YIELD LOSS ASSESSMENT OF ONION DUE TO ROOT-KNOT NEMATODE *MELOIDOGYNE INCOGNITA*

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ABSTRACT

Faruk, M. I., Islam, M. M., Elahi, F. and Khatun, F. 2018. Yield loss assessment of onion due to root-knot nematode *meloidogyne incognita*. Bangladesh J. Plant Pathol. 34 (1&2): 39-42

A study on assessment of yield loss of onion due to root knot nematode caused by *Meloidogyne incognita* was undertaken in the pot-house. Onion var. BARI piaz-4 seedlings were inoculated with heavily *M. incognita* infected chopped roots of tomato @2, 4, 6, 8, 10 g root/kg soil in the pot experiment during 2012-13, 2013-14 and 2014-15 cropping years. Data on gall index and bulb yield were collected at harvest. Onion bulb yield was reduced with the increasing root knot disease severity i.e. initial inoculum levels of *M. incognita* with the few exception. The reduction of onion bulb yield was 3.43% to 30.25% when seedlings of onion were inoculated with 2 to 10 g root knot nematode, *M. incognita*, infested chopped gall roots of tomato /kg of soil. The maximum reduction in bulb weight was 30.25% at inoculums level 8 gm of chopped gall root/kg soil.

Key words: Onion, *Meloidogyne incognita*, Yield loss

INTRODUCTION

Onion (*Allium cepa* L.) belongs to the family Alliaceae is one of the most important and familiar crop specially bulb onion through the world. It is also used as popular vegetable in many countries of Asia and most popular spice in Bangladesh. It ranks first in the area (459000 acres) and production (1867000 MT) (BBS 2017). It covers almost 45% of the total areas under spices (BBS 2017). The national average yield is only 4.07 t/ha which are quite low compared to world average of 17.27 t/ha (FAO 1998). Onion crops are affected by a number of soil borne and foliar diseases (Munoz *et al*. 1984, Ahmed and Hossain 1985, Meah and Khan 1987). Common soil-borne diseases of onion are damping-off, pink root and Fusarium basal rot and root knot nematode. Recently, root knot nematode of onion is become destructive and most prevalent where temperatures are 18 to 27°C, except for *Meloidogyne hapla*, which is adapted to lower temperatures. A number of phytonematodes are associated with onion roots and soil of onion fields in onion growing countries. The well documented species are *Aglenchus siddiqii* (Khan *et al.* 1992), *Ditylenchus dipsaci*, *Helicotylenchus indicus* (Khan *et al.* 1985), *Meloidogyne incognita* (Khan and Omiyi 1985, Doucet *et al.* 1994), *M. hepla* (Romney *et al.* 1974), *M. chiwoodi* (Westerdahi *et al.* 1993), *M. arenaria* (Babu and Vadivelu 1989), *M. graminicola* (Monterio *et al.* 1988), *M. javanica, M. thamesi*, *Pratylenchus brachyurus* (Lordello *et al.* 1971). Among them *M. incognita* and *M. graminicola* are known as onion root knot nematode, which are the common pest of the crop. *Meloidogyne* spp. have a wide host range belonging to many plant species but onion is the most suitable host among them (Doucet *et al.* 1994). In Bangladesh, information is not available about yield loss of onion due to infection of root-knot nematode. So, the present work has been carried out to determine the yield loss of onion by root-knot nematode.

MATERIALS AND METHODS

The pot experiment was conducted during 2012-13, 2013-14 and 2014-15 cropping seasons in the pot house of Plant Pathology Division, BARI, Joydebpur, Gazipur. Sterilized soil (5 kg) was used in each pot. Five different level of preplant root knot nematode inoculums density were used which considered as treatment viz. i) Control (no nematode inoculums), ii) Inoculum density 2 g/kg soil, iii) Inoculum density 4 g/kg soil, iv) Inoculum density 6 g/kg soil, v) Inoculum density 8 g/kg soil, vi) Inoculum density 10 g/kg soil. The root knot nematode *M. incognita* infested chopped galled roots of tomato was used as a pre-plant nematode inoculums for each treatment. The experiment was laid out in a completely randomized design (CRD) with 5 replications. Forty-five days old onion seedlings, BARI piraz-4 grown on sterilized soils and five seedlings were transplanted on each pot. All intercultural operations such as fertilizers application, weeding and irrigation were done as per standard 1 Vol. 34, No. 1 & 2, 2018 39 2017). After 120 days of transplanting, all plants from each pot were uprooted carefully without damaging

the root system and cleaned the root system with tap water. Root knot disease severity was recorded as gall index following 0-10 scale of Zeck (1971) and weight of bulbs was recorded.

RESULTS AND DISCUSSION

Results of the present study are presented in table 1, 2 and 3. During 2012-13 cropping year results indicated that onion bulb yield was decreased with the increase of nematode population except inoculum density 4 g/kg soil where more reduction of bulb yield was observed (Table 1). In this cropping year bulb weight was reduced by 4.74 to 11.71% when plants were inoculated with 2 to 10 g/kg soil of root knot nematode infested chopped gall roots of tomato. The maximum yield reduction 11.71% was observed when the highest initial nematode inoculums density (10 g/kg soil) was used followed by the intermediate level of pre-plant nematode inoculums density 4 g/kg, 8 g/kg and 6 g/kg of soil of chopped gall roots of tomato, respectively were used. The minimum yield reduction 4.74% was recorded when 2 g/kg inoculums of soil of chopped gall roots of tomato were used. Regarding root knot nematode disease severity, the maximum gall index value 2.30 was observed when the highest pre-plant nematode inoculums (10 g/kg of soil of chopped gall roots of tomato) was used followed by the preplant nematode inoculums density 4 g/kg, 8 g/kg and 6 g/kg of soil of chopped gall roots of tomato with gall index value 2.25, 2.20 and 1.75, respectively.

Table 1. *In-vitro* assessment of yield losses of onion due to the infestation of root knot nematode, *Meloidogyne incognita* during 2012-13 cropping season

Treatments	Gall index (0-10 scale)	Average yield (g $bulb^{-1}$)	Yield reduction over control (%)
Control	0.00	43.50	-
Inoculum density (2 g/kg soil)	1.50	41.53	04.74
Inoculum density (4 g/kg soil)	2.25	39.13	11.17
Inoculum density (6 g/kg soil)	1.75	39.38	10.46
Inoculum density (8 g/kg soil)	2.20	39.25	10.83
Inoculum density (10 g/kg soil)	2.30	37.25	11.71

During 2013-14 cropping season the onion bulb yield is decreased as the increased of pre plant nematode ioculums density 6 g/kg and 10 g/kg soil where less yield reduction of bulb was observed (Table 2). Bulb weight was reduced by 20.02% to 30.35% when soils were inoculated with 2 to 10 g/kg soil of root knot nematode infested chopped gall roots of tomato. The maximum yield reduction 30.35% was observed when initial nematode inoculums density 8 g/kg soil was used followed by pre-plant nematode inoculums density 4 g/kg, 10 g/kg and 2 g/kg of soil of chopped gall roots of tomato with the reduction of bulb is 28.94%, 25.24% and 25.08%, respectively. The minimum yield reduction 20.02% was recorded when 6 g/kg inoculums of soil of chopped gall roots of tomato were used. Regarding the root knot disease severity, the maximum gall index value 2.88 was recorded in inoculums density 8 g/kg soil followed by 6 g/kg soil and 10 g/kg soil where the gall index value was 2.48 and 2.16, respectively. The minimum gall index value 1.28 was observed by the inoculums density 2 g/kg of soil followed by the inoculums density 4 g/kg of soil.

Table 2. *In-vitro* assessment of yield losses of onion due to the infestation of root knot nematode, *Meloidogyne incognita* during 2013-14 cropping season

Treatments	Gall index (0-10 scale)	Average yield (g $bulb^{-1}$)	Yield reduction over control (%)
Control	0.00	49.76	-
Inoculum density (2 g/kg soil)	1.28	37.28	25.08
Inoculum density (4 g/kg soil)	1.32	35.36	28.94
Inoculum density (6 g/kg soil)	2.48	39.80	20.02
Inoculum density (8 g/kg soil)	2.88	34.68	30.35
Inoculum density (10 g/kg soil)	2.16	37.20	25.24

During 2014-15 cropping year results indicated that onion bulb yield is decreased as the increased of nematode population except inoculums density 6 gkg^{-1} and 10 gkg^{-1} soil where less yield reduction of bulb was observed (Table 3). Bulb weight was reduced by 3.43 to 27.58% when soils were inoculated with 2 to 10 gkg^{-1} soil of root knot nematode infested chopped gall roots of tomato. The maximum yield reduction 27.58% was observed when initial nematode inoculums density 8 gkg^{-1} soils was used followed by pre-plant nematode inoculums density 4 gkg^{-1}, 10 gkg^{-1} and 6 gkg^{-1} of soil of chopped gall roots of tomato, respectively were used. The minimum yield reduction 3.43% was recorded when 2 gkg^{-1} inoculums of soil of chopped gall roots of tomato were used. The maximum gall index value

3.02 was recorded in 8 gkg^{-1} soils treatment followed by 10 g kg^{-1} and 6 g kg^{-1} of soil treatments.

Table 3. *In-vitro* assessment of yield losses of onion due to the infestation of root knot nematode, *Meloidogyne incognita* during 2014-15 cropping season

Treatments	Gall index (0-10 scale)	Average yield (g $bulb^{-1}$)	Yield reduction over control (%)
Control	0.00	48.33	-
Inoculum density (2 g/kg soil)	1.58	46.67	03.43
Inoculum density (4 g/kg soil)	1.71	36.67	24.13
Inoculum density (6 g/kg soil)	2.58	37.50	22.41
Inoculum density (8 g/kg soil)	3.02	35.00	27.58
Inoculum density (10 g/kg soil)	2.87	36.67	24.13

The present study showed that root knot nematode *M. incognita* casing yield loss of onion. This is in agreement with previous findings of Khan (2003) who reported that *M. incognita* causing damage to onion production. From the present study it was observed that onion bulb yield is related to the root knot nematode disease severity which indicated that increased the root knot disease severity resulted decreased the bulb yield as a results increased the yield reduction of onion. Similar findings have been reported by many other researchers. Some of them reported that marketable yields of onion were reduced by 31%, 72%, and 64%, respectively at 2, 6, and 18 root knot nematode *M. hapla* J2/cm3 soil (Olthof and Potter 1972a and 1972b; Merrifield 1999). Reduction in the bulb yield up to 70% was observed in heavily infested commercial fields in New York (Widmer *et al*. 1999). Pang *et al*. (2009) reported that *Meloidogyne hapla* and *M. incognita* both cause severe damage in onion production and the initial inoculums density of *M. hapla* and and *M. incognita* are co-related with yield loss of onion. Corgan *et al.* (1985) and Babu and Sivagami (1989) also reported that *Meloidogyne incognita* population densities greater than 1 egg and juvenile/cm3 soil can cause significant yield loss of onion in sandy loam soil.

From the study it may be concluded that root knot nematode infestation causes yield loss of onion and the higher the root knot disease severity resulted increased the reduction of onion yield as a results increased yield losses of onion.

ACKNOWLEDGEMENT

This research was supported by Bangladesh Agricultural Research Institute, Gazipur. Special thanks to Chief Scientific Officer and Head, Plant Pathology Division, BARI for his valuable suggestion. Thanks to Mr. Md. Abdur Razzak and Mr. Zamil Akter (Scientific Assistant) for their assistance in this research work.

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