Chapter I

INTRODUCTION
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Natural rubber (*Hevea brasiliensis* Muell. Arg.) is an important plantation crop in India. A number of agricultural practices have been introduced to improve the production of natural rubber. Establishment of leguminous cover crops in the initial stages of cultivation is an important agronomic practice adopted in rubber plantations. Leguminous cover crops enrich soil with nitrogen, prevent soil erosion, reduce soil temperature, augment organic carbon in soil and support soil microbial activity. All these beneficial effects of cover crop help in increasing the growth rate and yield of *Hevea*. Among the various cover crops used in rubber plantations, *Pueraria phaseoloides* is the most popular one in India and elsewhere (Potty *et al.*, 1980). A number of biotic and abiotic factors are reported to influence the growth, nodulation and nitrogen fixation of *Pueraria phaseoloides*. One of the important biotic factors that adversely affects *Pueraria phaseoloides* is the root-knot nematode, *Meloidogyne incognita* (Mammen, 1973).

The root-knot nematodes are the predominant group of plant parasitic nematodes. They are also the parasites on major food crops, vegetables, plantation crops, fruits and ornamental plants (Sasser, 1980). The infected plants show stunted growth, become chlorotic and loose vitality and vigour. Various mineral deficiency symptoms are also reported to occur due to nematode infection. Flowering and fruiting are suppressed...
and consequently the yield is greatly reduced. Severe infection at seedling stage may cause death of the plants. The severity of damage caused by the nematodes to the plants depends upon population density of nematodes, plant age and several other biotic and abiotic factors. The optimum damaging threshold level of *Meloidogyne incognita* varies in different crops. Each crop species has a minimum threshold level below which it is not significantly affected by a given species of root knot nematode. The potential damaging threshold level of root-knot nematode is of importance in gaining insight for designing effective control measures.

The frequency and density of root knot nematodes show variations from location to location due to variations in climatic conditions, soil type and agronomic practices adopted for cultivation in each location. The damage caused by nematodes to plant root in clayey soil with little organic matter was initially lesser than that in such soils with more organic matter. Among the soil types, the rate of penetration occurs in descending order in clay, sand, clay loam respectively. Soil type and cropping systems are probably the major components that play a vital role in root knot incidence.

Root-knot nematode is highly pathogenic to different pulse crops (Gupta *et al*., 1986; Kalita and Phukan, 1993) and affects the growth, nodulation, nitrogen fixation and total biomass of the plants. Due to the mechanical injury caused by the nematodes to root tissues, the water
absorption efficiency, mineral uptake and total root biomass are found reduced. The hydrolytic and oxidative enzymes and growth regulators secreted by the nematodes play a determinative role in the development of nodules, alteration of host nutrition and interference in the nitrogen fixing capacity of nodules. The early destruction of nodules by nematodes results in the reduction of nitrogen fixation (Chahal and Chahal, 1989).

The population of plant parasitic nematodes fluctuated with seasonal changes. Rainfall pattern, air and soil temperature, soil moisture and host root growth are the predominant factors influencing the population of nematodes in soil (Mukherjee and Dasgupta, 1993). But the population of *Meloidogyne incognita* is correlated more with the soil temperature than with soil moisture. Temperature between 26 and 28°C induces more penetration of nematodes in plant roots irrespective of soil types. The influence of seasons on the nematode population was reported to be more evident at the upper layer of the soil than in the deeper layers. Similarly, nematode population was more in summer and low in winter months. Due to availability of fresh and actively growing roots, post monsoon period is reported to be congenial for the survival and multiplication of root-knot nematodes (Eapen, 1993). Root-knot nematodes are bound to interact with soil microorganisms. The interactions of *Meloidogyne incognita* with different saprophytic fungi, vesicular arbuscular mycorrhizae (VAM) and *Rhizobium* sp. have been reported to reduce the pathogenicity of root-knot
nematodes. The symbiotic association of VAM improves the plant growth by increasing nutrition, phosphorous uptake and provides more resistance to the host plant. The mycorrhizal association is reported to cause changes in root physiology by increasing amino acid and sugar contents in the root and the wall thickness of the root cortical cells. These conditions are not favourable for the penetration and multiplication of root-knot nematodes. Thus the root infection of plants by nematodes can be reduced by the establishment of VA mycorrhizae. It is logical to state that the penetration rate of parasitic nematodes can be decreased, their development inside the root may be retarded or the degree of damage caused by the nematode may be lowered by the early establishment of VA mycorrhizae. VAM has thus been reported as a biocontrol agent against root-knot nematode, *Meloidogyne incognita* (Jain and Hasan, 1994).

Root knot infection in plant in general causes a series of changes in the plant metabolism. Accumulation of phenols has been reported as a resistance factor against many infection agents. The increased content of phenolic compounds helps in the formation of hypersensitive reaction towards nematode infestation (Shukla and Chakraborty, 1988). Phenolic compounds play a major role in the control of nematodes through larval mortality and by making the plant roots less attractive to nematodes. Polymerization and transformation of phenolic compounds are reported to act against the parasites (Anwar and Israr, 1976). Root-knot infested plants grown in soil containing
high organic matter showed increase in total phenol, *ortho* dihydroxy phenols and amino acid contents (Singh *et al.*, 1985).

Plants infested with root knot nematodes accumulate carbohydrates in the tissue. Increase in soluble and structural proteins was also observed due to the infestation of root-knot nematodes (Simte and Dasgupta, 1987). The interaction of nematodes and plants leads to the depression of novel genes, which results the de novo synthesis of RNA and protein molecules. *De novo* synthesis of the isozymes of peroxidase and ribonuclease and proteins and isoflavonoids in response to *Meloidogyne incognita* has been reported by Kaplan (1977) and Ganguly and Dasgupta (1981).

The root-knot nematode, *Meloidogyne incognita* has caused significant changes in growth, nodulation, nitrogen fixation and biochemical constituents in a variety of leguminous crops. In rubber plantation, even though there are reports on the incidence and intensity of root-knot nematode in the cover crop, *Pueraria phaseoloides*, its adverse effect on the growth of the plant and biochemical activities are lacking. A study on the effect of root-knot nematode *Meloidogyne incognita* infestation on *Pueraria phaseoloides* will help in understanding the host pathogen interaction and to device suitable management practices for their control. Therefore, this study was carried out with the following objectives.
1. Isolation of root-knot nematodes from different rubber growing soils and testing their infectivity.

2. Studying the effect of nematode infestation in *Pueraria phaseoloides* on growth, biomass, nodulation and nitrogen content.

3. Effect of seasonal variations in nematode population and gall formation on *Pueraria phaseoloides*.


5. Investigations on the biochemical changes in *Pueraria phaseoloides* due to root knot infestation.