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Heavy metal toxicity on seed germination of four pulses

SANTI MOHAN MANDAL[1], RABINDRA NATH BHATTACHARYYA[2]*
[1] Central Research Facility, Indian Institute of Technology, KHARAGPUR (W.B.) INDIA.
[2] Department of Botany, Presidency College, KOLKATA (W.B.) INDIA.

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SUMMARY

A preliminary study on four common pulses (*Vigna mungo* (L.) Hepper, *Vigna radiata* (L.) Wilzek, *Pisum sativum* L. and *Lens culinaris* L.) have shown that they can germinate in the presence of certain level of some heavy metals. We studied the individual effects of several doses of As (V), Cd (II), Pb (II), Hg (II), Cu (II), Zn (II) on the seed germination. *V. mungo* and *V. radiata* were the most tolerant ones than *L. culinaris* and *P. sativum* to most of the tested metal elements, although effective concentrations of these metals for a certain degree of inhibition were different. Exposure of 20 ppm Hg (II) showed higher toxicity than other heavy metals and reduced the germination potential 50% compared to control. The toxicity of the metal elements on the four herbs pulses decreased as follows: Hg> As> Cd> Pb> Cu> Zn.

Key words : Pulses, Heavy metal, Seed germination, Toxicity.

Heavy metals are serious environmental problems throughout the world limiting crop production. The main sources of elevated level of heavy metals concentration in soils are agricultural, manufacturing, mining, smelting, refining based products, vehicular exhausts, burning of coal, industrial rubbish, waste disposal practices and the use of sewage sludge as fertilizer in agricultural fields (Salgare, 1991). Heavy metals concentration is introduced due to the application of metal containing agrochemicals such as pesticides and fertilizers (Vlamis *et al.*, 1985). Groundwater contamination with arsenic is reported from many regions in the world and this problem is also serious in Bangaladesh, India, China (WHO, 2001). Arsenic contaminated groundwater is not only used as source of drinking water but also extensively used for irrigation in some regions and the long term use of contaminated water for irrigation also elevated the arsenic level in soil (Allam and Sattar, 2000). Heavy metals can cause various toxic effects on plants such as inhibition of seed germination, plant growth; yield production and alternation of normal metabolic pathways including respiration and photosynthesis by disrupting cellular enzymes (Krupa *et al.*, 1993; Ge *et al.*, 2002). Different vegetative response endpoints such as germination percentage, root length, shoot height; root biomass, shoot biomass, and total biomass are used to indicate plants resistance to metal (Abedin and Meharg, 2002).

Legumes are appropriate crops for the enhancement of bioproductivity and the recovery of marginal lands. Legumes are not only yield nutritious fodder and protein-rich seeds but also enrich soil nitrogen through symbiotic association with *Rhizobium*. Presently different legumes are cultivated in India, Pakistan, Mayanmar, Bhutan, Bangladesh, Thiland, Malayasia, Philippines, Afganistan, Iran, Kenya, and United states (Anonymous, 1998). Since, the crop is grown in various agrochemical conditions and cropping systems with diverse cultural practices and no single plant type is appropriate for all production systems. This calls for an extensive survey of existing germplasm collections for potential utilization in development of appropriate plant type. The aim of the present investigation is to determine genetically based differences in reaction to particular metal elements in commercial germplasm and to propose suitable candidates for both phytoextraction (high accumulators) and food /pharmaceuticals (low accumulators) purpose.

MATERIALS AND METHODS

Four herb pulses (*Vigna mungo* (L.) Hepper, *Vigna radiata* (L.) Wilzek, *Pisum sativum* L. and *Lens culinaris* L.) were selected to check the effects of some heavy metals on rate of seed germination. Seeds were collected from farmers cultivated field of Midnapore district, W.B. India. The seeds were immersed in 4% (w/v) sodium hypochlorite solution for five minutes. After that, the seeds were washed with deionized Milli-Q water in twice and placed in Petriplates containing double layer of Whatman No. 1 filter paper moistened with 5 ml test solutions. The seeds were kept to germinate at 25±2°C in dark and 85-90% relative humidity inside the growth chamber. The results were expressed as mean percentage over control in triplicates. Seeds were considered germinated when

* Author for correspondence.