Available online at www.scholarsresearchlibrary.com

Scholars Research Library

***J. Nat. Prod. Plant Resour.*, 2014, 4 (5):14-18**
(http://scholarsresearchlibrary.com/archive.html)

ISSN : 2231 – 3184
CODEN (USA): JNPPB7

Disease complex of *Meloidogyne incognita* and *Fusarium solani* on Chilli (*Capsicum annuum* L.)

Dania Ahmed[1], Sheila Shahab[2] and Safiuddin[1]

[1]Section of Plant Pathology and Nematology, Department of Botany AMU, Aligarh
[2]Botany Section Women's College, AMU Aligarh

ABSTRACT

In case of multi-pathogenic infection on host plant inter-pathogenic competition for food and survival are very much expected. In order to study the effect of early establishment of either of the two test pathogen i.e root knot nematode Meloidogyne incognita (Kofoid and White) Chitwood and root rot fungus Fusarium solani (Mart.)Sacc. on plant growth characters, nematode multiplication and root rotting, chilli seedlings (variety "Japani longi") were inoculated with these pathogens individually and in their various combinations of simultaneous, pre and post inoculations. Simultaneous (Mi+Fs) and sequential inoculation of M. incognita 15 days prior to F. solani showed synergistic interaction and caused greater reduction in plant growth parameters as compare to damage caused by either of the pathogen alone. However multiplication of nematode and number of galls/root system were reduced significantly as compared to individual inoculations .Intensity of root rot was increased in presence of M. incognita as compared to when F. solani was inoculated alone.

Keywords: chilli, disease, Fusarium, Meloidogyne, interaction

---

INTRODUCTION

Chilli (*Capsicum annuum* L.) is a vegetable as well as a spice and it is a good source of Vitamin C. Chillies contain health benefiting alkaloid compound in them, capsaicin, which gives strong spicy pungent character. Chillies contain good amount of vitamins and minerals like potassium, manganese, iron, and magnesium. Root knot nematode *Meloidogyne incognita* greatly affects the productivity of chilli in India [16,11,2].*Fusarium solani* cause root rot disease in several crop plants. It has been associated with diseased chilli plants in Pakistan [8,7].Under natural conditions, a plant is a potential host to various microorganisms and they can influence each other by occupying the same habitat. The association of nematodes and fungi on plants may be synergistic, additive, or antagonistic with respect to disease development and yield suppression. Synergistic associations of fungi and nematode generally result in enhancement of fungal infections due to physiological effects on the plant caused by nematode [10,19]. *Meloidogyne* spp. has been a part of nematode-fungal disease complexes on many crops [10,6,1,20].Thus an experiment was conducted to study different interactions of *Meloidogyne incognita* and *Fusarium solani* on chilli.

MATERIALS AND METHODS

For each treatment 1000 freshly hatched second stage juveniles of *Meloidogyne incognita* and 1g mycelial mat of *Fusarium solani* in the form of suspension was used. 21 days old plants were used for inoculation. Just before inoculation, roots of chilli seedlings (var. japani longi) were exposed by carefully removing the top layer of soil and the required quantity of nematode suspension and fungus inoculum was poured uniformly all around the exposed roots using sterilized pipette. Exposed roots were immediately covered with soil properly. Un-inoculated plants

served as control. Each treatment was replicated five times. Plants were watered as and when required. Inoculations were made according to the following scheme:

1. Un-inoculated (control)
2. Inoculated with *M. incognita*
3. Inoculated with *F. solani*
4. *F. solani* inoculated 15 days prior to *M. incognita*
5. *M. incognita* inoculated 15 days prior to *F. solani*
6. Concomitantly inoculated with *M. incognita* and *F. solani.*

Plant growth was determined on the basis of length, fresh and dry weight of plants. Plants were uprooted after 75 days of inoculation and roots were washed thoroughly in slow running tap water. Most care was taken to avoid loss and injury of root system during the entire operation. For measuring length, fresh and dry weight, the plants were cut with a sharp knife just above the base of root emergence. Length of shoot and root was recorded in centimeters from the cut end to the tip of first leaf and the longest root respectively. For measuring dry weight, the shoot and root were kept in envelops separately for drying in an oven running at 80^{o}C for 24 hours and the weight was recorded in grams. For interpretation of results, the reduction in plant growth was calculated in terms of percentage reduction for all plant growth parameters.

Root-knot and root-rot estimation: The galls produced by root-knot nematode (*Meloidogyne incognita*) were estimated by counting the number of galls per root system. The root rot estimation was done by taking percentage of rotting per root-system.

Nematode population estimation

For extraction of nematodes, the soil from the pot of each treatment was mixed thoroughly and a sub-sample of 200gm soil was processed through sieves according to Cobb's sieving and decanting method followed by 'Baermann funnel technique'. The nematode suspension was collected in a beaker and volume made up to 100ml. For proper distribution of nematodes, the suspension was bubbled with the help of pipette and 2ml suspension from each sample was drawn and transferred to a counting dish. The number of nematode were counted in three replicates for each sample. Mean of three such counting was calculated and the final population of nematodes per kg soil was determined.

To estimate the nematode population in roots, 1.0g root from each replicate was macerated with enough water in an electrically operated waring blender for about 30 to 40 seconds. The macerate was collected in a beaker and the volume was made up to 100ml. The nematode population was calculated as described above. Reproduction factor (Rf.) of root knot nematode was calculated by the formula Rf=Pf/Pi where "Pf" represented the final and "Pi" initial population of the nematode.

Statistical analysis

Data was analyzed by one-way analysis of variance (ANOVA) and LSD was calculated at p=0.05 and p=0.01 to test for significance. The analysis was performed with the software R [15].

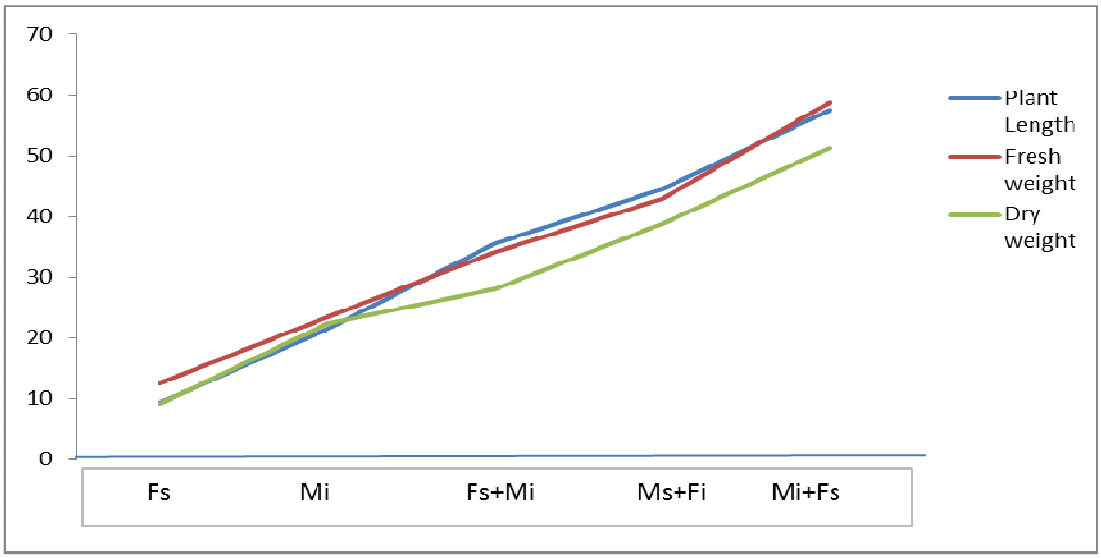
RESULTS AND DISCUSSION

It is evident from the Table and Fig. 1 that the inoculation of chilli seedlings with *Meloidogyne incognita* (Mi) and *Fusarium solani* (Fs) individually, simultaneously and sequentially caused significant reduction in plant growth characters as compared to un-inoculated plant (control). The reduction in plant growth characters i.e. length, fresh and dry weight of the plant was recorded as 21.39, 23.47 and 22.31 respectively in the plants individually inoculated with *M. incognita.* Similarly, the percent reduction was found as 9.32, 12.53 and 9.09 for length, fresh and dry weight respectively as compared to control, in the plants inoculated with *F. solani. M. incognita* was found more damaging than *F. solani* on chilli.

Moreover, the greatest reduction in plant growth parameters was caused by the simultaneous inoculation of *M. incognita* and *F. solani* (Mi+Fs) followed by sequential inoculation of nematode 15 days prior to fungus (Mi→Fs), and fungus inoculation 15 days prior to nematode (Fs→Mi).The reduction in plant growth characters viz., length, fresh and dry weight of the plant was recorded as 57.59, 58.67 and 51.24 when the plants were simultaneously inoculated with *M. incognita* and *F. solani*. Inoculation of nematode 15 days prior to fungus led to 44.42, 42.93 and 38.84 percent reduction in plant growth parameters. Reduction in length, fresh weight, and dry weight were shown to be 35.47, 34.13, 28.10 when the plants were inoculated with fungus 15 days prior to nematode. Simultaneously as well as sequential inoculation of both pathogen caused more reduction in plant growth characters as compared to the

damage caused by either pathogen alone. Minimum reduction in plant growth characters was recorded in the treatment which received the treatment of fungus alone.

The final nematode population of *M. incognita* was highest (i.e., 12928) in and around plants inoculated with nematode only having the Rf (12.93) and lowest (i.e., 6858) in and around plants in sequential inoculation where fungus was inoculated 15 days prior to nematode (Fs→Mi) having the Rf (6.86). In sequential inoculation, nematode population was more where nematode was inoculated 15 days prior to fungus (Mi→Fs) i.e. 10670 having the Rf (10.67). In concomitant inoculation (Mi+Fs) nematode population was 8960 having Rf (8.96). Multiplication of the nematode was significantly reduced in the presence of the fungus. Maximum galling (i.e.132/root system) was observed when nematode was inoculated alone and minimum number of galls was recorded in fungus inoculated prior to nematode (Fs→Mi) i.e.56/root system treatment.



Fs = *Fusarium solani*
Mi = *Meloidogyne incognita*
Fs → Mi = *F. solani* inoculated 15 days prior to *M. incognita*
Mi → Fs = *M. incognita* inoculate 15 days prior to *F. solani*
Mi + Fs = *M. incognita* and *F. solani* inoculated simultaneously

Fig 1. Percentage reductions in plant growth parameters of chilli caused by individual, sequential and concomitant inoculation of *Meloidogyne incognita* and *Fusarium solani*

The intensity of root-rot/root system caused by *F. solani* was increased in the presence of root-knot nematode *M. incognita* as compared to when *F. solani* was inoculated individually.The highest root-rot (52.70%) was recorded in concomitant inoculation (Mi+Fs), followed by sequential inoculation where nematode was inoculated 15 days prior to fungus (Mi→Fs) (38.70%) and *F. solani* 15 days prior to *M. incognita* (Fs→Mi) (31.56%). Minimum root rotting (15.50%) was observed when fungus was inoculated alone (Table and Fig.2).

In sequential inoculation when *M. incognita* was inoculated prior to *F. solani* (Mi→FS) 15 days before there was significant reduction in all the plant growth parameters and it was found to be greater than the sum of independent effect of *M. incognita* and *F. solani*. However in sequential inoculation where *F. solani* was inoculated 15 days before *M. incognita* the reduction in plant growth parameters was less as compared to Mi→Fs. Lesser reduction in plant growth in Fs→Mi inoculation is understandable as it is likely by the time plants were inoculated with nematode the fungus got sufficient time to colonize the cortex making it less suitable for nematode attack or the fungal metabolites produced adverse effects on the nematode or affected the feeding cells [12,13,4,17].

Damage to the plant was maximum when both the pathogens i.e *M. incognita* and *F. solani* were inoculated simultaneously. This may be due to the fact that both the pathogens had their own share while damaging the plant. These results are in agreement with reports of [21] Zaidi and Tiyagi (1989). Thus it can be concluded that the interaction between *M. incognita* and *F. solani* was synergistic in nature on chilli in both concomitant (Mi+Fs) and sequential inoculation (Mi→Fs). The results are in agreement with [5] Chahal and Chabra (1984) and [9] Ganaie and Khan (2011).

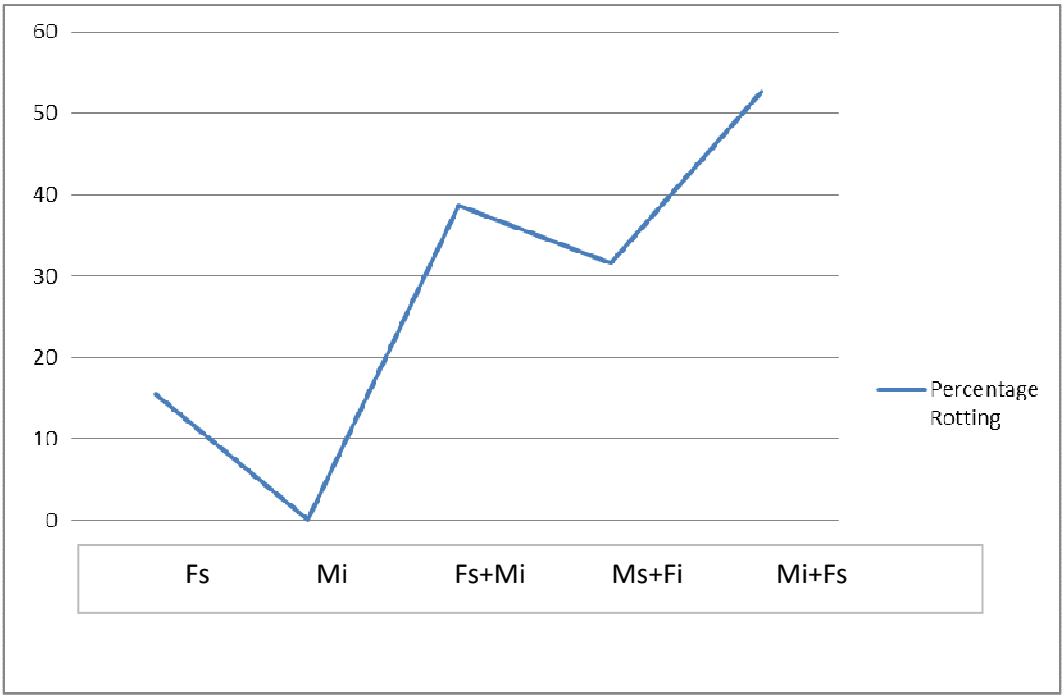


Fig 2. Percentage rotting caused by *Fusarium solani* on chilli

Prior inoculation with the fungus (Fs→Mi) was comparatively inhibiting to nematode multiplication and galling compared with fungus inoculation after the nematode (Mi→Fs) or when two pathogens were inoculated simultaneously.

Highest root rot index was observed when the nematode preceded the fungus by 15 days (Mi→Fs). Increase in root rot index in presence of nematode has been reported earlier by several workers.[10,3,18].The nematode infected cells are more easily parasitized by fungus than normal cells [14].

Table 1: Studies on the interaction of *Meloidogyne incognita* and *Fusarium solani* on plant growth parameters of chilli *(Capsicum annuum* L.)

Treatments	Plant length (cm)				Plant fresh weight (g)				Plant dry weight (g)			
	Shoot	Root	Total	% reduction	Shoot	Root	Total	% reduction	Shoot	Root	Total	% reduction
Control (uninoculated)	37.50	17.20	54.70		26.50	11.00	37.50		8.50	3.60	12.10	
Fungus (Fs)	34.80	14.80	49.60	9.32	24.00	8.80	32.80	12.53	8.30	2.60	11.00	9.09
Nematode (Mi)	31.50	11.50	43.00	21.39	21.00	7.70	28.70	23.47	7.20	2.20	9.40	22.31
Fs →Mi	26.80	10.50	35.30	35.47	18.30	6.50	24.70	34.13	6.90	1.80	8.70	28.10
Mi→Fs	22.80	7.50	30.30	44.42	16.90	4.50	21.40	42.93	6.10	1.30	7.40	38.84
Mi+Fs	17.40	5.80	23.20	57.59	12.80	2.70	15.50	58.67	5.00	0.90	5.90	51.24
LSD 5%			5.05				3.30				1.05	
LSD 1%			7.10				4.51				1.45	

Values are mean of five replicates
→ = followed by

Table 2: Studies on the effect of interaction of *Meloidogyne incognita* and Fusarium *solani* on nematode multiplication, gall formation and root-rot development on chilli (*Capsicum annuum* L.)

Treatment	Juveniles	Females	Total	Reproduction factor	No. of galls	Percentage of rotting/root system
Control (uninoculated)	0.00	0.00	0.00	0.00	0.00	0.00
Fungus (Fs)	0.00	0.00	0.00	0.00	0.00	15.50
Nematode (Mi)	12560	368	12928	12.93	132	0.00
Mi → Fs	10334	336	10670	10.67	95	38.70
Fs→Mi	6573	285	6858	6.86	56	31.56
Mi+Fs	8650	310	8960	8.96	75	52.70
LSD 5%			823.50	0.81	6.40	2.58
LSD 1%			1115.97	1.10	8.67	3.50

Values are mean of five replicates
→ = followed by

REFERENCES

[1] Abawi, G.S. and Barker, K.R. (**1984**). *Phytopath.*, 74: 433-438.
[2] Ahmad, S.F. and Khan, T.A. (**2004**). *Arch. Phytopath. Pl. Protec.*, 37(1): 35-40.
[3] Anver, S., Tiyagi, S.A., Yadav, A. and Alam, M. (**1991**). *Pak. J. Nematol.*, 9(2): 127-130.
[4] Ashraf, M.S. and Khan, T.A. (**2005**). *Arch. Phytopath. Pl. Protec.*, 38: 227-233.
[5] Chahal, P.P.K. and Chhabra, H.K. (**1984**). *Ind. J. Nematol*., 14: 56-57.
[6] Diomande, M., Black, M.C., Bente, M.K. and Barker, K.R. (**1981**). *J. Nematol.*, 13: 321-327.
[7] Ehteshamul-Haque, S. (**2006**) HEC. Project. Final Research Report. Department of Botany, University of Karachi, Karachi-75270, Pakistan.
[8] Ehteshamul-Haque, S. and Ghaffar, A. (**1994**). *Pak. J. Phytopath*., 6: 50-57.
[9] Ganaie, M.A. and Khan, T.A. (**2011**). *Int. J. Bot.*, 7(2): 205-208.
[10] Golden, J.K. and Van Gundey, S.D. (**1975**). *Phytopath.*, 65: 265-275.
[11] Jain, R.K. (**1992**) *In*: *Nematode Pests of Crops* (*Eds. D.S. ,Bhatti and R.K ,Walia).* C.B.S. Publishers and Distributors, Delhi-India, pp.381.
[12] James, G.L. (**1966**). *Nature*, 212: 1466.
[13] Khan, T.A. and Hussain, S.I. (**1989**). *Pak. J. Nematol*. 7: 109-113.
[14] Melendez, P.L. and Powell, N.T. (**1967**). *Phytopath.*, 57: 286-292.
[15] R Development Core Team (**2011**). R Foundation for Statistical Computing, Vienna, Austria. ISBN 3-900051-07-0, URL http://www. R-project.org/
[16] Nagnathan, T.G. (**1984**). *South Ind. Hort.*, 32: 115-116.
[17] Sharma, A. and Haseeb, A. (**2006**). *Ann. Pl. Protec. Sci*., 14: 129-133.
[18] Siddiqui, Z.A. and Husain, S.I. (**1992**). *Fundam. Appl. Nematol.*, 16: 491-494.
[19] Starr, J.L. and Aist, J.R. (**1977**). *Phytopath.* 67: 497-501.
[20] Starr, J.L., Martyn, R.D., Jeger, M.J. and Schilling, K. (**1989**). *Phytopath.*, 79: 640-646.
[21] Zaidi, S.B.I. and Tiyagi, S.A. (**1989**). . *Ind. Phytopathol*., 1: 48-52.