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## Effect of soil moisture on *Colletotrichum gloeosporioides*, *Fusarium oxysporum* and *Meloidogyne incognita* causing twister disease in onion

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### Abstract

Onion twister disease caused by *Colletotrichum gloeosporioides*, *Fusarium oxysporum* and *Meloidogyne incognita* which causes heavy losses to the crop. To study the effect of soil moisture on the development of twister disease of onion, an experiment was conducted in sick pots. Onion seedlings were transplanted in pots, pathogens were inoculated and different soil moisture were maintained. It was observed that *C. gloeosporioides* inoculated plant showed cent percent disease incidence at 50, 60 and 70 percent moisture level. *F. oxysporum* inoculated plants showed maximum disease of 77.38 percent at 50 percent moisture level. *M. incognita* inoculated plants showed maximum disease (55.71%) at 60 percent moisture level. *C. gloeosporioides* + *F. oxysporum* + *M. incognita* combined inoculation showed cent percent disease incidence at 50, 60 and 70 percent moisture levels.

**Keywords:** Soil moisture, *Colletotrichum gloeosporioides*, *Fusarium oxysporum*, *Meloidogyne incognita*

### Introduction

Onion (*Allium cepa* L.) is one of the important oldest bulbous vegetable crop among the genus *Allium* in India. Which belongs to the family Alliaceae with a chromosome number of  $2n=16$  (Firbas and Amon, 2014) [8]. It is rich in carbohydrates, proteins, vitamin C and minerals (phosphorus and calcium). It is having various health functions such as antioxidant, anti-inflammatory, antimicrobial, anti-diabetic, anti-obesity, anti-cancerous, cardiovascular protective, hepatorenal protective, neuroprotective, digestive system protective, respiratory protective, reproductive protective and immunomodulatory properties (Zhao *et al.*, 2021) [15]. Onion crop is infected by many fungal and bacterial diseases among which onion twister disease become major in many onion growing areas during *kharif* season in the recent years. Onion twister disease was first reported near Zaria, northern Nigeria, in 1969 during the rainy season with 50-100 percent yield loss (Ebenebe, 1980) [7]. In India, the twister disease was first reported in Bihar caused by the *Glomerella cingulate* during the *kharif* season (Sinha and Singh, 1994) [13]. In Karnataka, a report on twister disease complex severity (7-52%) has been submitted to the government from KVK, Hagari, Bellary (Anon., 2005) [4]. This disease become major in many onion growing areas during *kharif* season in the recent years. Hence soil moisture parameter was taken in to consideration to check the any effects of soil moisture on twister disease development. As this soil moisture is an important parameter which greatly influences the growth and development of pathogens. Attri *et al.* (2018) [5] reported that 40 percent of soil moisture has shown maximum disease incidence (66.66%) of Fusarium wilt (*F. oxysporum* f. sp. *capsici*) of bell pepper followed by 50 (58.33%) and 60 percent (50.00%). Daulton and Nusbaum (1962) [6] reported that *M. javanica* had shown a more rapid reduction in egg viability in wet soil than in dry soil. Hence, the present investigation is concentrated on the role of moisture levels on the development of twister disease.

### Material and Methods

This experiment was conducted to know the favorable moisture conditions for the growth and development of *C. gloeosporioides*, *F. oxysporum* and *M. incognita* alone and in combination. Red soil was oven dried at 60 °C for 2 days. The empty water leakage proofed pots were weighed (234 g). Later for each pot, an equal quantity of soil was added and weighed again (5 kg).

For this experiment, 45 days old healthy onion seedlings were transplanted in sterile dry soil filled in water leakage proofed pots. For each moisture level 10 onion seedlings were maintained.

### Moisture maintenance

The pots were filled to a known (1.2 g/cc) bulk density after ascertaining the volume of the pots. At this combination, the pore space will be approximately around 50 percent. In other words, 50 percent is mineral matter along with organic matter and remaining 50 percent is of voids meant for water and air. In order to achieve 10 percent pore volume being occupied by moisture (water) 256 ml of water was added. The same calculation was followed for higher saturation viz., 20, 30, 40, 50, 60 and 70 percent. The moisture was maintained by refilling the evaporated moisture for every 2 days once.

### Inoculum preparation and inoculation

The pathogens suspension of 50 ml/pot of *C. gloeosporioides* was sprayed to healthy onion seedlings by pin prick method. *F. oxysporum* sorghum giant culture was prepared in conical flask and inoculated at the root portion of the seedlings. Fifty ml *M. incognita* (10 nematode/ml) inoculum suspension prepared by Baermann's funnel technique and was added to the root portion of seedlings. A plant without pathogen inoculation was maintained as a control. The percent disease incidence was recorded at regular intervals.

### Results and Discussion

The effect of seven moisture levels on disease incidence was recorded and the observations were presented in Table 1.

#### *C. gloeosporioides*

The cent percent disease incidence was recorded at 50, 60 and 70 percent moisture levels. In 10, 20, 30 and 40 percent moisture levels, the disease incidence recorded was 0.00, 30.00, 62.83 and 75.00 percent, respectively. Under low moisture condition the disease incidence is less and as the moisture level increases the disease incidence also increases. Generally, under low moisture condition stomata are closed to limit the transpiration and also reduce plant growth. Whereas, under high moisture condition more stomatal openings will be there with high transpiration (Ahmad *et al.*, 2021) [1]. Panday *et al.* (2012) [12] reported that, the *C. gloeosporioides* pathogen can also directly enter through stomatal openings of onion leaves. The conidia produce infection hypha from the base of the appressorium and penetrate the host through stomatal openings. Further, it produces hyphae inside the cells and as a result, small water soaked lesions were observed on leaves.

#### *F. oxysporum*

The data shows that the fungus *F. oxysporum* had shown a maximum disease incidence of 77.78 percent at 50 percent soil moisture level. Whereas, there is no disease incidence at 10 percent moisture level. At 20, 30, 40, 60 and 70 percent moisture levels, the disease incidence was about 33.33, 49.67, 66.78, 66.78, 55.79 and 40.37 percent, respectively. At lower soil moistures, there is less secretion of root exudates and lower spore germination. Under optimum soil moisture conditions high rate of secretion of root exudates by the host leads to a high rate of *Fusarium* spores germination and infection hyphae development at the root tips (Allen and Nehl, 1997; and Jangir *et al.*, 2021) [2, 9]. During high moisture

condition there is no spore production and multiplication. Under water logging conditions the viability of the spores was reduced due to anaerobic condition (Ullah *et al.*, 2021) [14]. A similar experiment was conducted by Attri *et al.* (2018) [5] reported a higher PDI of 66.66 of *Fusarium* wilt (*F. oxysporum* f. sp. *capsici*) at 40 percent soil moisture level on bell pepper. They concluded that very low and very high soil moisture was not favorable for disease development. Similar findings were obtained by Ammajamma (2010) [3] and Mahato *et al.* (2017) [10].

#### *M. incognita*

The table data shows that the *M. incognita* can cause a maximum PDI of 55.71 at 60 percent moisture level, followed by a 70.00 percent moisture showed 49.67 percent. Whereas, at 10 and 20 percent moisture levels zero disease incidence was observed. The other three soil moisture levels i.e., 30, 40 and 50 percent had shown PDI of 19.00, 29.62 and 29.79, respectively. This may be due to the rapid reduction in egg viability in wet soil than in dry soil and also the quick hatching of eggs and increased activity of larvae in this environment, resulting in the depletion of stored energy (Daulton and Nusbaum, 1962) [6]. At lower soil moisture conditions nematodes may die. Whereas the moderate moisture level favours the nematode population. The high moisture level in soil may cause nematode death due to a lack of oxygen (Nouh, 2022) [11].

#### *C. gloeosporioides* + *F. oxysporum* + *M. incognita*

The data shows that the combined inoculation of all three pathogens, *C. gloeosporioides* + *F. oxysporum* + *M. incognita* showed cent percent disease incidence at 50, 60 and 70 percent moisture levels, followed by 40 percent moisture level with PDI of 85.81. Whereas, other soil moisture levels of 10, 20 and 30 percent moisture levels showed PDI of 0.00, 42.87, 50.00 and 85.81 percent, respectively. It indicates that with an increase in soil moisture condition the twister disease also increases.

**Table 1:** Influence of soil moisture on disease incidence of *C. gloeosporioides*, *F. oxysporum* and *M. incognita*

Percent Soil Moisture Levels	Percent Disease Incidence (30 DAI)			
	<i>C. gloeosporioides</i>	<i>F. oxysporum</i>	<i>M. incognita</i>	<i>C. gloeosporioides</i> + <i>F. oxysporum</i> + <i>M. incognita</i>
10	0.00 (0.00)*	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
20	30.00 (33.21)	33.63 (35.44)	0.00 (0.00)	42.87 (40.90)
30	62.83 (52.43)	49.67 (44.81)	19.33 (26.08)	50.00 (45.00)
40	75.00 (60.00)	66.78 (54.80)	29.62 (32.97)	85.81 (67.87)
50	100.00 (90.00)	77.38 (61.60)	29.79 (33.08)	100.00 (90.00)
60	100.00 (90.00)	55.79 (48.32)	55.71 (48.28)	100.00 (90.00)
70	100.00 (90.00)	40.37 (39.45)	49.67 (44.81)	100.00 (90.00)
S.Em±	0.13	0.28	0.32	0.05
CD (P=0.01)	0.53	1.20	1.35	0.19

\*Values in parenthesis are arc-sine transformed values

## Conclusion

In order to study the moisture level requirement for growth of twister disease pathogens, studies were conducted under pot condition. The present study revealed that maximum incidence of twister disease by *C. gloeosporioides* + *F. oxysporum* + *M. incognita* showed cent percent disease incidence at 50, 60 and 70 percent moisture levels.

functions and safety concerns of onion (*Allium cepa* L.). *Front. Nutr.* 2021;8:1-23.

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## References

1. Ahmad U, Alvino A, Marino S. A review of crop water stress assessment using remote sensing. *Remote Sens.* 2021;13(20):4155-4181.
2. Allen S, Nehl D. Soil borne inoculum. *App. Soil Eco.* 1997;5:219-230.
3. Ammajamma R. Studies on etiology, epidemiology and management of wilt complex of *Coleus forskohlii* (Wild.) Briq. Ph.D. (Agri) Thesis, Univ. Agric. Sci., Dharwad (India); c2010.
4. Anonymous. Investigations on bulb rot and twisting of onion leaves and it's management. Report submitted by S. T. Yenjerappa, Krishi Vigyan Kendra, Hagari, Bellary to Dept. of Horticulture, GOK, Bangalore; c2005.
5. Attri K, Sharma M, Gupta SK. Influence of edaphic factors on Fusarium wilt of bell pepper. *Int. J Bio-resour. Stress Manag.* 2018;9(5):606-610.
6. Daulton RA, Nusbaum CJ. The effect of soil moisture and relative humidity on the root-knot nematode *Meloidogyne javanica*. *Nematologica.* 1962;8(2):157-168.
7. Ebenebe AC. Onion twister disease caused by *Glomerella cingulata* in Northern Nigeria. *Plant Dis.* 1980;64:1030-1032.
8. Firbas P, Amon T. Chromosome damage studies in the onion plant *Allium cepa* L. *Caryologia,* 2014;67(1):25-35.
9. Jangir P, Mehra N, Sharma K, Singh N, Rani M, Kapoor R. Secreted in xylem genes: Drivers of host adaptation in *Fusarium oxysporum*. *Front. Plant Sci.* 2021;12:1-17.
10. Mahato A, Biswas MK, Patra S. Effects of soil edaphic components on incidence of tomato collar rot disease caused by *Sclerotium rolfsii* (Sacc.). *Int. J Plant Soil Sci.* 2017;20(6):1-8.
11. Nouh GM. Effect of temperature and soil moisture on the efficacy of indigenous and imported strains of the entomopathogenic nematode, *Heterorhabditis* sp. against the black cutworm, *Agrotis ipsilon* (Hufnagel) (Lepidoptera / Noctuidae). *Egypt. J Biol. Pest Control.* 2022;32(1):1-7.
12. Panday SS, Alberto RT, Labe MS. Ultra structural characterization of infection and colonization of *Colletotrichum gloeosporioides* in onion. *Plant Path. Quar.* 2012;2(2):168-177.
13. Sinha JN, Singh AP. Severe curls or twister disease of onion in India. *Indian Phytopathol.* 1994;47(2):214.
14. Ullah S, Mostert D, Serfontein K, Viljoen A. The survival and treatment of *Fusarium oxysporum* f. sp. *cubense* in water. *J. Fungi* 2021;7(10):1-11.
15. Zhao XX, Lin FJ, Li H, Li HB, Wu DT, Geng F, et al. Recent advances in bioactive compounds, health