CHAPTER ~ 1

INTRODUCTION

Today, Zn deficiency is widely recognized and it is considered as one of the most important micronutrient problem in the world. Micronutrient (Zn) needed in small quantities as compared to primary nutrients, and have major role in terms of impact on crop growth and productivity. Zinc deficiency is the most widespread micronutrient deficiency in the world (Fageria *et al.,* 2002). Sommer and Lipman (1926) were the first to prove the essentiality of Zn as a nutrient requirement for higher plants. Plants emerged from seeds with low concentration of Zn could be highly sensitive to biotic and a biotic stress (Obata *et al.,* 1999). Zinc enriched seeds can perform better with respect to seed germination, seedling health, crop growth, and finally yield advantage (Cakmak *et al.*, 1996).

Zinc deficiency is a worldwide nutritional problem in crop production. It is estimated that about 50% of world soils for cereal production have lower available Zn, which reduces grain yield and nutritional quality of grain (Graham and Welch, 1996).

The geographical area of the Odisha state is 155.57 lakh ha, out of which 39.2 percent are arable. It lies between 17^0 47′ to $22^0$33′ N latitude and $81^0$27′ to $87^0$30′E longitude.

The Nabarangpur District, Odisha where experiment has been conducted situated in Eastern Ghats High land agro –climatic zone having cultivated area of 186, 000 ha. The district is having normal annual rainfall 1569.5mm with fertilizer consumption of 130.25 Kg/ ha and cropping intensity is approximately 155%. The soils are mostly Alfisols (red and laterite soil), mixed red and black forest clay loam. The soils are acidic in

reaction, having medium in organic carbon, available P, available K. The soils are deficient in Zinc, Iron, Sulphur and Boron. Maize is the predominant crop in the district. The farmers preferred to cultivate maize based cropping systems in both Kharif and Rabi season. The micronutrient Zn is needed in small quantities as compared to primary nutrients, and have major role in terms of impact on crop growth and productivity. Farmers of these areas preferred to add more NPK to maize crop but ignorant about application of Zn for getting higher yield. Maize is highly responsive to Zn fertilization (Benton, 2003). Continuous use of high analysis fertilizer and cropping system resulting heavy removal of nutrient and causes deficiency of micronutrient.

The soil samples were collected from three blocks of Nabarangapur district of Odisha by using GPS which is very important for preparing the GPS and GIS based thematic soil fertility maps. GPS instrument is used to know the latitude and longitude of that particular place and it has great significance in agriculture for future monitoring of soil nutrients status of that particular location. Dominant clay minerals are Kaolinite and Illite. Soils on the uplands are strongly acidic whereas valley bottom and lowland are mildly acidic. Due to low CEC and base saturation, red soils are deficient in Ca and Mg, high phosphate fixation and sulphate adsorption. A high dose of phosphate fertilizer and sulphur is necessary. The areas are mainly maize-maize cropping system. In kharif it covers 63.04 lakh ha with average yield of 2764 kg/ha against 2407 kg/ha of Odisha along with the productivity of 174.27 lakh MT. Its population density is 230 persons/km^2 and literacy rate is 48.20 per cent. Micronutrient Zn needed in small quantities as compared to primary nutrients, and have major role in terms of impact on crop growth and productivity. Farmers of these areas

preferred to add more NPK to maize crop but ignorance about application of Zn for getting higher yield.

Maize cultivation in India

In India, maize (*Zea mays)* is the third most important food crops after rice and wheat. It is one of the most versatile emerging crops having wider adaptability under varied agro-climatic conditions. Globally, maize is known as queen of cereals because it has the highest genetic yield potential among the cereals. It is cultivated on nearly 150 m ha in about 160 countries having wider diversity of soil, climate, biodiversity and management practices that contributes 36 % (782 m t) in the global grain production. The United States of America (USA) is the largest producer of maize contributes nearly 35 % of the total production in the world and maize is the driver of the US economy. The USA has the highest productivity (> 9.6 t ha-1) which is double than the global average (4.92 t ha-1). Whereas, the average productivity in India is 2.43 t ha-1.

The maize cultivation in our country is increasing because of high yield potential as well as its high market demand for poultry feed. There are several reasons that can explain this yield variation, which cover biotic and abiotic factors. Among the biotic and abiotic factors, unavailability of high yielding varieties and nutrient deficiency (Carsky and Reid, 1990; Zuo *et al*., 1995) are responsible for lower productivity of maize. Maize is recognized as highly sensitive to Zn deficiency.

According to advance estimate it is cultivated in 8.7 m ha (2010-11) mainly during *Kharif* season which covers 80% area. Maize in India, contributes nearly 9 % in the national food basket and more than Rs. 100 billion to the agricultural GDP at current prices apart from the generating employment to over 100 million man-days at the farm and downstream agricultural and industrial sectors. In addition to staple food for human

being and quality feed for animals, maize serves as a basic raw material as an ingredient to thousands of industrial products that includes starch, oil, protein, alcoholic beverages, food sweeteners, pharmaceutical, cosmetic, film, textile, gum, package and paper industries etc.

Recent trends (2003-04 to 2008-09) in growth rate of area (2.6 %), production (6.4 %) and productivity (3.6 %) of maize in India has been of high order and experienced highest growth rate among the food crops. Since 1950-51, the area, production and productivity of maize have increased by more than 3.4, 12 and 4.5 times from 3.2 m ha, 1.7 m t and 547 kg ha-1 to current level of 8.17 m ha, 19.33 m t and 2414 kg ha-1, respectively due to increasing maize demand for diversified uses. In India, the maize is used as human food (23%), poultry feed (51 %), animal feed (12 %), industrial (starch) products (12%), beverages and seed (1 % each). With the increasing trends of maize production, the projected demand of maize (22.73 m t) by the end of XIth five year plan (2011-12) will be achieved through improved maize production technologies focused on 'Single Cross Hybrids'.

Zinc is a micronutrient essential for the growth and development of plants, as well as for animals and humans. As far back as 1926 the findings of Sommer and Lipman (Arnon, 1976) for the first time shown that zinc is an essential element for normal plant development, while the extensive use of zinc as a plant nutrient began in the early thirties of last century. It was found that symptoms of zinc deficiency frequently occur in some areas of the world, for example in Australia (Leece, 1976), India (Randhawa et al., 1974) and Turkey (Yilmaz et al., 1995; Cakmak et al., 1999).

Though Zn deficiency is considered as one of the most important micronutrient problem in the world. So crop responses to Zn application have been obtained in alluvial, red and lateritic soils and swell-shrink soils of the country (Singh and Behera, 2011). Appropriate amounts of zinc and

nitrogen have to be used to cover both the absorptive and antagonistic effects (Shafea and Saffari, 2011**).**

Keeping above views, the present study was designed to investigate the response of zinc to maize based cropping system in alfisols of Odisha of Nabarangapur district with the following objectives:

1. (a) To delineate available micronutrient status in surface soils of Nabarangapur district and preparation of soil fertility map using GPS.

(b) To study the correlations of available micronutrients with Physico-chemical properties of soil.

2. To study the vertical distribution of available Zn in alluvial, black, red and Laterite soil.

3. To study the adsorption characteristics of Zinc in alluvial, black, red and Laterite soil.

4 To study the effect of Zinc on growth and yield of Maize.

5. To study the response of Zn on maize based cropping system.