Phytoremediation Potential of Indian Mustard (*Brassica Juncea*) genotypes for Cr (Vi) Mitigation

W.M.K.T. Wijethunga, K.B. Wijesekara,
Uva Wellassa University, Badulla, Sri Lanka

and

R. Weerasooriya
Institute of Fundamental Studies, Kandy, Sri Lanka.

Introduction

Phytoremediation is a low cost, environmental friendly technology of using plants to mitigate hazardous contaminants from the environment (Dushenkov *et al.*, 1997). Phytoremediation efficiency of selected nine accessions of Indian mustard (Brassica juncea) was examined at different experimental conditions, in vitro and in vivo. Phytoremediation ability of Indian mustard (Brassica juncea) is well established, thus a good candidate plant for phytoremediation. (Weerakoon and Somaratne, 2009). This investigation demonstrates phytoremediation potential of Brassica juncea genotypes for Cr (VI) mitigation.

Methodology

Experiments were conducted to screen nine accessions (Ac. 501, 790, 1774, 1814, 5088, 7707, 7788, 7789, and 8831) and three accessions with high accumulation (Ac. 0501, 1774, 5088) were used for further experiments on hydrophonic system with parallel to *in vitro* experiments in liquid media. All experiments were designed with, three replicates with three plants per replicate. After three weeks of culturing, plants were exposed to five weeks with a growth media containing four different concentrations of Cr (VI), (0 ppm, 50 ppm, 150 ppm, and 200 ppm). Growth media for hydrophonically grown plants was Albert's solution while liquid MS media was used for *in vitro* grown plants. Performance of plants for Cr (VI) accumulation in hydrophonic system and *in vitro* was studied to select the accession with maximum accumulation.

The software program Minitab 14 (Minitab Inc., 2003) was used for the statistical analysis of metal accumulation data. Statistical analysis was done in three factor factorial design. Analysis of variance (ANOVA) was performed followed by multiple comparisons to determine which means differed significantly (□= 0.05) by using Tukey and Dunnett tests.

Results and discussion

The chromium accumulation is depending on genotype and growth media. Highest accumulation (3511 mg kg^{-1}) was shown in accession 1774 grown in MS media contains 200 ppm of Cr (VI) at *in vitro* conditions (Figure 1). Plants grown on *in vitro* showed high accumulation levels than plants grown hydrophonically (Figure 1). Seed of *Brassica juncea* were unable to germinate on the growth media contains Cr (VI) □250 ppm. *B.juncea* itself contains some amount of Cr (VI) which is negligible when compared with mean accumulation of Cr (VI) (Table 1). However, *Brassica juncea* did not show any toxic symptoms when media contains Cr (VI) □200 ppm.

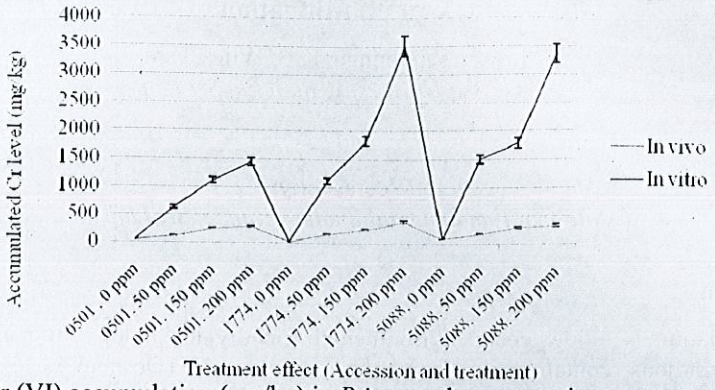

Figure 1: Cr (VI) accumulation (mg/kg) in *B.juncea* three accessions exposure to *in vitro* and *in vivo* conditions in different Cr (VI) treatments

Table 1: Mean Cr (VI) accumulations (in mg/kg) in selected best three accessions of *B. juncea* grown in *inviro* and hydrophonic systems with standard error of mean (n = 9).

Treat. / Acc.	0 ppm		50 ppm		150 ppm		200 ppm	
	Hydro:	*Invitro*	Hydro:	*Invitro*	Hydro:	*Invitro*	Hydro:	*Invitro*
AC	22.4	49.9	125	621.8	257.1	1114	294	1446
0501	±0.033	±0.0433	±0.065	±0.072	±0.072	±0.08	±0.038	±0.01
AC	36.9	24	159.3	1112.3	257.3	1825.6	387.5	3511
1774	±0.0427	±0.0814	±0.028	±0.03	±0.069	±0.04	±0.071	±0.07
AC	90.9	89.4	175.1	1498.1	296.3	1788.4	330.6	3374
5088	±0.0468	±0.029	±0.023	±0.04	±0.032	±0.02	±0.064	±0.06

Conclusions

Brassica juncea is a chromium hyper-accumulator and the accumulation level is depend on the genotype, growth medium, and initial Cr (VI) loading. Maximum tolerance limit for Cr (VI) for selected accessions is 200 ppm and *B.juncea* accumulated high amounts of Cr (VI) at *in vitro* conditions compared to *in vivo*. Indian mustard accession 1774 is the best accession among selected accession for Cr (VI) mitigation. So, there is a potential for using accession 1774 of Indian mustard in the remediation of chromium contaminated sites.

Moreover, *B.juncea* itself contains some amount of chromium itself and the attention has to be made when *Brassica juncea* is used as a vegetable due to its high heavy metal accumulating ability.

References

Dushenkov, S., Y.Kapulnik, M.Blaylock, B.Sorochisky, I.Raskin, and B.Ensley, 1997. Phytoremediation: a novel approach to an old problem. Global Environmental Biotechnology. 66:563-572.

Ileperuma, O.A. 2000. Environmental pollution in Sri Lanka: A review. Ceylon Journal of Science. 28(4):301-325.

Weerakoon, S.R. and S.Somaratne 2009. Phytoextractive potential among mustard (*Brassica juncea*) genotypes in Sri Lanka. Cey. J. Sci. (Bio. Sci.) 38(2):85-93.