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Kamlesh Ram

Department of Plant Pathology,
Brahmanand Post Graduate
College, Rath, Hamirpur,
Uttar Pradesh, India

In vitro evaluation of systemic and non-systemic fungicides against *Fusarium oxysporum* f. sp. *lentis* causing wilt of lentil

Kamlesh Ram**Abstract**

Studies conducted on the effect of systemic and non-systemic fungicides. Among the tested six systemic fungicides, Carbendazim is the most effective as they have inhibits the completely mycelial growth recorded of the test pathogen at 0.05, 0.1 and 0.2% concentration. The next best of Difenconazole evaluated against *Fusarium oxysporum* f. sp. *lentis*, radial growth were found of (12.33mm and 82.38%), (11.66mm and 83.34%) and (9.33mm and 86.67%). Thiophanate-methyl was least effective which showed 18.66mm, 16.66mm and 15.00mm radial growth and 73.34, 76.67 and 78.57% inhibits mycelial growth observed at 0.05, 0.1 and 0.2% concentration. Its six non systemic fungicides were tested, Thiram was found to be most effective and recorded least mycelial growth 11.33mm, 10.33mm and 8.33mm with highest mycelium inhibition 83.81, 85.24 and 88.10 percent at 0.05, 0.1 and 0.2% concentration against *Fusarium oxysporum* f. sp. *lentis*. The Copper oxychloride was next best fungicides found (18.00mm and 74.28%), (16.66mm and 76.185) and (13.33mm and 80.95%). The Zineb was comparatively least effective observed (44.33mm and 36.66%), (43.33mm and 38.10%) and (41.66mm and 40.48%) at 0.05, 0.1 and 0.2% concentration, against *Fusarium oxysporum* f. sp. *lentis* as compared to untreated control.

Keywords: wilt lentil, systemic and non systemic fungicides**Introduction**

Lentil (*Lens culinaris* Medik.) is one of the most important pulse crop grown in India. It's can be provides several dietary nutrients, these includes protein, essential minerals and vitamins for beneficial to the promotion of good health of humans and straw is also valued animal feed of Grusak, (2009) [6] and Iqbal, *et al.* (2006) [7]. It is usually grown after the rainy season on conserved soil moisture. The crop suffers from a several diseases among the fungal pathogen of lentil wilt caused by *Fusarium oxysporum* f. sp. *lentis* reported by Chaudhary, *et al.* (2010) [4]. It Play a major role in reducing lentil yield and caused severe damage at all stages of plant growth, with more incidence in flowering and pod filling stage than early vegetative stage by Stoilova and Chavdarov, (2006) [16]. These decrease productivity through infection and damage to leaves, stems, roots and pods, and reduces marketability by discoloring seed quality reported by Taylor, *et al.* (2007) [17]. Vascular wilt (*Fusarium oxysporum* f. sp. *lentis*) of lentil is an important soil borne disease and causing significance yield losses under dry and warm condition Bayaa, *et al.* (1997) [2]. In Madhya Pradesh wilt incidence as 50 to 78 percent has been reported in some fields of Khare, (1981) [8] and Agrawal, *et al.* (1991) [1]. The present study is carried out to evaluate different systemic and non-systemic fungicides against lentil wilt and their effect on mycelial growth and percent inhibition.

Materials and Methods**Collection of the samples and isolation of causal pathogen**

Fresh diseased plants were collected from the field of different location of Bundelkhand region. Tissue isolation technique was followed after through surface sterilization of root pieces (2-3 mm size) with 0.1 percent mercuric chloride solution for a minute. After this, the cut pieces thoroughly washed thrice in sterile distilled water to remove mercuric chloride from the treated pieces. These pieces were transferred in petri plates containing solidified PDA medium. The inoculated plates were then incubated at 25±2 °C temperature and regularly observed for the fungal growth. The fungal growth appearing on the root pieces were examined and purified by following single hyphal tip cut methods. *Fusarium oxysporum* f. sp. *lentis* was identified based on the spores and conidiophores morphology.

Corresponding Author:**Kamlesh Ram**

Department of Plant Pathology,
Brahmanand Post Graduate
College, Rath, Hamirpur,
Uttar Pradesh, India

Efficacy of different groups of fungicides against the pathogen of *Fusarium oxysporum* f. sp. *lentis*

To test the different systemic and non-systemic fungicides against the test pathogen. Twelve fungicides Viz., Carbendazim, Propiconazole, Metalaxyl, Difenconazole, Thiophanate-methyl Azoxystrobin, Thiram, Chlorothalonil, Maneb Captof, Copper oxychloride and Zineb were tested for their efficacy through laboratory by the using poisoned food technique against *Fusarium oxysporum* f. sp. *lentis* by Nene and Thapliyal (1993) [11]. Requisite quantities of fungicide were incorporated in two percent potato dextrose agar medium. About 15 ml of poisoned melted PDA medium was poured in sterilized petri plates. Control petri plate was maintained without addition of fungicides to the media. After solidification all the plates were inoculated individually with 5 mm diameter culture disc of *Fusarium oxysporum* f. sp. *lentis*. PDA plates without fungicide but inoculated with *Fusarium oxysporum* f. sp. *lentis* served as control. Three times were maintained for all the treatments and plates were incubated at 25±2 °C. Toxicity of each fungicide against the test fungi was calculated in terms percent inhibition of mycelia growth using the inhibition zone was formed and expressed as percent inhibition using the formula given by Vincent (1927) [18] and data was analyzed by using OPSTAT statistical program by Sheoran (2006) [13].

(Equation 1)

$$\text{Percent inhibition} = \frac{\text{Colony diameter in Control (mm)} - \text{Colony diameter in - treatment (mm)}}{\text{Colony diameter in control (mm)}} \times 100$$

Results and Discussion

Efficacy of different systemic fungicides against the pathogen of *Fusarium oxysporum* f. sp. *lentis*

All the treatments were found significantly superior compared to control (Table-1). Among the tested six systemic fungicides, Carbendazim is the most effective as they have inhibits the completely mycelial growth recorded of the test pathogen at 0.05, 0.1 and 0.2% concentration. The next best of Difenconazole evaluated against *Fusarium oxysporum* f. sp. *lentis*, radial growth were found of (12.33mm and 82.38%), (11.66mm and 83.34%) and (9.33mm and 86.67%) followed by Propiconazole, Metalaxyl and Azoxystrobin at 0.05, 0.1 and 0.2% concentration respectively, they were statistically at par with each other. Thiophanate-methyl was least effective which showed 18.66mm, 16.66mm and 15.00mm radial growth and 73.34, 76.67 and 78.57% inhibits mycelial growth observed at 0.05, 0.1 and 0.2% concentration

respectively. In the similar reported that Maheshwari *et al.*, (2008) [12] and Singh *et al.* (2010) [14], against the wilt of lentil caused by *Fusarium oxysporum* f. sp. *lentis*, and same as result were also reported by Somu, *et al.* (2014) [15] and Chanu *et al.*, (2019) [3] tested the different fungicides as inhibiting the mycelia growth of the *Fusarium oxysporum* f. sp. *cubense* and *Fusarium oxysporum* f. sp. *psi*.

Effect of different non systemic fungicides against the pathogen of *Fusarium oxysporum* f. sp. *lentis*

The six non-systemic fungicides Viz. Thiram, Chlorothalonil, Maneb Captof, Copper oxychloride and Zineb were evaluated against *Fusarium oxysporum* f. sp. *lentis* *in vitro*. The result presented in table -2, revealed that all the fungicides tested were significantly effective in reducing mycelial growth over the control. Out of the six fungicides tested, Thiram was found to be most effective and recorded least mycelial growth 11.33mm, 10.33mm and 8.33mm with highest mycelium inhibition 83.81, 85.24 and 88.10 percent at 0.05, 0.1 and 0.2% concentration against *Fusarium oxysporum* f. sp. *lentis*. The Copper oxychloride was next best fungicides found (18.00mm and 74.28%), (16.66mm and 76.185) and (13.33mm and 80.95%) followed by Captof, Maneb and Chlorothalonil respectively, inhibits the radial growth of test pathogen. The Zineb was comparatively least effective observed (44.33mm and 36.66%), (43.33mm and 38.10%) and (41.66mm and 40.48%) against *Fusarium oxysporum* f. sp. *lentis* as compared to untreated control. Similar results were earlier several workers reported by Nikam *et al* (2007) [10], Kumar and Tripathi (2012) [9] and Chaudhary *et al.* (2019) [5] on *Fusarium oxysporum* f. sp. *ciceri*, *Fusarium oxysporum* f. sp. *lentis* and *Fusarium udum*. In the present study, laboratory testing of different groups of fungicides by food poisoning technique revealed that all of the fungicides were efficient in reducing fungal growth at increased dosages of the fungicides against the pathogen *Fusarium oxysporum* f. sp. *lentis*. Among the twelve systemic and non-systemic fungicides, carbendazim and thiram is the most effective as they have checked the mycelia growth of the test fungus whereas difenoconazole and copper oxychloride were found the next best and thiophanate-methyl and zineb was least effective, inhibited the mycelia growth of the test fungus. In conclusion, the present study demonstrated that Carbendazim, Difenconazole, Thiram and Copper oxychloride fungicides significantly inhibit the mycelial growth of *Fusarium oxysporum* f. sp. *lentis*, which causes wilt disease of lentils. These experiments proved to be helpful for management of wilt incidence and improved the yield.

Table 1: Efficacy of different systemic fungicides against the pathogen *in vitro*

S.N.	Treatments	Av. diameter of fungal growth (mm)			Inhibition over control (%)		
		Concentration of fungicides			Concentration of fungicides		
		0.05%	0.1%	0.2%	0.05%	0.1%	0.2%
1	Carbendazim	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	100	100	100
2	Metalaxyl	16.66 (24.51)	14.66 (22.49)	13.33 (21.40)	76.20	79.05	81.42
3	Difenconazole	12.33 (20.48)	11.66 (19.90)	09.33 (17.74)	82.38	83.34	86.67
4	Propiconazole	15.33 (22.95)	14.00 (21.94)	12.00 (20.21)	78.10	80.00	82.85
5	Thiophanate-methyl	18.66 (25.58)	16.33 (23.78)	15.00 (22.77)	73.34	76.67	78.57
6	Azoxystrobin	17.00 (24.28)	16.00 (23.55)	13.66 (21.66)	75.71	77.14	80.48
7	Control	70.00 (56.81)	70.00 (56.80)	70.00 (56.81)	-	-	-
	CD at 5%	3.75	3.02	2.81			
	SE(m)	1.22	0.98	0.91			

Table 2: Efficacy of different non-systemic fungicides against the pathogen *in vitro*

S.N	Treatments	Av. diameter of fungal growth (mm)			Inhibition over control (%)		
		Concentration of fungicides			Concentration of fungicides		
		0.05%	0.1%	0.2%	0.05%	0.1%	0.2%
1	Thiram	11.33 (19.63)	10.33 (18.73)	8.33 (16.76)	83.81	85.24	88.10
2	Chlorothalonil	43.00 (40.95)	36.33 (37.05)	32.00 (34.41)	38.57	48.10	54.28
3	Maneb	33.66 (35.42)	30.66 (33.61)	26.66 3(31.05)	51.90	56.18	61.91
4	Captof	25.33 (30.19)	22.00 (27.94)	19.00 (25.79)	63.81	68.57	72.85
5	Copper oxychloride	18.00 (25.04)	16.66 (24.02)	13.33 (21.38)	74.28	76.18	80.95
6	Zineb	44.33 (41.72)	43.33 (41.14)	41.66 (40.18)	36.66	38.10	40.48
7	Control	70.00 (56.81)	70.00 (56.81)	70.00 (56.81)	-	-	-
CD at 5%		3.75	3.10	3.32			
SE(m)		1.22	1.01	1.08			

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