



Research Article

DISTRIBUTION OF POTATO CYST NEMATODES, *GLOBODERA ROSTOCHIENSIS* AND *G. PALLIDA* IN POTATO GROWING AREAS OF TAMIL NADU

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Abstract: The random survey was conducted during autumn season in the Nilgiris and Dindigul districts of Tamil Nadu to assess the occurrence and distribution of potato cyst nematodes, *Globodera rostochiensis* and *G. pallida* on potato. Four blocks of the Nilgiris district, Udhagamandalam, Kotagiri, Coonoor and Gudalur comprised of 44 revenue villages were surveyed. In Dindigul district 15 villages at Kodaikanal block were selected for survey. The total of 1009 soil samples were collected from potato cultivar Kufri Jyoti infested by potato cyst nematodes. The survey results showed that, out of 59 villages the severe infestation of cyst population was observed in Doddabetta (734 cysts/200cc) followed by Sholur (646 cysts/200cc) and Solada (624 cysts/200cc). The cyst population ranged from 0 - 734 cysts /200 cc of soil in the Nilgiris district and 0- 645cysts/ 200 cc of soil in Dindigul district. Hence, the results showed that 88.06 and 86.66 % of potato fields in the Nilgiris and Kodaikanal hills were infested with potato cyst nematodes and no occurrence was recorded at Poondi in Kodaikanal block and Kunthasapai and Pudiyanjiin Udhagamandalam and Kotagiri block respectively.

Keywords: Survey, Potato Cyst Nematode (PCN), *G. Rostochiensis*, *G. Pallida*, Cyst Population

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Introduction

Potato (*Solanum tuberosum* L.) is an important commercial vegetable crop widely grown in more than 100 countries. It is a temperate and high yielding short duration crop. In potato production, the major constraints in potato production are nematodes, insects and diseases which accounts for nearly 37% yield loss throughout the globe, of which 23% yield loss is caused by nematodes and diseases [1] root knot nematodes (*Meloidogyne* spp.) and cyst nematodes (*Globodera* spp.) are major pests, especially in India. Several nematode species are found associated with potato, some of which cause significant yield losses and while others may cause minor injuries of local importance. The major nematode species associated with potato includes the yellow potato cyst nematodes, *Globodera rostochiensis* (Woolen Webber, 1923) and the white potato cyst nematode *G. Pallida* (Stone, 1973), these two nematode species found in temperate regions where potato is cultivated has gained worldwide significance and causes 65% yield loss in potato [2]. These two species viz., *G. Pallida* were prevalent in 25 countries and the *G. rostochiensis* reported from about 57 countries [3] and British Columbia [4]. First record of potato cyst nematode *Globodera rostochiensis* in Indonesia [5] and Australia [6]. In India, the potato cyst nematodes was first reported by F. G. W. Jones [7] who detected cysts from the roots of potato plants which exhibited the symptoms of yellowing of leaves from a field at Vijayanagaram farm, Ooty. This resulted in establishment of Nematological Unit in the Tamil Nadu and initiated an Indo-German collaborative programme of intensive chemical application in the infested area to avoid further spread. The potential damage of this nematode to potato cultivation amended the Destructive Insect Pest Act 1919 by the Tamil Nadu Government in 1971 to ensure strict check on potato for marketing from infested fields. At the same time, Quarantine was enforced in the state prohibiting movement of potatoes from the infested

areas to any other parts of the state or Union Territories of India. However, in the present scenario, the nematodes were found to occur in the neighbouring states, Karnataka [3] and Kerala [8] and Delhi [9] and Himachal Pradesh (Shimla) [10] of northern states. Hence, the survey work was carried out to study the occurrence and distribution of potato cyst nematodes, *G. rostochiensis* and *G. Pallida* in potato growing hilly areas of Tamil Nadu.

Materials and Methods

Field survey

The random survey was conducted during autumn season (August – November) 2017-2018 in 44 revenue villages at four blocks of the Nilgiris district and 15 villages at Kodaikanal block of Dindigul district of Tamil Nadu for the occurrence of *G. rostochiensis* and *G. Pallida* on potato. The total of 1009 soil samples were collected from 508 potato fields. The soil samples were collected at a depth of 15-30cm from the rhizosphere, after that the soil samples were shade dried for the extraction of cysts.

Estimation of cyst population from soil sample

Soil samples collected from five plants were pooled to form a composite sample of 2 kg. From the composite sample, a sub sample of 200 cc was used for cyst extraction. The dry soil samples were processed by Fenwick can method [11]. The 60 mesh (250 µm) sieve was used to collect the residue from Fenwick can apparatus and residue was passed through filter paper fitted over a funnel. Then the Petri plate containing filter papers samples were dried and labelled. The cysts were easily separated by Acetone or Acetone: Carbon Tetrachloride method [12] and counted under astereozoom microscope at 40x magnification.

Estimation of cyst population from root sample

Grainger's Test

Five plants from each field were uprooted, observed for the presence of golden or white coloured adult females and counted per 2.5 cm (linear inch) root length. Based on counting of no. of females (or) cyst per inch length potato root, Index for Potato cyst nematodes infestation was given as per Grainger's test [13].

Table-1 Grainger's Test Index for potato cyst nematodes

No. of females per linear inch root	Grade
None	1
1	2
5	3
>10	4

Results and Discussion

The survey results showed that, out of 59 villages the severe infestation of cyst population was observed in Doddabetta (734 cysts/200cc) followed by Sholur (646 cysts/200cc) and Solada (624 cysts/200cc). The cyst population ranged from 0 - 734/ cysts 200 cc of soil in the Nilgiris district and 0- 645 cysts/ 200 cc of soil in Dindigul district (Table 2 and Fig 1). The mean population of potato cyst nematodes in Udhagamandalam (72.43) and Gudalur (108.60) blocks shown higher population than Coonoor and Kotagiri blocks of the Nilgiris. In Udhagamandalam the maximum population of *Globodera* spp. was recorded in Doddabetta (60-734 cysts/200cc) followed by Cole grain (50-315 cysts/200cc) and Nanjanadu (40-629 cysts/200cc) and the minimum population was recorded Wood house and Melkodappamund as 0-18 and 0-24 cysts /200cc respectively in 265 fields. In Gudalur block the two villages (Sholur and Solada) showed maximum population range of 50-700 cysts/200cc soil in 26 fields. In Coonoor block the least population was observed in Ketti at the range of 0-47 cysts/200cc soil out of 32 fields and the highest population range was recorded in Kollimalai and Aravangadu as 15-173 and 08-104 cysts/200cc soil respectively. Out of 4 villages comprising 44 fields in Kotagiri block the maximum population range of 10-118 cysts/200cc soil was recorded in Yuilatti and the minimum population range of 0-34 cysts/200cc soil were observed in Kettikampai and Kookaldurai. Hence, the results showed that 88.06 % of potato fields in the Nilgiris hills were infested with potato cyst nematodes and no occurrence was recorded at Kunthasapai and Pudiyangii in Udhagamandalam and Kotagiri blocks respectively. These results were similar to the observations made by [10] as the population range of *G. rostochiensis* and *G. Pallida* in Shimla were 58-549 cysts /100 cc soil and the possible reason for very high populations in that the samples were taken immediately after the harvest. Followed by [14] recorded the presence of *Globodera* spp. as mixed population in the Nilgiris district. These results coincide with the observations made by [15] as the potato cyst nematodes showed wide spread occurrence in all the potato growing areas to an extent of 3050 ha of the Nilgiris district during 1964 to 1976 and was confirmed with the subsequent survey made under ICAR Adhoc scheme during 1988 to 1993. Additionally [16] reported that there was an increase in the incidence of potato cyst nematodes comprising the species of *G. rostochiensis* and *G. Pallida* and it was worked out as 74, 72 and 71% in Udhagamandalam, Coonoor and Kotagiri blocks respectively in the Nilgiris district. In Dindigul district the survey in Kodaikanal block covering 15 villages showed the maximum population range at Mattupatti (54-594cysts/200cc soil), Attuvampatti (75-645cysts/200cc soil) and Perumpallam (62-582cysts/200cc soil). The population range from 15-100 cysts/200cc soil were seen in Mannavanur, Kavunji, Shenbaganur, Villpatty, Pallangi. The least population ranged from 0-56cysts/200cc soil was recorded in Kaikkatti, Chellapuram, Bambarpuaram and Naidupuram (Fig 2). Hence, the results showed that 86.66 % of potato fields in Kodaikanal hills covering 135 fields were infested with potato cyst nematodes and no occurrence was recorded at Poondi. Similarly the findings by [17] reported that 36% of potato fields in Kodaikanal hill were infested with potato cyst nematodes. The mixed populations of *G. rostochiensis* and *G. Pallida* were common in all nematode infested fields. The results incurred from the Grainger's test for potato cyst nematodes infestation in the Nilgiris district viz., Udhagamandalam (2.33 grade), Gudalur (3.47 grade), Coonoor (1.94 grade) and Kotagiri blocks (1.79 grade) and Kodaikanal block (2.32 grade) in Dindigul district. The minimum range of 0-5 no. of females per 2.5 cm root was observed in 24 villages, 1-10 no. of

females per 2.5 cm root in 4 villages Santhoor, Cole grain, Thummanatti and Muthurai and the maximum females range was observed in Doddabetta, Nanjanadu, Bagulatti and Mullikorai as 5-15, 5-12, 0-12 and 3-12 no. of females per 2.5 cm root respectively in the Nilgiris district. In Dindigul district Kodaikanal block showed maximum female population range of 1-10 no. of females per 2.5 cm root in 6 villages. The minimum range of 0-5 no. of females per 2.5 cm root were recorded in 5 villages followed by 0-8 no. of females per 2.5 cm root in Vazhaikkattuodai and 1-6 no. of females per 2.5 cm root in Shenbaganur. As per the survey report of [18] the interest of potato cyst nematodes infestation was ranged from 2.6 to 2.7 grade as per Grainger's test in the Nilgiris district. Based on present findings, it has been revealed that urgent management strategy has to be imparted to control the prevalence of potato cyst nematodes by formulating quarantine regulations.

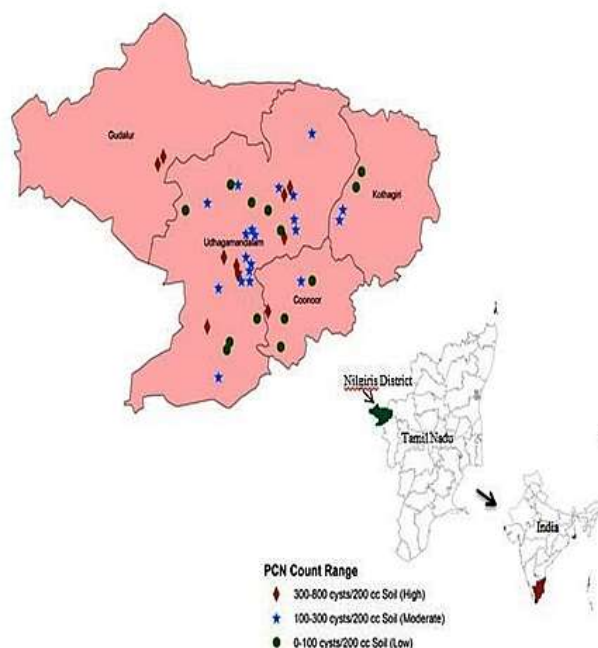


Fig-1 Intensity of Potato Cyst Nematodes, *Globodera* spp. in Nilgiris Hills

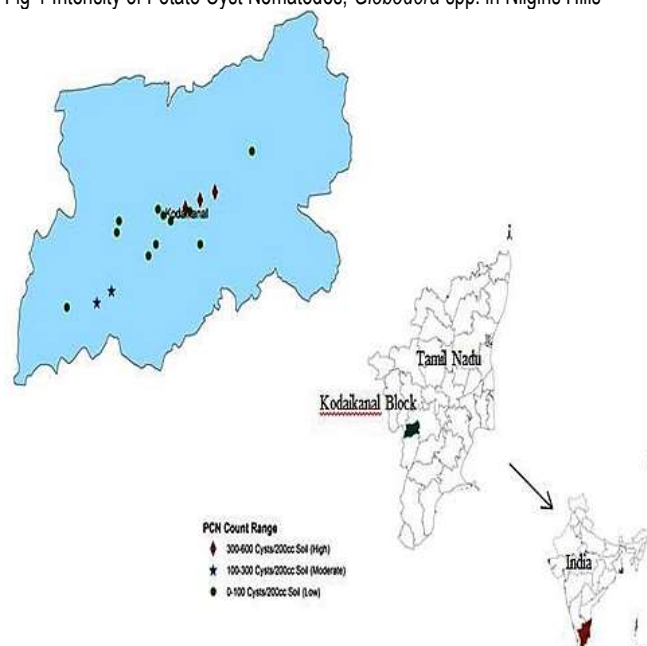


Fig-2 Intensity of Potato Cyst Nematodes, *Globodera* spp. in Kodaikanal Hills

Application of research: Study of current status of potato cyst nematodes, *Globodera* spp. in potato growing hilly areas of Tamil Nadu

Research Category: Nematology

Table-2 Occurrence of potato cyst nematodes, *Globodera* spp. in potato growing hilly areas of Tamil Nadu

District	Block	Village	Area (ha)	No. of fields surveyed	Total no. of samples collected	Cysts/200 cc soil		Grainger's Test		
						Range	Mean	Range	Mean	Grade
Nilgiris	Udhagamandalam	Doddabetta	5	9	25	60-734	205.24	May-15	9.33	3.73
Nilgiris	Udhagamandalam	Thummanatti	3	5	11	50-554	152.55	01-Oct	8.4	3.53
Nilgiris	Udhagamandalam	Mullikorai	6	8	19	60-414	108.32	03-Dec	7.36	3.25
Nilgiris	Udhagamandalam	Kappadhurai	3	6	15	25-286	102.27	05-Sep	7.25	3
Nilgiris	Udhagamandalam	Melkodappamund	2	8	15	0-24	32.67	01-May	3.58	2.25
Nilgiris	Udhagamandalam	Kilkodappamund	2	9	16	0-36	34.31	0-5	2.5	2.22
Nilgiris	Udhagamandalam	Thalayathimund	5	11	24	0-43	32.08	01-May	3.5	2.12
Nilgiris	Udhagamandalam	Nanjanadu	9	13	25	40-629	175.33	05-Dec	5.16	3.62
Nilgiris	Udhagamandalam	Kuruthukuli	5	9	20	20-291	97.55	01-May	2	2.62
Nilgiris	Udhagamandalam	Adasolai	4	10	22	0-65	45.47	01-May	3.71	2.24
Nilgiris	Udhagamandalam	Vally view	2	6	7	0-86	31.52	0-5	2.12	2.13
Nilgiris	Udhagamandalam	Agalar	4	10	22	68-200	75.65	0-8	4.23	2.46
Nilgiris	Udhagamandalam	Bagulatti	8	12	25	62-424	97.81	0-12	5.1	3.58
Nilgiris	Udhagamandalam	M. pallada	5	8	20	12-283	84.83	01-Sep	2.46	3.21
Nilgiris	Udhagamandalam	Thuneri	2	5	10	0-59	26.5	01-Aug	4.86	2.14
Nilgiris	Udhagamandalam	Shanthoor	5	12	25	20-276	89.25	01-Oct	5.1	3.16
Nilgiris	Udhagamandalam	Wood house	0.25	2	5	0-18	14.4	0-4	0.35	1.3
Nilgiris	Udhagamandalam	Muthorai	5	12	26	30-686	101.57	01-Sep	6.52	3.01
Nilgiris	Udhagamandalam	Semanthada	4	12	24	32-445	74.91	01-May	3.21	2.5
Nilgiris	Udhagamandalam	Pudhumundu	5	15	25	16-229	84.53	01-Jun	2.15	2.52
Nilgiris	Udhagamandalam	Moradakkombai	3	6	15	0-76	65.95	0-5	3.65	1.78
Nilgiris	Udhagamandalam	Anikorai	2	6	15	Nov-64	27.65	0-5	0.58	1.52
Nilgiris	Udhagamandalam	Cole grain	1	4	12	50-315	105.42	01-Oct	8.52	3.68
Nilgiris	Udhagamandalam	Thampatti	8	10	22	18-46	23.43	0-5	1.52	1.96
Nilgiris	Udhagamandalam	Butter kampai	3	11	22	20-278	57.63	0-5	2.56	1.21
Nilgiris	Udhagamandalam	Kunthasapai	3	5	12	-	-	-	-	-
Nilgiris	Udhagamandalam	Kukkal	2	5	10	18-234	54.63	0-5	3.15	1.65
Nilgiris	Udhagamandalam	HPF	2	5	12	12-228	56.23	0-5	3.42	1.64
Nilgiris	Udhagamandalam	Kakkathoppu	2	5	10	16-237	48.75	0-5	2.85	1.52
Nilgiris	Udhagamandalam	Kallakorai	1	3	8	0-168	44.63	0-5	3.45	1.9
Nilgiris	Udhagamandalam	Appukodu	2	4	10	0-118	47.65	0-5	2.75	1.26
Nilgiris	Udhagamandalam	Kendharai	4	7	15	15-156	54.71	0-5	2.56	1.28
Nilgiris	Udhagamandalam	Minikkumanthu	5	12	25	0-197	64.46	0-8	6.5	2.57
Nilgiris	Coonoor	Aravangadu	3	8	18	08-104	36.47	0-5	3.25	1.3
Nilgiris	Coonoor	Ketti	2	6	13	0-47	25.43	0-5	0.42	1.5
Nilgiris	Coonoor	Kollimalai	4	8	17	15-173	42.15	0-10	6.54	2.46
Nilgiris	Coonoor	Kettipallada	2	5	10	Dec-51	17.65	0-5	0.45	2.5
Nilgiris	Coonoor	Jegathala	2	5	10	Oct-68	16.25	0-5	0.28	1.92
Nilgiris	Gudalur	Sholur	7	12	25	58-646	111.53	May-15	9.5	3.41
Nilgiris	Gudalur	Solada	5	14	25	52-624	105.67	May-15	9.32	3.53
Nilgiris	Kotagiri	Kookalthurai	15	12	25	0-34	15.21	0-5	0.25	2.25
Nilgiris	Kotagiri	Pudiyangii	8	12	25	-	-	-	-	-
Nilgiris	Kotagiri	Yuilatti	10	12	25	10-118	51.67	0-5	3.54	1.57
Nilgiris	Kotagiri	Ketikampai	7	8	20	0-26	21.46	0-5	0.03	1.38
Dindigul	Kodaikanal	Poombarai	12	10	22	16-127	51.27	01-Oct	4.63	2.68
Dindigul	Kodaikanal	Kaikkatti	5	10	22	0-34	24.19	0-5	3.15	1.53
Dindigul	Kodaikanal	Bambarpuaram	3	7	15	0-42	27.67	0-5	0.95	1.67
Dindigul	Kodaikanal	Chellapuram	7	5	10	0-56	30.15	0-5	0.18	1.56
Dindigul	Kodaikanal	Mannavanur	10	8	20	25-100	61.45	01-Oct	4.25	2.5
Dindigul	Kodaikanal	Kavunji	15	10	25	16-94	59.45	01-Oct	5.68	2.25
Dindigul	Kodaikanal	Poondi	2	5	10	-	-	-	-	-
Dindigul	Kodaikanal	Shenbaganur	3	5	10	19-86	25.85	01-Jun	3.5	2.42
Dindigul	Kodaikanal	Villpatty	10	15	10	15-56	35.67	0-5	2	1.53
Dindigul	Kodaikanal	Attuvampatti	10	15	20	75-645	106.45	01-Oct	8.1	3.57
Dindigul	Kodaikanal	Mattupatti	6	15	20	54-594	101.56	01-Oct	7.96	3.53
Dindigul	Kodaikanal	Perumpallam	7	15	20	62-582	85.65	01-Oct	8.65	3.28
Dindigul	Kodaikanal	Naidupuram	3	6	15	0-28	13.13	0-5	2.1	1.2
Dindigul	Kodaikanal	Pallangi	4	4	10	28-97	23.65	01-Jun	2.5	2.25
Dindigul	Kodaikanal	Vazhaikkatuodai	3	5	10	18-73	21.15	0-8	3.35	2.64

Abbreviations: cc: Cubic Centimetres, cm: Centimetre

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Author statement: All authors read, reviewed, agreed and approved the final manuscript. Note-All authors agreed that- Written informed consent was obtained from all participants prior to publish / enrolment

***Chairperson of research: Dr A. Shanthi**

University: Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu 641003

Research project name or number: Ph. D. Thesis

Study area / Sample Collection: Nilgiris district and 15 villages at Kodaikanal block of Dindigul district of Tamil Nadu

Cultivar / Variety name: Potato (*Solanum tuberosum*) Kufri Jyoti

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.

Ethical Committee Approval Number: Nil

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