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RESEARCH ARTICLE

HEAVY METAL ACCUMULATION IN PLANTS GROWN IN PERI-URBAN METAL CONTAMINATED AREAS OF EASTERN U. P.

S. N. Singh, S. K. Goyal, Jai P. Rai and Shree Ram Singh

Krishi Vigyan Kendra, Institute of Agricultural Sciences, RGSC, Banaras Hindu University, Barkachha, Mirzapur – 231 001 (Uttar Pradesh)
E-mail: sunil.svbp@gmail.com

ABSTRACT

In Eastern U.P., many acres area of cultivated fields are likely to be polluted by heavy metals due to sewage sludge, untreated municipal and industrial solids & liquid wastes, fertilizers and other agro-chemicals. Some of these lands located near highways are further subjected to pollution by automobile exhausts. Objective of the present study was to determine the content of Cd, Pb, Cr, Cu and Zn in different plants growing on heavy metal polluted soils of Eastern U P. Samples of *Jwar, Berseem, Maize, Dub, Bathua and Cow pea* were collected from each site. Plants were digested in tri-acid mixture (10 HNO_3:4HCl_4:1H_2SO_4) and analyzed for heavy metals with the help of DTPA extracts methods at recommended wavelengths i.e. Cd 228.8, Pb 283.3, Cr 357.9, Cu 324.8 and Zn 213.9 (nm) by AAS. The results exposed that the concentration of Cd, Pb, Cr, Cu and Zn (ppm) in selected samples were in a wide range. Most metals were found more than their permissible limit. Continuous supply of such type of heavy metals to the cultivable fields through various sources should necessarily be banned and steps for safe disposal of such toxic materials must be taken in order to reduce the risk of health hazards to our community and crops, which are becoming toxic gradually. This is particularly important so that we can cultivate cereals, pulses, oilseed crops, fruits & vegetables, medicinal plants and fodder for feeding the ever bulging population and cattle of our country.

Key Words : Heavy metals, Cd, Pb, Cr, Cu, Zn, concentration.

Next to pesticides heavy metals lead the list of environmental hazards. These metals can be accumulated, over a period of time, along a food chain, at very high proportions in organisms from very low concentration in atmosphere, hydrosphere, lithosphere and biosphere. Once these elements enter the biological systems, they disturb the biochemical processes leading in some cases to fatal results. It has been reported that plants growing in areas affected by heavy metal deposition may get elevated levels of these metals by uptake from the contaminated soil or from direct deposition on the leaves. A large area of cultivated fields of Eastern U.P. are likely to be polluted by heavy metals due to sewage sludge, untreated municipal and industrial solid and liquid wastes, fertilizers and other agrochemicals. Some of these lands near highways are

further subjected to contamination by automobile exhausts. Therefore, the present study was undertaken to determine the content of Cd, Pb, Cr, Cu and Zn in different plants growing on heavy metal polluted soils of Eastern U P.

MATERIALS AND METHODS

Area under study was divided into six (A, B, C, D, E and F) different sites . Samples of Jwar (*Sorghum vulgare*), Berseem (*Trifolium alexandrinum*), Maize (*Zea mays*), Dub (*Cynodon dactylon*), Bathua (*Chenopodium album*) and Cow pea (*Vigna sinensis*) were collected from each site. Plants were digested in tri-acid mixture (10 HNO_3: $4HCl_4$:$1H_2SO_4$). Plant were analyzed for heavy metals with the help of DTPA extracts methods suggested by Lindsay and Horwell (1978) at recommended wavelengths i.e. Cd 228.8, Pb 283.3, Cr 357.9, Cu 324.8 and Zn 213.9 (nm) by Atomic Absorption Spectrophotometer (Perkin Elmer 3100).

RESULTS AND DISCUSSION

Data of heavy metals content of selected samples of forage crops, grasses and weeds of different sites of Eastern U P are given in Table - 1. Maximum Cd concentration (1.88 ppm) was determined in Maize (site D) and minimum (0.39 ppm) in the Dub (site E). The maximum value of Pb was 9.10 ppm of Maize samples (site D) and 2.11 ppm i.e. minimum of Jwar samples (site C). Whereas, maximum and minimum Cr concentrations were noticed in samples of site C (2.11 (cow pea) and 0.48 ppm (jwar)). In case of Cu 0.95 (berseem) and 0.32 ppm (jwar) were recorded as maximum and minimum, respectively at site A. While, 9.30 and 6.84 ppm Zn concentration were found as maximum and minimum in samples of site A and site C, respectively.

The concentration of Cd, Pb, Cr, Cu and Zn in ppm in the samples of Jwar, Berseem, Maize, Dub, Bathua and Cow pea varied from 0.90 to 1.29, 0.82 to 1.21, 1.65 to 1.88, 0.39 to 0.49, 0.51 to 0.82 and 0.91 to 1.87; 2.11 to 7.40, 5.09 to 8.01, 7.11 to 9.10, 4.95 to 6.19, 7.46 to 8.19 and 8.26 to 9.06 ppm; 0.48 to 0.89, 0.76 to 1.01, 0.81 to 3.60, 0.67, 0.97, 0.40 to 0.90 and 1.82 to 2.15; 0.19 to 0.49, 0.56 to 0.96, 0.35 to 0.69, 0.39 to 0.69, 0.72 to 0.90 and 0.45 to 0.92; 7.98 to 8.30, 8.36 to 9.26, 8.30 to 9.28, 9.84 to 7.86, 8.20 to 9.30 and 7.79 to 9.00 ppm, respectively. Accumulation of Cd, Pb, Cr, Cu and Zn in different plant samples was possibly due to uptake of these metals from the fields contaminated by the concerned metals. this results also advocated by of Ramachandran and D' Souza (1999) .

Disposal of raw sewage sludge and industrial wastes rich in heavy metal were possibly the main sources of Cd, Pb, Cr, Cu and Zn contamination of agricultural land of the concerned locality. Ratan *et. al.* (2001); Oliveira *et. al.* (2005) and Singh,*et. al.* (2013) have also reported that crops accumulated large amounts of heavy metals under the influence of sewage and industrial wastes. Singh *et al*. (1991) reported that content of Cd, Pb and Cr in Berseem crop increased with increasing level of irrigation with sewage water. Blind application of agro-chemicals including fertilizers to agricultural land is another possible source of these heavy metals, for example phosphatic fertilizers are the main source of these heavy metals, Bansal and Takkar (1985) and Bansal *et. al*. (1992) have also reported that Zn, Cu, Mn and Fe in plants increased with increased rates of industrial waste water application. Other important source for the accumulation of Cd and Pb seem to be aerial contamination through automobile exhausts. The auotmobile exhausts may contain Cd and Pb enriched dust particles which ultimately fall on leaves and on soil surface causing contamination of plants.

Results presented in Table-1, revealed that samples collected from site "D" contain higher amounts of Cd and Pb than other sites, whereas higher amount of Cr was found in samples collected from site "E". This may be due to surface contamination from excessive vehicular traffic (automobiles) near sampling site in these area plus contamination by Cr rich chrome dye present in carpet industrial effluents used for irrigation. Singh (2003) and Singh *et. al.* (2009) also reported similear fingdings.

Table 1 : Heavy Metal Content in plants growing on polluted soil

Sampling Sites	Plant Species	No. of Samples	Cd	Pb	Cr (ppm)	Cu	Zn
Trans Varuna	**Forage Crops**						
(Varanasi)	Jawar	20	0.95	2.75	0.75	0.32	8.09
	Berseem	20	1.01	6.09	0.99	0.95	9.12
	Maize	20	1.65	7.11	2.10	0.42	8.12
	Grasses and Weeds						
	Dub	20	0.46	5.04	0.67	0.48	7.12
	Bathua	20	0.82	8.06	0.73	0.89	9.30
	Cow Pea	20	0.91	8.26	1.82	0.81	7.79
Varanasi City	**Forage Crops**						
	Jwar	20	1.00	3.00	0.80	0.43	8.30
	Bereseem	20	1.21	8.01	1.01	0.96	9.26
	Maize	20	1.70	7.40	3.60	0.50	8.30
	Grasses and Weeds						
	Dub	20	0.49	6.08	0.86	0.50	7.80
	Bathua	20	0.80	8.19	0.79	0.90	9.20
	Cow Pea	20	0.99	8.86	1.91	0.87	8.01
Between Sigra to	**Forage Crops**						
Manduadih (Varanasi)	Jwar	20	0.90	2.11	0.48	0.38	8.01
	Bereseem	20	0.82	5.09	0.82	0.67	8.69
	Maize	20	1.72	9.08	0.95	0.35	8.20
	Grasses and Weeds						
	Dub	20	0.42	4.95	0.56	0.41	6.84
	Bathua	20	0.72	7.49	0.45	0.78	8.23
	Cow Pea	20	1.75	8.76	2.11	0.45	8.12
Between Ramnagar	**Forage Crops**						
(Varanasi) to	Jawar	20	1.29	7.00	0.51	0.36	8.08
Chandauli	Berseem	20	0.88	5.16	0.86	0.70	8.66
	Maize	20	1.88	9.10	0.98	0.39	8.30
	Grasses and Weeds						
	Dub	20	0.40	5.11	0.67	0.49	7.10
	Bathua	20	0.70	7.82	0.40	0.72	8.28
	Cow Pea	20	1.79	9.06	2.20	0.46	8.20
Sant Ravidas Nagar	**Forage Crops**						
Bhadohi (South West)	Jwar	20	0.99	2.19	0.51	0.36	7.99
	Bereseem	20	0.87	5.12	0.76	0.69	8.96
	Maize	20	1.79	8.49	2.60	0.62	9.28
	Grasses and Weeds						
	Dub	20	0.39	5.09	0.79	0.39	6.91
	Bathua	20	0.51	7.46	0.51	0.89	8.20
	Cow Pea	20	1.66	8.79	2.02	0.92	9.00
Saidpur (Ghazipur)	**Forage Crops**						
	Jwar	20	0.99	7.40	0.89	0.49	7.98
	Bereseem	20	0.89	6.17	0.89	0.76	8.36
	Maize	20	1.77	8.16	0.81	0.69	8.80
	Grasses and Weeds						
	Dub	20	0.49	6.19	0.97	0.69	7.86
	Bathua	20	0.76	7.96	0.90	0.81	8.82
	Cow Pea	20	1.87	6.19	2.15	0.86	8.90

CONCLUSION

Heavy metals are hazardous for soils and plants in the same manner as poison is to any living being. Continuous supply of such type of heavy metals to the cultivable fields through industrial wastewater, sewage and sludge etc. should necessarily be banned and steps for safe disposal of such toxic materials must be taken in order to reduce the risk of health hazards to our community and crops, which are becoming toxic gradually as various reports across the world reveal time to time. This is particularly important so that we can cultivate cereals, pulses, oilseed crops, fruits & vegetables, medicinal plants and fodder for feeding the ever bulging population and cattle of our country

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