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Survey for Root-Knot Nematode Infestation in Bean (*Phaseolus vulgaris* L.) Fields in Mysore District of Karnataka, India

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A B S T R A C T

Phaseolus vulgaris L. belongs to the family Fabaceae, and also known as Common bean or French bean. There are numerous plant parasitic nematodes have been reported to be associated with French bean in India among them, *Meloidogyne incognita* and *Meloidogyne javanica* are the most prevalent nematodes which makes the way for the secondary infection and disease complex with different pathogens like fungal and bacterial pathogens in the soil. A random survey was conducted for incidence of root-knot nematode in beans during September to December 2022 in Mysuru district of Karnataka state. Survey conducted in seven taluks comprising of twenty-three villages, the major symptoms recorded during survey are presence of root galls, yellowing, marginal and tip drying of leaves and galling and rotting of roots. The results revealed that, the mean root-knot index and mean egg mass index of French bean crops of Mysuru district ranged 3.69 and 3.56 respectively on a 0-5 disease rating scale. The overall mean soil nematode population per 200cc soil sample and mean root nematode population per 5g root sample of French bean crop ranged 722.60/200cc soil and 86.13/5g root respectively which is more than that of Economic thresh-hold level. If proper strategies are not adopted for their management, the French bean crops will result in higher economic loss. In order to mitigate the negative impact of nematodes in French bean production, there is the need for identity and promote the use of resistant cultivars along with these some integrated nematode management strategies has to be adopted.

Introduction

Phaseolus vulgaris L. commonly called French bean belongs to the family Fabaceae and it is also known by various names such as snap bean, kidney bean, garden bean or string bean. It is the most important leguminous vegetable grown for its tender fleshy pods, shelled green seeds, and also for dry beans (Praveenkumar *et al.*, 2012). French bean originated from Central America and South America, it spread to Europe during the Sixteenth century and it was introduced in India during the Seventeenth century

from Europe. Beans are important crops resulting in the production of 2,277 tons cultivated in 228 thousand hectares of area and the main states of India under the cultivation includes Himachal Pradesh, Punjab, Haryana, Uttar Pradesh, Gujarat, Madhya Pradesh, Maharashtra, Andhra Pradesh, Karnataka and Tamil Nādu. French bean is a nutritive vegetable contributing for human diet rich in protein, calcium, iron, fiber, potassium, magnesium and vitamin-c and it also has anti-diabetic properties and is good for the natural cure of bladder burns and cardiac problems, diarrhea and etc.

French beans are susceptible to fungal and bacterial pathogens and the most important diseases are Anthracnose, Powdery mildew, Bacterial brown spot, Bacterial wilt, etc. However, with the increase in the cultivation areas and the improvement in management tools, several phytosanitary problems have limited productivity in many regions. Between these problems plant parasitic nematodes are the one which is also a menace in bean cultivation.

Plant parasitic nematodes are the major pests of crop plants with global estimated loss of 125 billion per year (Chitwood, 2003). Most of these losses are attributed by Root-Knot Nematodes (*Meloidogyne* species) all over the world. Root-Knot Nematodes are obligate root parasites and very damaging Phyto-pathogens limiting agricultural productivity. About 2000 plants are susceptible to their infestation causing approximately 5% of global crop loss (Hussey and Jenssen, 2002). Most of the cultivated species of crop plants are susceptible to Root-Knot Nematode infestation (Sasser and Carter, 1985). Root-Knot Nematodes are the important pests that cause root dysfunction by generally reducing the volume of root and reduce the efficiency of nutrient and water uptake (Noling, 2005). Root-Knot Nematode is a major pest of French bean causing yield losses of up to 45-60 percent (Mullin *et al.,* 1991 and Kimenju *et al.,* 1999).

In the present study, attempts have been made to investigate the root-knot nematodes associated with French beans in and around Mysore by assessing the soil and root nematode population and intensity of the disease.

Materials and Methods

Survey and Sample collection

An intensive random survey was conducted during August – December 2022 in the Mysore district bean-growing regions. From each taluk of Mysore district, three to four villages and each in village four to six farmer fields were surveyed. Soil and root samples were collected from the rhizosphere of the infected bean plants. Samples from 6-7 spots were collected randomly representing the whole field. From this, composite samples, 200cc of soil, and 5g of roots were used as working samples for further studies. Each sample collected was filled in a polythene bag and tied with a rubber band and labeled immediately, and other information like the locality, date of collection, crop history, etc. were obtained along with the samples. Samples of soil and roots were placed in a refrigerator and analyzed on the next day of collection. The nematode populations from soil and root samples were estimated.

Root-Knot Index and Egg Mass Index

The galled root system and Egg mass index was scored by using a 0 to 5 disease rating scale given by Taylor and Sasser (1978).

Nematode Population Assessment

Estimation of Nematode population in Soil samples

From the collected samples, nematodes were extracted by following Cobb's sieving and decanting technique (Cobb's, 1918) followed by Modified Baermann's funnel method (Whitehead and Hemming, 1965). The dilution method was followed for counting root-knot nematodes. After incubation of 24 hours, the extracted Juvenile nematode

population was made up to a known volume and the suspension was bubbled through a pipette, out of which 5ml was transferred to a counting dish. The nematode numbers were counted by using a counting dish under a stereo binocular microscope. The nematode population from this was finally estimated for 200 cc of soil.

Estimation of Nematode population in Root samples

The nematode population in 5g of roots was estimated by the root incubation method (Ayoub, 1977). Roots were gently washed with tap water to get free of soil particles. Washed roots were cut into small pieces of 1.5 to 2.0 cm and these were placed over tissue paper spread on wire mesh and mounted on a Petri dish. The level of water was maintained in a Petri dish and left undisturbed for 24 hours, the content of the Petri dish was transferred into a beaker, diluted to a suitable volume and population counts were made with the help of counting dish and observed for nematodes by using a stereo binocular microscope. Based on the requirement the suspension was diluted with sterile water. Five aliquots were examined from each sample and the average population was calculated.

Identification of the Species

The species of *Meloidogyne* collected from each locality and maintained in the greenhouse was done by applying the perineal pattern method (Eisenback *et al.*, 1981). Mature females were dissected out from large galls on the roots of tomato plants. Perineal pattern slides from each sample or locality were prepared and examined under a microscope to study their characteristics. The species were identified based on perineal pattern characteristics (Eisenback *et al.*, 1981).

Results and Discussion

A random survey was carried out to know the occurrence of root-knot nematodes in bean (*Phaseolus vulgaris* L.) growing regions of the Mysuru district of Karnataka state viz., Mysuru, Tirumakudalu Narasipura (T. Narasipura), Nanjanagud, Heggadadevanakote (H. D. Kote), Hunsur, Piriyapatna and Krishnarajanagara (K. R. Nagara) taluks during August – December 2022. The soil and root samples collected from different places were brought to the laboratory for analysis.

The presence of plant-parasitic nematodes and the identification were done. Four plant-parasitic nematodes, namely *Meloidogyne incognita*, *Meloidogyne javanica*, *Pratylenchus* and *Rotylenchulus* belonging to different genera were found to be associated with Beans crop. Root-Knot Nematode, *Meloidogyne* species (*Meloidogyne incognita*) being the most prevalent nematode in all the locations surveyed.

Identification of Root-knot Nematode species

Meloidogyne incognita is one of the most ubiquitous species in the genus and has large host range. Galls produced by *M. incognita* are not the distinguishing factor for the species. Depending upon the population, development of galls take place, either it occurs or singly or if the population is high, many galls merge to form large and sometimes massive knots. Less number of secondary roots emerge from the galls which is observed in the results. Similar observations have been made by Sasser (1979).

Perineal pattern of females is the most important morphological character for distinguishing the *Meloidogyne* species (Kaur and Attri, 2013). Perineal pattern is oval to round, high with squarish dorsal arch and distinct lateral lines are absent and rounded to oval shaped, dorsal arch round to moderate in height and lateral lines were clearly visible which divided into dorsal and ventral sectors. Female perineal patterns of the root-knot nematodes population obtained in this study was typical *Meloidogyne incognita* and *Meloidogyne javanica* respectively.

In the Mysuru district of Karnataka state, out of 23 villages surveyed and from each village four to six

bean fields were visited and from each field surveyed four to six samples of soil and roots were collected and analysed for the nematode population per 200cc soil sample, and 5g root sample along with root-knot index and egg mass indices in the laboratory.

Root-Knot Index and Egg Mass Index

The maximum root-knot index (5) was observed in Mallahalli and Yelachanahalli villages of Mysuru district and Beguru and Krishnapura villages of H. D. Kote taluk and also the least root-knot index (2) was observed in Chunchanakatte and Hebsuru villages of K. R. Nagara taluk. Overall mean root-knot index recorded in Mysuru district of Karnataka state is 3.69.The maximum Egg mass index (5) was recorded in Beguru village of H. D. Kote taluk and the least egg mass index (2) was observed at Chunchanakatte village of K. R. Nagara taluk and the overall mean Egg Mass Index of Mysuru district is 3.56 (Table-01 and Graph-03).

Soil and Root Nematode population

The nematode population per 200cc soil sample was ranged from 460 to 1040. The maximum soil nematode population (1040/200cc soil) was observed in Mallahalli village of Mysuru taluk followed by (860/200cc soil) Maranahalli village of Mysuru taluk, Krishnapura village of H. D. Kote taluk and Govindanahalli village of Hunsur taluk and the least nematode population per 200cc soil was observed in Hebsuru (460/200cc soil) village followed by Chunchanakatte (520/200cc soil) and Saligrama (560/200cc soil) villages of K. R. Nagara taluk and the overall mean soil nematode population of Mysuru district is 722.60/ 200cc soil which is more than that of the Economic Thresh-hold level (Table-01 and Graph-01).

On an average nematode population per 5g root sample was found maximum in Beguru (112 nematode/5g root) village of H. D. Kote taluk followed Yelachanahalli (110 nematode/5g root) village of Mysuru taluk and Dasanapura (102 nematode/5g root) village of H. D. Kote taluk.

The least root nematode population was observed in Hebsuru (60 nematode/5g root) village followed by Chunchanakatte (66 nematode/5g root) and Saligrama (72 nematode/5g root) villages of K. R. Nagara taluk. The mean root nematode population per 5g root sample in Mysuru district is 86.13 (Table-01 and Graph-02).

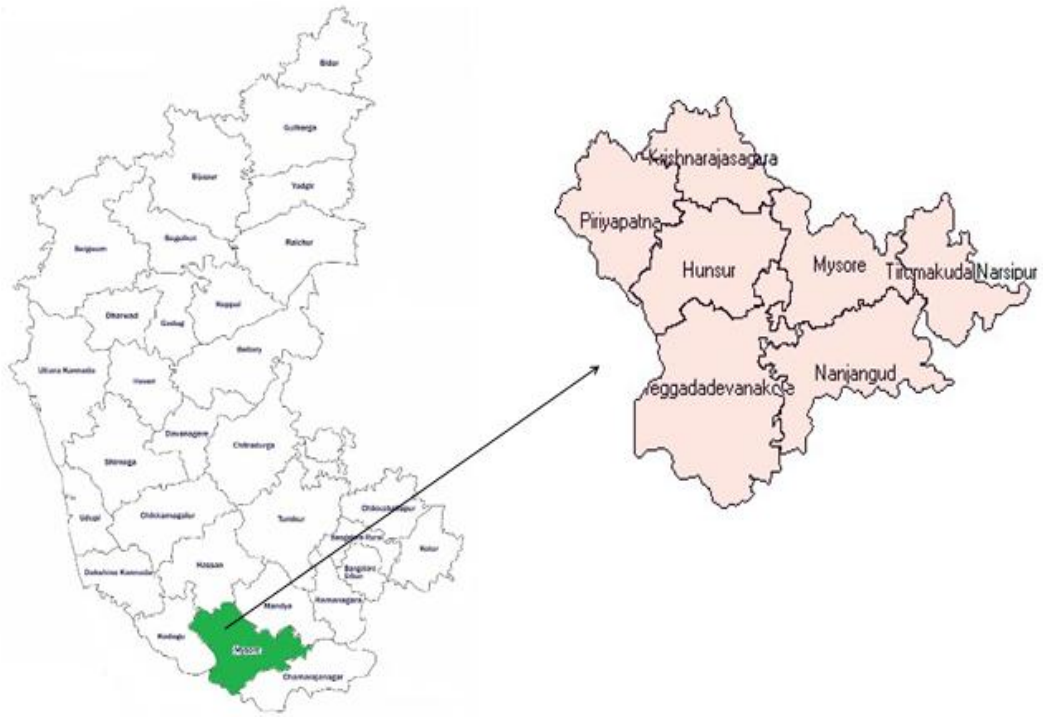
In Karnataka Ravindra *et al.,* (2016) reported the infestation of *Meloidogyne* species in various crops under protected cultivation which leads to almost 60% of crop loss annually including the French beans. The present investigations are in conformity with the findings of survey conducted by Mullin *et al.,* (1991); Ijani *et al.,* (2000); Schwartz *et al.,* (2005) and Dijan-Caporalino (2012). Who observed that there was no healthy bean crop found in Tanzania, Colombia and Peru. They also noticed that root-knot nematode disease was widespread in bean growing areas and who reported that *Meloidogyne incognita* was most common in the area they surveyed.

Table.1

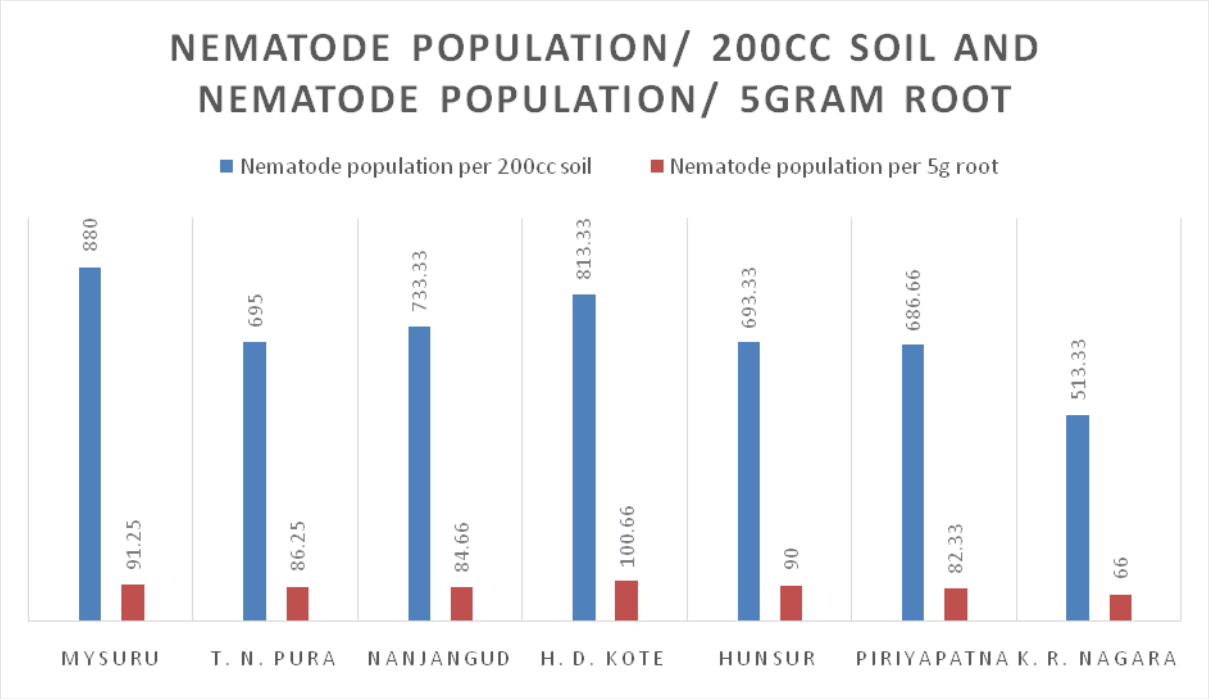
Grade	Description
0	No galls / No Egg mass
1	1-2 galls per root system / 1-2 Egg mass per root system
2	3-10 galls per root system / 3-10 Egg mass per root system
3	11-30 galls per root system / 11-30 Egg mass per root system
4	31-100 galls per root system / 31-100 Egg mass per root system
5	> 100 galls per root system / >100 Egg mass per root system

Fig.1 & 2 A bean field surveyed in Mysore district of Karnataka state and Galled roots of Bean plant.

Fig.3 Survey for the incidence of root-knot nematode infestation in beans in the Mysuru district during August – December 2022.



Graph.1 Nematode population/ 200cc Soil and Nematode population/ 5-gram Root.



Graph.2 Root-Knot Index and Egg Mass Index.

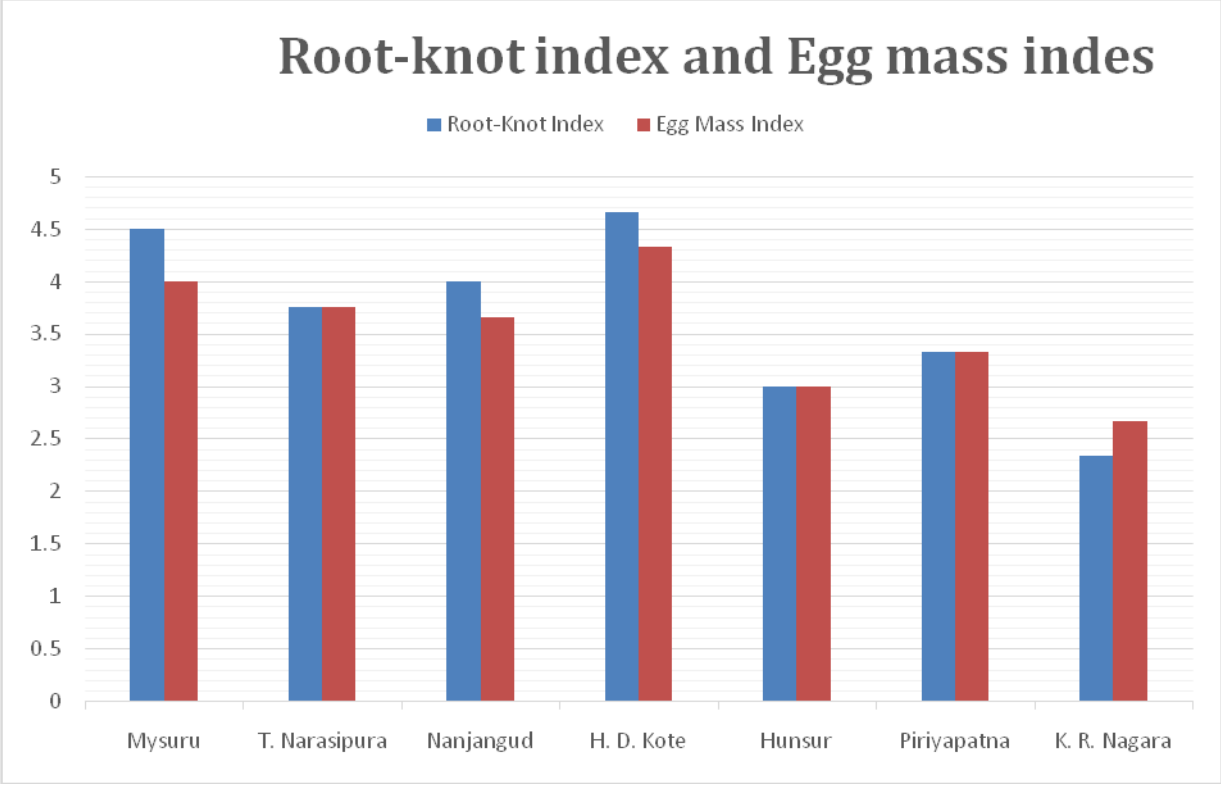


Table.2 Survey for the incidence of root-knot nematode infestation in beans in the Mysuru district during August – December 2022.

Taluk	Village	Nematode population/ 200cc soil	Nematode population/ 5g root	Root-Knot Index	Egg Mass Index
Mysuru	Maranahalli	860	84	4	4
	Mallahalli	1040	76	5	4
	Alanahalli	820	95	4	4
	Yelachanahalli	800	110	5	4
Taluk Mean		**880**	**91.25**	**4.5**	**4**
T. Narasipura	Ankanahalli	660	74	4	4
	Doddamulagudu	720	86	4	4
	Hosahalli	760	92	4	4
	Basavanahalli	640	93	3	3
Taluk Mean		**695**	**86.25**	**3.75**	**3.75**
Nanjangud	Devarasanahalli	720	70	4	4
	Hejjige	700	98	4	4
	Thoremavu	780	86	4	3
Taluk Mean		**733.33**	**84.66**	**4**	**3.66**
H. D. Kote	Dasanapura	740	102	4	4
	Beguru	840	112	5	5
	Krishnapura	860	88	5	4
Taluk Mean		**813.33**	**100.66**	**4.66**	**4.33**
Hunsur	Govindanahalli	860	82	3	3
	Niluvagilu	580	94	3	3
	Ramanahalli	640	94	3	3
Taluk Mean		**693.33**	**90**	**3**	**3**
Piriyapatna	HitneHebbagilu	740	90	3	3
	Hardur	680	81	4	4
	Kampalapura	640	76	3	3
Taluk Mean		**686.66**	**82.33**	**3.33**	**3.33**
K. R. Nagara	Saligrama	560	72	3	3
	Chunchanakatte	520	66	2	2
	Hebsuru	460	60	2	3
Taluk Mean		**513.33**	**66**	**2.33**	**2.66**
Overall District Mean		**722.60**	**86.13**	**3.69**	**3.56**

In conclusion, the survey showed that the disease varied from region to region with soil type, cultivar used and cropping pattern practiced. The association of plant parasitic nematode species *Meloidogyne incognita* and *Meloidogyne javanica* caused severe economic loss to bean growers of Mysuru district of Karnataka state. If proper strategies are not adopted for their management could lead to further loss of the crop and may result in disease complex with other pathogens like fungi and bacteria. In order to mitigate the negative impact of nematodes in French bean production, there is the need for identity and promote the use of resistant cultivars along with these some integrated nematode management strategies has to be adopted.

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