
ORIGINAL ARTICLE

Assessment of Population of Important Plant Parasitic Nematodes in Host Free Conditions of Eastern And Western Zones of Tamil Nadu

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ABSTRACT

During August 2014 to July 2015, a total of 20 fallow locations at two widely separated zones viz., eastern and western districts of Tamil Nadu were sampled for quantitative analysis of plant parasitic nematode communities. A total of eight genera were identified from the fallow soil viz., Helicotylenchus incisus, Rotylenchulus reniformis, Hoplolaimus seinhorsti, Meloidogyne incognita, Tylenchorhynchus mashoodi, Pratylenchus penetrans and Radopholus similis have been recovered from the host free soils of eastern and western Tamil Nadu. Of these, four genera viz., Helicotylenchus incisus, Hoplolaimus seinhorsti, Meloidogyne incognita and Rotylenchulus reniformis were found to be predominant. These encountered plant parasitic nematodes were found to tolerate desiccation.

Key words: Community, Desiccation, Fallow soil

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INTRODUCTION

Plant-parasitic nematodes are microscopic in nature causing yield loss in major crops and appear to be well adapted for surviving extremes of temperature, moisture stress and carbon dioxide concentration. These strategies allow nematodes to persist in soil, by limiting its activity for specific periods of desiccation. Desiccation tolerance can be defined as the ability of organisms to maintain its internal water potential with that of moderately dry air and after rehydration it could retain its normal function [9].

Based on environmental stress to which the organisms are responding the desiccation status can be called as cryobiosis, anhydrobiosis, aerobiosis and osmobiosis [13, 5]. Among these anhydrobiosis is more prevalent in major nematode species, which means "life without water" [12]. Information on desiccation survival plays a vital role in effective management and control measures for plant parasitic nematodes. The present investigations were made to study the desiccation tolerance of nematodes under host free condition.

MATERIAL AND METHODS

A random survey was carried out in eastern and western zones of Tamil Nadu to assess the population of plant parasitic nematodes in fallow soil during the year 2014-2015. Soil samples were collected from each zone separately. The sampling was restricted to 10 per location. Samples were taken at 15-20 cm depth using a hand shovel. Each sample consisted of 200cc sample and packed in polythene bag sealed tightly with a rubber band. A label containing relevant information like date of collection, soil type, period of desiccation, previous crop, locality *etc.*, was kept in each bag and numbered. The nematodes were extracted by Cobb's decanting and sieving followed by Baermann's funnel technique [16]. The extracted nematodes were killed and fixed using 4 % formalin and the nematode genera were identified by comparing the characters given by Mai and Lyon [14]. The total population was estimated by converting

the counts of sample to total volume with regard to nematode population encountered from soil samples. The population densities of nematode species were calculated using the formulae [15]:

$$\begin{aligned} \text{Absolute frequency} &= \frac{\text{No. of samples containing a species}}{\text{No. of samples collected}} \times 100 \\ \text{Relative frequency} &= \frac{\text{Frequency of a species}}{\text{Sum of frequency of all species}} \times 100 \\ \text{Relative density} &= \frac{\text{No. of individuals of a species in a sample}}{\text{Total of all individuals in a sample}} \times 100 \\ \text{Absolute density} &= \frac{\text{No. of individuals of a species in a sample}}{\text{Volume or mass or units of the sample}} \times 100 \\ \text{Prominence value} &= \frac{\text{Absolute density} \times \sqrt{\text{absolute frequency}}}{100} \end{aligned}$$

RESULTS

Eight genera of plant parasitic nematodes viz., *Helicotylenchus incisus*, *Rotylenchulus reniformis*, *Hoplolaimus seinhorsti*, *Meloidogyne incognita*, *Tylenchorhynchus mashoodi*, *Pratylenchus penetrans* and *Radopholus similis* have been recovered from the host free soils of eastern (Table 1) and western Tamil Nadu (Table 2). Of these, four genera viz., *Helicotylenchus incisus*, *Hoplolaimus seinhorsti*, *Meloidogyne incognita* and *Rotylenchulus reniformis* were found to be predominant.

Table 1. Population of plant parasitic nematodes in host free soil - Eastern Tamil Nadu

| S.No | Locality | Duration of host free condition | Previous crop | Soil type | Nematodes observed | Nematode Population/ 200 soil |
|------|--------------|---------------------------------|---------------|------------|----------------------|-------------------------------|
| 1. | Villupuram | 5 months | Tomato | Loamy | <i>M. incognita</i> | 80 |
| | | | | | <i>R. reniformis</i> | 60 |
| | | | | | <i>H. incisus</i> | 40 |
| 2. | Perambalur | 3 months | Tomato | Sandy loam | <i>M. incognita</i> | 160 |
| | | | | | <i>H. incisus</i> | 120 |
| 3. | Kallakurichi | 3 months | Vegetables | Loamy | <i>T. mashoodi</i> | 140 |
| | | | | | <i>M. incognita</i> | 80 |
| | | | | | <i>H. incisus</i> | 140 |
| | | | | | <i>R. reniformis</i> | 60 |
| 4. | Vellore | 6 months | Ragi | Loamy | <i>H. seinhorsti</i> | 40 |
| 5. | Kallanatham | 4 months | Tomato | Loamy | <i>M. incognita</i> | 80 |
| | | | | | <i>H. incisus</i> | 120 |
| | | | | | <i>R. reniformis</i> | 60 |
| 6. | Thozhudhoor | 3 months | Vegetables | Loamy | <i>P. penetrans</i> | 100 |
| | | | | | <i>T. mashoodi</i> | 120 |
| | | | | | <i>H. incisus</i> | 160 |
| 7. | Cuddalore | 2 months | Brinjal | Loamy | <i>H. incisus</i> | 240 |
| 8. | Kulathoor | 4 months | Tomato | Loamy | <i>R. reniformis</i> | 20 |
| | | | | | <i>H. incisus</i> | 80 |
| | | | | | <i>M. incognita</i> | 40 |
| 9. | Poondi | 6 months | Cumbu | Loamy | <i>H. seinhorsti</i> | 140 |
| 10. | Allore | 3 months | Cumbu | Loamy | <i>H. incisus</i> | 240 |

Table 2. Population of plant parasitic nematodes in host free soil - Western Tamil Nadu

| S.No | Locality | Duration of host free condition | Previous crop | Soil type | Nematodes observed | Nematode Population/ 200 cc soil |
|------|---------------------|---------------------------------|---------------|------------|----------------------|----------------------------------|
| 11. | Boluvampatti | 8 months | Cumbu | Loamy | <i>H. incisus</i> | 40 |
| | | | | | <i>R. reniformis</i> | 30 |
| | | | | | <i>H. seinhorsti</i> | 10 |
| 12. | Vettaikaran thottam | 3 months | Banana | Sandy loam | <i>R. similis</i> | 120 |
| 13. | Vengatapuram | 2 months | Cotton | Red soil | <i>R. reniformis</i> | 180 |
| 14. | Maadhampatti | 4 months | Cotton | Loamy | <i>R. reniformis</i> | 40 |
| 15. | Saravanampatti | 8 months | Cotton | Red soil | <i>R. reniformis</i> | 30 |
| 16. | Vedappatti | 2 months | Cumbu | Loamy | <i>H. incisus</i> | 80 |
| 17. | Chennimalai | 8 months | Sorghum | Red soil | <i>H. incisus</i> | 10 |
| | | | | | <i>H. seinhorsti</i> | 30 |
| 18. | Perundhurai | 9 months | Cumbu | Loamy | <i>H. seinhorsti</i> | 10 |
| | | | | | <i>R. reniformis</i> | 10 |
| 19. | Veerakeralam | 6 months | Sorghum | Loamy | <i>H. seinhorsti</i> | 30 |
| 20. | Oonjaloor | 8 months | Sunflower | Loamy | <i>H. incisus</i> | 10 |

Table 3. Community analysis of plant parasitic nematodes in fallow soil of eastern Tamil Nadu

| S.No | Nematode sp | AF | RF | AD | RD | PV |
|------|-----------------------|------|------|--------|------|-------|
| 1. | <i>M. incognita.</i> | 60.0 | 26.1 | 600.0 | 25 | 46.5 |
| 2. | <i>R. reniformis.</i> | 40.0 | 17.4 | 200.0 | 8.3 | 12.6 |
| 3. | <i>H. incisus</i> | 80.0 | 34.8 | 1140.0 | 47.5 | 102.0 |
| 4. | <i>T. mashoodi.</i> | 20.0 | 8.7 | 260.0 | 10.8 | 11.6 |
| 5. | <i>H. seinhorsti.</i> | 20.0 | 8.7 | 100.0 | 4.2 | 4.5 |
| 6. | <i>P. penetrans</i> | 10.0 | 4.3 | 100.0 | 4.2 | 3.2 |

Table 4. Community analysis of plant parasitic nematodes in fallow soil of western Tamil Nadu

| S.No | Nematode sp | AF | RF | AD | RD | PV |
|------|-----------------------|------|------|-------|------|------|
| 1. | <i>H. incisus</i> | 40.0 | 28.6 | 140.0 | 22.2 | 8.9 |
| 2. | <i>R. reniformis.</i> | 50.0 | 35.7 | 290.0 | 46.0 | 20.5 |
| 3. | <i>H. seinhorsti.</i> | 40.0 | 28.6 | 80.0 | 12.7 | 5.1 |
| 4. | <i>R. similis</i> | 10.0 | 7.1 | 120.0 | 19.0 | 3.8 |

DISCUSSION

Helicotylenchus incisus

The spiral nematode *Helicotylenchus incisus* was the most predominant species which has highest densities in both the zones viz., east and western Tamil Nadu. The survival of the spiral nematode in host free soil was upto 12 months. However at 12 months, the frequency of occurrence was less when compared to 2, 3, 4, 5, and 6 months of host free conditions.

The present finding on the survival seems to be new under Indian conditions as no studies indicated the survival of *Helicotylenchus* sp. in host free soil. Not much of the studies indicated the survival in desiccated conditions except that of Demeure *et al.* [6] who found that survival of *H. dihystra* increases when dehydration is lengthened.

Duncan [7] observed that final population of *H. dihystra* and *H. pararobustus* levels were reduced by an average of 85 and 70 per cent respectively. Nevertheless, population levels should continue to decline during the six months prior to the succeeding rainy season and it is unknown whether these species are pathogenic to local cultivated crops.

Meloidogyne incognita

The present study reveals that *M. incognita* survives in host free soil upto six months. It was not encountered in western Tamil Nadu this may be due to the presence of higher population of *R. reniformis* and prolonged dry spell in the surveyed locations of western zone might be the possible reason for the absence of *M. incognita* in these zones.

Gaur *et al.* [10] reported that *M. incognita* survived up to 450 days without the host with a moisture tension ranging from 0.01 to 30.0 bars at controlled conditions. The present study is under field condition and the soil temperature could be more than 40 °C and hence no J₂ were recovered beyond 6 months of host free condition. The earlier study indicates that the root knot nematode survives adverse conditions both as eggs and juveniles.

Rotylenchulus reniformis

The reniform nematode *R. reniformis* was found to be predominant in the western zone, under host free condition of Tamil Nadu. The frequency of occurrence of *R. reniformis* is more in the western zones and the population could be recovered after 9 months of host free condition and their population densities are higher in the western zone.

Several reports are available indicating the survival of *Rotylenchulus reniformis* under adverse conditions [2, 3, 20]. Retention of moulted cuticle [10, 11] and coiling behavior [21] enhance survival of *Rotylenchulus reniformis*.

The present studies indicated that *R. reniformis* was prominent in the western zone. Anon [1] indicated that the prevalence of *R. reniformis* is mostly found in the foot hills of Western Ghats and the districts adjoining. This could be the possible reasons for the increased frequency and populations of *R. reniformis* under host free condition.

Pratylenchus penetrans

The lesion nematode *P. penetrans* was present in the eastern Tamil Nadu and was absent in western zone and further their frequency of occurrence was less in east and high in western zones. The population densities were highest upto four months of starvation under host free condition and at five months the population declined moderately. This result coincides with the findings of Townshend [19] that *P. penetrans* could survive in dry soil upto 770 days.

The present study is in conformity with the findings of Subramaniyan and Selvaraj [18] who have observed the survival of *P. coffeae* upto 4 months under host free status under dry soil.

Radopholus similis

The burrowing nematode *R. similis* was recovered only from western Tamil Nadu where the favorable host *viz.*, banana cultivation is more, and the frequency of occurrence is highest in western zone. *R. similis* was recovered up to 5 months of host free conditions. However the population of *R. similis* at 3 months of starvation is higher than 5 months.

The western region adjoining Kerala are the typical banana belt and the banana nematode *R. similis* could perpetuate in the soil even under host free conditions. This could be the possible reason for the high populations of *R. similis*.

Hoplolaimus seinhorsti

The lance nematode *Hoplolaimus seinhorsti* an ectoparasite was found to occur in both zones and the frequency of occurrence was high in western zone. *Hoplolaimus seinhorsti* survives even up to 12 months under host free conditions.

Although three species of Lance nematode *viz.*, *H. indicus*, *H. seinhorsti*, *H. Columbus* are widely prevalent in Tamil Nadu. Of these *H. seinhorsti* is the most predominant species in all over Tamil Nadu [17].

Scutellonema cavenessi a member of Hoplolaimidae could survive desiccation and declined in relation to time spent in moist free soil [7].

Tylenchorhynchus sp.

The stunt nematode *Tylenchorhynchus sp.* was recovered only in eastern zone under host free condition and with less frequencies of occurrence. The survival under host free condition was up to four months in the present study.

Cadet *et al.* [4] reported that in young fallows, large populations of *Scutellonema cavenessi* and *Tylenchorhynchus gladiolatus* were seen and in older fallows *Helicotylenchus dihystera* was dominated.

CONCLUSION

These results exposes that the population of nematodes in the soil varied from location to location and was reduced as fallow period progressed. Estimation of phytonematodes in fallow soil before planting plays a vital role in effective management.

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