REVIEW OF LITERATURE
The soil in which plants grow varies widely in its physical, chemical and biological properties. Several of these factors influence plant growth, both directly and indirectly. Soil being loaded with millions of microorganisms influences the plant growth. As a result, the interaction between the soil and plant micro-organisms becomes distinct and dynamic (G. Rangaswami 1988). Fungi occupied a unique place in the soil microbiology since Adametz (1886) initiated the study of soil fungi. The selective colonization of the growing plant root surface by micro-organisms was first reported by Hiltner (1904). The importance of this phenomenon known as "rhizosphere" effect was brought about half a century later by Starkey (1929-38) which revealed the roots of plant, influence the environment that varied both quantitatively and qualitatively with the species and the age of the plant. This effect was correlated with quantity and quality of root excretions and biochemical and biophysical activities in the rhizosphere of soils such as CO$_2$ evolution, nitrification of soil nitrogen, soil texture, pH, moisture and temperature. Since then, many workers have reported variations in rhizosphere effect and the factors influencing such variations. Starkey (1929) suggested the seasonal
affect of plant growth upon root activity and hence upon rhizosphere population as a possible cause of seasonal fluctuations in number of soil microflora, especially in case where such fluctuations could not be directly correlated with temperature and rainfall differences. This was supported by Eagleton (1938) who found weekly fluctuations in number of soil bacteria, actinomycetes and fungi under grass, over a period of 24 weeks with a special reference to the effect of rainfall and the growth of surface vegetation.

Clark (1949) suggested that root surface itself, the "Rhizoplane" be used in studying the phenomenon, since it may be a more sensitive index of the specific qualitative effect of roots on soil microorganisms. According to Warcup (1960) rhizoplane offers a distinct advantage in studies of root fungi in that, vegetatively active forms rather than rapidly sporulating types may be isolated and studied. Later the approach of rhizosphere problem has been made from three different viewpoints, namely (i) effect of plants on the microorganisms in the rhizosphere, (ii) foliar application of chemicals and their influence on the rhizosphere microflora and (iii) pathogenesis by the microorganisms. The quantitative and qualitative nature
of the rhizosphere-rhizoplane flora is subject to many influencing factors as evidenced in a series of early papers by Starkey (1958) and in subsequent studies (Rovira, 1965; Bowen and Rovira, 1976; Domnergues and Krupa, 1978; Antique et al., 1982), and roots contained 22 amino acids like alanine, asparagine, aspartic acid, glutamic acid, proline, serine and valine etc., and sugars like glucose, fructose, sucrose and maltose. Similarly Andal et al., (1956) found that rice root excretions contained aspartic acid, glutamic acid, tryptophan and lysine. Mishra (1967) reported many amino acids from root exudates of different crop plants. Similarly Bharadwaj (1970) recorded a large number of amino acids and sugars from extracts of Melilotus alba and M. indica at seedling, flowering and fruiting stages of plant growth. Palmitic, stearic, oleic, and linoleic acid have been found in bean (Papavizas and Kovacs 1972) and peanut (Thompson and Hale 1983) root exudates. Rovira and Harris (1961) and Sulochana (1962) reported the presence of Vitamin "B" in root exudates of certain plants. Miskovic et al., (1977) reported that a higher dehydrogenase activity occurred in the rhizosphere of corn than in root-free soil. Satyaprasad and Rama Rao (1983) noted
that chick pea root exudates of the resistant and susceptible varities differed in quality and type of sugars and amino acids. Schroth and Hilderbrand (1964) reported that the pattern of exudation and the composition of root exudates play a key role in the success or failure of infection by soil borne pathogens.

The prevalence of phytohormone producing bacteria in wheat rhizosphere was reported by Rivière (1963). Vasantharajan and Bhat (1967) reviewed the work on interaction of soil microorganisms and mulberry roots and discussed that rhizosphere isolates were more active in phytohormone synthesis than their soil counterparts. Rangaswami and Balasubramanian (1963) reported that on excretion of hydrocynic acid by the roots of sorghum which supresses certain micro-organisms in the rootzone. Fries (1973) discussed that the volatile organic compounds from living roots effects the growth and development of fungi.

There are many reports to show that the quality and quantity of microorganisms present in the rhizosphere of disease resistant crop varities are significantly different from those susceptible varities. In some cases organisms specifically antagonistic to the concerned
Pathogens have been isolated from the rhizosphere of resistant crop varieties, but not from the susceptible ones. Some reports also showed that the application of fertilizers, soil amendments and foliar chemical sprays enhanced the number and qualities of the group of antagonistic microorganisms in the rhizosphere.

Venkatasubbaiah et al., (1984) reported that Trichoderma harzianum, Aspergillus niger, Penicillium sp., and Bacillus subtilis of rhizosphere and rhizoplane of coffee seedlings were antagonistic to Rhizoctonia solani. Dumitras and Sesan (1980) have studied the antagonistic nature of Trichoderma viride against R. solani isolated from sugar beet, bean and cotton seedlings. Arora and Dwivedi (1979) investigated antagonistic interaction between some rhizosphere fungi of Lens esculenta and its roots parasite, Sclerotium rolfsii sacc and found fungi such as Trichoderma harzianum, Aspergillus flavus, A. niger and Penicillium rubrum showed strong antagonistic ability. Sivasithamparam and Parker, (1979) reported that the number of antagonists on seminal (wheat) root at week 2 were significantly less than on nodal roots (Wheat) while at 5th week, the numbers of antagonists in the rhizosphere of seminal (Wheat) were significantly higher. Siddaramaiah
et al., (1979) reported that the Streptomyces isolated from soil were antagonistic to cercospora moricola causing leaf spot of mulberry.

Root infecting fungi which have a phase of existence as competitive saprophytes in soil under complex circumstances as saprophytic competitors among soil fungi are still incompletely known and imperfectly understood. Several workers reported the interaction between plant and soil microorganisms. Rovira (1965a,b) reviewed the work on interactions between plant root and microorganisms, and discussed the influence of root exudates upon microorganisms. Generally rhizosphere harbours more number of bacteria, actinomycetes and fungi. Agnihotrudu (1953) while studying the rhizosphere microflora of pigeon pea, cluster bean, french bean reported the higher number of bacteria in their rhizosphere than in nonleguminous plants. Bahadur and Sinha (1965) observed the fungal population of rhizosphere of cluster bean up to harvest time in correspondence with the effect of root exudates. Rhizosphere effect increased with the age of the plant and reached a peak in its greatest vegetative development (Katznelson, et al., 1954). Barber and Lynch (1977) reported that increase of rhizosphere microbial population with
increase of the plant age but this fell with plant age. Mishra (1967) compared the rhizosphere fungi of different plant species occurring in the same field and reported that the fungal species derived from different plants exhibited more specificity in the rhizoplane region than the rhizosphere. Dangerfield et al. (1978) reported that crop plants tend to show greater rhizosphere effect than tree roots. Curl and Truelove (1986) reviewed that the rhizosphere effect generally increases with age of a plant, reaching a peak at the height of vegetative development and declining with root senescence.

Ranga Rao and Mukergi (1971) who studied four cultivated plants rhizosphere and rhizoplane observed that peak population levels were attained at different stages of plant growth and the rhizosphere and rhizoplane populations differed appreciably in four cultivated plants. According to Youssef and Mankarios (1974) plant age and nature of soil type had the significant influence on nature of fungi of three varieties of broad bean and cotton.

Abdel - Fattah (1982) reported the stimulation of Aspergillus and Penicillium species in the rhizosphere and rhizoplane of wheat. Ranga Rao (1972) reported Aspergilli and Penicilli were prominent in rhizosphere and rhizoplane,
while sterile mycelial forms and *Rhizoctonia solani* were prominent in direct roots of *Luffa cyllndrica, Cucumis sativus*. Gangawane (1978) reported variations in the rhizosphere mycoflora of groundnut and reported that the qualitative and quantitative differences of fungal flora was due to their response to seasonal variations rather than rhizosphere effect because the variations were similar in rhizosphere and control soil. Srivastava and Dayal (1982) reported that rhizosphere fungi were stimulated by root extracts of *Abel moscus esculentus*. Rakesh Pratap et al., (1983) noted the heighest percentage of *Aspergi llus niger, Fusarium sp., Curvu laria sp.,* and *Trichoderma sp.*, in sugarcane seedlings.

Microbial population in the root region increases with age of a plant and reaches maximum with the vegetative development, and with the onset of senescence the population gradually decline to the level present in the surrounding soil following the death of plant and decomposition of its tissue. Sivapithamgram and Parker (1979) reported that the rhizosphere population of bacteria, actinomycetes and fungi decreased, while in the residue their number increased with the age of the seminal and nodal roots of wheat. Roal and Vaidya (1988) working with rhizosphere
and rhizoplane of sugarcane isolated *Trichoderma harzianum* only from rhizosphere but not detected in nonrhizosphere. Dubey and Dwivedi (1988) stated that the average number of fungi gradually increased from seedlings to flowering stage, thereafter declined at senescent stage of soybean root region. Rao (1962) reported that high R/S ratios were obtained at the age of 30 days old and at the time of flowering and later started gradually decreasing up to three months duration.

There is a vast amount of literature on the mycoflora of root region with regard to diseased plant (Tominin, 1940; Agnihotrudu, 1955; Garrett, 1959; Chang and Kommedahl, 1968; Mishra and Srivastava 1969; Ranga Rao and Mukerji, 1972; Bowen and Rovira, 1976; Chattopadhyay and Nandi, 1982; Azad et al., 1985, Ganesan and Gnanamani-ckam, 1987; Weller, 1988).

Attempts have been made in recent years to influence the rhizosphere microflora through various extraneous means. Soil amendments with organic matter and fertilizers bring in changes in the soil microflora. Many investigators observed that the rhizosphere effect has been influenced by the soil type and various chemical treatment of soil and crop plants. Tiwari and Singh (1977) reported
that the fungal population decreased consistently in sterilized soil with lapse of time. Peterson (1958) made a comparative study on the effect of three different soils on the fungal flora of wheat and red clover roots. Gangawane and Leela (1985) found that the higher number of species of fungi were seen in sewage treated soils than sludge treated and untreated soils. Gadzhieva (1959) recorded increased counts in the rootzone of winter wheat due to soil treatments with organic minerals. Nishat Kalis and Manoharachary (1985) reported that the amendments of soil with cakes of safflower, groundnut and neem greatly increased the fungal populations. Reddy and Rao (1966) showed that red sandy soil amended with sesame cake stimulated fungal population while groundnut cake depressed fungi. Davey and Papavizas (1960) stated that rhizosphere fungi on bean roots obtained a positive effect in soils amended with organic and nitrogen compounds while the same authors (1961) working with fungi of lupine roots observed no significant differences in response to organic amendments with or without ammonium nitrate. Mosdov et al., (1959) reported an increase in the microflora populations of both rhizosphere and nonrhizosphere soil enriched with NPK fertilizer. Rovira (1961) while
studying the effect of cao or cao plus minerals in both rhizosphere and nonrhizosphere soils found a marked increase in the bacterial count but R/S values actually decreased for clover and increased with paspalum only with cao treatment, for fungi treatment increased the counts in both rhizosphere and nonrhizosphere soil but R/S values on the whole decreased, owing to the fact that numbers increased proportionally more in the soil than in the near root. Singh et al., (1983) noted that the soil amended with saw dust reducing the population of fungi around the roots of tomato. Curl and Truelove (1986) discussed the amendments apparently stimulated fungal proliferation out side the rhizoplane, resulting in reduced R/S values and less rhizoplane - rhizosphere effect.

Venkatesan (1962) showed that the addition of form yard green leaf manure lowered the rhizosphere effect of rice for bacteria and fungi for first 45 days after which the R/S values increased from 4 to 21. NPK treatments did not effect much fungi and actinomycetes. Absalyamova (1963) reported that soil amendment with organomineral mixtures greatly increased the total number of bacteria in the rhizosphere of maize, beet and winter wheat. Sudhir Chandra et al., (1981) showed that certain pathogenic
fungi have been suppressed by organic soil amendments. Mishra (1971a, b, 1972) reported the effect of NPK fertilizers individually on the rhizosphere mycoflora of *oryza sativa*. Application of ammonium nitrate and urea increased the rhizosphere and nonrhizosphere mycoflora of paddy plants throughout their growth.

Mishra and Das (1975) observed that bacteria with comparatively simple nutritional requirements are more abundant in the rhizosphere of rice plants grown in unamended soil, while bacteria with complex requirements were predominant in the rhizosphere of plants supplied with farmyard manure or mineral fertilizers. Davey and Papavizas (1960) found that certain genera or species of fungi were stimulated in soils amended with various plant materials (barley straw, corn stover, or soybean meal).

Besides organic and inorganic fertilizers, pesticides also are extensively used in modern agriculture for the control of plant diseases and to improve the soil fertility with specific microorganisms. In recent years several reviews have been put forth on this subject (Clark, 1947; Fletcher, 1960; Bollen, 1961; Richardson, 1968; Shamiyeh and Johnson, 1973; Siddaramaiah et al., 1979; Hsu and Bartha, 1979; Randhawa and Schaad, 1985; Schipper et al.,
It was found that actinomycetes were more resistant than bacteria or fungi to fumigants or Dithiocarbomate fungicides, (Wensley, 1934; Richardson, 1964). Hoseworth and Tweedy (1969) working with combination of thiram with atrazine or flumeturon showed that fungal populations in thiram - atrazine combinations at field rates were about the same as soil treatments with atrazine alone suggesting that atrazine may stimulate a specific group of soil fungi tolerant to thiram. According to Sullia (1969) the fungicide kitazine decreased the fungal numbers in the rhizosphere and rhizoplane of rice. Rawal and Ullasa (1988) reported that the systemic fungicides namely, topsin and bavistion were much effective against *Cercospora psidii*. Similar observations were made by Balasubranian et al., (1973) and Bhandari et al., (1987). Kuthubutheen and Pugh (1979) showed that species of *Hemicola*, *Botrytiscum* and *Trichoderma* were sensitive to captan, dicloran, thiram and verdasan, while *cladosporium* sp., *Mortierella* sp., *Trichocladium asperum* and *trichoderma hamatum* were resistant to the fungicides. Captan and dicloran were fungistatic to *Trichoderma viride*, while thiram and verdasan were fungicidal. Foster and Mc. Queen (1977b) studied the multiple application of benomya
and reported that did not result in progressive decrease in the total number of fungal colonies and different genera were affected differently. Genera belonging to Duteromycetes were highly sensitive showing significant reduction in population, particularly *Fusarium*.

Pugh and Williams (1971) found that the fungal population in the golf greens (grass) treated with verdasan was reduced compared with untreated. Hoseworth and Tweedy (1973) reported that the captan inhibited soil fungi longer than thiram in soils planted with bean and wheat. Ashok Aggarwal and Marhotra (1988) reported the growth and rate of respiration of *Phytophthora colacasiae* was significantly inhibited by eleven fungicides. Smiley and Craven (1979) stated that the combination of fungicides supressed fungi but stimulated bacteria and actinomycetes more than individual toxicants. Wainwright and Pugh (1974) reported an increase in bacterial and fungal populations by six fungicides after 28 days of treatments. It was also reported by Wainwright and Pugh (1975) that in field soils fungal numbers were initially reduced following application of captan, dicloran, milcol, triarimol but returned to the normal level after 157 days. According to them certain species such as *Trichoderma koningi* and *Penicillium*
nigricans became dominant in treatment soil while species of Chaetomium and Verticillium decreased in frequency. However the major Cellulolytic fungi were generally unaffected or increased in frequency in treated soils.

The changes in the fungal population of treated soils are due to the alteration of the physico-chemical characteristics of the soil by fungicides. Pugh and Williams (1971) reported that the soils treated with verdasan reduce decomposition and contribute an accumulation of organic matter. Shekhawat et al., (1987) found that both tikka and rust diseases of groundnut controlled by spraying carbenendazim (0.025%) and mancozeb (0.2%) 2 to 4 times in alternate species Gangawane and Deshpande (1978) reported that dominant species such as Asperillus carbonarius and A. fumigatus were suppressed by formaldehyde, acetic acid and BHC, whereas F. semitectum and Helminthosporium tetramera were stimulated in the rhizosphere soil. Rama Rao and Isaac (1980) reported that foliar sprays of bacitracin and chloromphenical increased the fungus and actinomycetes and reduced the bacterial populations while Gibberellic acid at 10 ppm concentration reduced all three groups of microorganisms of pea seedlings rhizosphere infected with Verticillium dahliae.
Peoples (1974) stated that incorporation of benomyl in soil cause variable effects on the nontarget soil microflora. Abdel - Fattah et al., (1982) while studying the effect of bavistin, cotoran and curaeron on Egyptian soil, fungi reported that bavistin when added to the soil induced a regular significant inhibition of the total count of fungi. Doneche et al., (1983) observed that the population of soil microorganisms including fungi were reduced by the application of mancozeb at 10 mg/kg of soil of four Bordeaux vineyards. Further it was noted that the fungicide was completely degraded after three months due to both chemical and biological factors after which the microbiol populations returned to normal levels. Thind and Bedi (1988) while studying the effect of eleven fungicides against anthracnose of grapes reported that bavistin, agrozim and derosal each at 0.1 per cent concentration proved highly effective. Rawal (1987) also reported bavistin (0.1%) more effective than non systemic fungicides against anthracnose of grapes in Karnataka.

Mulberry is the principal and basic food material for mulberry silk worms. This plant is affected by number of diseases which are caused by fungi, bacteria and viruses. The diseases affect different parts of the
plant. The economy of agriculture is severely affected since both the quality and quantity of the leaf produced are affected by the diseases (Rangaswami et al., 1976). Siddaramaiah and Krishnaprasad (1978) showed that bavistin at 25 ppm and above, Duterat at 200 ppm and above, Dithane M-45 and Hex aferb at 400 ppm completely inhibited the growth Cercospora moricola causing leaf spot on mulberry. Similarly Kanti (1975) reported that complete inhibition of C. moricola was observed in 250, 500 and 1000 ppm of bavistin and 500 to 2000 ppm of Dithane M-45. Siddaramaiah et al., (1978) reported that bavistin and calixin at 0.05 and 0.1 per cent were very effective against Phyloctonia corvlea causing powdery mildew in mulberry. Many investigators studied the effect of foliar sprays of urea (Rama Chandra Reddy, 1959; Venkataram, 1960; Horst and Herr, 1962; Agnihotri, 1964; Balasubramanian and Rangaswami, 1969; Rao and Rangaswamy, 1970; Annapurna and Raghuvare Rao, 1983). 2, 4-D and growth regulators (Clark, 1949; Vrany et al., 1962; Gujarathi, 1965; Sullia, 1966; Leelavathi, 1966; Singh, 1968; Anil Kumar and Chakravarthi, 1970; Sethunathan, 1970; Rama Rao and Isaac, 1980; Bagyaraj and Rangaswami 1982) antibiotics (Vrany et al., 1962; Rama Chandra Reddy, 1969; Sunar and Chohan, 1971a, and Chakrabarty
and Purkayastha, 1984) and fungicides (Domsch, 1964; Gangawane, 1978; Rao and Sharma, 1978; Smiley and Craven, 1979; Shekawat et al., 1985; Gunasekhar, 1985; Ashok Aggarwal and Merhotra, 1988; and Narayana 1988) on the rhizoplane, rhizosphere and non-rhizosphere soils of various crop plants.