ESTIMATION OF HEAVY METALS IN PADDY PLANT SYSTEM GROWING UNDER IRON AND STEEL FACTORIES POLLUTED ENVIRONMENT

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ABSTRACT

In this research work a much stress is given for estimation of different types of heavy metals (Fe, Pb, Cr, Cd) in Paddy plant system due to severe water pollution in Sponge Iron Factory. Paddy plant (Oryza sativa L.) was selected from the vicinity Agricultural field of Durgapur steel factory industrial zone (Angadpur area) and another Agricultural site Burdwan University Farm was selected for comparative studies because this site is totally free from any kind of pollution. In polluted zone the washed water from different point inside factory comes out from industry enter into the nearest paddy field can change a significant biomolecular loss and create a stress environment for this plant due to enrichment of different Heavy metals i,e (Fe, Pb, Cr, Cd). In polluted zone these Heavy metals which are already present in Industrial water(Cd 0.0096 mg/l , Pb 0.2153 mg/l , Cr 0.2433 mg/l , Fe 4.93 mg/l) enter into plant system and create a superoxide can hamper this plant. Chromium (Cr) playing a crucial detrimental role to poor growth of radicle and plumule in Paddy plant reported by (Sharma et.al., 1995). The sources of heavy metals comes from washing dust, coal, sprinkling to remove dust, cooling rotary kiln and washed inside the factory. In iron and steel factory the used water for cooling kilner the iron dust and coal dust mixed into this water, enter into paddy field and create a stress environment for this plant so there are the presence of significant amount of Heavy metals (Fe 0.224 mg/kg in root, Pb 0.0286 mg/kg in shoot, Cr 0.0025 mg/kg in leaf, Cd 0.0004 mg/kg in root inside paddy plant as a result damage of this plant takes place and which ultimately effect biomolecule proportion as well as food production.

***Keywords**: Paddy Plant, Sponge Iron Factory, Heavy metals, Agricultural field, Pollution.*

Introduction:

Worldwide there is an increasing emphasis on environmental issues. Iron & Steel industry is growing globally & so are its related environmental issues. Although iron and steel is one of the most important industries in the Indian manufacturing sector, India is only the 15th largest steel producer in the world. Originating from the first set up of a single steel plant in 1911-12, the iron and steel sector included 7 integrated iron and steel plants in 1995-1996. It is observed that during the last few years, there has been phenomenal growth of Sponge Iron units in Angadpur area (Burdwan district, West Bengal, India) & such growth has been accompanied by serious environmental impact in the surrounding areas, resulting in, contamination of water resources & destruction of food crops. During of solid & liquid waste results in air & water pollution, which is aggravated by discharge of heavy metals & chemicals into water & drainage of liquid effulents. According to Singh *et al*., (1985); Sharma *et al*., (1986) the discharge of untreated industrial effluents is one of the most significant reasons for pollution of environment ecosystem and irrigated lands. Most of the waste or effluent water contains trace quantities of many heavy metals such as nickel, manganese, lead, chromium, cadmium, zinc, copper, iron, mercury as reported by above mentioned workers.

Any form of stress leads to mal functioning of the system leading to abnormal metabolites, which reflect through the growth, vigour, morphological attributes. The detrimental effect of high percentage of Cr could be ascribed to poor growth of radicle and plumule of paddy plant (Sharma *et al*., 1995).

The possible effect of environmental degradation can be listed as, the degradation of other common property resources like forest & grazing land has its adverse effects on like stock & livelihood of the people depending on those resources. The effect on ecology & bio-diversity creates condition for loss of life support system both for the present & future generations. The heavy metals are known to cause stress in the plants and lead to production of free radicals. The antioxidants catalyse the reduction of superoxide radicle (Sairam *et al*., 1998).

The aims and objectives of this study was to estimate the status of Heavy metals upon paddy plant species under Iron and Steel Industries water pollution stress. The variations of different heavy metals parameters under study due to pollution level indirectly will plants sensitivity towards water pollution and subsequently the extent effect the water pollution stress in an industrial area.

Materials and methods:

Site Selection: For this study two specific sites were selected. One place is regarded as control site or safe site & other place is regarded as stress or polluted site. The Burdwan University farm (Burdwan) was regarded as control zone as it is situated towards north east of Burdwan town is however, a relatively pollution free zone, as it is surrounded by dense canopy of trees with less movement of vehicles. Angadpur area (Durgapur) was regarded as polluted zone because it is industrial zone. The sampling sites paddy field was selected in close vicinity of this industry. There was also selected a paddy field in control area.

Species selection: One specific plant species was selected from both Burdwan University farm house & Angadpur area of Durgapur for observing the changes. The plant species was 1) *Oryza sativa* L. (IR-36)

Study period: During the exposure period from June to October, 2010

Heavy metal Study: After 5 months of exposure different plant parts were analysed for different heavy metal estimation. Different heavy metal detection from water, by APHA 1998. Determination of heavy metal from plant sample by AAS (wet ashing method) analytical service laboratory, Indian Rice Research Institute.

Result:

Table 1: Different heavy metal concentration (mg/l unit) in respective two sites.

	Cadmium	Lead	Chromium	Iron
Polluted areas water	0.0096±0.003	0.2153±0.02	0.2433±0.11	4.93±2.05
Control areas Water	0.0016±0.0006	0.0022±0.0006	Not detectable	0.28±0.02

Graph 1: Graphical representation of different heavy metal concentration in respective study sites

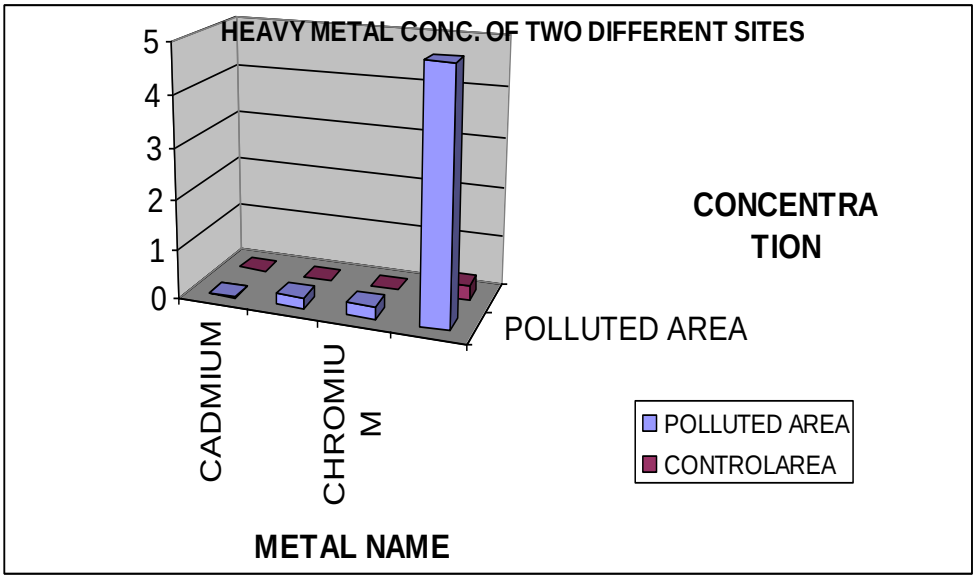

Table 2: Metal concentration in different parts of paddy sample.

Plant parts	Heavy Metals (mg/Kg) unit							
	Cadmium		Lead		Chromium		Iron	
	Polluted zone	Control zone	Polluted zone	Control zone	Polluted zone	Control zone	Polluted zone	Control zone
Leaf	0.00046 ±0.0001	0.000073 ±0.000015	0.0037 ±0.0004	0.00017 ±0.000025	0.0025 ±0.001	Not detectable	0.261 ±0.0026	0.055 ±0.0077
Shoot	0.00023 ±0.0001	0.000026 ±0.000005	0.0286 ±0.0098	0.00019 ±0.000030	0.00063 ±0.00023	Not detectable	0.1743 ±0.018	0.043 ±0.0020
Root	0.00040 ±0.000	0.000063 ±0.000015	0.0157 ±0.00086	0.00024 ±0.000020	0.0038 ±0.0002	Not detectable	0.224 ±0.0258	0.051 ±0.0045

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After 5 months of exposure, leaf, shoot & root plant parts sample of this species were analysed for heavy metal (Cd, Pb, Cr, Fe) detection. All the heavy metals parameters exibited significant variation between two sites.

Leaves of *Oryza sativa* (control site) in the present investigation revealed 84.13%, 95.40% and 78.92% reduction of Cd, Pb and Fe respectively with respect to polluted area's plant. Shoots of *Oryza sativa* (control site) also revealed 88.69%, 99.33% and 75.32% reduction of Cd, Pb and Fe respectively with respect to polluted area's plant.
Roots of *Oryza sativa* (control site) also revealed 84.25%, 98.47% and 77.23% reduction of Cd, Pb and Fe respectively with respect to polluted area's plant.
Heavy metal estimation from collecting water samples of polluted site shows Lead and Iron was present at a greater ratio than permissible limit of water. Iron is present at very high quantity 4.93 miligram/liter , Lead 0.2153 mg/l and Chromium 0.2433mg/l. The different heavy metal i.e., Cadmium, Lead, and Iron were present in very negligible amount and Chromium was not detectable in the control areas water sample.

Discussions: There are significant different variations of heavy metals quantities in the same species in two different sites and also showed significant variation in all the heavy metals present in irrigation water in two different sites. Behera and Reddy (2002) have carried out analysis of impact of industrial pollution on agriculture production through deterioration in the quality of irrigation water for a village in Andhrapradesh in India. Most of the heavy metals with large quantities were found accumulated in the root and leaf region than shoot region. Kisku et al., (2011) noticed that in case of some vegetable plants some Heavy metal accumulation occured in these sequencial order root > shoot > seed. It may be assumed that the root portion is the first contact with irrigation water and roots acts as absorption nature.

Cadmium was evenly distributed more or less same quantities throughout the whole plant system. Yap *et al*., (2009) reported that the most of the heavy metals accumulated in the roots portion which was uptake by paddy plant in Kota Marudu, Sabah, Malaysia. Cd was evenly

distributed throughout the whole plant at very low concentration while Pb was detected much quantities in the paddy shoots.

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