Summary

The apple plants like other plants require adequate nutrient supply from the soil for good growth and productivity. Presently fertilizers are used in abundance to ensure availability of nutrients to the plants. Fertilizers are costly and also cause environmental hazards with increase in application. Expansion in apple cultivation has also resulted in the increase in diseases and pests. Hence exploitation of mycorrhizal association of apple plants seems a viable alternative in crop management because the role of mycorrhiza is well known in plant nutrition especially in soils of low fertility. The present studies have been therefore undertaken on mycorrhiza of apple plants considering the following parameters:

. To isolate and multiply ectomycorrhiza of apple.
. To inoculate seedlings with mycorrhizal fungus.
. To observe effects of ectomycorrhizae on the growth of apple plants.
. To see response of ectomycorrhizae on host nutrition of some major and minor elements.
. To study the interaction of ectomycorrhiza with white root rot (*Dematophora necatrix*)
. To observe effect of ectomycorrhizae on disease endurance with respect to powdry mildew (*Podospheara leuchotricha*)
To carry out work on these parameters different apple orchards were surveyed and root samples were collected for morphoanatomical studies. Morphological changes showed that roots in apple seedlings were monopodial, dichotomous, variously coloured (light orange, creamish white, light yellow, pastel yellow and dull yellow etc.), tasteless and odourless, surrounding mycelium and attached rhizomorph was absent. Anatomical features of the root showed presence of ectendo-type of mycorrhizal association. Sections of the root showed well developed ‘Hartig Net’ surrounding the cortical cells and hyphae were also seen to invade the cortical cells. Hence both inter and intracellular infection was observed in the roots. Intracellular infection was in the form of small rounded vesicles. In apple seedlings root infection was restricted to the cortical cells with well developed ‘Hartig net’ and mature plant roots were heavily infected as compared to other plant roots and Hartig net was either absent or was present in reduced form. In VAM infection hyphae running in the cortical region were observed, some of the hyphae showed presence of vesicles and finger like projections i.e. arbuscules.

For isolation of the mycobiont, the mycorrhizal root segments were surface sterilized, transferred aseptically on to Potato Dextrose Agar medium and incubated at 22 ± 1°C to obtain pure culture of mycobiont. For mass multiplication of mycorrhizal inoculum, for different experimental studides,
wheat grain spawn was prepared. Mycobiont exhibited fast growth and colonization on wheat grains. Wheat grain inoculum was easy for quantification (by counting the number of wheat grains) and it helps in easy inoculation of the seedlings under glass house conditions. For seed inoculation, apple seeds (Golden Delicious) were collected, surface sterilized and stratified for 60-80 days. Two different techniques for seed inoculation were tested. Column method was found superior to bottom layer technique to investigate the establishment of mycobiont and its impact on apple seedlings with respect to growth parameters, nutrient status and interaction with diseases in two types of soil (i.e. natural orchard and basin soil). Four sets in each soil type were made to layout the different experiments as Natural Orchard Soil (NS) Natural Sterilized Soil (NSS), Natural Sterilized soil plus mycorrhiza (NSS+M) and Natural sterilized soil+Mycorrhiza + Farmyard manure (NSS+MF). Similarly four sets were made in basin soil also. The ice cream cup technique was devised for seed inoculation and subsequent transfer’ in pots during the active growth period which otherwise is possible during dormant stage of seedling only. Twenty day old seedlings were transplanted in the pots. For this purpose soil cavity equal to the size of ice cream cup was made at the centre of the earthen pot and seedling with intact soil was gently placed in the cavity after dissecting away the ice cream cup.

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The studies on growth and development showed that artificial inoculation of mycorrhiza and farmyard manure combination produced better seedling growth followed by mycorrhiza alone. The results were statistically analysed and were found to be significant. Artificial regeneration with this specific combination is therefore, doubtlessly beneficial. The inoculated seedlings with mycorrhiza plus farmyard manure combination acquire the grafting height and collar diameter (25 - 30 cm and 6 - 10 mm diameter) in six months as compared to one year in the natural soil. The application of this technique may help in saving nursery care and extra investment. In addition, this combination has been found to enhance uptake of different macro-and micro nutrients significantly.

The studies on the interaction of inoculated seedlings to the white root rot (Dematophora necatrix) at variable disease pressure revealed that MF and mycorrhiza alone successfully delayed the expression of disease syndrome (chlorosis, defoliation and mortality) at lower disease pressure however none of the treatments could check the disease at higher disease pressure.

The comparison of powdery mildew development (P. leucotricha) in different treatments indicated that the rate of powdery mildew development was lower in mycorrhiza plus farmyard manure combination and mycorrhiza alone in both
the soil types. The severity of both the diseases was higher in basin soil than natural orchard soil.

The inoculation of seedling with the combination of MF is highly beneficial to seedling growth and health. They not only help in efficient absorption of plant nutrients but also protect seedling root from soil borne pathogens.

The standardization of mycorrhizal inoculation technique in the nursery beds to produce mycorrhizal seedling which have better survival rate in new orchard sites is therefore advisable.