicity, persistence and bioaccumulation problems.They can easily enter aquatic ecosystems from different natural as well as anthropogenic sources in particulate or dissolved forms (Defew et al., 2004; Maheshwari et al., 2006),and are readily taken up, distributed and accumulated by aquatic organisms namely plants and animals including fishes.

Alternantheraphiloxeroides (Mart.)Griseb., commonlyknown as alligator weed is an invasive aquatic perennial herb. It can tolerate and grow in almost all climatic and edaphic conditions (Masoodi and Khan, 2012; Mandal and Mondal, 2011; Langeland, 2008). It grows well in eutrophic conditions and invades the area. Being an important sink for various pollutants and contaminants, plants growing in contaminated water have high tendency to absorb heavy metals through nutrient uptake.

The present work is, thus,designed to study the concentrations of Copper (Cu) and Nickel (Ni) in the stem and root of Alternanthera philoxeroides growing in Nambul river, Imphal West district, Manipur, India.

Materials and methods

One of the major rivers draining Imphal Valley, Nambul river originates in the Kangchup Hill range in the western side of the state of Manipur at an approximate elevation of 1830 m above mean sea level. With a total length of 62.7 km. (Singh, 1982), a major portion of it flows through Imphal West District passing right into the heart of Imphal, the Capital city of Manipur. After flowing out of Imphal West, it enters Bishnupur District to finally drain into the Loktak Lake, which is a Ramsar site (Fig. 1). The river has an approximate stretch of about 10 km within the city limits where the pollution level is at its highest.Regarded as one of the most polluted rivers in Manipur, it receives a heavy influx of sewage, domestic and agricultural waste, and other effluents which may range from nutrients to toxic hazardous substances. The Nambul river catchment harbours a population of about 0.28 million, and generates 72.23 tons of solid waste and 31.207 m^3 of sewage daily [http://www.moef.nic.in/soer/state/manipur-SoE.pdf].

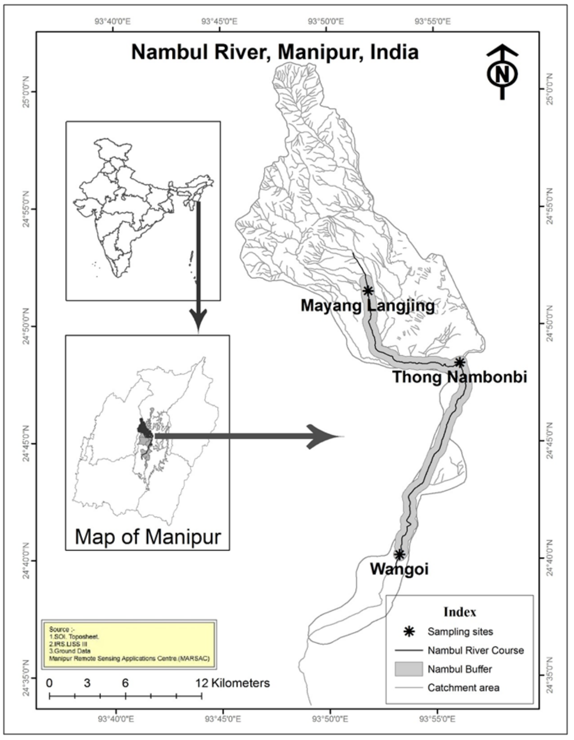

Figure 1: Map of Nambul river showing the sampling sites

Samples of A. philoxeroides were collected from three sites: Mayang Langjing (ML), Thong Nambonbi (TN) and Wangoi (WN). Plants growing on the river bank and projecting into water were selected for collection. About 100 cm of full grown stems with apical shoot, leaves and roots were carefully cut for the analysis. Collection of sample was done during two seasons, namely wet (June, July, August, September and October) and dry (November, De-

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cember, January and February) in 2012 and 2013.

For heavy metal analysis, stem and leaves were taken together as shoot,while roots comprised a separate sample . About 15 cm of shoot along with5 to 6 leaves,and bunches of rootsfrom the collected plants were taken. The samples were then washed repeatedly with double distilled water to clean them thoroughly. The samples were oven-dried at 60^0C till a constant weight was obtained. Dried stem and leaves were then finely ground together, and the roots ground separately. One gram (1 g) each of the ground sample was then digested in 10 ml concentrated nitric acid (Gupta, 1996; Soegianto et al., 2013). The residue was dissolved in 10 ml double distilled deionized water, filtered and stored at 4^0C for Copper (Cu) and Nickel (Ni) concentration analysis in ICP-MS. All the diluted samples were then filtered through Whatman filter paper.

Data obtained were subjected to one way ANOVA followed by post-hoc Tukey test to check the significance of difference among heavy metal concentrations for the sampling sites using SPSS 20 statistical software for windows. Differences were considered significant at $P \leq 0.05$.

Results and discussion

Table 1 presents the Cu and Ni concentrations found in shoot and root of A. philoxeroides during wet and dry seasons at the three study sites. It can be observed that the mean Cu concentration in shoot and root in WN is higher than those in ML and TN during wet season. Similar observation can be seen in the case of Ni concentration where a concentration range of 10.89 μg g^{-1} was recorded for root found at ML. For each site, most of Cu and Ni concentrations in both shoot and root was higher during dry season.

Table 1: Concentration of Cu and Ni in shoot and root of Alternanthera philoxeroides Griseb. grown at Nambul river, Imphal West, Manipur

Site	Tissue	Wet season		Dry season	
		Cu	Ni	Cu	Ni
ML	Shoot	1.326±0.428	1.153±0.621	2.005±0.007	1.092±0.002
	Root	1.501±0.005	0.987±0.002	2.337±0.001	10.89±0.024
TN	Shoot	0.486±0.024	0.379±0.118	0	0
	Root	1.161±0.004	1.343±0.005	0	0
WN	Shoot	3.153±2.669	1.662±1.515	7.264±0.011	4.322±0.011
	Root	1.681±0.007	1.882±0.01	1.023±0.01	0.938±0.006

[Values represent Mean ± SD; all values in μg g^{-1}]

One way ANOVA analysis of the Cu concentrations in the shoot of Alternanthera philoxeroides Griseb.for the three sites revealed significant difference in the mean concentrations (p = 0.013). Tukey post-hoc test results also showed that mean Cu concentration of TN and WN is statistically significant (p = 0.016). Significant mean concentration of Cu was also observed in case of root (p = 0.036) with significant Tukey post-hoc variation between Ml and TN (p = 0.029).

In the case of Ni concentrations in Alternanthera philoxeroides Griseb. shoot, the one way ANOVA is significant for the three sites (p = 0.022) with Tukey post-hoc significance between TN and WN (p = 0.022). However, the mean concentration variation was not significant in the case of Alternanthera philoxeroides Griseb. root for the three sites (p = 0.231). The overall uptake of these metals by Alternanthera philoxeroides shoot and root may be attributed to the presence of anthropogenic contaminants such as chemical fertilizers and municipal wastes discharged into the river. Earlier works conducted by Singh et al., (2013) found extensive use of pesticides and fungicides containing Cu and Ni leaching directly into the river from the adjoining areas.

Conclusion

Alternanthera philoxeroides Griseb. is an exotic plant with very high invasive and tolerance potential in varied growing conditions. The present study shows that the shoot of Alternanthera philoxeroides Griseb. has comparatively higher Cu and Ni uptake than the root portion. It will be of interest to investigate the ability of this plant to absorb other toxic heavy metals discharged into Nambul river and thus used as an effective monitoring species for heavy metal contamination.

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REFERENCE Defew, L., Mair, J. & Guzman, H. (2004). An assessment of metal contamination in mangrove sediments and leaves from Punta Mala Bay, Pacific Panama. MarinePollution Bulletin 50(5):547-552. | Gupta, A. (1996). Heavy Metals in Water, Periphytonic Algae, Detritus, and Insects from two Streams in Shillong, Northeastern India. Environmental Monitoring and Assessment 40: 215-223. | Langeland, K.A. (2008) Alternanthera philoxeroides Griseb., University of Florida – IFAS Publication, SP 257. | Mandal A. & Mondal, A.K. (2011). Taxonomy and ecology of obnoxious weed Alternanthera philoxeroides Grisebach (Family Amaranthaceae) on spore germination in Ampelopteris prolifera (Ketz.) Cop. Advances in Bioresearch, 2(1):103-110. | Masoodi, A. & Khan, F. (2012). Invasion of alligator weed (Alternanthera philoxeroides) in Wular Lake, Kashmir, India. Aquatic Invasions, 7(1): 143-146 | Singh, N.K.S., Devi,C.B., Sudarshan,M., Meetei,N.S., Singh, T.B. and Singh, N.R. (2013). Influence of Nambul river on the quality of fresh water in Loktak Lake. International Journal of Water Resources & Environmental Engineering 5(6):321-327. | Singh, R.P. (1982). Geography of Manipur. National Book Trust, India, p: 1-185. | Soegianto, A., Winarni, D. & Handayani, U.S. (2013). Bioaccumulation, elimination, and toxic effect of Cadmium on structure of gills and hepatopancreas of freshwater prawn Macrobrachium sintangese (De Man, 1898). Water, Air, &Soil Pollution 224:1-10. | Tam, N.I.Y. & Wong, Y.S. (2000). Spatial variation of heavy metal in surface sediments of Hong Kong mangrove swamps. EnvironmentalPollution 110: 195-205. |