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Phytotoxic effect of aluminium and copper in senescence green gram [*Vigna radiata* (L.) wilczek] leaves

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SUMMARY

Aluminium (Al) and copper (Cu) treatment at higher concentrations decreased the pigment and protein content in senescing green gram (*Vigna radiata* L.) leaves with the increasing duration of the treatment. Accumulation of proline was observed with increasing concentration of Al and Cu. A significant increase in lipid peroxidation measures in terms of malondialdehyde (MDA) content was observed in senescing green gram leaves concurrently in total peroxide content. Ascorbate and glutathione content showed an increase under Al- and Cu-treatment. Activities of catalase (CAT), superoxide dismutase (SOD) and glutathione reductase (GR) decreased was observed with a corresponding increase in peroxidase (POX) activity in the increase in concentration of Al and Cu and increase in the period of treatment. These results suggested that acceleration senescence in green gram leaves under Al and Cu phytotoxicity stress.

Key words : Antioxidant response, Green gram, Heavy metal toxicity, Senescence.

Soils occasionally contains phytotoxic amounts of metals (Pb, Cd, Cr, Zn, Ni, etc) but more frequently, that accumulate them as a consequence of industrial and agricultural activity (Zancani *et al*., 1995). Copper (Cu) is important metals in various biochemical process, but at toxic concentrations it interferes with numerous physiological processes such as seed germination, seedling growth, senescence, pigment status, nutrient content and enzyme activities of various plants system (De Vos *et al*., 1992). It has been investigated that Cu-mediated reactive oxygen species (ROS) generation in detached leaves (Luna *et al*., 1994) and isolated chloroplasts (Chen and Kao, 1998). Aluminium (Al) toxicity is the primary factor limiting crop productivity is acidic soils (Foy, 1984). Phytotoxic level of Al is known to affect plant growth and developments especially root system. Direct evidence has been demonstrated that the root apex is the primary site of Al-induced root growth inhibition. Al can interact with a number of extracellular and intracellular substances like interaction within the root cell walls, disruption of plasmamembrane and plasma membrane transport system, interaction with symplastic constituents such as calmodulin (Kochian, 1995).

The presence of oxygen in the cellular environment poses a constant oxidative threat to cellular structure and process. Univalent reduction of oxygen as a consequences of spin restriction results in the formation to toxic ROS such as, superoxide (O_2^-) radical, hydrogen peroxide (H_2O_2), hydroxyl (OH^-) radical, alkoxy (OH^-) radical, singlet oxygen ($^1O_2$) etc (Halliwell and Gutteridge, 1984; De Vos *et al*., 1992). The half life of O_2^- is less than a second and is usually rapidly dismutated to H_2O_2, which is relatively stable. Protonation of SO_2 can produce the hydroperoxy (HOÿ) radical which can convert fatty acids to toxic lipid peroxides, destroying biological membranes. In the presence of divalent metal ions such as Fe^{2+}, H_2O_2 undergoes the Fenton reaction, production, producing the OH^-, the most reactive species known to chemistry (Cakmak and Marschner, 1992). The ROS have the capacity to initial lipid peroxidation and degrade proteins, lipids and nucleic acids (De Vos *et al*., 1992).

The ROS are produced in the young senescing leaf cells excessively under stressful conditions and are removed by complex enzymatic (catalase (CAT), peroxidase (POX), superoxide dismutase (SOD) and glutathione reductase (GR)) and non-enzymatic (ascorbate, glutathione, carotenoids, á-tocopherol) antioxidative systems (Halliwell and Gutteridge, 1984; Cakmak and Marschner, 1992). Heavy metals are known to induce free radical formation and a consequent oxidative damage in senescing leaf cells under light (Luna *et al*., 1994; Rama Devi and Prasad, 1998; Karuppanapandian *et al*., 2006a,b,c). The objective of present study was to examine the effect of increased concentrations of Al and Cu in the nutrient medium to accelerate senescence in green gram (*Vigna radiata* L.) leaves.

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