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QUALITATIVE AND QUANTITATIVE STUDIES OF PLANT AND SOIL INHABITING NEMATODES ASSOCIATED WITH RICE CROP IN SIKKIM, INDIA

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INTRODUCTION

Rice is the main cereal crop in Sikkim State of India. The state is divided into four districts, i.e., North, South, East and West. During November, 1984, a random surey was conducted to collect the rice root and soil samples from East, West and South districts in order to study the qualitative and quantitative distribution of nematodes associated with the rice crop in Sikkim. In all, 100 root and soil samples were collected from 36 localities of three districts.

Material and Methods : Permanent slides were made in anhydrous glycerin for species identification. For quantitative estimation of nematodes, the methodology described by Baqri *et al.* (1983) was followed, except that the nematode population was counted per 200 ml of soil and 10 gm of roots from sample.

A. QUALITATIVE STUDY

Upon identification, the samples yielded 19 species of stylet bearing nematodes (mostly parasitic) belonging to 13 genera of the Orders Tylenchida and Aphelenchida (17 and 2 respectively); 20 species of Order Dorylaimida, of which three are ecto-parasitic while others are predaceous or free living; and 7 predaceous species belonging to the Order Mononchida. The species are listed below :

Order TYLENCHIDA Thorne, 1949

1. *Aglenchus fragariae* Szczygiel, 1969
2. *Tylenchorhynchus mashhoodi* Siddiqi & Basir, 1959
3. *Tylenchorhynchus nudus* Allen, 1955

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4. *Quinisulcius capitatus* (Allen, 1955) Siddiqi, 1971
5. *Hoplolaimus indicus* Sher, 1963
6. *Scutellonema brachyurum* (Steiner, 1939) Andrassy, 1958
7. *Helicotylenchus erythrinae* (Zimmermann, 1904) Golden, 1956
8. *Helicotylenchus dihystera* (Cobb, 1893) Sher, 1961
9. *Helicotylenchus egyptiensis* Tarjan, 1964
10. *Meloidogyne graminicola* Golden & Birchfield, 1965
11. *Pratylenchus scribneri* Steiner, 1943
12. *Pratylenchus thornei* Sher & Allen, 1953
13. *Pratylenchus loosi* Loof, 1960
14. *Hirschmanniella gracilis* (de Man, 1880) Luc & Goodey, 1963
15. *Macroposthonia ornata* (Raski, 1958) de Grisse & Loof, 1965
16. *Hemicriconemoides cocophillus* (Loos, 1949) Chitwood & Birchfield, 1957
17. *Hemicriconemoides brachyurus* (Loos, 1949) Chitwood & Birchfield, 1957

Order APHELENCHIDA Siddiqi, 1980

1. *Aphelenchus avenae* Bastian, 1865
2. *Aphelenchoides* sp.

Order DORYLAIMIDA Pearse, 1942

1. *Laimydorous finalis* Thorne, 1975
2. *Laimydorous coomansi* Baqri, 1991
3. *Labronemella hemicaudata* Baqri, 1991
4. *Eudorylaimus chauhani* (Baqri & Khera, 1975) Andrassy, 1986
5. *Labronema* sp.
6. *Oriverutus sundarus* (Williams, 1964) Siddiqi, 1971
7. *Oriverutus lobatus* Siddiqi, 1971
8. *Opisthodorylaimus cavalcantii* (Lordello, 1955) Carbonell & Coomans, 1985
9. *Aporcelaimellus* spp.
10. *Xiphinema insigne* Loos, 1949*
11. *Xiphinema brevicolle* Lordello & Costa, 1961*
12. *Belondira neortha* Siddiqi, 1964
13. *Dorylaimellus indicus* Siddiqi, 1964
14. *Tylencholaimus pakistanensis* Timm, 1964
15. *Tylencholaimus obscurus* Jairajpuri, 1965
16. *Proleptonchus clarus* Timm, 1964
17. *Tyleptus veriabilis* Jairajpuri & Loof, 1966
18. *Dorylaimoides micoletzkyi* (de Man, 1921) Thorne & Swanger, 1936
19. *Dorylaimoides longiurus* Siddiqi, 1965
20. *Paratrichodorus (Atlantodorus) porosus* (Allen, 1957) Siddiqi, 1974*

* Ectoparasites and virus vectors

Order MONONCHIDA Jairajpuri, 1969

1. *Clarkus elongatus* Jairajpuri & Khan, 1977
2. *Mylonchulus hawaiiensis* (Cassidy, 1931) Andrassy, 1958
3. *Paramylonchulus mulveyi* (Jairajpuri, 1970) Jairajpuri & Khan, 1982
4. *Parahadronchus shakili* (Jairajpuri, 1969) Mulvey, 1978
5. *Iotonchus indicus* Jairajpuri, 1969
6. *Iotonchus longicaudatus* Baqri, Baqri & Jairajpuri, 1978
7. *Iotonchus nayari* Mohandas & Prabhoo, 1979

B. QUANTITATIVE STUDY

The results of the quantitative estimation of different parasitic nematode genera and other nematodes from East, West and South districts have been furnished in Table nos. I, II and III respectively.

Table IV provides the comparative information from three districts regarding average percent frequency of occurrence and dominance of important pests in soil and only occurrence from rice roots.

District East Sikkim

The amalgamated results of the quantitative estimation of 41 soil samples collected from 16 localities have been analysed in Table I. The study reveals that the species of the genera *Tylenchorhynchus* and *Helicotylenchus* are most abundant. The results also confirm that *Helicotylenchus* are most abundant. The results also confirm that *Helicotylenchus* spp. (*H. dihystera, H. erythrinae*) and *Tylenchorhynchus* spp. (*T. mashhoodi & T. nudus*) are the key pests of paddy in East Sikkim because of their high degree of occurrence and dominance. *Meloidogyne graminicola* should also be considered as serious nematode pest because of its presence in almost all the localities, except Samsing, and high degree of dominance in a few samples. *Scutellonema brachyurum* was also recorded. Surprisingly, the *Hirschmanniella* species (rice root nematode) was not recorded.

District. West Sikkim

In all, 42 soil and root samples were collected from 14 localities of district West Sikkim. Table - II provides the frequency of occurrence and dominance of the important pests of the district. The results reveal that *Helicotylenchus* spp. and *Tylenchorhynchus nudus* are the key pest and the potential pest of paddy, respectively, in West Sikkim. The analysis of the soil populations shows that the *Helicotylenchus* spp. and the *Tylenchorhynchus* sp. occur in 81% and 74% samples and dominate over other parasitic species in 64% and 28.5% samples respectively. *Hirschmanniella gracillis, Macroposthonia ornata, Scutellonema brachyurum* and *Meloidogyne graminicola* have also been estimated but their frequency of occurrence or dominance has been found very low.

District South Sikkim

Only 17 soil and root samples could be collected from six localities of South Sikkim. The results of quantitative estimation of soil samples have been provided in Table - III. The results in this table reveal that the species of the genus *Helicotylenchus* are present in 100% samples with high degree of dominance. Hence, *Helicotylenchus* spp. are the key pest in South Sikkim also. *Tylenchorhynchus nudus* is a potential pest of paddy because of its dominance and occurrence has been calculated 82.3% and 17.3% respectively. The *Meloidogyne graminicola*, *Pratylenchus* spp. and *Macroposthonia ornata* have been found only from a few localities and in a limited number.

Table - IV provides the comparative information regarding occurrence and dominance of important nematode pests of rice in soil as well as roots in East, West and South districts of Sikkim State. This may easily be concluded from the degree of dominance and occurence that the species of *Helicotylenchus* and *Tylenchorhynchus* are serious and important nematode pests of rice in three surveyed districts.

SUMMARY

During November, 1984, a random survey was conducted so as to know the qualitative and quantitative distribution of plant and soil nematodes associated with rice crop at 36 localities of the following three districts : East Sikkim, West Sikkim and South Sikkim. In all, 100 soil and root samples were collected and processed for the study. The study concludes that species of *Tylenchorhynchus* (*T. mashhoodi* and *T. nudus*) and *Helicotylenchus* (*H. dihystera*, *H. erythrinae* and *H. egyptiensis*) are most abundant and dominant pests of rice crops in the area. The other important pests are : *Scutellonema-brachyurum*, *Hirschmanniella gracilis*, *Meloidogyne graminicola*, *Pratylenchus* spp. and *Macroposthonia ornata*. However, their frequency of occurrence and degree of dominance was not found alarming, except at few localities. The paper also reports 48 species of the Orders Tylenchida (19 spp.), Aphelenchida (2 spp.), Dorylaimida (20 spp.) and Mononchida (7 spp.).

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TABLE - I

Results of the survey of Rice crop in East district, Sikkim State.
Range of nematode number with its avarage per 200 ml of soil.
Figures in parenthesis indicate percent frequency of occurrence.

	LOCALITY/VILLAGE				
	Chota Singtham	Aahoo	Namchapong	Samsing	Chalamthang
No. of samples collected	3	2	5	1	3
Nematodes					
1. *Tylenchorhynchus*	10 : 10 (33.33)	20-20 : 20 (100)	30-120 : 60 (80)	—	90 : 90 (100)
2. *Helicotylenchus*	20-240 : 90 (100)	40-40 : 40 (100)	20-200 : 96 (100)	20 : 20 (100)	170-270 : 193 (100)
3. *Pratylenchus*	—	—	—	—	40 : 40 (33.33)
4. *Macroposthonia*	—	—	150 : 150 (20)	—	40 : 40 (100)
5. *Meloidogyne*	20-120 : 23 (100)	20 : 20 (100)	20-100 : 53 (60)	—	20-40 : 33 (100)
6. Other dorylaims	100-430 : 220 (100)	100-160 : 130 (100)	210-1280 : 580 (100)	40 : 40 (100)	230-400 : 290 (100)
7. Saprophagous	180-360 : 243 (100)	40-40 : 40 (100)	70-560 : 274 (100)	260 : 260 (100)	120-230 : 183 (100)

Table - I contd.

Results of the survey of Rice crop in East district, Sikkim State.

	LOCALITY/VILLAGE					
	Diling Pachakhani	Pachakhani	Pakyong	Dikling	Mamzoy	Magitar
No. of samples collected	1	3	3	1	2	2
Nematodes						
1. *Tylenchorhynchus*	—	10-20 : 17 (100)	40 : 40 (33.33)	—	120 : 120 (50)	20-30 : 25 (100)
2. *Helicotylenchus*	310 : 310 (100)	80-290 : 193 (100)	60-400 : 193 (100)	90 : 90 (100)	40-90 : 65 (100)	100-200 : 150 (100)
3. *Meloidogyne*	50 : 50 (100)	40-70 : 55 (66.6)	120 : 120 (33.3)	20 : 20 (100)	40 40 (50)	120 120 (50)
4. Other dorylaims	320 : 320 (100)	60-240 : 120 (100)	80-740 : 347 (100)	110 : 110 (100)	170-260 : 215 (100)	40-150 : 95 (100)
5. Saprophagous	330 : 330 (100)	160-500 : 277 (100)	60-540 : 313 (100)	90 : 90 (100)	110-510 : 310 (100)	20-90 : 55 (100)

Table - I contd.

Results of the survey of Rice crop in East district, Sikkim State.

	LOCALITY/VILLAGE				
	Sirwani	Ralap	Singbel	Makha	Bardan
No. of samples collected	5	4	1	4	1
Nematodes					
1. *Tylenchorhynchus*	140-340 : 230 (80)	40-400 : 167 (75)	180 : 180 (100)	10-60 : 35 (50)	30 : 30 (100)
2. *Helicotylenchus*	220-980 : 560 (100)	120-820 : 370 (100)	320 : 320 (100)	50-830 : 509 (100)	20 : 20 (100)
3. *Macroposthonia*	20-80 : 47 (60)	100-500 : 300 (50)	60 : 60 (100)	10 : 10 (25)	10 : 10 (100)
4. *Meloidogyne*	20-40 : 30 (100)	20 : 20 (25)	260 : 260 (100)	20-80 : 50 (75)	70 : 70 (100)
5. Other tylenchids	20 : 20 (60)	20 : 20 (25)	-	60 : 60 (25)	-
6. Other dorylaims	40-740 : 260 (100)	40-740 : 350 (100)	60 : 60 (100)	180-580 : 312 (100)	590 : 590 (100)
7. Saprophagous	80-880 : 288	100-820 : 295	260 : 260	260-770 : 455	260 : 260

TABLE - II

Results of the survey of Rice crop in West district, Sikkim State.
Range of nematode number with its average per 200 ml of soil.
Figures in parenthesis indicate percent frequency of occurrence.

	LOCALITY/VILLAGE				
	Geyalsing	Gurthang	Kyongsha	Lower Geyalsing	Omchung
No. of samples collected	3	2	3	5	6
Nematodes					
1. *Tylenchorhynchus*	20-350 : 185 (66.67)	100 : 100 (50)	10-160 63 (100)	20 : 20 (20)	30-1060 : 280 (83)
2. *Helicotylenchus*	80-140 : 110 (66.67)	100-170 : 135 (100)	70-260 165 (66.67)	20-70 : 38 (80)	100-390 273 (50)
3. *Hirschmanniella*	—	—	—	—	20-60 40 (50)
4. *Macroposthonia*	—	—	20.: 20 (33.33)	—	10-20 : 13 (50)
5. *Meloidogyne*	20 20	—	30 : 30 (33.3)	—	30 30 (16.6)
6. Other tylenchids	—	30 : 30 (50)	—	20 : 20 (20)	—
7. Other dorylaims	40-140 : 86 (100)	170-200 : 185 (100)	150-250 207 (100)	60-320 : 166 (100)	20-280 : 178 (100)
8. Saprophagous	50-690 : 293 (100)	140-200 : 170 (100)	30-260 : 137 (100)	30-360 : 158 (100)	110-280 : 156 (100)

Table - II contd.

Results of the survey of Rice crop in West district, Sikkim State.

	LOCALITY/VILLAGE				
	Legship	Sikip	Ghumoni	Baigunia	Budang
No. of samples collected	1	2	1	2	5
Nematodes					
1. *Tylenchorhynchus*	40 : 40 (100)	60 : 60 (50)	—	30 : 30 (50)	10-330 : 106 (100)
2. *Helicotylenchus*	320 : 320 (100)	900-2220 : 1560 (100)	80 : 80 (100)	20-30 : 15 (100)	10-790 : 248 (100)
3. *Hirschmanniella*	20 : 20 (100)	80 : 80 (50)	—	—	30 : 30 (20)
4. *Macroposthonia*	20 : 20	—	—	—	—
7. Other dorylaims	120 : 120 (100)	60-280 : 170 (100)	120 : 120 (100)	100-170 : 135 (100)	30-280 : 136 (100)
8. Saprophagous	60 : 60 (100)	280-600 : 440 (100)	260 : 260 (100)	30-60 : 45 (100)	40-330 : 114 (100)

Table - II contd.

Results of the survey of Rice crop in West district, Sikkim State.

	LOCALITY/VILLAGE			
	Upper Budang	Mansari	Daramdim	Tharpu
No. of samples collected	4	1	4	3
Nematodes				
1. *Tylenchorhynchus*	30-890 232 (100)	10 : 10 (100)	20-50 : 35 (50)	100-220 117 (100)
2. *Helicotylenchus*	20-80 70 (100)	60 60 (100)	60-190 125 (50)	160-580 : 370 (66.67)
3. *Macroposthonia*	20 : 20 (25)	10 10 (100)	—	—
4. Other tylenchids	—	—	—	20 : 20 (33.33)
5. Other dorylaims	20-210 : 120 (100)	130 : 130 (100)	80-520 : 282 (100)	180-240 : 200 (100)
6. Saprophagous	10-420 : 215 (100)	140 : 140 (100)	70-1440 : 755 (50)	200-600 : 360 (100)

TABLE - III

Results of the survey of Rice crop in South district, Sikkim State.
Range of nematode number with its average per 200 ml of soil.
Figures in parenthesis indicate percent frequency of occurrence.

	LOCALITY/VILLAGE					
	Mamring	Bermoik	Namphing	Raship	Tarku	Tanak Tarku
No. of samples collected	2	3	2	1	6	3
Nematodes						
1. *Tylenchorhynchus*	140-260 : 200 (100)	40-720 : 447 (100)	30-90 : 60 (100)	120 : 120 (100)	10-60 : 38 (66.67)	20-90 : 55 (66.67)
2. *Helicotylenchus*	640-800 : 720 (100)	180-940 : 440 (100)	750-860 : 805 (100)	200 : 200 (100)	110-460 : 280 (100)	90-700 : 363 (100)
3. *Pratylenchus*	90 : 90 (50)	—	—	—	10 : 10 (16.67)	—
4. *Macroposthonia*	—	10 : 10 (33.33)	—	—	40 : 40 (16.67)	10 : 10 (33.33)
5. Other dorylaims	220-360 : 280 (100)	200-480 : 307 (100)	150-240 : 195 (100)	160 : 160 (100)	120-570 : 270 (100)	60-460 : 213 (100)
6. Saprophagous	180-320 : 250 (100)	80-420 : 353 (100)	120-180 : 150 (100)	360 : 360 (100)	120-500 : 250 (100)	240-840 : 453 (100)

TABLE - IV

Comparative results of the 1984 survey of rice crop in East Sikkim, West Sikkim and South Sikkim.
Range of nematode number (important parasites) with its average per 200 ml and 10 gm roots.
Figures in parenthesis indicate percent frequency of occurrence with dominance in soil/only occurrence in roots.

Name of the district	West Sikkim		South Sikkim		East Sikkim	
	Soil Population	Root Population	Soil Population	Root Population	Soil Population	Root Population
Important Nematodes						
1. *Hirschmanniella*	20-80 : 42 (14.2 : 0)	—	—	—	—	—
2. *Tylenchorhynchus*	10-1060 : 147 (74 : 28.5)	40 : 40 (4.7)	10-720 : 160 (82.3 17.3)	40-120 : 80 (23.5)	10-400 90 (63.4 10)	40-120 70 (10)
3. *Helicotylenchus*	10-2220 : 239 (81.64.2)	40 : 40 (4.7)	90-940 432 (100 83)	40-360 152 (29.4)	20-980 : 207 (100 83)	40-200 96 (20)