GENERAL INTRODUCTION

One of the greatest challenges faced by the world today is feeding of an ever-increasing population. Low agricultural productivity in developing countries and inadequate means of food distribution contribute greatly to this problem. Low yielding varieties, poor soil fertility, semi-or non-mechanized farming, traditional methods of farming and inadequate pest management practices are some of the factors responsible for low productivity (Sasser and Carter, 1985). Root-knot nematodes (Meloidogyne species) are one of the most widespread pathogens limiting world agricultural productivity. Almost all of the plants that account for the majority of the world’s food supply are susceptible to this group of pathogens (Taylor and Sasser, 1978; Sasser et al., 1982; Taylor et al., 1982). In areas where root-knot nematodes are not controlled average crop yield losses are estimated to be about 25 per cent with damage in individual fields ranging as high as 60 per cent (Sasser, 1980; Sasser and Carter, 1982).

Since root-knot nematodes occur throughout the world, infect all major crop plants and cause substantial reduction in crop yield and quality, the North Carolina State University at Raleigh (U.S.A.) in 1975 initiated an international project known as International Meloidogyne Project (IMP), to investigate the various aspects of the problem on worldwide basis. This project was funded by the United States Agency for International
Development (USAID). With the cooperation of nearly 100 nematologists from 70 countries of the world, investigations on root-knot nematodes were carried out under the aegis of IMP till its termination in 1984. The project achieved its main objective in identifying the species and races of *Meloidogyne* causing damage to various crops in different parts of the world. Four species of root-knot nematodes viz., *Meloidogyne incognita* (Kofoid and White, 1919) Chitwood, 1949; *Meloidogyne javanica* (Treub, 1885) Chitwood, 1949; *Meloidogyne arenaria* (Neal, 1889) Chitwood, 1949; and *Meloidogyne hapla* Chitwood, 1949 were recognized as major root-knot nematode species of international importance. These species comprised about 93% of the total *Meloidogyne* populations obtained from different countries of the world and analysed at the IMP headquarters at Raleigh (Carter and Sasser, 1982). In 1984 a new replacement project called Crop Nematode Research & Control Project (CNRCP) was started at Raleigh initially for three years to look for the suitable and effective measures to solve the problems of root-knot nematodes on various crops in different parts of the world utilizing the information gained through IMP researches. This project is, however, still continuing after extension by the funding agency, USAID.

Although all the four major species of *Meloidogyne* are known to exist in India, their identity and relative importance on various crops in different agro-climatic zones of the country have not been thoroughly investigated and documented.
Available information in this respect in the country is scanty and fragmentary. Eleven species of *Meloidogyne* have been reported attacking a large number of host plants in the country (Sitaramaiah, 1984). Out of the eleven, only three species, *M. incognita*, *M. javanica* and *M. graminicola* are predominant in India. *M. incognita* and *M. javanica* have been found to attack mostly vegetables, whereas *M. graminicola* is confined to rice (Krishnappa, 1985). This picture of their occurrence and dominance has emerged from a relatively very few studies. Similarly, there have been very limited studies on differentiation of races in *M. incognita* populations. Such information is partly available from the States of Andhra Pradesh, Haryana, Karnataka, Madhya Pradesh, Orissa, and Tamil Nadu out of the 25 States in the country.

Krishnappa (1982) studied samples of root-knot infected crops collected from different places in the State of Karnataka as well as some samples from the States of Madhya Pradesh, Tamil Nadu and Andhra Pradesh. In all the 40 samples studied, *M. incognita* was invariably found as the causal species. Three races i.e. Race 1, Race 2, and Race 3 were identified in *M. incognita* populations. Race 1 was most prevalent. Race 2 and Race 3 showed limited distribution each being present only in one of the localities in the State of Karnataka. A later report indicated the occurrence of Race 1 and Race 3 of *M. incognita* in the State of Karnataka (Krishnappa and Setty, 1983). In the State of Orissa, around Bhubaneshwar, occurrence of Race 1 and
Race 2 of *M. incognita* was recorded by Routray and Das (1982). Race 1 of *M. incognita* has been recorded to exist in the State of Haryana (Raja and Gill, 1982). Isolates of *M. incognita* from Jaipur, Jodhpur, Sriganganagar and Udaipur areas in the State of Rajasthan differed in pathogenicity in host differential tests carried out by Parihar and Yadav (1986) which suggested the presence of races in the isolates. But races were, however, not designated by them. Krishnappa (1985) while reviewing the work done in IMP region VIII (India) advocated for the need of collections and characterization of as many as possible populations from different hosts in each State of India for identification of species and races of *Meloidogyne* and assessment of frequency and distribution of root-knot nematodes.

Since the responses of host cultivars to different species of *Meloidogyne* and their races are likely to be variable, it is essential to know the occurrence of species of *Meloidogyne* and their races in a given area. The establishment of the identity of *Meloidogyne* spp. in different parts of India is a matter of fundamental importance for successful cultivation of various crops vulnerable to attack by root-knot nematodes. At the same time, relative dominance of the species of *Meloidogyne* and their races, their pattern of distribution and concentration in different agro-climatic zones of the country need to be investigated and documented. This is more true for North India, particularly in the Indo-Gangetic plains of Uttar Pradesh, the area with most extensive and intensive agriculture in India.
Responses of host cultivars, being grown in different States of India, to species and races of *Meloidogyne* known to exist in the State or country have not been ascertained and it demands sufficient study. Commercial cultivars being grown by farmers and the new cultivars before introduction should be screened against the species and known races of *Meloidogyne*. Before recommending cultivars for commercial cultivation, information regarding their performance against different species and races of *Meloidogyne* is necessary and should be provided to growers. Some attempts had been made to screen cultivars of vegetables like bean, tomato, eggplant, pepper, cowpea, okra cucumber, cauliflower, cabbage, carrot, radish etc. against the species of root-knot nematodes. Since there has been very little effort to identify the races in *Meloidogyne* spp. in India, screening of cultivars grown in India against the known races has not been attempted.

Soil salinity is a serious problem in certain parts of India including Uttar Pradesh and attempts are being made to reclaim these lands, popularly known as "Usar" lands. High salt content of these lands debilitate the grown plants. The interaction of high salt content and the root-knot nematodes has received little study. There are, however, some reports which indicate that infectivity and development of *M. incognita* are impaired by increasing soil salt concentration (Edongali *et al.*, 1982). This aspect needs to be examined using different
species and races of root-knot nematodes in relation to various crops.

In view of the above, the following three major aspects have been studied:

1. Incidence and intensity of root-knot disease and identity of species and races and their pattern of distribution in some parts of the Western Uttar Pradesh.

2. Relative susceptibility of some cultivars of vegetable crops to species and races of *Meloidogyne*.


Three different but related aspects of the root-knot nematode problem, studied for Ph.D. programme are presented in three sections each with separate introduction (including literature review), materials and methods, results, discussion and summary in the thesis. In order to avoid duplication, the literature cited in the text of all the three sections, however, are presented jointly at the end of the thesis.