

Evaluation of the growth parameters AGR, RGR and NAR of soybean [*Glycine max* (L.) Merr.] under Cd (II) stress

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SUMMARY

Heavy metals are one of the major toxic pollutants resulted due to various industrial developments and anthropogenic activities, which should be considered, for their innumerable negative effects on ecology, evolution, health, nutrition and environment. Anthropogenic activities and industrial activities have polluted the soil and water bodies extensively. Plants possess various types of cellular mechanisms to handle and regulate the levels of metal ions inside the cell and to minimize the heavy metal toxicity that could result from the exposure to heavy metals contaminated environment. Among the heavy metals, Cd is of special concern because of its potential toxicological profile even at lower concentration. This study aims to evaluate the various growth parameters such as AGR, RGR and NAR of Co-2 variety soybean under heavy metal Cadmium stress (0, 5, 10, 15, 20 and 25 ppm). The observation was done on 20th day and 40th day of its growth and the results were compared and evaluated. This study demonstrated the need for understanding and evaluation of the effects of effluents or wastewater containing cadmium on soybean which may help to improve the production of soybean to meet the increasing global demands and for development of effective treatment methods for reuse of waste water for agriculture.

Key words : Soybean, Cadmium, AGR, RGR, NAR.

The increasing contamination and consequential accumulation of heavy metals in the soil by anthropogenic activities, in particular the disposal of sewage sludge can be very serious, if the crops are grown and cultivated in such polluted environment (Wagner, 1993). The current worldwide mine production of various heavy metals such as Cu, Cd, Pb, and Hg is very high (Pinto *et al.*, 2004). Metal toxicity and its effect on the growth and metabolism in higher plants is a subject that has a wide economical and ecological interest and also have been widely reviewed and gaining importance on several occasions over the last few decades (Brown and Jones, 1975; Foy *et al.*, 1978; Ernst *et al.*, 1992; Das *et al.*, 1997; Sanità di Toppi and Gabbrielli, 1999; Hall, 2002; Clemens *et al.*, 2002). Another interesting reason for this is out of the ninety naturally occurring elements fifty-three are heavy metals as reported by Weast (1984). Few metals are found to be essential for growth of plants, while few are found to be toxic for the growth of plants. Some of the heavy metals do not interact with the plant metabolism directly but decreases the level of soil microbes, affecting the growth of the plants (Niess, 1999).

The background cadmium (Cd) level in agricultural

soils is found to be less than 1mg.kg⁻¹ (Adriano, 2001). However, higher values until 30 ppm have been observed in many agricultural and contaminated soils due to long-term use of phosphate fertilizers, release of effluents to water bodies and agricultural lands, contamination of ground water levels with cadmium and sewage sludge application (Chaney, 1980). Increased Cd levels were also found in the surface soils near the metal processing industry. High mobility of this metal in soil-plant system allows its easy entering into food network (Ryan *et al.*, 1982) where it may provoke both human diseases (Nogawa *et al.*, 1987) and well-known toxicity effects on animals, microorganisms and plants. Increasing international concern about the risks associated with long-term consumption of crops contaminated with Cd has led the international food standards organization, Codex Alimentarius Commission, to propose a 0.1mg Cd.kg⁻¹ dry weight limit for cereals, pulses and legumes (Harris and Taylor, 2001).

Soybean is an important legume crop, which is an excellent source of protein, which is also referred to as poor man's meat (Tandale and Ubale, 2007). The low productivity of soybean is observed in India, comparing to other countries. In addition, the water scarcity and pollution of the agricultural land has become a big threat for agriculture in India and worldwide. Hence, new agricultural practices or new irrigational techniques are to be developed and practiced in order to meet the current demand for soybean, as a food source and source of non-

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