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INTERACTION EFFECT OF MELOIDOGYNE– *FUSARIUM* WILT ON PLANT GROWTH OF CHICKPEA

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ABSTRACT

The efficacy interaction of *Meloidogyne incognita* and *Fusarium* wilt on plant growth of chickpea was investigated under glasshouse condition. The pathogenicity level of *M. incognita* was recorded to be j_2 / g of soil. One g of mycelium mat could be produce significantly high wilt index value. The presence of root knot nematode irrespective of the presence of other organism showed reduction in shoot length to a significant manner. However, maximum reduction in shoot length was observed in nematode inoculated one week prior to fungus. Both the organisms suppressed the plant growth parameters in general and shoot length in particular. Maximum reduction in nematode population was found to be in nematode alone and nematode followed by fungus inoculation. The wilt index on chickpea after 75 days was reduced to be 3.5, 4.0 and 4.2 in F + N, F_7 + N, N_7 + F, respectively.

Key Words: Chickpea, *Fusarium* wilt, Interaction, Plant growth, Root – knot nematode.

INTRODUCTION

Chickpea (*Cicer arietinum*) is an important source of human food and animal feed that also helps in the management of soil fertility, particularly in dry lands. One of the most significant biotic stresses to chickpea crops is caused by nematode, especially the genus *Meloidogyne*. Another biotic stress on chickpea is exposed to *Fusarium* wilt. These occurrences are widespread and the damage is particularly striking in the case of continuous cultivation, as it occurs in irrigated areas (Jalali and Chand, 1992; Halila and Strange, 1996; Singh and Saxena, 1996; Navas – Cortes *et al*., 2000; Silva *et al*., 2003). Present study therefore, was undertaken to evaluate the greenhouse efficacy of *Fusarium oxysporum* f.sp. *ciceri* and *Meloidogyne incognita* on different growth parameters of chickpea.

MATERIALSAND METHODS

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During survey in fields of chickpea crop, it was observed that plants were affected by wilt symptoms and symptoms was aggregated in the presence of root knot nematode (*M. incognita*) such wilted plants were brought to laboratory along with soil samples. Both roots and soil were washed, processed for fungal isolation. The roots and adjoining areas of stem were washed in running water. Small bits of affected parts just touching the healthy portion were cut out. These pieces were surface sterilized with 0.1% mercuric chloride solution for one min., followed by several washing with sterilized water to remove the least traces of mercuric chloride. Each piece was transferred aseptically to PDA slants and was incubated at 27 ± 2 ^{0C}. The isolate of the fungus was purified by established single spore culture and identified as *F. o.* f.sp. *ciceri*.

Chickpea plants were collected from field having galls and egg masses. The egg masses were isolated and kept for hatching ofj_2. These juveniles were inoculated on chickpea seedlings and after 40 days, egg mass was isolated and the females were identified on the basis of perennial pattern identified as *M. incognita*. Two seeds

were sown in pots. After 15 days, one seedling was maintained in each pot. Roots of each plant were exposed carefully for nematode (j_2) inoculation. The j_2 inoculation in exposed roots of chickpea was done @ 100, 500, 1000, 1500, 2000, 4000 and 8000 and therefore, chickpea roots were covered with the same sterilized soil.

Four levels of the fungus, *F. o.* f.sp. *ciceri*, *viz.*, 0.50, 1.00, 2.00 and 4.00 g of mycelia mat / kg soil along with taken in test the pathogenicity. The mycelia mats were thoroughly mixed in soil and filled in 15 cm earthen pots and two seeds were sown in each pot, replicated five times. After germination of seeds, single plant was maintained in each pot and incidence of disease was recorded after 50 days of sowing. Observations were recorded on plant height, weight and root length and weight of chickpea plant. Nematode population was estimated by washing 100 g soil sample, taken from pot soil. Root knot nematode was estimated by counting juveniles inside the root system. Root was stained in acide fuchin lactophenol and 1 g of roots was counted then, multiplied with the weight of the roots (Byrd *et al*., 1983).

RESULTS AND DISCUSSION

With the increasing inocula of *M. incognita*, there was a progressive decrease in all plant characters of chickpea from 100 to 8000 j_2 / pot. The plant become stunted and showed yellowing of leaves with increase of inoculums density of nematode population. There was a significant reduction in plant height at and above 4000 j_2 / pot. The plants showed chlorosis, rogue in leaves at highest inoculums level. There was a significant reduction in shoot weights (fresh and dry) of chickpea plant with 4000 and 8000 j_2 / pot. The number of galls and egg masses increased gradually with increasing levels of inoculums up to 2000 j_2 / pot. Similarly, a gradual increase in nematode population in pot with increase of inoculums level was noted (Table 1).

The maximum reproduction rate was observed in 500 j_2 and minimum reproduction in higher inoculums level by 46.11 and 0.20, respectively. All the above observations in respect of nematode multiplication were found to the population density dependent.

Four levels of fungus *Fusarium oxysporum* f.sp. *ciceri viz.* 0.50, 1.00, 2.00 and 4.00 g mycelium mat / kg soil along with the check were taken to test its Pathogenicity (Table 3) replicated five times and after germination of seeds, single plant was maintained in each pot. The incidence of disease was recorded after 75 days of sowing. Data indicated conspicuous wilt symptom visible at 1.00 g mycelium mat and higher inocula.

The initial symptoms of wilt infection were observed on affected seedling showed as drooping of leaves and pale in color of the seedlings at higher inoculums levels. In general, the intensity of the wilt increased with increase in inoculums levels of fungus and the wilt index was higher in 4.00 g of mycelium mat / kg soil (Table 3). Significant reduction in growth of chickpea was recorded in the presence of the root knot nematode (Siddique *et al*., 2013). Plants treated with both organisms (*M. incognita* and *Fusarium* wilt) on cotton showed the highest decreasing on all the parameters of plant including shoot and root length, fresh and dry weight (Chawla *et al*., 2012). In the other investigation observation pointed out that reduction of fresh and dry weights of the shoot corresponded with the increase level of root knot nematode inoculums (Starr *et al*., 1989). A similar result on tea plant by *M. incognita* was clearly reported (Devay *et al*., 1997).

The presence of nematode irrespective of the occurrence of other organism showed reduction in shoot length to a significant manner. However, the maximum reduction in shoot length was observed in treatment inoculated with nematode one week prior to fungus (Table 4). Both the organisms *viz.* nematode and fungus suppressed the plant growth characters in general and shoot length in particular, significant reduction was observed in the treatment either fungus or nematode inoculated earlier (Srivastava and Tewari, 2011). Moreover, significant reduction in shoot length was observed when the root knot nematode was inoculated prior to fungus; the per cent reduction was calculated to be 31.99. Greatest restriction of plant growth was observed in plants inoculated with nematode followed by fungus. The similar trends in case of weight of shoot was also recorded maximum being in nematode followed by fungus treatment considering the importance of the crop, the fresh weight of plant had important parameter. The per cent decrease was found to be 15.59, 18.01 and 40.05 in F + N, F_7 + N and N_7 + F treatments. Comparatively the length of chickpea plant was greatly affected by nematode followed by fungus as compared to fresh weight of shoot and root. These finding are the all most correlated with the results of other scientist (France and Abawi, 1994; Bhagwati *et al*., 2000; Carneiro FF *et al*., 2010).

This interngreatly affected the number of nodules /plant. Maximum nodules were present in untreated control in tested plant. Both organisms had a positive detrimental effect on number of nodules. However, significant reduction was observed in all the treatment as compared to control, maximum being in treatment where nematode was inoculated one week before to fungus. Highest nematode population / 100 g soil was isolated from nematode alone which counted as 4.00 root knot gall index. Similar results were reported by (Summer and Minton, 1987; Colyer *et al*., 1997; Hussain *et al*., 2013; Pereira *et al*., 2013). Nematode multiplication was hampered in presence of fungus; the number of root knot nematode juveniles was isolated as 240 and 210 in F + N, simultaneous treatment followed by fungus inoculated one week prior to nematode.The symptom followed in the treatment where the fungus was inoculated prior to

nematode. However, simultaneous inoculation of fungus and nematode showed little less intensity in the wilt expression whereas nematode one week prior to fungus showed maximum wilting of chickpea plant in nematode (Mahapatra and Swain, 2001). The wilt index was recorded to be 3.50, 4.00 and 4.20 in F + N, F_7 + N and N_7 + F, respectively.

Table 1. Effect of inoculums levels of *M. incognita* on growth of chickpea[a]

Inoculum	Shoot length (cm)	Shoot weight (g)		Root weight (g)	
		Fresh	Dry	Fresh	Dry
100	15.50[b]	8.85	46.15	11.36	56.25
500	17.69	9.73	48.72	25.00	62.50
1000	20.48	15.93	56.41	26.14	62.50
1500	21.87	36.28	71.80	35.23	75.00
2000	28.03	63.72	76.92	73.86	81.25
4000	83.30	74.34	82.05	73.86	87.50
8000	55.47	88.50	89.74	90.91	93.75
SEm ±	0.78	0.36	0.07	0.13	0.03
CD (P= 0.05)	1.58	0.74	0.15	0.27	0.06

[a] Each value is an average of five replicates. [b] value is per cent reduction over uninoculated control.

Table 2. Effect of different inocula of *M. incognita* on nematode multiplication [a]

Inoculum	No. of galls/root	No. of egg masses/root	Nematode population/pot	Reproduction rate
100	68.20	48.80	1350	13.50
500	120.40	100.30	4310	46.11
1000	196.80	99.60	3600	3.51
1500	198.30	113.00	3410	2.31
2000	221.40	166.40	2470	1.21
4000	158.70	92.00	1500	0.40
8000	138.00	73.70	1390	0.20
SEm ±	5.47	3.61	44.72	0.77
CD (P= 0.05)	11.21	7.40	91.60	1.58

[a] Each value is an average of five replicates.

Table 3. Wilt index caused by *Fusarium oxysporum* f.sp. *ciceri* on chickpea[a]

Treatments (g mycelia mat/kg soil)	Wilt index
Control	1.00
0.50	1.25
1.00	2.03
2.00	3.66
4.00	4.20
SEm ±	0.13
CD (P=0.05)	0.27

[a] Each value is an average of five replicates.

Table 4. Inter – relationship between *M. incognita* and *F. oxysporum* f.sp. *ciceri* on chickpea [a]

Treatments	Length (cm)		Fresh weigh (g)		No. of nodules	Nematode population j_2/100 soil	Wilt index	Gall index
	Shoot	Root	Shoot	Root				
Control	39.20	27.40	35.50	20.30	29.00	---	---	---
N	29.50	23.50	27.40	18.20	19.50	490	---	4.00
F	32.20	25.20	29.40	19.20	16.30	---	4.20	---
F + N	31.40	25.00	26.50	16.70	24.00	240	3.50	3.00
F + N_7	22.50	26.40	25.30	17.00	17.70	210	4.00	3.00
N + F_7	16.30	15.60	18.60	13.80	10.50	150	4.20	2.00
SEm ±	0.52	0.46	0.52	0.49	0.47	8.36	0.07	0.07
CD (P= 0.05)	1.08	0.96	1.07	1.01	0.97	17.26	0.15	0.15

[a] Each value is an average of five replicates.

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