INTRODUCTION

Zinc is one of the essential plant micronutrients. It belongs to group II B of the periodic table and exhibits only +2 valence state. The ion Zn$^{2+}$ is colorless and exists in hydrated forms in acidic and neutral aqueous solutions. However, its hydroxide is precipitated in alkaline solutions.

The role of Zn application in improving crop productivity is important as that of major nutrients in present day agriculture. Zinc is now regarded as the third most important limiting nutrient element in crop production after nitrogen and phosphorous.

Zinc is an essential component of several enzyme systems having vital role in plant metabolism. It influences protein synthesis and involves in auxin production in plants, promotes seed production and maturation and stimulates growth hormones and starch formation and influences permeability of membranes (Marschner, 1986). Zinc stimulates plant’s resistance to dry and hot weather and also to bacterial and fungal diseases. Zinc deficiency leads to the accumulation of a large number of amino acids, amides and urides owing to the impairment of protein synthesis. Zinc deficiency reduces the level of phospholipids and fatty acids, especially unsaturated fatty acids and affect membrane integrity (Cakmak and Marschner 1988 a). Zinc deficiency increases the activity of peroxidase but decreases auxin level. Excess level of Zn suppresses the activity of iron containing enzymes.

Increasing cropping intensity and accompanying changes in the soil and fertilizer management practices have altered the Zn status of soils and its availability. Enhanced removal of micronutrient as a result of adoption of high yielding varieties and intense cropping together with application of high analysis NPK fertilizers resulted in decline in the level of micronutrients in the soils (Rathore et al., 1995).
Deficiency of micronutrients may be primary, due to low total content of element or secondary, caused by soil factors reducing their availability to plants. The availability of micronutrients to plants is influenced by their distribution within the soil profile and other soil characteristics (Singh et al., 1989). For an effective correlation of micronutrient deficiency in the field, it is necessary to understand the reasons for its deficiency in the soil. Knowledge of vertical distribution of micronutrient cations in soil is helpful in understanding the inherent capacity of soils to supply these nutrients to plants and their downward movement in soil. Roots of many crop plants go beyond the surface layer and thus draw part of their nutrient requirement from sub-surface layers of soil.

The availability of Zn depends on the content of chelating agents in the soil exuded by plant roots or from the decomposition of organic matter (Lindsay, 1974; Murphy and Walsh, 1972). High correlation between available Zn and soil organic matter has been reported by many workers. Calcium carbonate adsorbs significant amount of Zn resulting in its fixation. The oxides of Fe, Al (Kalbasi et al., 1978) and Manganese (Shuman, 1988) present in soils are capable of adsorbing significant amounts of Zn. Higher level of available P or applied fertilizer P induces Zn deficiency in plants. Depressive action of P on Zn may be a physiological one largely taking place in roots, restricting translocation to above ground parts (Stucken Holtz et al., 1966).

The availability of soil Zn to plants is governed by a dynamic equilibrium among the different fractions of soil Zn and the relative abundance of these chemical pools depends upon the physical and chemical properties of the soil (Mandal et al., 1986). Zinc concentration in soil solution, and its availability to plants is regulated by its adsorption on the surface of soil colloids and also by precipitation resulting from its interaction with other ions in soil (Swift and Mc Laren, 1991).
High solubility of Zn is maintained in acid soils of pH 5 or below and Zn deficiency may occur because of the leaching of Zn from root zone. Some highly leached acid soils are very poor in Zn with total values of 10-30 ppm. Available Zn content in Indian soils ranges from 0.08 to 20.5 ppm. On an average, it is around 0.6 ppm. According to Takkar et al. (1989), 43 per cent of the soils in India are deficient in Zn.

Rubber growing soils are acidic in pH and under acidic conditions normally Zn is available for plant growth. However, the soils under rubber are highly weathered and are prone to severe leaching losses due to intense rainfall and the physiography promoting intense leaching. Low Zn content of the rubber growing soils in the traditional belt of rubber cultivation was reported by Joseph et al. (1995). Further, in an extensive study with 9682 surface soil samples covering the traditional rubber growing tract of Kerala and Tamil Nadu it was reported that 41.0 per cent of the soils in the traditional rubber growing tract is deficient in available Zn (NBSS and LUP,1999).

Hence, the present investigation was taken up with the following objectives.

Objectives

1. To study the status and distribution of Zn in the major rubber growing soils in the traditional belt of rubber cultivation
2. To identify the suitable extractant for estimating availability of Zn in the major rubber growing soils in the traditional belt of rubber cultivation
3. To study the adsorption characteristics of Zn in the major rubber growing soils in the traditional belt of rubber cultivation
4. To study the response of rubber plants to supply of Zn through Zn fertilizer.