Advances in Bioresearch
Adv. Biores., Vol 9 (6) November 2018: 105-108

Print ISSN 0976-4585; Online ISSN 2277-1573
Journal's URL:http://www.soeagra.com/abr.html
CODEN: ABRDC3
DOI: 10.15515/abr.0976-4585.9.6.105108

Advances in Bioresearch

ORIGINAL ARTICLE

A Field survey of Vegetable crops to determine the injuries by Root Knot Nematodes (*Meloidogyne* spp) in different localities of bihar (India)

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ABSTRACT
India is the second largest producer of vegetables in world (Next to China). The area under horticulture crops has increased to about 25% million hectares in India. The production of vegetables in India was about 177 million tones in 2017-18. The total area under vegetables cultivation in Bihar is currently about 11% of the state's gross sown area, and is increasing. The important vegetable crops include potato, tomato, okra, onion, Brinjal, Cauli flower etc. The root-knot nematodes (Meloidogyne spp) are plant parasitic nematodes. They exist in soil in areas with hot climates or short winters. Their larvae infest plant roots, causing development of root-knot galls that drain the plant's nutrients. During recent years, the root-knot nematodes have became a cosmopolitan pest of economic crop plants. During present investigation, a field survey of vegetable crops was made in different localities of Bihar to determine the percentage of infestation in different vegetable crops. It was observed that tomato, okra and Brinjal, were highly susceptible to the attack of root-knot nematodes.
Keywords: *Root-Knot nematodes, Meloidogyne, Vegetables crops, Injuries, Bihar.*

Received 14.07.2018 Revised 29.07.2019 Accepted 09.10.2018

How to cite this article:
Manendra Kumar. A Field survey of Vegetable crops to determine the injuries by Root Knot Nematodes (*Meloidogyne* spp) in different localities of bihar (India) . Adv. Biores., Vol 9 [6] November 2018.105-108.

INTRODUCTION

India is the second largest producer of vegetables (next to China) in world. The production of vegetables in India was about 177 million tones in 2017-18. The total area under vegetables production in Bihar is currently about 11% of the state's gross sown area. The important vegetable crops are potato, tomato, okra, onion, brinjal, canliflaver, peas etc. In India, Bihar ranks second in Cauliflover production; fourth in onion production and fifth in tomato production: on the whole, Bihar ranks third in vegetable production. Vegetables are vital for good health as they provide essential vitamins and minerals and also reduce the risk from dangerous diseases. Vegetables play a significant role in human nutrition, especially as sources of vitamins (A, B1, B6, B9, C, E) minerals, dietary fibre and phytochemicals [9, 15]. Vegetables in the daily diet have been strongly associated health, good vision, and reduced risk of heart disease, stroke, Chronic diseases such as diabetes and some forms of cancer [6. *Meloidogyne* spp are plant parasitic nematodes. They exist in soil areas with hot climates or short winters. Their larvae infest plant roots, causing development of root-knot galls that drain the plant's nutrients. During recent years the root-knot nematodes (*Meloidogyne* spp) have become a cosmopolitan pest of economic crop plats including vegetables. The first plant parasitic nematodes was reported by Barber (1901) from South India. As per nematological records from Bihar, Lall and Das [8]; Sen [12]; Siddiqui, Prasad and Ansari [13] reported two species of root-knot nematodes (*Meloidogyne incognita* and *M. Javanica*) from different localities. The contribution of Nath & Pathak, [10] and Ahmad & Khan, [1] is also very important in plant nemotology. During present investigation (during 2017-18), a field survey of different vegetable crops was carried out

in different localities of Bihar to determine the injury caused by root-knot nematodes (*Meloidogyne* spp). It was observed that tomato, okra, brinjal, potato, cucumber and sponge gourd were susceptible to the attack of root-knot nematodes.

MATERIAL AND METHODS

Bihar was divided in three categories-High horticulture, Medium, horticulture and low horticulture zones. Different districts selected from all three zones for field survey.

High horticulture zone- Muzaffarpur Samastiput, Patna, Saran, Nalenda, West Champaran, Darbhanga & Madhubani Medium horticulture zone- siwan, Vaishali, Nawada, East Champaran and Bhagalpur. Low horticulture zone- Sitamarhi, Sheohar, Munger, Buxar and Gaya The nematode infested plants were isolated by external symptoms in form of yellowing, dwarfing and wilting of foliage as suggested by Walker [4] and Franklin [15]. The selected plants were uprooted carefully by the "spade" and "Khurpi". The infested roots were washed thoroughly, cut and kept in a Jar containing five percent formaldehyde solution and labelled during survey. The root samples were brought to the laboratory for identification and further studies.

For differentiating different species of the root-knot nematodes, the infested roots were fixed in five percent formaldehyde solution for 24 hrs. A piece of root containing mature female was then transferred in the same solution in a watch glass with the aid of dissecting microscope. Individual female was removed carefully from the root tissue with a fine knife. The posterior portion of the female was then cut off by a sharp blade. The posterior portion of the female body containing perineal region was placed on a dry slide. A circular cover slip was then placed gently on the specimen and a small drop of lactophenol, mounting media was applied. The mounts were examined under the compound microscope and the species of root.-knot nematodes was identified with the help of keys suggested by Chitwood [3], Sasser [11]. Percentage of infestation in different vegetable crops was also estimated.

RESULTS AND DISCUSSION

For filed survey, Bihar was divided into three zones-High horticulture zone, medium horticulture zone and law horticulture zone. A survey was made in different vegetable tracts of different districts of different zones as described under materials and methods and percentage of infestation by root-not nematodes was estimated in different vegetables crops. The apparently infested plants, based on the external symptoms were collected. The roots of the plants were washed thoroughly in water and preserved in 5% formaldehyde with proper labelling. The number of healthy and apparently infested plants was recorded. The samples of the infested roots were brought to the laboratory for examination. The mounts of the perineal pattern was made by cutting the posterior portion of the adult female as described in materials and methods. By examination of the mounts under compound microscope, different species of root-knot nematodes were identified with the help of key suggested by Chitwood [3] & Saser [11]. The results of the survey are summarized in the Table-1. From the data of the table, this is evident that three species of *Meloidogyne* were found to be involved in infestation- *M. Javanica*, *M.incognita* and *M.arenaria*. Out of these, *M.Javanica* was found to be most common followed by *M.incognita*. The vegetable crops which were found to be susceptible to the attack of root-knot nematodes were: tomato, okra, brinjal, potato, cucumber and sponge gourd. Out of these, tomato, okra and brinjal were found highly susceptible in different areas of Bihar. As per nematological records from Bihar, Lall & Das [8], Sen [12] and Siddiqui, Prasad & Ansari [13] reported two species of root-knot nematodes (*Meloidogyne incognita* and *M.Javanica*) from various localities. Jensen [5] reported that all vegetables were hosts of root-knot nematodes. Kumar *et al.* [7] reported that *Melodogyne spp.* caused root-gall diseases and commonly known as root-gall nematodes. They reported that among vegetable crops sampled, okra gave the highest (92-68%) frequency of infestation followed by tomato (82.53%) and garden egg (78.94%)

Table 1: The species of *Meloidogyne* attacking vegetable crops in Bihar

Place of Survey	Host Plants	Species of *Meloidogyne* involved	Average infestation in percentage
(A) High Horticulture Zone			
(1) Muzaffarpur	Tomato	*M. Javanica*	64.5
	Okra	*M.Javanica*	61.3
	Brinjal	*M. incognita*	49.6
	Potato	*M. Javanica*	58.4
(2) Samastipur	Tomato	*M. Javanica*	66.6
	Okra	*M.Javanica*	58.4
	Brinjal	*M. incognita*	52.2
	Potato	*M. Javanica*	59.4
	Cucumber	*M. Javanica*	54.4
(3) Patna	Tomato	*M. Javanica*	44.4
	Tomato	*M. incognita*	32.2
	Okra	*M. Javanica*	56.6
	Brinjal	*M. incognita*	48.4
(4) Saran	Tomato	*M. incognita*	56.6
	Okra	*M. incognita*	74.4
	Brinjal	*M. Javanica*	58.8
	Potato	*M. Javanica*	62.4
(5) Nalenda	Okra	*M. incognita*	72.5
	Brinjal	*M. incognita*	68.5
	Potato	*M. incognita*	48.2
	Spange guard	*M. aranaria*	44.4
(6) West Champaran	Tomato	*M. Javanica*	54.4
	Brinjal	*M. incognita*	52.2
	Okra	*M. Javanica*	58.8
	Cucumber	*M. Javanica*	52.6
(7) Darbhanga	Tomato	*M. Javanica*	58.8
	Okra	*M. Javanica*	56.6
	Brinjal	*M. incognita*	52.4
(8) Madhubani	Tomato	*M. Javanica*	60.2
	Okra	*M. Javanica*	58.8
	Brinjal	*M. Javanica*	52.2
	Cucumber	*M. Javanica*	48.4
(B) Medium Horticulture Zone			
(1) Siwan	Tomato	*M. Javanica*	54.2
	Okra	*M. incognita*	56.4
	Brinjal	*M. Javanica*	42.4
	Potato	*M. Javanica*	52.2
(2) Vaishali	Tomato	*M. Javanica*	56.6
	Okra	*M. Javanica*	54.4
	Brinjal	*M. Javanica*	52.2
	Cucumber	*M. Javanica*	62.4
	Spongegeurd	*M. incognita*	52.4
(3) Nawada	Potato	*M. incognita*	42.2
	Okra	*M. incognita*	58.2
	Brinjal	*M. Javanica*	52.2
(4) East Champaran	Tomato	*M. Javanica*	48.8
	Okra	*M. Javanica*	46.6
	Brinjal	*M. Javanica*	42.4
(5) Bhagalpur	Okra	*M. Javanica*	76.5
	Brinjal	*M. incognita*	56.4
	Cucumber	*M. Javanica*	58.8
(c) Low Horticulture Zone			
(1) Sitamarhi	Tomato	*M. Javanica*	42.2
	Brinjal	*M. Javanica*	40.2

	Okra	*M. Javanica*	44.4
	Potato	*M. Javanica*	40.4
(2) Sheohar	Tomato	*M. Javanica*	38.6
	Brinjal	*M. Javanica*	36.4
	Okra	*M. Javanica*	38.8
(3) Munger	Tomato	*M. Javanica*	40.4
	Brinjal	*M. incognita*	38.2
	Okra	*M. Javanica*	42.4
(4) Buxar	Okra	*M. Javanica*	46.6
	Brinjal	*M. incognita*	42.2
(5) Gaya	Okra	*M. Javanica*	44.2
	Tomato	*M. Javanica*	46.6
	Brinjal	*M. incognita*	34.4

ACKNOWLEDGEMENT

The author is thankful to University Grant Commission for sanctioning research project on root-knot nematodes of vegetables.

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