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Comparative study of *Fusarium oxysporum* f sp. *lycopersici* and *Meloidogyne incognita* race-2 on plant growth parameters of tomato

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ABSTRACT

Many species of soil-inhabiting fungus Fusarium, cause severe yield loss in many crops. Experiments were conducted in net house condition with complete randomized block design to determine the individual effect of different inoculum levels of root-knot nematode, *Meloidogyne incognita*, Race-2 and *Fusarium oxysporum* f sp. *lycopersici* on plant growth parameters viz., Plant length, fresh and dry weight and number of fruits of tomato var. P21. The experimental results showed that both the pathogens cause significant reduction in plant growth parameters. However, the fungus was not much effective on plant growth parameters in comparison to root-knot nematode. Greatest reduction in plant growth parameters was recorded in plants inoculated with 8000 J_2/kg soil of *Meloidogyne incognita* race 2. The threshold level of root-knot nematode was 1000 J_2/kg soil while threshold level of Fusarium was @ 1 g/kg soil. Inoculum level of *Fusarium oxysporum* f sp. *lycopersici* and *Meloidogyne incognita* race-2 was pathogenic and caused significant reduction at and above 1 g/kg soil and 1000 J_2/kg soil respectively.

Keywords: *Fusarium oxysporum* f sp. *lycopersici*; *Meloidogyne incognita* Race-2; Tomato and Threshold Level

1. INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill.) is the most important tropical vegetable crop and is widely used throughout the world. It is a native of Andes region of South America. Tomato occupies second position amongst the vegetable crops in terms of production. The total production of tomato in the country in 1998-1999 was 8.27 MT from an area of 0.46 Mha. Tomato, as one of the vegetable crops and fruits, is very important in human nutrition Abubakar [1]. Fruit of tomato is rich in Vitamin A, B and C Janes [2].

Plant parasitic nematodes cause serious problem in various crops. Lamberti [3] reported that the root-knot nematode cause highest suppression in production of tomato ranging from 10% Taylor [4] to 80% Siddiqi [5]. Four species (*Meloidogyne javanica, M. incognita, M. hapla and M. arenaria*) of root-knot nematodes are major pests worldwide while another seven being important on a local basis, Eisenback and Triantaphyllou [6]. Root-knot nematodes spend maximum time of their active lives within plant roots feeding on host cells, Williamson and Hussey [7]. The infective stage secondstage juvenile (J_2) penetrates through the root and migrates to a site near the vascular tissue.

Reduction in yield due to root-knot nematodes (*Meloidogyne* spp.) in tomato range from 28% to 68% Adesiyan *et al*. [8] and 40% to 46%, Bhatti and Jain [9], Reddy [10].

The tomato crop is affected by several fungal pathogens and Fusariums sp are essentially soil borne, Berkley [11], Horsfall [12]. The fungus *Fusariums oxysporum* f sp and *lycopersici* cause wilt disease in tomato crop.

2. MATERIALS AND METHODS

The important pathogens viz., root-knot nematode (*Meloidogyne incognita*), root-rot fungus (*F. oxysporum f* sp. *lycopersici*) and an important host plant, tomato, was selected for the present study.

2.1. Isolation and Incubation of Fungus

The tomato plant infected by fungus Fusarium was collected from field and brought in laboratory. Fusarium

was isolated from roots and collar region of infected tomato plant. Infected part was cut into pieces (5 cm each) sterilized with sodium hypochlorite (5%) solution for 2 min and rinsed 3 time with sterile water for removal of traces of sodium hypochlorite solution. Sterilized and rinsed pieces were then transferred on petriplates filled with sterilized PDA (Potato Dextrose Agar) Medium in laminar flow. After transfer on PDA it was incubated in BOD at ±26˚C for fifteen days. Fungus was inoculated on Czapek medium and identified morphologically, Burgess *et al.* [13] and Rahjoo *et al.* [14]. Pathogenicity test was carried out for the identification of race of *Fusarium oxysporum* f sp. *lycopersici.*

2.2. Raising of Fungus Culture and Maintain of Inoculums

Fungus culture was raised on Richard's liquid medium (Magnesium sulphate: 0.25 g, Potassium dihydrogen phosphate: 5.00 g, Potassium nitrate: 10.00 g Potato starch: 10.00 g, Sucrose: 50.00 g, Distilled water, 1000.00 ml) Riker and Riker [15] in BOD at ±26˚C for fifteen days.

Inoculums were prepared by mixing 10 g mycelial mat with 100 ml of distilled water in warring blender.

2.3. Isolation and Preparation of Nematode Inoculum

Root-knot nematode *M. incognita* was isolated from the infected roots of tomato plant. Nematodes were extracted by Petridish assembly method by Chawla and Prasad [16]. Monoculture of root-knot nematode, *Meloidogyne incognita* race 2 was maintained on tomato plants. Pure culture was multiplied and after processing the number of larvae per ml, suspension was counted before inoculation. The counting of nematode @ per ml of suspension was done with the help of especially made counting dish under the microscope. The species/race was identified by using perineal pattern determination/ differential host range test Hartman and Sasser [17] before use.

The experiment was conducted under net house conditions in the Department of Botany Aligarh Muslim University Aligarh (AMU) India during the year 2011. Throughout the course of studies, 6 clay pots containing 1 Kg sterilized soil + river sand + farm yard manure (3:1:1) were used and arranged in randomised complete block design and five replicates of each treatment were made and an untreated plant was served as control. The plants were watered regularly. The experiment was terminated after 45 days and plant growth parameters were observed in terms of Plant length, fresh weight, dry weight, number of fruits and fruit weight. Data obtained were analysed statistically at P = 0.05 and P = 0.01%.

3. RESULTS AND DISCUSSION

Inoculums level of fungus *Fusarium oxysporum* f sp. *Lycopersici* 0.25 g and 0.50 g/kg soil showed no significant reduction in plant growth parameters viz. Plant length, fresh and dry weight, number of fruits and fruit weight. However, the plants inoculated with inoculum levels 1.0 g - 8.0 g/kg soil showed significant reduction in plant length (66.5 - 63.1 cm), fresh weight (179.1 - 174.8 gm), dry weight (33.3 - 29.3 g), number of fruits (13.7 - 10.5) and fruit weight (234.6 - 225.0) respectively. Similarly plant inoculated with 250 to 500 J_2/kg soil of *Meloidogyne incognita* race-2 showed no significant reduction in plant growth parameters while plants inoculated with 1000 - 8000 J_2 showed significant reduction in plant growth parameters viz., Plant length (63.8 - 58.8 cm), Fresh weight (178.3 - 164.4 g), dry weight (31.7 - 23.6), number of fruits (11.8 - 8.1) and fruit weight (230.3 - 216.8) as compared to control (Uninoculated) **Table 1**.

Tabel 1. Effect of different inoculum levels of root-knot nematode, *Meloidogyne incognita* race 2 on plant growth parameters of tomato.

Treatments	Length (cm)			Fresh wt. (gm)			Dry wt. (gm)			No. of fruits	Fruit weight (gm)
	Shoot	Root	Total	Shoot	Root	Total	Shoot	Root	Total		
250N	49.1	24.7	73.8	138.6	62.2	200.8	25.2	13.3	38.5	17.7	267.2
500N	48.3	23.9	72.2	134.9	60.6	195.5	23.7	12.5	36.2	15.3	266.8
1000N	42.4	21.4	63.8	124.4	53.9	178.3	19.2	12.5	31.7	11.8	230.3
2000N	41.5	20.8	62.3	128.2	52.4	180.6	18.5	11.7	30.2	10.4	227.2
4000N	40.4	20.3	60.7	120.1	50.6	170.7	15.9	9.4	25.3	9.3	220.6
8000N	39.5	19.3	58.8	117.1	47.3	164.4	14.7	8.9	23.6	8.1	216.8
Control	49.8	25.2	75.0	141.3	63.5	204.8	26.1	13.6	39.7	19.2	268.8
LSD at 5%			5.26			16.25			2.45	1.20	21.20
LSD at 1%			7.78			23.03			3.41	1.69	28.14

Value are mean of five replicates.

Table 2. Effect of different inoculum levels of fungus, *Fusarium oxysporum*, f sp. *lycopersici* on plant growth parameters of tomato.

Treatments	Length (cm)			Fresh wt. (gm)			Dry wt. (gm)			No. of fruits	Fruit wt. (gm)
	Shoot	Root	Total	Shoot	Root	Total	Shoot	Root	Total		
0.25F	49.6	25.0	74.6	140.9	63.3	204.2	25.4	13.4	38.8	18.4	268.2
0.50F	49.2	24.6	73.8	140.2	62.9	203.1	24.6	13.0	37.6	16.6	267.3
1.00F	43.5	23.0	66.5	123.9	55.2	179.1	21.1	11.2	33.3	13.7	234.6
2.00F	43.9	22.3	66.2	125.0	53.2	178.2	20.6	10.9	31.5	12.2	230.8
4.00F	42.0	22.3	64.3	122.4	53.1	175.5	19.7	10.4	30.1	11.1	227.1
8.00F	42.2	20.9	63.1	122.6	52.2	174.8	19.2	10.1	29.3	10.5	225.0
Control	49.8	25.2	75.0	141.3	63.5	204.8	26.1	13.6	39.7	19.2	268.8
LSD at 5%			5.44			16.94			2.22	1.28	22.54
LSD at 1%			8.03			24.25			3.71	1.80	30.01

Values are mean of five replicates.

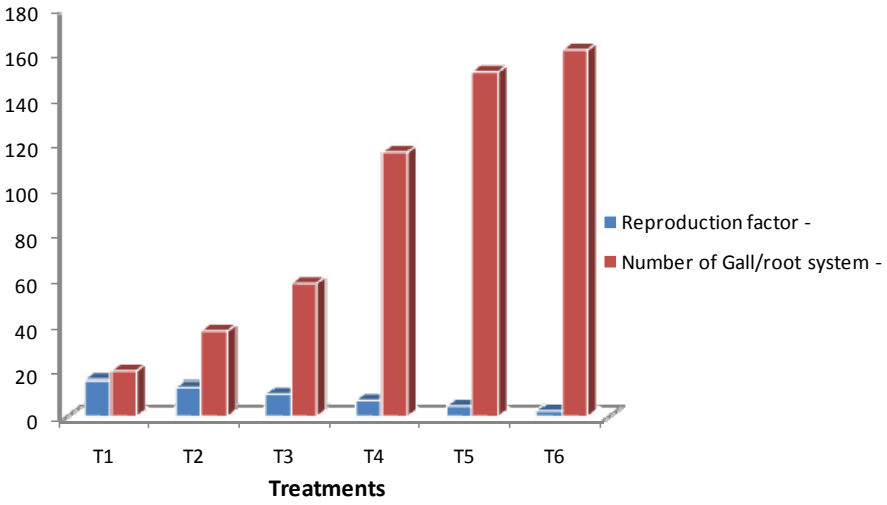

Figure 1. Reproduction factor and Number of galls/root system induced by different inoculum levels of root-knot nematode, *Meloidogyne incognita* race 2 on tomato plants. T1 = 250 J_2 of root-knot nematode, *Meloidogyne incognita* race 2; T2 = 500 J_2; T3 = 1000 J_2; T4 = 2000 J_2; T5 = 4000 J_2; T6 = 8000 J_2.

Fusarium species is most important and soil borne disease of tomato Jones *et al*. [18] and Smith *et al*. [19]. Fungal pathogen can survive in soil for several years and cause infection in plants, Walker [20] Holiday [21]. Plants treated with *M. incognita* race 2 showed greatest reductions in plant growth parameters in comparison to plants treated with *Fusarium oxysporum* f sp. *lycopersici* (**Table 2**).

A significant linear relationship was found between the initial population (Pi) and the final population (Pf) of *M. incognita* race 2. The multiplication of root-knot nematode significantly reduced with the increase in the inoculum levels. The reproduction factor was highest (16.6%) at the minimum inoculums level 250 J_2/kg soil and lowest (2.6%) at the maximum inoculum level 8000 J_2/plant. Thus, the rate of nematode multiplication showed a declining trend with the increase in the initial inoculum level suggesting it to be a density depending phenomenon (**Figure 1**). Higher multiplication rate for low initial population and low multiplication rate in high initial population was observed. Same results were also observed by Brker *et al.* [22], Di Vito and Ekanayake [23] and Haseeb *et al*. [24]. It can be concluded from these results that the damaging threshold levels of *M. incognita* race 2 on tomato was found to be as 1000 J_2/kg soil while threshold level of fungus, *Fusarium oxysporum* f sp. *Lycopersici*, was 1 g/kg soli (**Table 1** and **Figure 1**) .

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