Chapter - 1

Introduction
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The apple (*Malus domestica* Borkh) belongs to genus *Malus* in the sub-family Pomoideae and the family Rosaceae. The primary centre of origin of apple is thought to be the region which includes Asia minor, The Caucasus, Soviet, Central Asia and Himalayan India and Pakistan (Wilcox, 1962). It has existed in Europe, both in wild and cultivated forms, since pre-historic times and have been well developed there at the beginning of the Christian era (Shoemaker and Teskey, 1959).

Apples are found wild in the hills of North India but nothing much is known about the cultivated apples. The earlier plantation must have been established in Kashmir by the turn of the sixteenth century. Emperor Jahangir, in his Tuzk, praises the Kashmir apple as "The apples of Kashmir are known for their goodness." In other hill regions of India, however, apple was introduced by the Europeans in the Nilgiris through the botanical gardens in Ootacamund as early as the 1850s. The commercial plantation was done at Bundrole in the Kullu valley in 1870 by Capt R.C. Lee, a retired British soldier. The credit of revolutionizing the economy of Himachal hills by introducing delicious group of apples goes to Mr. Satya Nand Stokes (Kanwar, 1987).

Apple is being commercially produced in temperate zones in India; Jammu and Kashmir, Himachal Pradesh, Uttar Pradesh, Sikkim and Arunachal Pradesh. The annual apple production in the country is now estimated 1031482 MT and the area 204999 hac. (1994-95 National Horticulture Board)
The development of apple industry in hilly areas especially Himachal Pradesh has been in post independence era in which massive efforts have been made to cultivate delicious group of apples. The most popularly cultivated varieties are ‘Royle Delicious’ (Starking Delicious), ‘Red Delicious’, ‘Golden Delicious’, ‘Richa Red’, Tiedman’s Early Worestar etc. In fact the economy of the entire temperate hill region of the country is overwhelmingly dependent upon apple alone than any other crop so far. It occupies about forty percent of the total area under fruit crops and constitutes more than ninety percent of total fruit crop production in the state.

For proper growth and development of apple plants require adequate nutrients in the soils. The requirement of phosphorus further increases since it remains in unavailable form in the soil. At present these and other components are supplied by the addition of fertilizers. Due to the application of technology like the use of fertilizers, pesticides, mechanization, soil fumigation, container production in soiless media, breeding, tissue culture methods for propagation and pathogen diminution, and a number of other innovations, the productivity has reached its peak. In near future severe problems of technological revolution and fertilizer production are imminent because most of these are expensive processes. The production of nitrogen fertilizers is energy intensive, and reservoirs of some fertilizer components especially the phosphate are becoming limiting, and it is
anticipated that in the following decades the gain in agricultural productivity will vanish because of limited phosphate for fertilizers and limited energy for other type of fertilizer production. Further the present fertilization practices are creating many environmental problems such as pollution of ground water and streams etc.

Thakur (1989) and Gupta (1990) highlighted the hazards of fertiliser uses and financial constraints as well. With the rapid expansion of apple cultivation in the country, diseases and pest problems have been further aggravated. The management of these diseases by chemical measures has been recommended. But the persistent use of chemicals has been known to cause deleterious effects on beneficial micro-organisms including mycorrhizal fungi. Therefore, it has become the need of the time that crop management strategy is modified to conserve fertilizers, prevent wastage of agricultural productivity and to protect environment. Exploitation of mycorrhizal association with the apple plant seems to be an important component in the crop management. The role of mycorrhizal fungi in plant nutrition (phosphorus) is well known Peterson etal., 1984. Mycorrhizae are symbiotic fungal organisms associated with the roots of most of the agricultural and horticultural crops including apple. Several field and laboratory experiments have demonstrated that the mycorrhizal colonisation improves the growth and nutrition of host plants (Mosse, 1973). In India most of the work with mycorrhizal fungi
so far has been done with economically important plants such as cereals, potato, sorghum, cowpea etc., but little is known about the horticultural plants. Mycorrhizal fungi are also known to impart resistance in plant against diseases. Some of these also have been reported to produce certain antibiotics though their production and identification are still not well documented (Marx, 1972; Marx and Davey, 1969).

A search into literature reveals that though apple is one of the vastly studied plants yet mycorrhizal aspects have received little attention. Therefore, present studies have been undertaken to investigate the role of ectomycorrhiza on apple plant growth, nutrition and general endurance to diseases. The establishment of inoculated seedlings in soils collected from uprooted tree sites will also be made.

Aims and objectives:
The present studies have been carried out considering following aims and objectives.

i. Isolation and multiplication of Ectomycorrhizae.

ii. Standardization of inoculation techniques for seeds.

iii. Effect of mycorrhiza on the growth of apple plants.

iv. Response of ectomycorrhizae to host nutrition of Nitrogen (N) Phosphorus (P) and Potassium (K).

v. To study the interaction of ectomycorrhizae with white root rot (Dematophora necatrix)

vi. Effect of Ectomycorrhizae on disease endurance with respect to powdery mildew (Podosphaera leucotricha).