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Enzymatic Studies in Relation to Micronutrient Deficiencies and Toxicities in Grountnut

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The activities of nitrate reductase, peroxidase and ascorbic acid oxidase in the leaves of groundnut grown in sand culture with deficient (0 ppm), sufficient (1 ppm for Cu and Mo and 5 ppm each for Fe, Mn and Zn) and toxic (100 ppm) levels of micronutrients were assayed. The groundnut leaves contained lesser nitrate reductase activity at deficient level of Fe, Mn, Zn, Cu and Mo and toxic level of Zn and Cu. The peroxidase activity in Fe and Cu deficient and Mo excess plants was less than normal plants. The ascorbic acid oxidase activity in Cu and, upto some extent, in Mn deficient plant was reduced but increased with increasing doses of these micronutrients upto their toxic levels.

Key words : Ascorbic acid oxidase, groundnut, micronutrient deficiency and toxicity, nitrate reductase, peroxidase

INTRODUCTION

The micronutrient deficiencies are of common occurrence in groundnut, it being grown in light textured soils in India. These deficiencies show their visual symptoms when there is acute shortage of the nutrient. Moreover, at the time when such deficiencies appear and diagnosed properly, it would be too late to recover the plant through application of appropriate nutrient fertilisers. It is therefore necessary to diagnose such nutritional deficiencies at an early stage of their occurrence. The enzymatic methods involving marker enzymes offer an approach to assess the mineral nutrient status of plants. In case of iron, peroxidase (Bar Akiva 1984, Bar Akiva *et al.* 1978, Chaney 1985) copper, ascorbic acid oxidase (Delhaize *et al.* 1982), molybdenum, nitrate reductase (Bar Akiva 1984), and zinc, carbonic anhydrase (Dwivedi and Randhawa 1974) seem to be much affected with the supply of the respective nutrient. The enzymatic methods are based on the fact that depending on the mineral nutrient status of the plant the activity of certain enzymes is lower or higher in the tissue. Such reports are there on several crops but groundnut has not been studied so far. The present investigation, therefore, was undertaken to study the enzymatic activities of groundnut plant showing micronutrient deficiencies and toxicities.

MATERIALS AND METHODS

A sand culture experiment was conducted. Ceramic pots of 30 cm length and 22 cm diameter were filled with 15 kg of acid-washed silica sand. A nutrient solution was used. Two stock solutions A and B were prepared, with stock A containing 150 g $Ca(NO_3)_2 4H_2O$ and 35 g $Mg(NO_3)_2 6H_2O$ per litre of solution and stock B 30 g KH_2PO_2 and 10 g $(NH_4)_2SO_4$ per litre. Ten ml of each A and B were mixed and diluted with water to make 1 litre of the nutrient solution. For iron a 500 ppm Fe solution was prepared from Fe EDTA and 10 ml of this was used per litre of nutrient solution. For other micronutrients the stock solutions were prepared by dissolving H_3BO_3 2.86 g, Mn $Cl_2 4H_2O$ 1.81 g, Zn $SO_4 . 7H_2O$ 0.22 g, $CuSO_4 . 5H_2O$ 0.08 g and H_3MoO_4 0.02 g in one litre of water. One ml of the micronutrient stock solution was added to 1 litre of nutrient solution. The micronutrient stocks for each treatment were prepared by deleting that particular micronutrient. The deficiency (0 ppm), sufficiency of normal (5 ppm for Fe, Mn and Zn and 1 ppm for Cu and Mo) and toxicity (100 ppm) levels or micronutrients were the treatments with three replications.

The groundnut seeds of cv. GG 2 were sown at a rate of four seeds per pot. The pots were irrigated with water at full saturation level. The nutrient solutions with different levels of micronutrients were applied at the rate of 250 ml per pot each on alternate day upto 10 days and every day thereafter.