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Relative toxicity of various nickel species on seed germination and early seedling growth of *Vigna unguiculata* L.

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Cowpea (*Vigna unguiculata* L.) seedlings were raised in water culture and exposed to varying concentrations (1,10,100,1000µM) of nickel as Ni $(NO_3)_2$ $NiSO_4$ and $NiCl_2$ with a view to compare the effect of the above nickel species on seed germination, ultimate percentage germination, dry matter production, chlorophyll contents and soluble protein (leaf) contents. The ultimate germination was 100% (except in 1000 µM) in all the treatments of various nickel species. The germination speed was found maximum at 1µM nickel concentration. Lower concentration of nickel resulted in an enhancement while higher levels resulted decrease in fresh mass, dry matter production and chlorophyll contents of seedlings. Soluble leaf protein contents increased linearly with increasing application rates of nickel. In general, $NiCl_2$ was more inhibitory than $NiSO_4$ and Ni $(NO_3)_2$. Ni $(NO_3)_2$ was found to be least toxic. The extent of inhibition increased with enhanced levels of Ni_2^+ ions. The toxicity series was found to be $NiCl_2$ > $NiSO_4$ > Ni $(NO_3)_2$.

Key words : Nickel, *Vigna unguiculata* L. Toxicity, Early seedling growth.

INTRODUCTION

Heavy metal contaminants affect the biosphere in many places worldwide (Cunningham *et.al.*, 1997; Raskin and Ensley, 2000; Meagher, 2000). In the majority of natural environments the concentration of heavy metal in soil is low and does not cause any significant phytotoxic effects (Gratao *et al*., 2005). Some heavy metals such as Cu, Zn, and Ni are essential micronutrient for plants, but are toxic to organism at high concentrations (Munzuroglu and Geckil, 2002). Although essential heavy metal ions, such as Ni^{+2}, are of major importance in different enzymatic reactions, excess cellular levels of such metals are toxic to all living cells. Nickel has one essential role in plants, which is to form the hexameric enzyme urease (E.C. 3.5.1.5.3) (Gerendas and Settelmacher, 1999). Nickel is not toxic at low concentration, but it becomes toxic at high concentrations (Poulik, 1997).

Seed is a developmental stage in plant life cycle that is highly protected against various external stresses. However, soon after imbition and subsequent vegetative developmental processes, they become stress sensitive in general. Therefore, according to Karssen, 1982; Pritchard *et al*., 1993; Bungard *et al.*, 1997 seeds are thought to carefully monitor such external parameters as light, temperature and nutrient in order to maintain the protective state until external conditions become favourable for following developmental processes. Seed germination represents an important and initial phase in the life cycle of plants (Bishnoi *et al*., 1993). Seed germination and early seedling growth responses of plants to adverse environmental conditions are critical for raising a successful agricultural crop stand density and establishment of resultant crop especially under stress conditions (Jagetiya and Aery, 1994a). A number of environmental factors together with the make up of seed affect germination phenomenon. The subject has attracted the attention of many workers right from the dawn of scientific research. Many treatises, review and proceedings have produced voluminous finding on germinability of seeds of several plants.

Several studies have been conducted in order to evaluate the effect of different heavy metal concentration on living plants (Thompson *et al.*, 1997). Most of these studies have been conducted using seedling or adult plants (Flores Tana *et al*., 1999; Lee and Leustek, 1999; Chatterjee and Chatterjee 2000; Gratton *et al.*, 2000; Oneel *et al*., 2000; Pichtel *et al*., 2000). In a few study the seeds have been exposed to the contaminants (Clair *et al*., 1991; Vajtechova and Leblova, 1991; Xiong, 1998).

Investigations on the effect of nickel on seed germination, growth and crop yield have been given conflicting results (Mishra and Kar, 1974). Das *et al.* (1978) responded that rice seeds when treated with nickel salts increased the germinations rates. It has been reported that at non-phytotoxic levels nickel stimulates germination and growth, promotes physiological activities

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