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**Shamsher Alam**  
Department of Plant Pathology,  
Indira Gandhi Agricultural  
University, Raipur,  
Chhattisgarh, India

**Gopal Krishna Awadhiya**  
Department of Plant Pathology,  
Indira Gandhi Agricultural  
University, Raipur,  
Chhattisgarh, India

## Cross-pathogenicity reaction of linseed *Fusarium* (*F. oxysporum* f. sp. *lini*) isolates in different crops

**Shamsher Alam and Gopal Krishna Awadhiya**

### Abstract

Linseed (*Linum usitatissimum* L.) also known as flax, is a member of the family Linaceae. The essential oils are Angiosperm plants species including herbs, shrubs, and tree; extracted by Clevenger Hydro distillation method. So, the present study was undertaken to evaluate the effects of some eco-friendly essential oils against *Fusarium oxysporum* f. sp. *lini*, by which we can improve the agricultural production of linseed. In cross-pathogenicity reaction of different crops and linseed against *Fusarium oxysporum* f. sp. *lini* isolates, no crops were showing pre-emergence mortality except control (linseed) (31.11%). Post emergence mortality were observed in Chickpea (58.33%) and linseed (51.11%). Total wilt incidence recorded linseed (82.22%) and Chickpea (58.33%). In effect of six isolates of *Fusarium* in different crops on growth parameters of linseed seedlings, the linseed crop is showing pre-emergence mortality linseed isolate (8.33%), soybean isolate (3.33%) and Chickpea isolate (5.00%). Post emergence mortality shown linseed isolate (73.33%) and Chickpea isolate (56.67%). Total wilt incidence recorded linseed *Fusarium* (81.67%) and Chickpea *Fusarium* (61.67%). No post-emergence mortality was shown in case of others *Fusarium* isolate. *Fusarium* was re-isolated from the inoculated plants which confirmed the presence of the disease.

**Keywords:** Linseed, wilt, *Fusarium oxysporum* f.sp. *lini*, *Fusarium*, cross pathogenicity

### Introduction

Linseed (*Linum usitatissimum* L.) is one of the most important extensively cultivated oilseed crop. Linseed oil is used for various industrial preparations and flax is used for preparing linen cloth in temperate countries. The crop encounters a number of diseases of fungal, bacterial, viral and nematode origin, which are responsible to take away a heavy toll of the crop loss every year. Among the fungal diseases of linseed, wilt caused by *Fusarium oxysporum* f.sp. *lini* (Bolly) Snyder and Hansen is a major constraint responsible for low production and productivity (Sharma *et al.* 2002) [4]. It damages the quality of seed (Damodaran and Hegde, 2005) [2]. On a global level, India occupies the first place in areas under cultivation; however, the productivity of this crop is very low, i.e. 407 kg/ha.

### Material and Method

The cross pathogenicity test of highly pathogenic isolates of *Fusarium oxysporum* f.sp. *lini* to ten others crops selected based on their crop-rotation. The experiment was conducted by following Koch's postulates under pot culture conditions by the soil infestation method. For soil inoculation, the fungus was multiplied on sterilized Sorghum seed for preparation of mass inoculums in laboratory. It was prepared in 1 kg pp beg. The medium in flasks was then sterilized in autoclave at 15 lb psi (1.036 kg/cm<sup>2</sup>) for 30 minutes for two consecutive time. These flasks were inoculated with 5 mm mycelia disc of actively growing fungal culture and incubated at 25 ± 2 °C. After 15 days, the mycelium covered entire surface of medium and this culture was then used for inoculation (Desai, 2014). The pots of 20 cm face diameter were thoroughly washed with 5 percent HgCl<sub>2</sub> solution and rinsed with sterilized water before use. The inoculum of each isolate was separately mixed in 2 kg sterilized soil @ 5 percent w/w and this mixture was put in 20 cm plastic pots. The disinfected seeds of susceptible variety R-7 were sown @ 15 seeds / pot. Observations of wilt were made at an of 21 days after sowing. Plants showing symptoms of drying were removed carefully from the pots and the soil adhering to the roots was washed with sterilized water. Re-isolations were made from the infected plants as described earlier and the recovered fungus was compared with the original fungus.

**Corresponding Author:**  
**Shamsher Alam**  
Department of Plant Pathology,  
Indira Gandhi Agricultural  
University, Raipur,  
Chhattisgarh, India

All others crops isolates inoculated into linseed susceptible cultivar R-7 and linseed highly virulent isolates inoculated 10 others crops, such as rice, lentil, green gram, black gram, pea,

chickpea, mustard, sesame and control was linseed. The experiment was laid out in a completely randomized design.

**Table 1:** *Fusarium* spp. isolates for cross-pathogenicity testing

Isolate name	Host isolated from	Location collected	Year collected
FOL-1	Linseed	Raipur	2019
FOL-2	Linseed	Bemetra	2019
FOL-3	Linseed	Mungeli	2019
FOL-4	Linseed	Kawardha	2019
FOL-5	Linseed	Rajnandgaon	2020
FOL-6	Linseed	Kanker	2020
FOL-7	Linseed	Balrampur	2020
FOL-8	Linseed	Surguja	2020
FOL-9	Linseed	Surajpur	2020
FOL-10	Linseed	Koriya	2019
Fu-11	Totamo	Jashpur	2020
Fu-12	Soybean	IGKV Farm	2019
Fu-13	Mungbean	IGKV Farm	2019
Fu-14	Urdbean	IGKV Farm	2019
Fu-15	Chickpea	IGKV Farm	2020

## Result and Discussion

### Cross-Pathogenicity reaction of different crops and linseed against *Fusarium oxysporum* f.sp. *lini* isolates

Ten crops selected based on crop rotation of linseed. Lintil (Local), Moong (POM- 135), Urd (Indira urd-1), Chickpea (Indira chana-1), Lathyrus (Local), Pea (Local), Mustard (Local), Sesame (Local), Soybean (Local), Rice (Swarna) and Linseed (R-7) as a Control. Three pot of *Fusarium oxysporum* f.sp. *lini* maintain for each crop. All crops were sown in kharif and rabi season. No crops were showing pre- emergence mortality except control (linseed) (31.11%). Post emergence mortality were observed in Chickpea (58.33%) and linseed (51.11%). Total wilt incidence recorded linseed (82.22%) and Chickpea (58.33%). *Fusarium oxysporum* was re-isolated from the inoculated plants which confirmed the presence of the disease and this re-isolated *Fusarium oxysporum* f.sp. *lini* was again inoculated in gram and linseed, resulted strong wilting were observe in both plant, then again isolate the pathogen in wilted plant and check microscopic view (Table 2 & Plate 1).

### Effect of six isolates of *Fusarium* in different crops on growth parameters of linseed seedlings

*Fusarium* spp. was isolated from different crops viz., Linseed, Tomato, Soybean, Mungbean, Urdbean and Chickpea from different location of Chhattisgarh. The pathogenicity test of all the 6 isolates of *Fusarium* was conducted by following Koch's

postulates under pot culture conditions by the soil infestation method. For soil inoculation, the fungus was inoculated on sterilized Sorghum seed preparation of mass inoculums in laboratory.

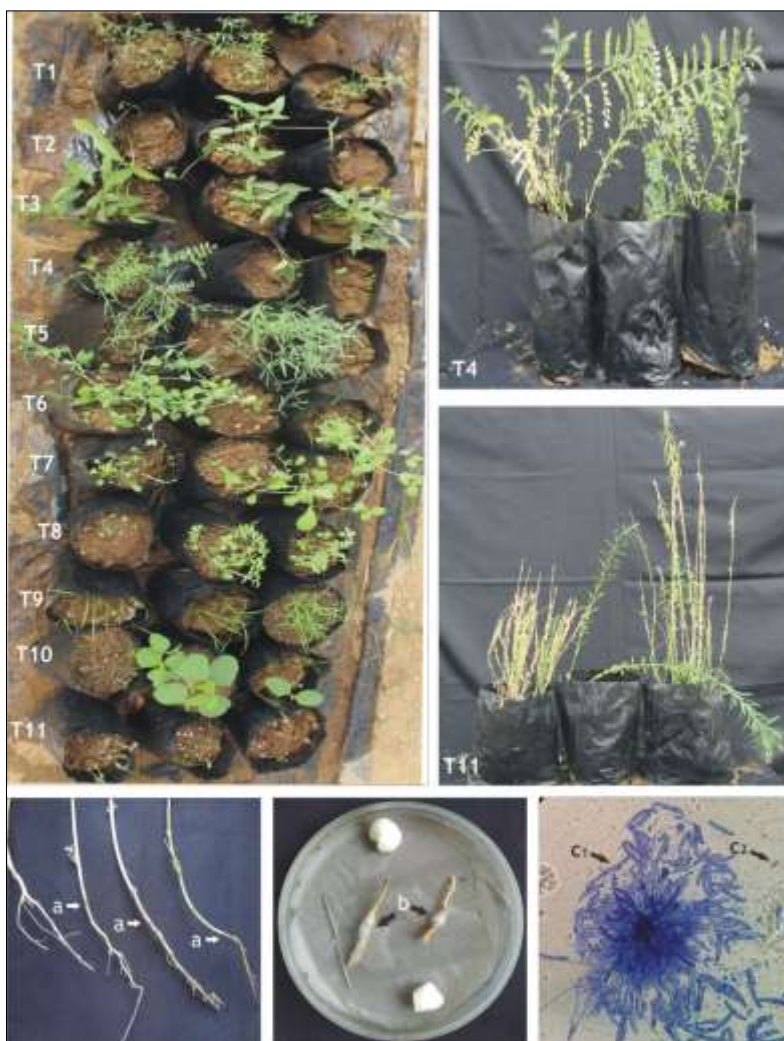
The pasturised soil mixed with mass of *Fusarium* grown on sorghum seeds and made sick soil. Five pot of *Fusarium* maintained for each isolates. Linseed were sown in rabi season. The linseed crop is showing pre- emergence mortality linseed isolate (8.33%), soybean isolate (3.33%) and Chickpea isolate (5.00%). Post emergence mortality shown linseed (73.33%) and Chickpea (56.67%). Total wilt incidence recorded linseed *Fusarium* (81.67%) and Chickpea *Fusarium* (61.67%). No post-emergence mortality was shown in case of others *Fusarium* isolate. *Fusarium* was re-isolated from the inoculated plants which confirmed the presence of the disease (Table 3 & Plate 2).

Owen (1955) conducted cross-inoculation studies with isolates of *Fusaria* from cucumber and watermelon and found that the *Fusarium* from cucumber was highly pathogenic on its original host and muskmelon and slightly pathogenic on watermelon. The *Fusarium* isolate from watermelon infected some collections of muskmelons but not cucumbers. From the late 1800s to the early 1900s researchers conducting pathogenicity studies reported that *Fusaria* causing wilt of cucurbits were host specific (Snyder (1933) found considerable differences in pathogenicity of *Fusarium* on different crops.

**Table 2:** Cross-Pathogenicity reaction of different crops and linseed against *Fusarium oxysporum* f. sp. *lini* isolates

Treatments	Crop	Germination (%)	Pathogenic Reaction		Wilt Incidence		
			Pre emergence	Post emergence	Pre emergence (%)	Post emergence (%)	Total (%)
T <sub>1</sub>	Lentil (Local)	100.00 (90.00)	-	-	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
T <sub>2</sub>	Moong (POM- 135)	100 (90.00)	-	-	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
T <sub>3</sub>	Urd (Indira urd-1)	100 (90.00)	-	-	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
T <sub>4</sub>	Gram (Indira chana-1)	100 (90.00)	-	+	0.00 (0.00)	58.33 (49.98)	58.33 (49.98)
T <sub>5</sub>	Lathyrus (Local)	100 (90.00)	-	-	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
T <sub>6</sub>	Pea	100 (90.00)	-	-	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
T <sub>7</sub>	Mustard (Local)	100 (90.00)	-	-	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
T <sub>8</sub>	Sesame (Local)	100 (90.00)	-	-	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
T <sub>9</sub>	Soybean	100 (90.00)	-	-	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
T <sub>10</sub>	Rice (Swarna)	100 (90.00)	-	-	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
T <sub>11</sub>	Linseed (R 7) Control	68.89 (57.89)	+	+	31.11 (32.08)	51.11 (45.62)	82.22 (65.33)
	SE (m) ±	3.56			3.56	3.67	1.75
	CD (5%)	10.57			10.57	10.90	5.21

Figures in parentheses are angular transformation



**Plate 1:** Cross-Pathogenicity reaction of different crops and linseed against *Fusarium oxysporum* f.sp. *lini*

**Table 3:** Effect of six isolates of *Fusarium* Spp. in different crops on growth parameters of linseed seedlings

Treatments	Isolated crop	Germination (%)	Wilt Incidence		
			Pre emergence (%)	Post emergence (%)	Total (%)
T <sub>1</sub>	Linseed	91.67 (75.53)	8.33 (22.21)	73.33 (59.06)	81.67 (65.42)
T <sub>2</sub>	Totamo	100.00 (90.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
T <sub>3</sub>	Soybean	96.67 (82.50)	3.33 (9.09)	0.00 (0.00)	3.33 (7.48)
T <sub>4</sub>	Mungbean	100.00 (90.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
T <sub>5</sub>	Urdbean	100.00 (90.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
T <sub>6</sub>	Gram	95.00 (78.75)	5.00 (7.48)	56.67 (48.86)	61.67 (51.82)
	SE (m) ±	2.70	4.03	1.38	2.68
	CD (5%)	8.20	12.25	4.20	8.14

Figures in parentheses are angular transformation  
Average of four replication

Cohen *et al.* (2008) [6] who found it induced *Fusarium* susceptibility in melons. From the cross-pathogenicity test results it seems that under controlled conditions any *F. oxysporum* isolate from Proteaceae has the potential to cause wilt of the selected cultivars. The isolates appear less aggressive when inoculated on a different genus from that which it was initially isolated. A similar trend was reported by

Alkher *et al.* (2009) [7] where *Verticillium dahliae* isolates caused more vascular discoloration in their original than in the alternative host, when cross-pathogenicity tests were performed on potato and sunflower. It can be concluded from our results that *Leucospermum* is very sensitive to *F. oxysporum*, but more cultivars need to be tested to confirm this hypothesis.



**Plate 2:** Effect of six isolates of *Fusarium oxysporum* in different crops on growth parameters of linseed seedlings

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