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IMPACT OF HEAVY METALS (CD AND AS) ON DRY BIOMASS OF ROOTS & SHOOTS OF *BRASSICA JUNCEA* AND *HELIANTHUS ANNUUS*

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ABSTRACT

To evaluate the impact of different concentrations of heavy metals Cd and As well rooted plantlets of *B. juncea* and *H. annuus* were cultured in Hoagland solution in a culture flask supplemented with 5, 10, 25 and 50 ppm of the above metals in the form of their salt. Healthy plants cultures in Hoagland solution served as control. The mean dry weight of each treatment was used for data presentation. Dry weight was taken after 21 days of incubation. The dry biomass of root of *B. juncea* was 0.012g while the dry biomass of the shoot was 0.076g in the culture containing 50 ppm of Cd. Dry biomass was reduced to 0.007g in roots and 0.068g in shoots at 25 ppm. The dry biomass was further reduced to 0.008g in roots and 0.062 in shoots. At lower concentration that is 5 ppm the dry biomass was increased in both the roots and shoots. In 50 ppm of As the dry biomass of roots was 0.036 g and shoots 0.107g. Here, lower concentration had much adverse impact. In case of *H. annuus* the dry biomass was reduced to 0.046g in root and 0.465 in case of shoots in comparison to the control where dry biomass was 0.088 g in roots and 0.668 in case of shoot. The reduction in dry mass was directly related with the concentration of Cd. It was also true in As where at 50 ppm the root biomass was reduced to 0.032 in roots and 0.426 in shoots. In the present work it was noted that As was much hazardous than Cd because at the similar concentrations difference in the dry biomass was observed.

KEYWORDS: Heavy metal, Biomass, *B. juncea, H. annuus*, Hazardous

In the race for growing more and more, uncontrolled amounts of the agrochemicals in the form of fertilizers, Pesticides, weedicities are being used, ignoring its impact on our soil and water bodies. Now it has been realized by the intellectuals, the scientists and the politicians about the hazardous impact of these pollutants and attempts are being made to develop an efficient, cost effective and ecofriendly technology, so that it may be reduced in soil and water. We know that through different food chains these heavy metals are accumulating or they are being biomagnified and biotransformed. The quanta of the release of the hazardous materials are increasing day by day because of the logarithmic growth in the release of industrial wastes. Major components of inorganic contaminants are heavy metals (Henry, 2000). Heavy metals are the chemical elements with specific gravity at least 5 times that of water. For example Arsenic has 5.7 and Cadmium (8.65). Heavy metals are responsible for different health anomalies which are caused due to exposure to these chemical diseases like Alzheimer, Parkinson's, Depression, Headaches, Thymid problems, Skin diseases, Cardio vascular diseases, Digestive problems all are related with exposure or consumption of heavy metals.

Different techniques are being used to remove heavy metals from the polluted soil and water. However, phytoremediation is the best for the above. Phytoremediation of heavy metals are cost effective, ecofriendly than the chemical methods. Nwosu *et al;* (1995) reported cadmium uptake by edible crops grown in silt loam soil. Honer and Keyval (1997) reported uptake of Cd by roots of *T. subterraneam*. Huang *et al;* (1997) reported phytoremediation of lead from the polluted water. Raskin *et al;* (1997) reported phytoremediation of heavy metals with the help of plants from polluted water. Roy *et al;* (2005) described removal of heavy metals and PAH form the soil with the help of plants. Raskin *et al;* (1996) reported removal of heavy metals by the plant seedling. Salt *et al;* (1998) discussed in detail the importance of Phytoremediation. Singh *et al;* (2003) described an overview of phytoremediation. January *et al;* (2008) reported hydroponic technique for phytoremediation of heavy metals by *H. annuus*. Phytoremediation of heavy metals has been described by several other workers. Shukla *et al;* (2010) reported bioremediation, developments and current practices and prospects. Keeping these reports in mind it was decided to observe the impact of heavy metals Cd and As at different concentrations of the dry weight of roots and shoots of *Brassica juncea* and *H. indicum*.

MATERIALS AND METHODS

Healthy seeds of *Brassica juncea* and *Helianthus annuus* were procured from the local traders. These seeds were surface sterilized and planted in the pots under laboratory condition. 30 days old plant was uprooted and tested for the growth of the roots. Well rooted plants were selected and cultured in culture jars containing Hoagland liquid medium supplemented with 5, 10, 20 and 50 ppm of Cd and As. 5 plants were cultured under the above conditions and plants were harvested after 21st day of culture. The dry biomass was determined after drying the roots at 60^{0}C. It was repeated till the final weight of the roots and shoots were obtained. The Hoagland medium without heavy metal served as the control. Like wise the initial weight of roots and shoots was determined before culture in the Hoagland solution supplemented with the solutions of heavy metals. The data obtained have been presented in the tables 1 and 2. Hoagland solution was prepared as Hoagland and Arnon (1938).

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RESULTS AND DISCUSSION

From the table one it is clear that *B. juncea* could survive in the Hoagland solution containing even 50 ppm concentration of Cd and As. At this concentration the dry biomass of the roots was 0.07g while the dry biomass of shoots was 0.060g. At the similar concentration of As the dry biomass of roots was 0.016 g while the dry biomass of the shoots was 0.068 g respectively. At 25 ppm Cd the dry biomass of the roots was 0.021 and 0.072g respectively. In case of *H. annuus* the dry biomass of roots was o.046 and that of the shoots it was 0.465g respectively. At 25 ppm the dry biomass of roots was 0.063 and shoots 0.572g. In case of As at 50 ppm the dry biomass of roots was 0.032 and that of shoots 0.426g. At 25 ppm it was 0.042 and 0.512 g respectively.

From the tables it is clear that there was gradual reduction of biomass along with the increasing concentrations of these two heavy metals. In this respect it may also be noted that among the heavy metal Cd could reduce the growth of roots and shoot at higher concentrations than As. Similarly roots and shoots of *B. juncea* were more affected than *H. annuus*. It may be due to the fact that *B. juncea* absorbs more and transport less therefore, they accumulate more than they transport and due to this they are affected more.

The percentage of loss in dry biomass in roots of *B. juncea* due to Cd was 47.8 while due to As it was 36.2. Similarly in shoot it was 30.3 in Cd and 33.0 in As. In *H. annuus* the percentage inhibition in dry biomass of roots due to Cd was 61, while due to As 38 respectively. The percentage of reduction in dry biomass of shoot in Cd was 30 while in As it was 27 respectively. It may be concluded that although there was loss in dry biomass of the roots and shoots of *B. juncea* and *H. annuus* at 50 ppm concentrations of Cd and As, their survival indicates that they have the ability to grow in the above concentrations and they can be utilized for phytoremediation of these heavy metals. Present findings corroborate with the finding of Gondek *et al;* (2003), Nehnevajoa *et al;* (2005) who also calculated the biomass of plants grown in the presence of heavy metals.

Phytoremediation is the best technology for the polluted soil and water has been discussed by Chaudhary (1998); Baker (2000); Raskin and Ensley (2000); Singh and Jaira (2003); Sinha *et al;* (2007b) and Anamika *et al;* (2009). Thus phytoremediaiton of different toxic pollutants are the best source which are easy, cheaper and ecofriendly.

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Initial weight of dry biomass of 30 days old plant

Brassica juncea = Roots = 0.012
Shoots= 0.054
Helianthus annuus= Roots = 0.76
Shoots= 0.122

Table 1: Dry biomass of *B. juncea* after 21 days exposure to the different concentrations of heavy metals (Cd and As) supplemented Hoagland solution

Heavy metal	Concentration ppm	Dry weight in g	
		Roots	Shoots
	Control	0.018 ± 0.003	0.086 ± 0.018
Cadmium	5	0.012 ± 0.004	0.082 ± 0.012
	10	0.010 ± 0.002	0.072 ± 0.008
	25	0.008 ± 0.003	0.068 ± 0.010
	50	0.007 ± 0.002	0.068 ± 0.016
Arsenic	5	0.034 ± 0.008	0.108 ± 0.012
	10	0.028 ± 0.004	0.080 ± 0.014
	25	0.022 ± 0.006	0.078 ± 0.016
	50	0.021 ± 0.006	0.072 ± 0.027

Table 2: Dry Biomass of *Helianthus annuus* after 21 days of exposure to the various concentrations of Heavy metals (Cd & As) supplemented in Hoagland solution

Heavy metal	Concentration ppm	Dry weight in g	
		Roots	Shoots
	Control	0.088 ± 0.004	0.668 ± 0.056
Cadmium	5	0.094 ± 0.008	0.672 ± 0.036
	10	0.081 ± 0.007	0.624 ± 0.038
	25	0.063 ± 0.006	0.512 ± 0.022
	50	0.046 ± 0.005	0.426 ± 0.038
Arsenic	Control	0.088 ± 0.004	0.668 ± 0.056
	5	0.092 ± 0.006	0.672 ± 0.036
	10	0.058 ± 0.005	0.624 ± 0.038
	25	0.042 ± 0.003	0.512 ± 0.022
	50	0.032 ± 0.005	0.426 ± 0.038

Number in the tables indicates the mean of 5 plants in one replica (± Standard Error)

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