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## Evaluation of phytoextracts against *Colletotrichum falcatum* causing red rot disease of sugarcane

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### Abstract

Red rot disease of sugarcane caused by *Colletotrichum falcatum* is a major biotic threat for its production. The use of synthetic pesticide for combating this disease is posing many serious concerns for the environment. In the present study, six plant extracts viz. Neem (*Azadirachta indica*), Garlic (*Allium sativum*), Bael (*Aegle marmelos*), Onion (*Allium cepa*), Tulsi (*Ocimum sanctum*) and Aloe Vera (*Aloe barbadensis*) were evaluated for their efficacy against the *C. falcatum*. They were tested *in vitro* at different concentrations of 5, 10, 15 and 20% against the three isolates i.e. CF 01, CF 07 and CF 08 of the pathogen. Among the botanicals, Neem leaves extract were found most effective in suppressing mycelial growth of the pathogen at all the concentrations followed by Tulsi, Garlic, Aloe Vera, Onion and least inhibition was observed in Bael extracts for all three isolates CF 01, CF 07 and CF 08. The highest inhibition (80.19%) of CF 01 isolate was expressed by Neem at 20% concentration and least inhibition (5.37%) exhibited by Bael for isolate CF 08 at 5% concentration. The present study concluded that plant extracts can play a key role in the management of sugarcane red rot disease.

**Keywords:** Sugarcane, evaluation, phytoextracts, red rot disease

### Introduction

Sugarcane (*Saccharum officinarum* L.) is an economically important industrial and energy crop, grown in the tropical and subtropical regions of India. In India, it is cultivated in 5.2 million hectares of land with an annual production of 400.37 million tonnes and productivity of 76.99 tonnes/ha. In Bihar, it occupies an area of 3.04 lakhs ha of land with a production of 182.85 lakh tonnes and productivity of 60.15 tonnes/ha (Government of Bihar, 2019) [4]. Red rot disease of sugarcane caused by *C. falcatum* is a major and devastating disease of Bihar which causes considerable losses both in yield as well as juice attributes. The reduction in various cane attributes due to this major disease observed by various workers. The reduction in cane weight, juice content and recovery of jaggery varies according to their levels of disease severity. Reduction in yield (30-100%) and 25-75% in juice content were observed by Tiwari *et al.* (2010) [9]. Minnatullah and Kamat (2018) [5] has also observed reduction in brix (16.60 to 20.80%), pol (31.60 to 38.60%) and 18.00 to 22.10% due to red rot disease in purity of cane juice qualities. In India, annual loss of revenues by *Colletotrichum falcatum* is estimated to range between 500 and 1000 million USD (Edward *et al.*, 2013) [3]. The sugar requirement of India, for the year 2030 is estimated to be 36 million tonnes for which the sugar recovery should be 11% and average cane yield should be 100 t/ha. This huge demand can be only fulfilled by increasing the acreage or reducing the losses (Premachandran, 2012) [6]. Although the use of disease resistant varieties are the most cheapest and effective solution for the disease management, but several popular varieties succumbed to infection and knocked down due to emergence of new pathotypes of red rot pathogen. The fungicidal use for setts treatment may pose several problems like resistant development, residual toxicity and environmental pollution. The effectiveness of different plant extracts are explored by the several workers of India but little information is available regarding effect of these botanicals in Bihar condition. Therefore, exploiting botanical extracts against this disease in sugarcane offers non-hazardous and environmentally safe methods of disease control. Keeping this in mind, the present investigation was accomplished in laboratory condition to search for the best phytoextracts against the *Colletotrichum falcatum*.

### Materials and Methods

#### Procurement of the isolates and evaluation of phytoextracts against *Colletotrichum falcatum*

All the three isolates (CF 01, CF 07 and CF 08) of *Colletotrichum falcatum* were obtained

from the sugarcane Research Institute, Department of Plant Pathology, Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar. The isolates were maintained and purified on oat meal agar media at  $27 \pm 1$  °C.

The six botanicals namely Neem, Garlic, Bael, Onion, Tulsi, and Aloe Vera collected from the local area were washed using sterilized distilled water. The botanicals were crushed in grinder by mixing 100 ml of water with 100 g of plant materials, filtered through muslin cloth and this formed the standard (100%) solution. The required amount of the filtered extracts was mixed thoroughly in distilled water to get the desired concentration. The 5, 10, 15 and 20% concentration of the extracts were obtained by mixing 10, 20, 30 and 40 ml of the extracts in 90, 80, 70 and 60 ml of sterilized distilled water. The double strength concentration of the botanicals and media were prepared. The poisoned food technique was employed to screen these phytoextracts against the three

isolates of *C. falcatum*. The oat meal amended media having various concentrations were inoculated in the center with 5 mm disc of seven days, actively growing pathogen of three isolates in triplicates. The oat meal media without any botanical extracts served as control. The plates were incubated at  $27 \pm 1$  °C and colony diameter was recorded both in treated and control plates after eight days of inoculation. The per cent inhibition of the mycelial growth was calculated according to given formula:

$$\text{Per cent inhibition} = \frac{C-T}{C} \times 100$$

#### Where

C = colony diameter of pathogen in control

T = colony diameter of pathogen in treated media

**Table 1:** Description of botanicals

S. No.	Local Name	Scientific Name	Family	Portion Used	Concentration (%)
1.	Onion	<i>Allium cepa</i>	Amaryllidaceae	Bulb	5, 10, 15, 20
2.	Garlic	<i>Allium sativum</i>	Amaryllidaceae	Bulb	5, 10, 15, 20
3.	Neem	<i>Azadirachta indica</i>	Meliaceae	Leaves	5, 10, 15, 20
4.	Bael	<i>Aegle marmelos</i>	Rutaceae	Leaves	5, 10, 15, 20
5.	Tulsi	<i>Ocimum sanctum</i>	Lamiaceae	Leaves	5, 10, 15, 20
6.	Aloe Vera	<i>Aloe barbadensis</i>	Liliaceae	Leaves	5, 10, 15, 20

## Results and Discussion

The six plant extracts namely neem, onion, tulsi, garlic, bael and aloe vera were assessed *in vitro* against the three isolates (CF 01, CF 07 and CF 08) of red rot pathogen at concentration of 5, 10, 15 and 20 per cent. All the tested plant extracts varied significantly in inhibiting the mycelial growth of the fungus at different concentration. At 5 per cent concentration, maximum inhibition in mycelial growth was exhibited by Neem (26.04, 22.34, 20.33%) which was followed by Tulsi (21.74, 18.72, 17.07%), Garlic (19.07, 16.22, 16.15%), Aloe vera (17.41%, 13.72% and 12.56%), Onion (15.85, 10.42 and 7.11%) and minimum by Bael (10.22, 5.95, 5.37%) for the three isolates CF 01, CF 07 and CF 08 respectively. At 10 per cent concentration, highest mycelial growth inhibition was shown by Neem (34.30, 33.70, 30.33%) followed by Tulsi (32.30, 30.33, 27.11), Garlic (30.48, 28.00, 25.00%), Aloe vera (28.96, 25.75, 21.59%) and Onion (24.78, 20.39, 17.33). The Bael displayed minimum growth inhibition (15.89, 15.74, 14.89) for CF 01,

CF 07 and CF 08 red rot isolates. At 15 per cent concentration, Neem (60.67, 55.59, 52.67%) proved to be the most effective in suppressing mycelial growth of three isolates CF 01, CF 07 and CF 08 followed by Tulsi (54.89, 51.97, 48.37%), Garlic (50.30, 49.42, 46.15%), Aloe vera (47.56, 46.00, 33.56%) and Onion (43.89, 37.75, 33.33%) and minimum inhibition in case of Bael (23.52, 22.78, 20.59%). At 20 per cent concentration, highest mycelial growth inhibition was displayed by Neem (80.19, 77.78, 73.68%) followed by Tulsi (74.96, 74.53, 67.96%), Garlic (70.48, 68.11, 65.48%), Aloe Vera (67.48, 63.67, 53.00%) and Onion (52.59, 51.64, 43.89%) while, least inhibition was exhibited by Bael (31.33, 30.39, 29.15%) for the isolates CF 01, CF 07 and CF 08 respectively. From the data generated from the Table 2 to 3 it can be concluded that Neem at all the concentrations (5, 10, 15 and 20%) was most efficient in suppressing the growth of all the three isolates i.e. CF 01, CF 07 and CF 08. The Bael was found to be the least effective among all the tested phytoextracts.

**Table 2:** Efficacy of phytoextracts on growth inhibition of *Colletotrichum falcatum* isolate CF 01

SI. No.	Treatment	Concentrations (%)								Mean
		Colony diameter (mm)				Growth inhibition (%)				
		5%	10%	15%	20%	5%	10%	15%	20%	
1.	Onion	75.73	67.70	50.50	42.67	15.85 (23.45)	24.78 (29.84)	43.89 (41.47)	52.59 (46.47)	34.28 (35.31)
2.	Tulsi	70.43	60.93	40.60	22.53	21.74 (27.78)	32.30 (34.62)	54.89 (47.79)	74.96 (59.95)	45.97 (42.54)
3.	Neem	66.57	59.13	35.40	17.83	26.04 (30.67)	34.30 (35.83)	60.67 (51.14)	80.19 (63.54)	50.30 (45.30)
4.	Bael	80.80	75.70	68.83	61.80	10.22 (18.63)	15.89 (23.48)	23.52 (29.00)	31.33 (34.03)	20.24 (26.28)
5.	Garlic	72.83	62.57	44.73	26.57	19.07 (25.89)	30.48 (33.50)	50.30 (45.15)	70.48 (57.07)	42.58 (40.40)
6.	Aloe Vera	74.33	63.93	47.20	29.27	17.41 (24.65)	28.96 (32.55)	47.56 (43.58)	67.48 (55.21)	40.35 (39.00)
7.	Control	90.00	90.00	90.00	90.00	0.00	0.00	0.00	0.00	0.00

						(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
	Mean	-	-	-	-	18.39 (25.18)	27.78 (31.64)	46.80 (43.02)	62.84 (52.71)	
		Treatment (T)				Concentrations (C)			T × C	
	CD (5%)	0.26				0.21			0.52	
	S Em±	0.09				0.07			0.18	

**Table 3:** Efficacy of phytoextracts on growth inhibition of *Colletotrichum falcatum* isolate CF 07

SI. No.	Treatment	Concentrations (%)								Mean
		Colony diameter (mm)				Growth inhibition (%)				
		5%	10%	15%	20%	5%	10%	15%	20%	
1.	Onion	80.63	71.65	56.03	43.53	10.42 (18.82)	20.39 (26.83)	37.75 (37.89)	51.64 (45.92)	30.05 (32.37)
2.	Tulsi	73.15	62.70	43.23	22.93	18.72 (25.63)	30.33 (33.41)	51.97 (46.11)	74.53 (59.67)	43.89 (41.20)
3.	Neem	69.90	59.68	39.98	20.00	22.34 (28.19)	33.70 (35.47)	55.59 (48.19)	77.78 (61.85)	47.35 (43.42)
4.	Bael	84.65	76.60	69.50	62.65	5.95 (14.10)	15.74 (23.37)	22.78 (28.50)	30.39 (33.44)	18.50 (24.68)
5.	Garlic	75.40	64.80	45.53	28.71	16.22 (23.74)	28.00 (31.93)	49.42 (44.65)	68.11 (55.59)	40.44 (38.98)
6.	Aloe Vera	77.65	66.83	48.60	32.70	13.72 (21.73)	25.75 (30.48)	46.00 (42.69)	63.67 (52.91)	37.29 (36.95)
7.	Control	90.00	90.00	90.00	90.00	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
	Mean	-	-	-	-	14.56 (22.04)	25.51 (30.13)	43.92 (41.34)	61.02 (51.56)	
		Treatment (T)				Concentrations (C)			T × C	
	CD (5%)	0.21				0.17			0.42	
	S Em±	0.07				0.06			0.15	

**Table 4:** Efficacy of phytoextracts on growth inhibition of *Colletotrichum falcatum* isolate CF 08

SI. No.	Treatment	Concentrations (%)								Mean
		Colony diameter (mm)				Growth inhibition (%)				
		5%	10%	15%	20%	5%	10%	15%	20%	
1.	Onion	83.60	74.40	60.00	50.50	7.11 (15.46)	17.33 (24.59)	33.33 (35.25)	43.89 (41.47)	25.42 (29.19)
2.	Tulsi	74.63	65.60	46.47	28.83	17.07 (24.40)	27.11 (31.37)	48.37 (44.05)	67.96 (55.51)	40.13 (38.83)
3.	Neem	71.70	62.70	42.60	23.70	20.33 (26.79)	30.33 (33.41)	52.67 (46.51)	73.67 (59.10)	44.25 (41.45)
4.	Bael	85.17	75.83	71.47	63.77	5.37 (13.37)	14.89 (22.69)	20.59 (26.97)	29.15 (32.66)	17.71 (24.09)
5.	Garlic	75.47	67.50	48.47	31.07	16.15 (23.68)	25.00 (29.99)	46.15 (42.77)	65.48 (54.00)	38.20 (37.61)
6.	Aloe Vera	78.70	70.57	59.80	42.30	12.56 (20.74)	21.59 (27.68)	33.56 (35.39)	53.00 (46.70)	30.18 (32.63)
7.	Control	90.00	90.00	90.00	90.00	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
	Mean	-	-	-	-	13.10 (20.74)	22.85 (28.40)	39.11 (38.49)	55.53 (48.24)	
		Treatment (T)				Concentrations (C)			T × C	
	CD (5%)	0.30				0.24			0.60	
	S Em±	0.10				0.09			0.21	

The results are in agreement with the Yadav *et al.* (2009) <sup>[10]</sup>, Abbas *et al.* (2016) <sup>[11]</sup> and Tariq *et al.* (2017) <sup>[8]</sup> they have also reported the fungicidal activity of Neem leaf extracts against the pathogen *Colletotrichum falcatum*. Bhardwaj and Sahu (2014) <sup>[2]</sup> reported that Tulsi was highly effective in suppressing mycelial growth of the red rot pathogen. The highest antifungal activity of Neem may be attributed to the presence of antifungal compound azadirachtin in Neem leaves as reported by Sadri *et al.* (1983) <sup>[7]</sup>.

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