Chapter-I
INTRODUCTION

Turmeric (*Curcuma longa* L.), a herbaceous perennial medicinal plant, belonging to family Zingiberaceae, is one of the most valuable spice all over the world and is cultivated in the country since ancient times. India is the largest producer of this crop in the world. It occupies an area of about 1.65 lakh hectares with a production of 5.6 lakh tonnes per annum with average yield of 3.5t ha$^{-1}$. It has about 14 per cent share by quantity wise and 7 per cent by value in export among all the spices and 22 percent share of total world production (Peter *et al.*, 2004). In Himachal Pradesh, turmeric occupies an area of about 150 hectares with an production of 110 tonnes with an average yield of 0.73 t ha$^{-1}$ which is quite low as compared to that of other states like Andhra Pradesh and Tamil Nadu *i.e.* 4.13 and 3.73 t ha$^{-1}$, respectively (Anonymous, 2005).

Ancient system of Indian medicine has fully documented the significance of turmeric in curing various diseases such as stomach disorders, leprosy, fever, dropsy, discharge from ear, ulcer, liver disorders, wounds, burns and as a blood purifier. The turmeric powder increases the mucus in gastric secretions and prevents the formation of the uretic stones (Divya Himachal, 1999; Kanwar, 2000). The root of turmeric is bactericidal and its paste is used to cure skin infections. The antibacterial effect of turmeric is due to three principal compounds *viz.* curcumin, curcuminoids and aromatic oil, out of which, curcumin is the most active therapeutic ingredient. It is a yellow, crystalline substance, which is a phenolic antioxidant, the scavenger of free radicals, which otherwise account for curing many diseases including cancer (Khanna,
Besides medicinal value, it is used as condiment with curry-stuff and as a dye. As for its quality ramifications, sun dried finger rhizomes of turmeric contains 1.4 - 6.1 per cent curcumin, 3.9 - 8.7 per cent starch, 5.2 - 7.0 per cent protein, 2.0 - 9.3 per cent essential oil, and curing percentage ranging from 16.0 - 37.4 per cent (Aiyadurai, 1966; Rao et al., 1975). Due to its increasing demand, not only for internal consumption but for export purpose also, the productivity and quality of crop needs to be upgraded (Medhi and Bora, 1993).

Turmeric is a versatile remunerative cash crop, which is under cultivation from sea level to an altitude of 1200 meters, and can be grown well in pH range of 5.0 to 7.5 (Panigrahi et al., 1987). Most of the soils are not so rich to supply all the nutrients for its optimum growth and development. Furthermore, it is difficult to sustain the yield of the crop and soil health for longer duration without integrated use of organics and inorganics. The removal of nitrogen, phosphorus and potassium by crops is much more than their replenishment through mineral fertilizers, thereby leading to nutrient mining. At present, the level of N, P and K removal in India is about 28 million tonnes against addition of only 18 million tonnes, thus resulting in a negative balance of about 10 million tonnes (Rao and Srivastava, 1998).

Nitrogen and potassium deficiencies in high rainfall areas is there due to NO$_3^-$ and K$^+$ leaching losses. A phosphorus deficiency is also not behind that of nitrogen because in acid soils Al, Fe and Mn fix available phosphorus. The soils are also becoming deficient in sulphur due to use of sulphur free fertilizers (Tiwari, 2002).

Nitrogen plays a significant role in the formation of chlorophyll, integral part of protein and enzymes. Phosphorus has a great role in forming reproductive primordia, root growth and development, formation of ATP, ADP, and NADP, transformation of
carbohydrates, fat metabolism and cell division as well as development. Potassium helps in stomatal regulation, disease resistance and improving the quality of the crops (Tisdale, 1995). Sulphur also helps in formation of chlorophyll and important constituents of many amino acids (Sharma et al., 2001). The intense use of chemical fertilizers alone poses serious threat to sustainability of agriculture production.

Application of organics improves physical, chemical and biological properties of the soil and maintain favourable environment for the growth of the crop, but when used alone these cannot meet the nutrient requirement of the crops. Considering the organic resources constraints the use of organics has to be supplementary and not complementary to inorganic fertilizers (Sharma and Biswas, 2004) Therefore, the best alternative is integrated nutrient management for sustainable crop production and good health of the soil. Use of farmyard manure through incorporation or as a mulch improves the physical, chemical and microbiological conditions of the soil. In addition to this, it also improves the water holding capacity; increases soil porosity, germination percentage, and checks weed infestation and ultimately results in higher crop yields. Integrated nutrient management envisaging conjunctive use of inorganic and organic sources of nutrient is a novel system of plant nutrient use for sustaining soil health and crop productivity. The integrated nutrient management ensures the better and sustainable yield while correcting some secondary and micronutrients deficiencies and it also increases the nutrient use efficiency.

Moreover, integrated nutrient management is of immense importance in high value crop like turmeric and by improving the productivity of this crop, the socio-economic status of the farmers of the state can be improved further.
Keeping this in view, the present research entitled “Integrated Nutrient Management Studies on Yield and Quality of Turmeric (*Curcuma longa* L.) in an Acid Alfisol” was chosen with the following objectives:

1) To study the effect of integrated nutrient management on
   a) Yield
   b) Quality
   c) Uptake of N, P, K, and S by turmeric.

2) To monitor the changes in chemical soil environment as influenced by integrated nutrient management.

3) To work out the economics of integrated nutrient management.