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COMMUNITY ANALYSES OF PLANT-PARASITIC NEMATODES IN TEA PLANTATIONS OF WEST BENGAL, INDIA

by
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Tea (*Camellia sinensis* L.) occupies a prominent place as an export crop in India. In West Bengal, it is cultivated in the subtropical Terai foot-hills and the high hills at different altitudes up to 6,500 ft. ASL over about 18,000 hectares. Most of the tea bushes in Darjeeling hill areas are about 80 years old and their leafbearing capacity has declined considerably. In West Bengal, the number of active tea gardens has dwindled from 100 to 74 and the average yield is 63 Kg/ha against the all-India average of 1500 Kg/ha (Indian Tea Board Golden Jubilee Supplement, Amrita Bazar Patrika, Calcutta, Sept. 4, 1980). Little information is available on plant nematodes associated with tea plantations in West Bengal. While 35 nematodes species have been found to be associated with tea, mainly from North-East India and South India (Sivapalan, 1972; Khera and Chaturvedi, 1977; and Baqri, 1978), only four species have so far been reported from West Bengal (Baqri, 1978). The purpose of this study was to investigate the incidence of endo - and ectoparasitic plant nematodes in mature and declining tea plantations of West Bengal and to make a community analysis.

Materials and Methods

During the period May to June, 1980, five declining plantations of tea in Darjeeling District were surveyed by collecting 120 soil and root samples from the tea estates as listed in Table II. Within a

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Table I - *Ecological variables of plant parasitic nematode community at tea plantations, West Bengal*

Nematode species	Frequency	Density	Prominence Value
Helicotylenchus dihystera (Cobb, 1893) Sher, 1961	0.666	140.2	114.472
Macroposthonia ornata (Raski, 1958) De Grisse *et* Loof, 1965	0.50	120.4	85.135
Pratylenchus loosi Loof, 1960	0.883	64.8	60.902
Meloidogyne brevicauda Loos, 1953	0.691	71.5	59.464
Helicotylenchus sp.	0.45	60.25	40.416
Paratylenchus lepidus Raski, 1975	0.583	52.75	40.288
Pratylenchus brachyurus (Godfrey, 1929) Filipjev *et* Schuurmans Stekhoven, 1941	0.333	44.33	25.593
Aphelenchoides sp.	0.491	25.25	17.705
Hemicriconemoides cocophilus (Loos, 1949) Chitwood *et* Birchfield, 1957	0.166	42	17.146
Aphelenchus avenae Bastian, 1865	0.30	30.75	16.842
Macroposthonia onoensis (Luc, 1959) De Grisse *et* Loof, 1965	0.166	36	14.696
Tylenchus (sensu stricto) sp.	0.25	26.33	13.165
Helicotylenchus erythrinae (Zimmermann, 1904) Golden, 1956	0.133	31	11.319
Hemicriconemoides mangiferae Siddiqi, 1961	0.20	21	9.391
Paratylenchus dianthus Jenkins *et* Taylor, 1956	0.15	18	6.971
Xiphinema sp.	0.175	13.25	5.542
Coslenchus sp.	0.183	12.25	5.245
Atlantadorus porosus (Allen, 1957) Siddiqi, 1980	0.05	13	2.906
Aglenchus agricola (de Man, 1884) Meyl, 1961	0.066	7	1.807

Nematodes are arranged in descending order of their prominence value, based on 100 ml of soil.

radius of 100 metres, 30 mature tea bushes were randomly selected and samples were taken to a depth of 40 cm. Soil and root samples were pooled for each 3 hectares of the tea plantations surveyed and used for nematode assay.

Nematodes were extracted from soil samples using a modified

Baermann funnel technique (Schindler, 1961). Chopped roots were comminuted and incubated in dilute hydrogen peroxide following the method of Gowen and Edmunds (1973) for the extraction of endoparasitic nemas. The nematodes thus recovered were heat-relaxed, killed and fixed in T.A.F. A 10 per cent aliquot of each suspension was examined with a stereomicroscope and nematode numbers counted. Plant parasitic nematodes were identified to species in permanent mounts in dehydrated glycerol. *Meloidogyne* spp. were identified by reference to perineal pattern (Taylor *et al.*, 1955).

Incidence of the nematode fauna, their frequency, population density and prominence values at different locations have been determined following the method of Norton (1978) and Norton and Schmitt (1978).

Results and Discussion

Nineteen species of plant parasitic nematodes within thirteen genera were identified from the sampled tea plantations. *Pratylenchus loosi, Helicotylenchus erythrinae, Paratylenchus lepidus, Atlantadorus porosus, Aglenchus agricola* and *Coslenchus* sp. are associated with tea for the first time from India, the last three species being new records of association with tea. The large increase in the number of nematode species found on tea in the State of West Bengal indicates that nematodes are a major factor in the decline of tea yields.

At least four of the nematode species encountered are known to be important parasites of tea in Sri Lanka and Japan (Sivapalan, 1972), i.e. *Helicotylenchus dihystera, Pratylenchus brachyurus, P. loosi* and *Meloidogyne brevicauda.*

H. dihystera, in addition to *Helicotylenchus* sp. tended to form a higher proportion of the nematode populations in all of the soil samples, whereas *H. erythrinae* occurred very rarely. The species spectrum of the spiral nematodes also seemed to be broad. It is surmised that these nematodes might play a major role in the decline of the tea bushes.

The root lesion nematode, *P. loosi* is the most serious nematode pest of mature tea bushes in Sri Lanka and Japan (Sivapalan, 1972). It occurred in almost all the tea plantations sampled and the above-ground symptoms of infestation (affected bushes appearing 'thin' due to deficiency of maintenance foliage and becoming unthrifty)

Table II - *Prominence, frequency of occurrence and population density of plant*

NEMATODE SPECIES	LOCATIONS					
	Chandmani Tea Estate (300 ft. ASL)			Dagapur Tea Estate (350 ft. ASL.)		
	Frequency	Density	Prominence Value	Frequency	Density	Prominence Value
Helicotylenchus dihystera	0.718	192	162.775	0.68	165	152.554
Macroposthonia ornata	0.468	158	108.175	0.6	127	98.373
Pratylenchus loosi	0.875	67	62.672	0.84	55	50.408
Meloidogyne brevicauda	0.843	72	66.136	0.76	85	74.101
Helicotylenchus sp.	0.593	95	73.202	—	—	—
Paratylenchus lepidus	0.75	53	45.899	—	—	—
Pratylenchus brachyurus	0.468	48	32.863	0.56	32	23.946
Aphelenchoides sp.	0.531	23	16.763	—	—	—
Hemicriconemoides cocophilus	0.375	38	23.270	0.32	46	26.021
Aphelenchus avenae	0.281	34	18.031	0.48	39	27.019
Macroposthonia onoensis	—	—	—	—	—	—
Tylenchus (sensu stricto) sp.	0.343	19	11.139	0.28	28	14.816
Helicotylenchus erythrinae	0.312	35	19.565	0.24	27	13.227
Hemicriconemoides mangiferae	—	—	—	—	—	—
Paratylenchus dianthus	—	—	—	0.72	48	40.729
Xiphinema sp.	0.156	8	3.162	0.32	15	8.485
Coslenchus sp.	0.218	15	7.015	—	—	—
Atlantadorus porosus	—	—	—	—	—	—
Aglenchus agricola	—	—	—	—	—	—

Tista Bazar Tea Garden (3000 ft. ASL.)			Happy Valley Tea Garden (6000 ft. ASL.)			Lebong Tea Garden (6500 ft. ASL.)		
Frequency	Density	Prominence Value	Frequency	Density	Prominence Value	Frequency	Density	Prominence Value
0.60	92	71.262	0.642	145	116.258	0.666	87	71.035
0.50	95	67.175	0.464	87	59.28	0.466	135	92.222
0.90	58	55.023	0.928	74	71.308	0.866	70	65.166
0.70	24	20.079	0.821	105	95.164	—	—	—
0.65	38	30.636	0.571	46	34.772	0.40	62	39.212
0.75	48	41.569	0.714	63	53.244	0.733	45	38.535
—	—	—	0.392	53	33.219	—	—	—
0.75	27	23.382	0.678	34	28.007	0.533	17	12.415
—	—	—	—	—	—	—	—	—
0.40	21	13.281	—	—	—	0.466	29	19.81
—	—	—	0.428	36	23.567	0.533	33	24.099
—	—	—	0.428	32	20.948	—	—	—
—	—	—	—	—	—	—	—	—
0.45	19	12.745	0.535	23	16.834	—	—	—
—	—	—	—	—	—	—	—	—
0.30	18	9.859	0.071	12	3.207	—	—	—
0.30	9	4.929	0.178	13	5.493	0.266	12	6.196
—	—	—	0.214	13	6.017	—	—	—
—	—	—	0.285	7	3.741	0.4	19	12.016

were also very prominent. The presence of discrete lesions on the feeder roots indicated parasitic involvement of *Pratylenchus* spp.

Large numbers of *Meloidogyne* larvae were present in all the plantations, except Lebong which was at the highest elevation. The characteristic root-knots and sedentary females of *M. brevicauda* were observed.

It was evident that the distribution of some species of nematodes was dependent on altitude while the distribution of others was more ubiquitous.

Table I enumerates all the species in the descending order of their prominence values. *H. dihystera* ranked first in mean population density/site and prominence value, although it was less frequent as compared to other nematode species, indicating the significance of prominence value (Beals, 1960) in determining the parasitic importance of nematodes in a diverse community. In terms of the number of species, the Happy-Valley Tea Garden (6,000 ft. ASL) was the most diverse. The Lebong garden (6,500 ft. ASL) is the least diverse with only ten nematode species. Biomass was not included as a measure of diversity as this may not show clear trends (Norton and Schmitt, 1978). Table II shows the importance of different species and the structure of the community at different locations. In analysing a nematode community, measurement of prominence values and diversity may offer a clearer understanding of the ecological situation as suggested by Norton (1978).

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SUMMARY

Analysis of 120 soil and root samples collected from five widely distributed but heavily declining tea estates and plantations in Darjeeling District, West Bengal showed the presence of nineteen species of plant parasitic nematodes within thirteen genera of which sixteen were hitherto unknown in West Bengal. Previously only four species were recorded from tea in West Bengal. *Pratylenchus loosi, Helicotylenchus erythrinae, Paratylenchus lepidus, Atlantadorus porosus, Aglenchus agricola* and *Coslenchus* sp. have been found to be associated with tea for the first time from India and the last three are first records for

association with tea. Intensity of nematode infestation was analysed by frequency, population density and prominence values of each nematode species for the entire region and at different locations. Nematode densities varied greatly among plantations (10 to 950 nematodes per 250 ml soil). Distribution of a few nematodes was dependent on altitude, while most others were ubiquitous. *Helicotylenchus dihystera, Macroposthonia ornata, Pratylenchus loosi, Meloidogyne brevicauda, Helicotylenchus* sp. and *Paratylenchus lepidus* were prominent in descending order.

LITERATURE CITED

BAQRI Q. H., 1978, Nematodes from West Bengal (India). VI Species of Criconematoidea (Tylenchida). *Indian J. Nematol., 8*: 116-121.

BEALS E., 1960. Forest bird communities in the Apostle Islands of Wisconsin. *Wilson Bull., 72*: 156-181.

GOWEN S. R., and EDMUNDS J. E., 1973. An evaluation of some simple extraction techniques and use of hydrogen peroxide for estimating nematode populations in banana. *Pl. Dis. Reptr., 57*: 678-681.

KHERA S., and CHATURVEDI Y., 1977. Nematodes from tea plantations of Dehra Dun, India. *Rec. Zool. Surv. India, 72*: 125-152.

NORTON D. C., 1978. Ecology of Plant Parasitic Nematodes. John Wiley & Sons, New York, 268 pp.

NORTON D. C., and SCHMITT D. P., 1978. Community analyses of plant-parasitic Nematodes in the Kalsow Prairie, Iowa. *J. Nematol., 10*: 171-176.

SCHINDLER A. F., 1961. A simple substitute for a Baermann funnel. *Pl. Dis. Reptr., 45*: 747-748.

SIVAPALAN P., 1972. Nematode pests of tea IN: Economic Nematology, Ed. J. M. Webster. Academic Press, London, New York, pp. 285-311.

TAYLOR A. L., DROPKIN V. H., and MARTIN G. C., 1955. Perineal patterns of root-knot nematodes. *Phytopathology, 45*: 26-34.

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