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Roving Survey for Root-Knot Nematode in Major Sweet Potato Growing Districts of Karnataka, India

H. Amaresh^{1*}, V. Kantharaju¹, S. Amruta Bhat¹,
K. Ramachandra Naik¹ and Y. S. Mahesh²

¹K. R. C. College of Horticulture, Arabhavi- 591218, Karnataka, India

²College of Horticulture, Bagalkot- 587104, Karnataka, India

*Corresponding author

ABSTRACT

Sweet potato, *Ipomoea batatas* (L.) Lam., is a dicotyledous plant that belongs to the family Convolvulaceae. A number of plant parasitic nematodes have been reported to be associated with sweet potato in India and among the species identified, *Meloidogyne incognita* is one of the economically important nematode which makes the way for the secondary infection by different pathogens like *Pythium*, *Fusarium* and *Ralstonia* in the soil. A roving survey was conducted for incidence of root-knot nematode in sweet potato during *kharif* season in 2018-2019 at Bidar, Bagalkot, Vijayapura, Belagavi, Dharwad and Chikkamagaluru districts of Karnataka. Survey conducted in eight taluks comprising of 38 fields, the major symptoms recorded during survey are having root galls, yellowing, marginal and tip drying of leaves and galling and rotting of roots. The results revealed that highest root-gall index was recorded in Belagavi followed by Dharwad, Bagalkot, Bidar, Mudigere districts. The lowest incidence was observed in Vijayapura.

Keywords

Social, economic,
Drying, Galling,
Rotting, Explorers,
traders

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Introduction

Sweet potato, *Ipomoea batatas* (L.) Lam., is a dicotyledous plant that belongs to the family Convolvulaceae. It is originated from Central America and the North Western part of South America from where it was introduced to Europe by Columbus and to Asia, Africa and

North America by Spanish and Portuguese explorers and traders. It is an herbaceous perennial crop with edible tuberous root that is usually long and tapered, with a smooth skin whose colour ranges between red, purple, brown and white. It can be cultivated throughout the tropical and warm temperature region wherever there is sufficient water to

support their growth. It is a vegetable crop with great social, economic and nourishing importance, especially for the poorest regions of the planet, where it is one of the most important food sources (Oliveira *et al.*, 2005).

Sweet potato is a perennial vine, usually cultivated as an annual crop. Its storage roots are rich in energy and are an important source of carbohydrates, vitamin A and C, fiber, iron, copper, calcium and folic acid, especially the orange-fleshed sweet potatoes (Collins *et al.*, 1999).

Sweet potato is mainly grown in China, Nigeria, Tanzania, Ethiopia and Indonesia. The crop is grown in all states of India, except Jammu and Kashmir, Himachal Pradesh and Sikkim. It can be grown in different environments and it became an excellent supplement to staple foods. In India, it is grown in an area of 1.39 lakh hectares with a production of 16.38 lakh tonnes having productivity of 12.2 MT per hectare.

In India, it is mainly grown in Odisha, Kerala, West Bengal, Uttar Pradesh, Chattisgarh, Assam and Maharashtra. In Karnataka, it is cultivated in an area of 2.54 thousand hectares with a production of 36 thousand tonnes. The major sweet potato producing districts of the state are Belagavi, Mandya, Dakshina Kannada and Chikmagalur (Anon, 2017).

A number of plant parasitic nematodes have been reported to be associated with sweet potato in India and among the species identified, *Rotylenchus reniformis*, *Helicotylenchus dihystra* and *Meloidogyne incognita* are the one which are economically important (Ramakrishnan and Mohandas, 1996).

A survey is necessary to assess the community structure of plant parasitic nematodes associated with sweet potato. Many biotic and

abiotic factors such as soil temperature, soil moisture, soil type, cultural practices, weed hosts and intercropping are known to influence nematode distribution. The survey on root-knot nematode will provide information on incidence, severity and distribution.

Materials and Methods

A roving (random) survey for plant parasitic nematodes associated with sweet potato was taken up during *Kharif /Rabi* season in 2018-19 at Bidar, Bagalkot, Vijayapura, Belagavi, Dharwad and Chikkamagaluru districts of Karnataka (Fig. 1). The sampling was done in plants showing nematode symptoms *viz.*, yellowing, poor growth or stunted growth with reduced leaf size, chlorosis of foliage, wilting and root galls.

Collection of soil and root samples

Soil and root system samples from 3 to 5 spots were collected randomly with the aid of shovel from the root zone of sweet potato crop. Later, a composite sample of 200cc soil and root system were put in a polythene bag with proper labeling. Information pertaining to the crop, locality, soil condition etc., was also collected along with the samples.

Estimation of nematode population in soil samples

Soil sample of 200 cc was washed thoroughly and processed using combined "Cobb's sieving and Baermann's funnel method" (Ayoub, 1977) as given below.

Two hundred cc of soil was taken in 1000 ml beaker and sufficient quantity of water was added to make soil solution.

This was stirred thoroughly and allowed to stand for heavier particles to settle down.

Then the soil solution was passed through a set of sieves of 100, 250, 325 and 400 mesh sizes, respectively. Residue from 325 and 400 mesh sieves were collected and poured over a tissue paper spread on a wire gauge and placed on Baermann's funnel.

Level of water in the Baermann's funnel was maintained to keep the tissue paper wet and left undisturbed for 48 hr. After incubation of 48 hr, the volume of suspension was made to 200 ml, out of which 10 ml was pipetted out and used for counting of various plant parasitic nematodes present. Nematode population from this was finally estimated for 200 cc soil.

Estimation of nematode population in root samples

Nematode population in 10 g roots was estimated by Root incubation method (Ayoub, 1977) as explained below:

Procedure

Roots were gently washed to remove adhering soil particles

Washed roots were cut into small bits of 2.5 cm and split longitudinally.

Then placed over tissue paper spread on a wire gauge and kept in a Petri plate filled with water.

Level of water was maintained in Petri plate and left undisturbed for 48 hours. Later, the suspension in the Petri plate was collected and observed for nematodes using stereo-binocular microscope.

Counting the number of nematodes

The number of nematodes in an aqueous suspension was determined by using a

counting dish. A five cm diameter glass Petri plate was used as a counting dish. Squares were made on the outer surface of the bottom of the dish to facilitate counting.

A 10 ml volume of aqueous suspension from the beaker was taken and placed into the petriplates. Nematodes were counted in all squares under a stereobinocular microscope. After counting, the suspension was transferred back to the mother container. Counting of each sample was repeated four times in same manner. The mean number of nematodes per 10 ml was determined by averaging the counts taken.

Results and Discussion

A roving survey was carried out to know the occurrence of plant parasitic nematodes in major sweet potato growing districts viz., Bidar, Bagalkot, Vijayapura, Belagavi, Dharwad and Chikkamagaluru during Kharif, 2018 and the data obtained are depicted in Table 1. The soil and root samples were collected from different places and brought to the laboratory for analysis. The presence of root-knot nematodes was assessed. In Belagavi district, the number of galls per root system was ranged from 10-32. Maximum number of galls (32) was recorded in Kenaye (1) field followed by Kenaye (2) field (31) and Mudekop (2) field (61). Minimum number of galls recorded in Navage (1) field (10) followed by Mudekop (1) field (18) and Hasanwadi (1) field (19).

The maximum gall index (4) was found in Kenaye (1 & 2) fields, against least gall index (2) from Navage (1) field and remaining fields recorded gall index of (3).

The nematode population per 200 cc soil was ranged from 61-88. The maximum soil nematode population (88) was recorded in Navage (2) field followed by Hasanwadi (2)

field (81) and Kenaye (2) field (80) as against minimum population in Mudekop (2) field (61) followed by Mudekop (1) field (69) and in Navage (1) field (70).

On an average, the number of galls per root system was 21.50, gall index of 3.10 and soil nematode population per 200 cc soil was of 74.25 recorded in Belagavi district.

In Bagalkot district, the number of galls per root system was ranged from 9-47 with the maximum of 47 in Mirji (1) field followed by Mirji (2) field (29) and Kesargoppa (1) field (28). The least number of galls was recorded in Mirji (3) field (9) and Kesargoppa (2) field (10).

The maximum gall index (4) was recorded in Mirji (1) followed by Kesargoppa (1, 3 & 4) fields (3) and minimum (2) in Kesargoppa (2) and Mirji (3) fields. Soil nematode population was ranged from 17–150. The maximum population (150) was recorded in Mirji (1) field followed by Kesargoppa (1) field (100) and Kesargoppa (2) field (87) whereas the least soil nematode population (17) was recorded in Mirji (3) field followed by Kesargoppa (3) field (38) and Mirji (2) field (46).

On an average, the number of galls per root system was 22.50, gall index of 2.87 and soil nematode population per 200 cc of soil was 65.25 recorded in Bagalkot district.

The results of the survey in Vijayapura district revealed that, the number of galls per root system was ranged from 0-34 with Bommanahalli (3) field was highest (34) followed by Bommanahalli (1) field (15). The least number of galls per root system was recorded in Bommanahalli (4) field (10) and zero galls were recorded in Bommanahalli (2) fields.

The range of gall index was 0-4 with highest in Bommanahalli (3) field (4) followed by Bommanahalli (1) field (3) as against least in Bommanahalli (2) field (0) and in Bommanahalli (4) field (2). The highest soil nematode population (200 cc) was observed in Bommanahalli (3) field (52) followed by Bommanahalli (4) field (42), as against minimum (38) from Bommanahalli (1) field and no population in Bommanahalli (2) field.

In Vijayapura district, on an average, the number of galls per root system was 14.75, gall index of 2.25 and soil nematode population of 33.00 was recorded.

In Dharwad district, the highest number of galls per root system was recorded in Dharwad (2) field (28) followed by Narendra (3) field (22) and Narendra (1) field (19). The least number of galls per root system was recorded in Dharwad (1) field (15). The highest gall index of 3 was recorded in Dharwad (1 & 2) and Narendra (1, 2 & 3) fields.

Table.1 Incidence of root-knot nematode was recorded by using the gall index given by (Taylor and Sasser, 1978) which is as follows

Description	Grade
No galls or egg masses	0
1 to 2 galls or egg masses	1
3 to 10 galls or egg masses	2
11 to 30 galls or egg masses	3
31 to 100 galls or egg masses	4
More than 100 galls or egg masses	5

Table.2 Roving survey of root-knot nematode in major sweet potato growing districts of Karnataka

District	Taluk	Sample number	Village	Variety	Season	Soil type	No. of galls/root system	Gall Index	Nematode population in soil (200cc)
Belagavi	Khanapur	01	Mudekop -1	BSP-23	<i>Kharif</i>	Red sandyloam	18	3	69
		02	Mudekop -2	BSP-23	<i>Kharif</i>	Red sandyloam	25	3	61
		03	Hasanwadi -1	BSP-23	<i>Kharif</i>	Red sandyloam	19	3	72
		04	Hasanwadi-2	BSP-23	<i>Kharif</i>	Red sandyloam	22	3	81
	Belagavi	05	Navage -1	BSP-23	<i>Kharif</i>	Red sandyloam	10	2	70
		06	Navage -2	BSP-23	<i>Kharif</i>	Red sandyloam	19	3	88
		07	Kenaye -1	BSP-23	<i>Kharif</i>	Red sandyloam	32	4	73
		08	Kenaye -2	BSP-23	<i>Kharif</i>	Red sandyloam	31	4	80
Total							173	25	594
Average							21.5	3.10	74.25
Bagalkot	Rabakavi banahatti	09	Kesargoppa-1	BSP-23	<i>Kharif</i>	Black soil	28	3	100
		10	Kesargoppa-2	BSP-23	<i>Kharif</i>	Black soil	10	2	87
		11	Kesargoppa-3	BSP-23	<i>Kharif</i>	Black soil	16	3	38
		12	Kesargoppa-4	BSP-23	<i>Kharif</i>	Black soil	22	3	84
	Mudhol	13	Mirji-1	BSP-23	<i>Kharif</i>	Black soil	47	4	150
		14	Mirji-2	BSP-23	<i>Kharif</i>	Black soil	29	3	46
		15	Mirji-3	BSP-23	<i>Kharif</i>	Black soil	09	2	17
		16	Mirji-4	BSP-23	<i>Kharif</i>	Black soil	19	3	55
Total							180	23	522
Average							22.50	2.87	65.25

Contd.....

District	Taluk	Sample number	Village	Variety	Season	Soil type	No.of galls/ro ot system	Gall Index	Nematode population in soil (200 cc)
Vijayapura	Sindagi	17	Bommanahalli-1	Local	<i>Kharif</i>	Black soil	15	3	38
		18	Bommanahalli-2	Local	<i>Kharif</i>	Black soil	00	0	00
		19	Bommanahalli-3	Local	<i>Kharif</i>	Black soil	34	4	52
		20	Bommanahalli-4	Local	<i>Kharif</i>	Black soil	10	2	42
Total							59	9	132
Average							14.75	2.25	33.00
Dharwad	Dharwad	21	Dharwad-1	Local	<i>Kharif</i>	Red sandy loam	15	3	59
		22	Dharwad-2	Local	<i>Kharif</i>	Red sandyloam	28	3	45
		23	Narendra -1	Local	<i>Kharif</i>	Red sandyloam	19	3	62
		24	Narendra -2	Local	<i>Kharif</i>	Red sandyloam	19	3	68
		25	Narendra -3	Local	<i>Kharif</i>	Red sandyloam	22	3	89
Total							103	15	323
Average							20.60	3	64.60

Contd...

Bidar	Basavakalyan	26	Tadola -1	Local	<i>Kharif</i>	Red sandyloam	30	3	39
		27	Tadola -2	Local	<i>Kharif</i>	Red sandyloam	20	3	60
		28	Tadola -3	Local	<i>Kharif</i>	Red sandyloam	29	3	33
		29	Rajola-1	Local	<i>Kharif</i>	Red sandyloam	09	2	45
		30	Rajola-2	Local	<i>Kharif</i>	Red sandyloam	22	3	61
		31	Rajola-3	Local	<i>Kharif</i>	Red sandyloam	07	2	38
Total							122	16	276
Average							20.33	2.66	46.00
Chikkamagaluru	Mudigere	32	Mudigere -1	Local	<i>Kharif</i>	Red sandyloam	09	2	42
		33	Mudigere -2	Local	<i>Kharif</i>	Red sandyloam	28	3	54
		34	Mudigere -3	Local	<i>Kharif</i>	Red sandyloam	21	3	31
Total							58	8	137
Average							19.30	2.60	42.33
Grand total							695.00	96.00	1984
Average							19.83	2.74	54.23

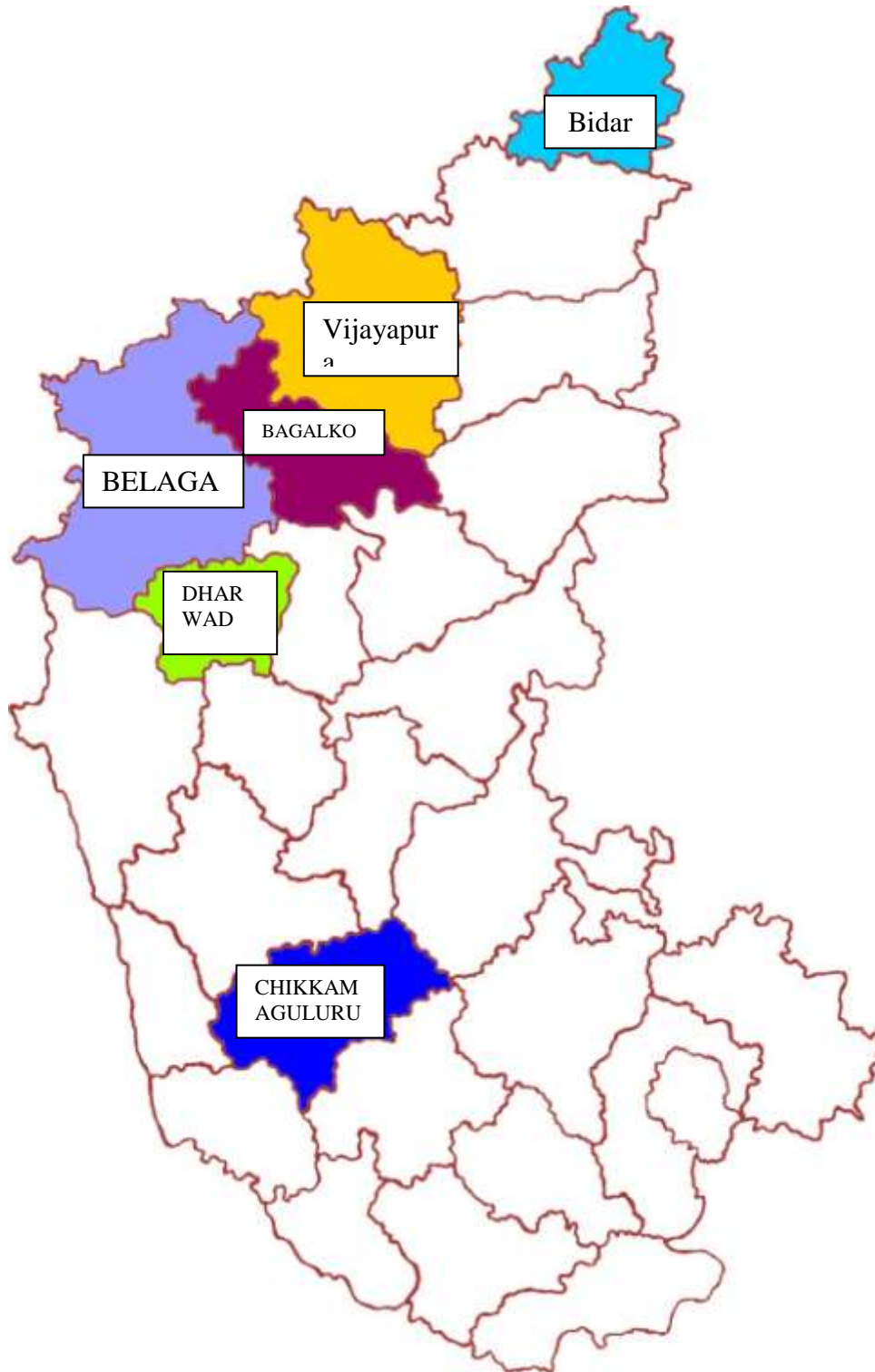


Fig.1 Roving survey for root-knot nematode incidence in major sweet potato growing districts of Karnataka

Maximum soil nematode population was recorded in Narendra (3) field (89) followed by Narendra (2) field (68) and Narendra (1) field (62). The minimum population was recorded in Dharwad (2) field (45) followed by Dharwad (2) field (59).

In Dharwad district, on an average, the number of galls per root system was 20.6 with the gall index of 3.0 and soil nematode population of 64.60 was recorded (Table 2).

The results of the survey in Bidar district revealed that, the number of galls per root system was ranged from 7-30 with highest in Tadola (1) field (30) followed by Tadola (3) field (29) and Rajola (2) field (22). The least number of galls per root system (07) was recorded in Rajola (3) field followed by Rajola (1) field (9). The maximum gall index of (3) was recorded in Tadola (1, 2 & 3) and Rajola (2) fields and minimum (2) in Rajola (1) and Rajola (3) fields.

The highest soil nematode population was observed in Rajola (2) field (61) followed by Tadola (2) field (60) and Rajola (1) field (45). The minimum population of 33 was recorded from Tadola (3) field followed by Tadola (1) field (39). In Bidar district, on an average, the number of galls per root system was 20.33, gall index of 2.66 and soil nematode population of 46.00 was recorded.

In Chikkamagaluru district, the number of galls per root system was ranged from 9-28. Maximum number of galls (28) was recorded in Mudigere (2) field followed by Mudigere (3) field (21) and minimum numbers of galls were recorded in Mudigere (1) field (9). The maximum gall index (3) was found in Mudigere (2 & 3) and minimum gall index (2) in Mudigere (1) field.

The nematode population per 200 cc soil was ranged from 31-54. The maximum soil nematode population (54) was recorded in

Mudigere (2) field followed by Mudigere (1) field (42) as against minimum population (31) in Mudigere (3) field.

On an average, among all the six districts surveyed, the maximum number of galls per root system (22.50) was found in Bagalkot district followed by Belagavi (21.50), Dharwad (20.60), Bidar (20.33), Chikkamagaluru (19.83) and Vijayapura (14.75).

The average highest gall index of (3.10) was recorded in Belagavi district followed by Dharwad (3.0), Bagalkot (2.87), Bidar (2.66) and Chikkamagaluru (2.60) and Vijayapura (2.25).

The average highest soil nematode population (74.25) was seen in Belagavi district followed by Bagalkot (65.25), Dharwad (64.6), Bidar (46.00), Chikkamagaluru (42.33) and Vijayapura (33.00).

Present findings with respect to infestation of root-knot nematode in sweet potato growing fields are in conformity with the results of by Karuri *et al.*, (2016), Olabiyi *et al.*, (2002) and Iwahori *et al.*, (2002) who reported that *Meloidogyne* spp. was the most common in the area surveyed. Several other plant parasitic nematodes associated with sweet potato have also been reported *viz.*, *Rotylenchulus reniformis*, *Helicotylenchus dihystra*, *Hoplolaimus indicus*, *Tylenchorhynchus* spp. and *Xiphinema* spp. (Ramakrishnan and Mohandas, 1996).

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