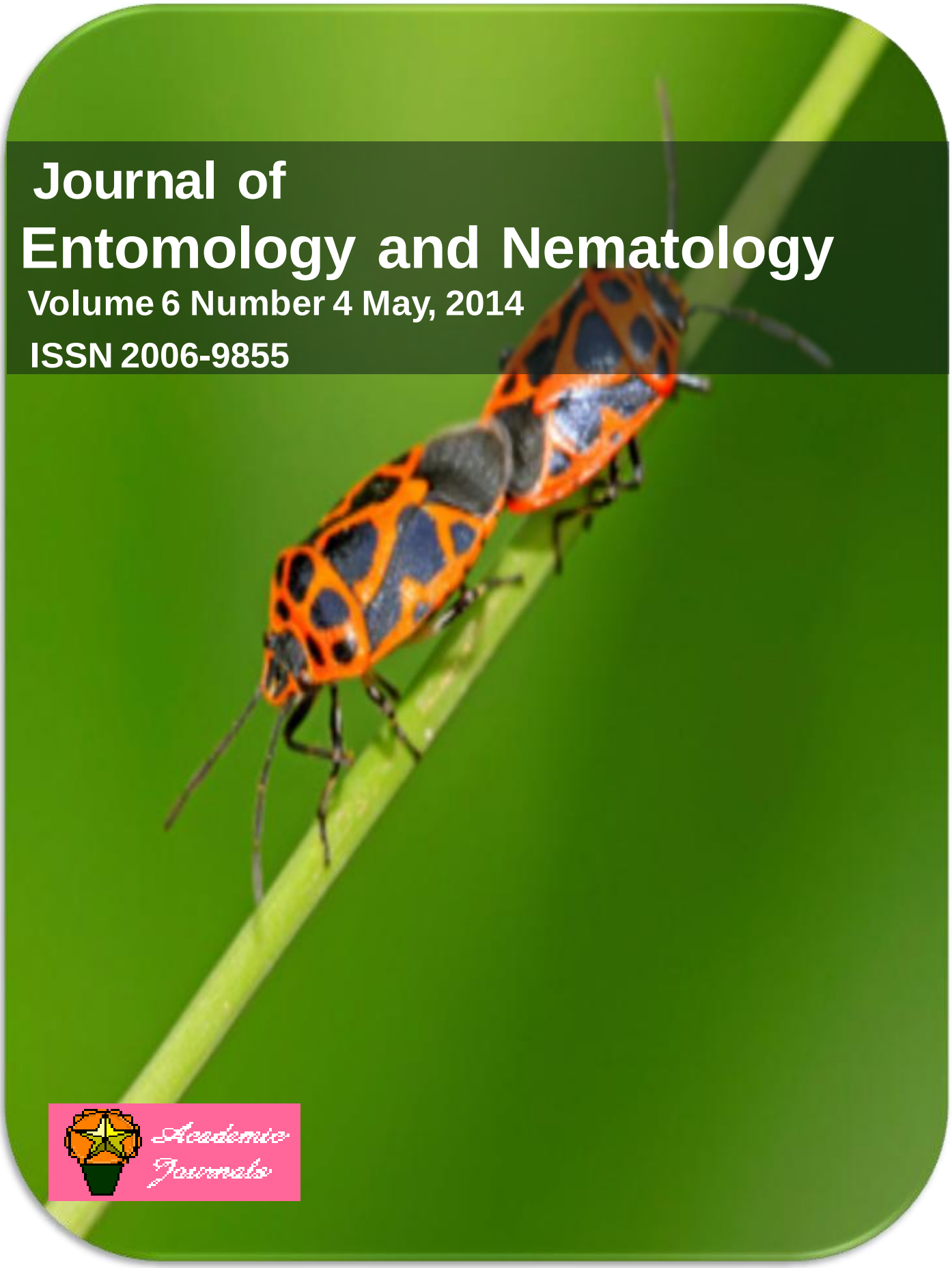

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Full Length Research Paper

Incidence of root-knot nematode (*Meloidogyne incognita*) in black pepper in Karnataka

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Black pepper *(Piper nigrum L.)* known as "King of Spices" is one of the important spice crops of India. It is affected by fungi, bacteria, phytoplasma, plant parasitic nematodes and phanerogamic parasites. Among plant parasitic nematodes, root-knot nematode *Meloidogyne incognita* is one of the important limiting factors in production and productivity of black pepper in various districts of Karnataka. Further, it is involved in creating disease complexes along with fungi apart from inflicting the disease on its own. Keeping this in mind, an extensive survey in major black pepper growing districts of Karnataka namely: Shimoga, Udupi, Chickmagalur, Dakshina Kannada, Uttara Kannada and Kodagu revealed the heavy incidence of root-knot nematode in all the major black pepper growing areas. The maximum mean RKI (3.52) was observed in Udupi district followed by Shimoga (3.58) and least mean RKI was observed in Kodagu district (2.73). Further in all the districts, fungal nematode associations were observed leading to slow wilt complex.

Key words: Black pepper, root knot nematode, *Meloidogyne* spp., *Phytophthora* spp., slow wilt disease.

INTRODUCTION

Black pepper *(Piper nigrum L.)* famous as "Black Gold" and also known as "King of Spices" is one of the important agricultural commodities of commerce and trade in India since pre-historic period. Black pepper is cultivated to a large extent in Kerala and Karnataka and to a limited extent in Tamil Nadu and other states. The crop is grown in about 0.165 lakh hectares with a production of 363.5 tons annually with productivity of 761 kg/ha. Kerala and Karnataka account for a major portion (92 %) of production of black pepper in the country (Anonymous, 2009).

Indian black pepper is preferred in the international market due to its proper combination of pleasant flavour, taste, piperine content and essential oil. Black pepper is not only used as a condiment but also, widely used in culinary preparations, food processing, and perfumery and as an important ingredient in most of the Ayurvedic medicine preparations. In Karnataka, the major black pepper growing districts are Kodagu, Dakshina Kannada, Uttara Kannada, Shimoga, Chickmagalur, Udupi. The important varieties are Paniur 1, Bilimalligesara, Karimalligesara, Doddiga, Kaluvalli, Malligesara,

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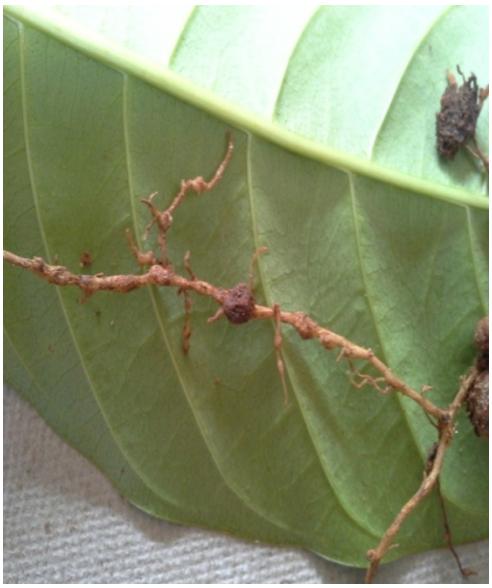

Figure 1. Galls on roots of black pepper.

Karimunda. Black pepper produced from these areas is exported to Russia, USA, Canada, Italy and Czechoslovakia. The processed black pepper products sent to USA, Germany, UK, Netherlands and France.

Black pepper in India is affected by fungi, bacteria, phytoplasma, plant parasitic nematodes and phanerogamic parasites. Among the diseases caused by fungi, foot rot disease (quick wilt disease) caused by *Phytophthora capsici,* slow decline caused by *Rhizoctonia bataticola* and/or species of *Fusarium* and *Pythium,* anthracnose caused by *Colletotrichum gloeosporioides* and *C. necator,* and thread blight caused by *Corticium solani* and *Marasmiellus scandens* are the most common in plantations. Bacterial leaf spot caused by *Xanthomonas campestris* pv *betlicola* and phyllody and little leaf supposed to be caused by Phytoplasma are the other diseases prevalent in black pepper plantations. Plant parasitic nematodes like *Radopholus similis* and *Meloidogyne incognita* are also implicated in slow decline of black pepper.

Ramana et al. (1994) has reported loss due to nematodes to the tune of 30.5 to 64.6% from Kerala. We believe that no work has been carried out regarding survey for the incidence and status of root-knot nematode of black pepper in Karnataka. Keeping this in mind, an extensive survey work was undertaken in coffee and is canut gardens of major black pepper growing districts of Karnataka, where black pepper is being grown in mixed cropping.

MATERIALS AND METHODS

An extensive survey was conducted in major black pepper growing districts of Karnataka to determine the association of root knot nematode problem in the black pepper fields. Random surveys were conducted in different taluks and villages representing each taluk of the districts. The complete enumeration method of survey was followed to find out the incidence of root-knot nematodes. During the survey of these taluks in black pepper growing fields, the association of the test nematode with black pepper crop was observed. In each field, ten separate soil samples around trees were collected, amounting to a total of 30 samples for nematological analysis. Each sample was comprised of the aerial part of the plant and the corresponding roots with adhering soil collected between 5 and 30 cm depth. After sample collection, all root samples were carefully washed under tap water to remove adhering soil particles and they were properly stained and observed under the microscope and assessed for the presence of different life cycle stages of root-knot nematode including the egg masses. The root-knot gall indices were determined on 0 to 5 scale, where 0 = no gall, 1 = 1-2, 2 = 3-10, 3 = 11- 30, 4 = 31-100 and 5 = >100 galls per root system (Figure 1) (Quesenberry et al., 1989). The nematode soil populations were estimated by using modified Bearman funnel technique and nematodes were identified using perineal patterns of adult females as well as the morphology of second-stage juveniles (Hartman and Sasser, 1985; Jepson, 1987).

RESULTS AND DISCUSSION

The survey revealed the heavy incidence of root-knot nematode in all the major black pepper growing districts. Gall indices upto 4 was observed in many of the villages and it is also observed that where root-knot nematode is observed there the *Phytophthora* infection is also more leading most devastating disease complex called slow wilt disease. Gall indices of four were noticed in Hebri, Someshwara, Mandarthi, Brahmavara, Siddapura villages of Udupi district. Nagara, Megaravalli of Shimoga district, Ponnampet, Gonikoppa, K.Badaga, Napoklu villages of Kodagu district, Iryvailu, Konaje, Naraavi villages of Dakshina Kannada district and Kammaradi, Halmatturu, Hosagodu of Chickmagalore district. Whereas the least gall indices of 2 was noticed in Anandpura village of Shimoga, Kaanur, Kunda, Haakatturu, Koodluru and Bhuvanagiri of Kodagu district. Mirjan village of Uttara Kannada, Kasaba village of Dakshina Kannada, Maagodu and NR Pura of Chickmagalur district (Table 1). The maximum mean RKI (3.66) of taluk was found in Udupi and Karkala taluk of Udupi district, Mangalore taluk of Dakshin Kannada and Koppa taluk of Chickmagalore district. With respect to the Mean RKI of districts, Udupi district having maximum mean index (3.52) followed by Shimoga (3.58) and least mean RKI was observed in Kodagu district (2.73). It was also found that the disease was unevenly distributed within the districts and in all the districts, fungal nematode association were observed and this leads to Slow wilt complex causing huge losses to the black pepper growing farmers. These results were in accordance with the results of survey conducted by ICAR in 2010 where they reported that root-knot nematode (*Meloidogyne incognita*), burrowing nematode (*Radopholus similis*), reniform nematode (*Rotylenchulus reniformis*), lesion nematode (*Pratylenchus coffeae*) as economically

Table 1. Incidence of root-knot nematode in various districts of Karnataka.

District	Taluks	Villages	RKI	Mean RKI of Taluk	Mean RKI of District
Udupi	Kundapura	Hosangadi	3	3.25	3.52
		Siddapura	4		
		Hallihole	3		
		Kamarshille	3		
	Udupi	Iyrbyl	3	3.66	
		Mandarthi	4		
		Brahmavara	4		
	Karkala	Hebri	4	3.66	
		Somehswara	4		
		Bailoor	3		
Shimoga	Sagara	Anandpura	2	2.66	3.08
		Talaguppa	3		
		Joga	3		
	Hosnagara	Jeni	3	3.33	
		Kargadi	3		
		Nagara	4		
	Thirtahalli	Bejjuvalli	3	3.25	
		Megharavalli	4		
		Agumbe	3		
		Tudur	3		
Kodagu	Virajpat	Ponnampet	4	3.20	2.73
		Gonikoppa	4		
		Kanuru	2		
		K Badaga	4		
		Kunda	2		
	Madikeri	Hakattur	2	3.00	
		Kushalanagara	3		
		Murnadu	3		
		Napokalu	4		
	Somavarpet	Kudluru	2	2.00	
		Bhuvanagiri	2		
Uttara Kannada	Kumta	Mirjan	2	2	2.75
	Sirsi	Sirsi	3	3	
	Karwar	Ankola	3	3	
	Siddapura	Siddapura	3	3	
Dakshin Kannada	Mangalore	Iruvailu	4	3.66	3.03
		Kuttar	3		
		Konaje	4		
	Bantwala	Kasaba	2	2	
	Putturu	Kudmaru	3	3	
	Sulya	Venooru	3	3	
	Beltangadi	Meramajalu	3	3.5	
		Naraavi	4		

Table 1. Contd.

District	Taluks	Village	RKI	Mean RKI of Taluk	Mean RKI of District
Chickmagalur	Chickmagalur	Rampura	3	2.75	2.98
		Bootanakadu	3		
		Alduru	3		
		Maagodu	2		
	Koppa	Kammaradi	4	3.66	
		Halmatturu	4		
		Hosakere	3		
	Sringeri	Hosagodu	4	3.5	
		Sringeri	3		
	NR Pura	NR Pura	2	2	
	Mudigere	Mudigere	3	3	

Figure 2. Slow wilting symptoms in black pepper.

important nematodes associated with spices. The association of fungus and nematode in slow wilt disease was also observed by Ramana et al. (1994) and they reported that, In India, it was shown that *R. similis* is involved in “slow wilt disease” of black pepper plants which is almost identical to the yellow(s) disease in Indonesia (Van der Vecht, 1950; Ramana and Mohandas, 1987). Two nematode taxa are considered to cause serious damage to black pepper crops *R. similis* and *Meloidogyne* spp. (Koshy et al., 2005) with annual economic loss of 38.5-64.6%.

Our results are also supported by the results of Koshy et al. (2005) who observed association of root-knot nematodes (*Meloidogyne* spp.) with black pepper plants in the beginning of the 1990’s in India. Later, *M. incognita* and *Meloidogyne javanica* were reported on black pepper plants in India, Thailand, Malaysia, Cambodia, Vietnam, Indonesia, Brunei, the Philippines and Brazil.

Ramana et al. (1994) and Anandaraj et al. (1994) reported that black pepper plants showed wilting symptoms faster when *Meloidogyne* spp. and *R. similis* were inoculated first followed by *Phytophthora capsici* (Figures 2 and 3). Thus, it is observed and believed that the diseases caused by fungi will develop faster and become aggravated in presence of plant parasitic nematodes (Ramana and Mohandas, 1987).

Figure 3. Complete wilting of black pepper plants.

Ramana et al. (1992) indicated that the reason led to slow decline of black pepper is rather complex, due to not only a species of nematode or fungi, but an interaction of nematode and fungi. The author had isolated various agents namely *Meloidogyne incognita, Radopholus similis, Fusarium oxysporum* in roots of pepper plants suppressed by slow decline.

Conflict of Interests

The author(s) have not declared any conflict of interests.

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