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Survey of nematodes in chilli fields of Andhra Pradesh zones

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ABSTRACT

A survey of chilli grown areas of Andhra Pradesh was undertaken to identify the predominant nematode race. The soil samples were collected and processed for nematode isolation an identification. Seven of the samples showed nematode infection of roots which were multiplied on the susceptible tomato cultivar, Rutgers for further race identification using host differentials.

Key words : Nematodes, Chilli fields, Andhra Pradesh

Introduction

Chillies (*Capsicum annuum L.)* species belongs to the family *Solanaceae,* and are closely related to egg-plant, potato, petunia, tomato and tobacco. They are used as spices or vegetables in the temperate zones as well as tropics. All capsicums are diploids with 2n = 2x = 24 except the two wild relatives with a diploid chromosomal number of 26. Chillies have a variable genome size from 3200Mb to 5600 Mb (Moscone *et al.,* 2003). The genus *Capsicum* consists of 5 domesticated and 25 wild species (Bosland and Votava, 2000). *Capsicum annum L.,* the most widely cultivated species, is a herbaceous annual that reaches a height of one meter and has glabrous or pubescent lanceolate leaves with white flowers, and fruits that vary in length, colour and pungency depending upon the cultivar. The reported life zone for chilli is 7ºC to 29ºC and annual precipitations of 0.3 to 4.6 meters and a soil pH 4.3 to 8.7. Capsicum species are cold-sensitive and generally grow best in well-drained sandy or silt-loam soil. It is considered to be self-pollinating although different rates of out-crossing ranging from 7.6% to 38.6% have been reported. The propagation is by seeds.

Chillies are commonly divided into groups, pungent and non-pungent, also called hot and sweet peppers. Sweet peppers include the bell pepper, paprika, pimento and the sweet yellow wax peppers. The pungent nature of chilli fruits is due to the unique oleoresins, capsaicinoids. capsaicinoids, capsicum spp. have another oleoresin 'capsanthin' which imparts red colour to the fruits.

Capsicum sp are used fresh, dried, whole or ground, and alone or in combination with other flavouring agents. Capsicum annum L. is used in tobacco, and other red chilli pepper. Fruits of Capsicum annum L. paprika types are widely used as colouring agents. Paprika is used primarily in the flavouring of garnishes, pickles, meats, barbecue, sauces, ketchup, cheese, snack food, salads, and sausages. Spanish paprika is called 'pimento' and is generally used for colouring purposes.

As a medicinal plant, the capsicum species has been used as a carminative, digestive irritant, stimulant, rubefacient, and tonic. The plants have also

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Fig. 1. Phenotypic pictures of chillies.

been used as folk remedies for dropsy, colitis, diarrhea, asthma and arthritis. Capsicum frutescens L. has been reported to have hypoglycaemic properties, as well.

Prehistoric capsicum peppers were widely spread throughout the new world tropics in pre-Columbian times. The long viability of the seeds and the ease with which they can be transported assisted in its rapid spread in the tropics and sub-tropics throughout the world, introduced into India by Portuguese towards the end of the 15th century. The peppers have been eagerly adopted in the country, which now leads the world market in both production and export. Grown over an area of 5500 m ha, cultivation of chillies account for 45% of the world hectarage with an annual production of 50,500 m tones. India is also the largest exporter (3792 mt 2002; FAO, 2004), Andhra Pradesh, Karnataka and Maharashtra account for 75% of the country's net area and production. Other major producers in the world include Mexico, Japan, Ethiopia, Uganda, China and Pakistan.

Vegetable crops like tomato, brinjal, pepper, okra and cucumber are greatly affected by root-knot nematodes (Meloidogyne spp). These parasitic nematodes are microscopic, non-segmental round worms that feed on plants and may cause yield or plant stand loss. Without appropriate control measures, they cause loss of yield and quality in most food and fiber crops. There are different types of control measures viz., chemical, cultural, biological etc. However, keeping in view the cost and availability of chemical nematicides, their influence on environment and health concerns of the people, polyphagous nature of the nematodes and non-availability of effective biological control, there is an urgent need for alternate control measures, which is environmentally sound, while maintaining high production standards. It is important to develop resistant varieties of vegetables that will fetch higher market price and the farmers will be encouraged to go for these vegetable cultivation.

Plant-parasitic nematodes often interact with other soil pathogens, causing more plant damage than either pathogen would cause alone. The interaction may render plant resistance ineffective. Feeding habits are endoparasitic, semi-endoparasitic or ectoparasitic. Nematode feeding sites can provide entrance for other disease organisms and increase plant damage. Nematodes are a greater problem where conditions favour nematode growth, such as long growing seasons, sandy soil and plants under stress. Most plant-parasitic nematodes get into the crops from infested soil. Once nematodes are present, they are almost impossible to eliminate, but their damage to plants can be reduced. Root-knot nematodes are the most damaging group among the plant-parasitic nematodes. Nematodes can severely restrict all the vital functions of plant roots, including the absorption and transfer of water and nutrients. With nematicides the problem can be limited but the cost and toxicity of these chemicals restrict the adoption of such methods by small and marginal farmers. Therefore, it is important to manage plant-parasitic nematodes through host resistance, a practical approach.

The four species of root-knot nematodes, which infect chillies, are *Meloidigyne incognita, M.arenaria, M. Javanica, M. hapla. M. Javanica* and *M. incognita* are important on vegetables including brinjal and chillies in India. The root-knot nematodes (Meloidogyne spp.) are the major pepper pest throughout the world (Di Vito *et al.* 1985; Thomas *et al.* 1995). These parasites are prevalent in open fields and controlled environment where several nematode generations can be completed within a year (Djian-Caporalino *et al.* 1999). The infective juveniles move intercellularly after penetrating the roots, migrating down the plant cortex towards the tip. They then enter the base of the vascular cylinder and migrate up the root (Wyss *et al.* 1992) and establish a permanent feeding site in the differentiation zone of the roots by inducing nuclear division without cytokinesis in host cells (Williamson and Gleason, 2003). This process gives rise to large, multinucleate cells, termed giant cells, which cause the formation of galls or root knots (Williamson and Hussey, 1996). These alterations severely affect the uptake of water and nutrients and interfere with the translocation of minerals and photosynthates in the host (Milligan *et al.* 1998), resulting in wilted and stunted plants with significantly reduced yield. Moreover, it makes the host plants more susceptible to other soil-borne pathogens, usually bacteria and fungi (Castaagnone-Sereno *et al.* 1992). Currently, the primary method to control nematodes is soil fumigation, and the principal fumigant used is methyl bromide (Fery and Dukes, 1996). However, environmental concerns and government regulations promote the use of non-chemical over chemical pest control methods. Cultivars resistant to this pest would potentially render soil fumigant and toxic systemic nematicides unnecessary as they would be an efficient and durable control method (Djian-Caporalino *et al.* 1999). Though chemical methods are available for the control of nematodes these are not often effective.

Materials and Methods

Survey of nematode in the different Chilli growing regions: Survey of nematode in the Chilli growing areas of Andhra Pradesh, and neighbouring states was conducted during the month of April and May 2007 as a first step in the identification of prevalent nematode races. The number of soil and root samples collected from the various districts of AP is given Table 1.

Table 1. Soil and root samples collected from chilli growing areas in AP

District	Crop	Number of soil and root samples
Ranga Reddy	Chilli	4
	Tomato	7
Guntur	Chilli	10
Prakasam	Chilli	9
Nellore	Chilli	2
Kurnool	Chilli	7
Mahaboobnagar	Chilli	3
Chittoor	Chilli	6
Total No. of samples collected		48

The soil and root samples were collected by following standard techniques. For each field 8-10 randomly selected sub samples were pooled as one soil sample lot (1 kg) and collected into labelled polythene bags. Nematode population in each soil sample (250g) was determined by the using sieving method. The roots present in the soil samples were separated by sieving and cut into small pieces and mixed with the remaining soil of each sample were used for multiplication of nematode population. A total of six soil samples (Ranga Reddy district), containing root knot nematode populations were multiplied on the nematode susceptible tomato (Rutgers) cultivar.

The earthen pots (6"diameter) were filled with nematode infected soil along with sterilized soil in the ratio of 1:1. A known susceptible tomato variety Rutgers was sown and pots were kept under glass-house conditions. Forty-five days after germination, plants from all the samples were uprooted carefully, washed free of adhering soil and observed for the presence of nematode caused galls. Single egg masses were collected from each plant of a sample and further inoculated on tomato (Rutgers) for mass multiplication of root knot nematode population. The nematode race was identified using host differentials.

Results and Discussion

Survey of chilli growing areas for nematode: A total of seventy root and soil samples were collected from different chilli growing regions of Andhra Pradesh. The samples were processed for the detection of nematodes and seven soil samples showed positive reaction to root-knot nematode. These samples were inoculated on the susceptible tomato cultivar, Rutgers for multiplication of culture and race identification using host differentials.

Nematodes: The root-knot nematodes are the major pepper pest in many of the vegetable crops throughout the world (Di vito*et al*,1985).These parasites are prevalent in open fields and controlled environments where several nematode generations can be completed within a year (Caporalino *et al*.,1999).The infective juveniles move intercellularly after penetrating the roots, migrating down the plant cortex towards the tip. They then enter the base of the vascular cylinder and migrate up the root (Wyss *et al*., 1992) and establish a permanent feeding site in the

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differentiation zone of the roots by inducing nuclear division without cytokinesis in host cells (Williamson and Gleason, 2003) thus producing multinucleate cells called giant cells which cause the formation of galls or root knots (Williamson and Hussey, 1996).These alterations severely affect the uptake of photosynthates in the host (Milligan *et al*. 1998) resulting in wilted and stunted plants with significantly reduced yield. Besides this, it makes the host plants more susceptible to other soil-borne pathogens, usually bacteria and fungi (Castaagnone-Sereno *et al*.,1992).

It has widely been recognized that plant parasitic nematodes constitute one of the most devastating pest groups and are responsible for insidious disease symptoms in different crops causing huge losses. Estimated annual yield losses in the world's major crops due to plant parasitic nematodes is about 12.3% and is about 14% in the developing countries (Sasser and Freckman, 1987). In India, recent estimate showed that nematode is responsible for both quantitative and qualitative losses amounting to about Rs.240 billion every year (Sehgal & Gaur, 1999). More than 97 known species of root-knot nematode have been recorded worldwide and only 14 known species of Meloidogyne are recorded in India. The most predominant species of root-knot nematodes are Meloidogyne incognita, M. javanica, M. arenaria and M. hapla. All the species of root-knot nematodes produce a characteristic 'root gall 'or knotted root symptom, which could be easily recognized by naked eye. There is hardly any vegetable crop which is not attacked by the root-knot nematodes. Therefore, it has widely been considered as an important constraint for cultivation of vegetables.

Currently, the primary method to control nematodes is soil fumigation (Fery and Dukes, 1996). However, environmental concerns and governmental regulations promote the use of non-chemical pest control methods. Cultivars resistant to this pest would obviate the use of chemical control methods.

Host-pathogen interaction: Plants need to defend themselves against attack from viruses, microbes, invertebrates, and even other plants. Because plants lack a circulatory system, each plant cell must possess a performed or inducible defence capability, so distinguishing plant defence from the vertebrate immune system. Following the rediscovery of Mendel's work, plant breeders recognized that resistance to disease was often inherited as a single dominant or semi-dominant genetic trait.

Conclusion

A survey of nematodes was carried out in the various chilli growing areas of Andhra Pradesh. About 48 soil samples with roots were collected and processed for nematode isolation and identification. Of these, seven soil samples showed positive reaction for the presence of nematode which were inoculated on to the susceptible tomato cultivar, Rutgers for culturing the nematodes and identification.

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