

## Influence of lead and cadmium on amino acids and protein content of pigeonpea seedlings

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### SUMMARY

Seeds of pigeonpea were grown in different concentrations of lead and cadmium for 8-days. The studies on the changes in free amino acid composition were confined to 6-day seedlings only. The total quantity of the amino acids increased with increasing lead and cadmium concentrations in both the cultivars of pigeonpea. The studies on protein content revealed the reduction in seedling axes and retention in cotyledons with increasing lead and cadmium concentrations when compared of their respective controls. From this observations it could be emphasized that the cultivar differed in response to two heavy metals.

**Key words :** Cultivars, Heavy metals, Pigeonpea, Proline, Protein

Lead and cadmium are toxic among the heavy metals. They are supplied to soil, air and water mainly by effluent from industries, mining, burning and leakage of waste and by fertilization with phosphates and sewage sludge. Soils contaminated with these heavy metals affect the growth, development and yield of plants (Tomsett and Thurman, 1988).

Amino acids are the primary products of inorganic nitrogen assimilation. In addition, free amino acids may also be formed by protein hydrolysis. Among the free amino acids, proline plays an important role under stress conditions and also a key role in osmoregulation (Aspinall and Paleg, 1981; Lilibute and Hellebust, 1989) protection of enzyme denaturation acts as a reservoir of carbon and nitrogen source and stabilizes the protein synthesis machinery (Fukutaku and Yamada, 1984; Kadpal and Rao, 1985). During germination and seedling growth, lead and cadmium affect the mobilization and hydrolysis of reserve proteins and their subsequent transport to growing axis (Krupa, 1988). Heavy metal toxicity causes the generation of reactive oxygen species (ROS) and its reaction with lipids, pigments, proteins and amino acids, resulting in membrane damage, inhibition of photosynthesis and enzyme inactivation (Stoeva *et al.*, 2003; Wang *et al.*, 2008). The inhibitory action of lead and cadmium on mobilization of seed storage proteins and consequent restricted availability of free amino acids to the growing axis impair the capacity of these tissues to carry out the synthesis of proteins involved in growth.

Amino acids and proteins are major components of pigeonpea. Pigeonpea is one of the important pulse crops of India. Its seed protein content is about 24% which is at par with any other legume. Seeds of pigeonpea constitute one of the principal sources of vegetable protein to the people of Indian homes hence the objectives of the initial phase of this research was to study the effect of lead and cadmium on free amino acid composition and protein content in pigeonpea cultivars.

### MATERIALS AND METHODS

#### *Plant material and its growth conditions :*

Seeds of pigeonpea (*Cajanus cajan*(L.)Millspaugh) cv. T21 (medium duration) and cv.LRG30 (long duration) supplied by ICRISAT, Patancheru, India were used in the present study. The seeds of uniform size and free from infection were selected for the experiments. The seeds were surface sterilized by using 0.01M sodium hypochlorite for 2 min, washed thoroughly with distilled water and were placed separately in trays lined with Whatman No.1 filter papers containing 0, 0.5, 1.0 and 1.5mM concentrations of lead (lead acetate:  $(\text{CH}_3\text{COO})_2\text{Pb}\cdot 3\text{H}_2\text{O}$ ) and cadmium (cadmium chloride:  $\text{CdCl}_2\cdot 2.5\text{H}_2\text{O}$ ), respectively. Twenty five seeds were taken in each tray. Seeds germinated and seedlings grown in distilled water (zero concentration) served as controls. The seeds were allowed to germinate at  $30\pm 2^\circ\text{C}$  for 8 days under a photoperiod of 12h and at  $195\text{m mol m}^{-2}\text{ s}^{-1}$  PPFD.

#### *Amino acid analysis and total proteins:*

Changes in free amino acid composition were studied in the control and treatments of 6-day old pigeonpea seedlings using LKB Automatic Amino Acid Analyser. For amino acid analysis, 200mg of plant material was

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