INTRODUCTION
The term “mycorrhiza” coined by Frank (1885), is a symbiotic association between a fungus and the roots of a plant (Kirk et al., 2001). Both fungal and plant partners derive benefit from this association (Smith and Read, 1997). This mutualistic association provides the fungus with relatively constant and direct access to carbohydrates such as glucose and sucrose produced by the plant in photosynthesis (Harrison, 2005). The absence of mycorrhizal fungi can also slow plant growth in early succession or on degraded landscapes (Jeffries et al., 2003). Mycorrhizae are present in 92% of plant families (80% of species), with arbuscular mycorrhizae being the ancestral and predominant form (Wang and Qiu, 2006).

Basically, the mycorrhizae are of two types ectotrophic and endotrophic (Frank, 1885), later they were renamed as ectomycorrhiza and endomycorrhiza (Peyronel et al., 1969). The five more types have been added to them i.e ectendomycorrhiza, orchidaceous, ericarious, arbutoid and monotropoid mycorrhiza (Harley and Smith, 1983).

Ectomycorrhiza is a specialized root organ, which is the result of a complex interaction between a plant and a compatible ectomycorrhizal fungus leading to a finely tuned symbiosis (Harley and Smith, 1983). Ectomycorrhizas are found in around 10% of plant families, including members of the birch, dipterocarp, eucalyptus, oak pine and rose families (Wang and Qiu, 2006). All ectomycorrhizal fungi, with only one or two exceptions, belong to phylum Dikaryomycota. The great majority are Basidiomycetes that belong to families within the Agaricales, although some are Gasteromycetes and possibly, Ascomycetes (Trappe, 1962).

Ectomycorrhizal fungi’s beneficial effects on plant nutrition have been known (Bowen, 1973; Hatch, 1937; Melin, 1925). The symbiotic nutrient exchange plays a major role in plant nutrition as well as in resistance of plant against pathogen, heavy metals, drought stress etc. (Muller et al., 2007). The mycorrhizal fungi increase the absorption area of the roots and provide host plants with nutrients (N, P, K, Ca,
Na, Zn, and Cu), resistance to stress and drought and protection against pathogens. As a result of the association, levels of several resistant and inhibitory chemicals (polyphenols and terpenes) increase in plants. Beneficial chemicals, including amino acids and hormones, are secreted in high amounts thus increasing the longevity of plants (Dubey et al., 1997).

The most direct and scientifically rigorous means of determining the ability of a fungal isolate to form mycorrhizae is provided by in vitro mycorrhizal synthesis. Melin (1921, 1922, 1923, and 1936) successfully demonstrated for the first time that ectotrophic mycorrhizae could be produced in synthetic cultures by inoculating seedlings of *Picea abies*, *Pinus sylvestris* and *Larix europaea* with appropriate fungi. An exogenous supply of vitamins and micronutrients in the medium is a prerequisite for successful mycorrhization (Langer et al., 2008). The first in vitro aseptic synthesis of mycorrhiza between *Abies firma* and *Pisolithus tinctorius* and *Cenococcum geophilum* has been reported by Vaario et al., (1999; 2000).

Nursery inoculation with selected fungi can be a key advantage for tree seedlings to surmount the initial transplant stress, assuring their establishment in the field (Rincon et al., 2007). The concept of improving field performance of tree seedlings by forming ectomycorrhizae on them in nurseries with specific fungi ecologically adapted to the planting site was originally developed by Moser (1958). Kropacek and Cudlin (1989) showed that growth of seedlings was affected positively by mycorrhiza introduced in the form of granulated inoculum. Strain *Laccaria laccata* was found to be an optimal symbiont for *Picea abies* and *Pinus silvestris*, particularly under an increased level of inoculum.

A good amount of work has been done on different aspects of mycorrhizal association in different parts of the world (Hacskaylo, 1953; Goss, 1960; Grand, 1968; Henderson and Stone, 1970; Harley,
1970, 1988, 1989; Marx et al., 1991; Burgess et al., 1994; Molina et al., 1992; Branzanti et al., 1999; Morte et al., 2000; Kernaghan et al., 2003; Ortega et al., 2004). In India, studies have been conducted on mycorrhiza of spruce, silver fir, sal, deodar and different pines (Bakshi, 1957, 1966; Bakshi et al., 1966, 1968, 1972).

A systematic work on the ectomycorrhizal relationships of high altitude conifers of Himachal Pradesh was started by Prof. Lakhanpal and his associates in early eighties (Lakhanpal, 1988; Lakhanpal and Sharma, 1988). A review of work revealed that while promising results like reduction in the transplanting period and successful establishment of seedlings in the field conditions have been achieved in case of Cedrus deodara (Singh, 1992) and Pinus wallichiana (Sagar, 1993), such study is lacking in case of Picea smithiana (used in wood based industries namely pulp and paper, railway carriage industry and for making packing cases for apples, other temperate fruits and vegetables in hilly areas of H.P. and J&K) whose natural regeneration is unsatisfactory as its seeds are eaten by birds and monkeys. Hardness of seed coat and inhospitable climatic conditions in Kinnaur (H.P.), further hinders the natural seed germination process.

Hence keeping into consideration the immense economic importance of Picea smithiana and difficulty in its natural regeneration, the present investigations have been undertaken to utilize the natural mycobiont in artificial inoculation of the seedlings and to observe the impact of inoculation on the performance and establishment of seedlings. The specific objectives of the study are:
OBJECTIVES

1. Study on morpho-anatomical characteristics of natural mycorrhizal roots of *Picea smithiana*.

2. Survey, collection and identification (taxonomic details) of *Boletopsis leucomelaena* a field associate of *Picea smithiana*.

3. Study on pure culture isolation and cultural characteristics of *Boletopsis leucomelaena*.

4. *In vitro* synthesis of ectomycorrhiza between *Picea smithiana* and *Boletopsis leucomelaena*.

5. Mass multiplication of *Boletopsis leucomelaena* for artificial inoculation of seedlings of *Picea smithiana* under glass house condition and evaluation of the effect of artificial inoculation on growth and development of seedlings of *Picea smithiana*.

6. Estimation of the chemical composition of the seedlings kept as control (grown in sterilized soil), seedlings grown in natural forest soil inoculum and seedlings artificially inoculated with culture of *Boletopsis leucomelaena* under glass house conditions.