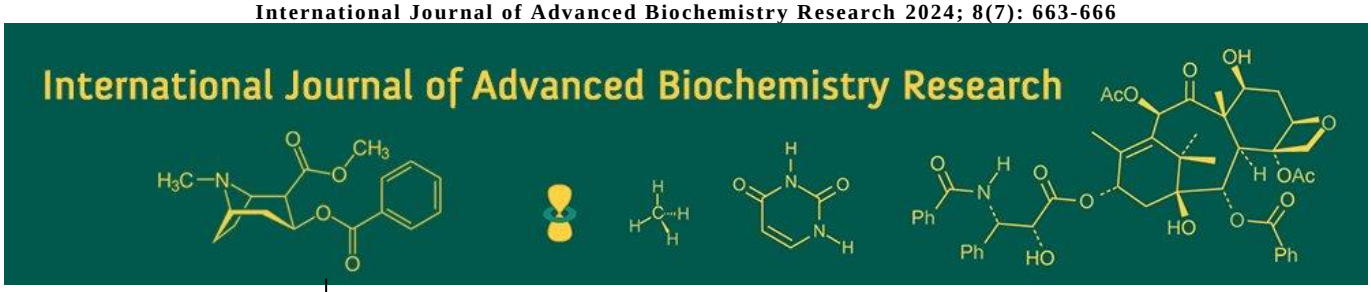

ISSN Print: 2617-4693
ISSN Online: 2617-4707
IJABR 2024; 8(7): 663-666
www.biochemjournal.com
Received: 23-05-2024
Accepted: 28-06-2024

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Evaluation of botanicals and essential oils under *in vitro* condition against sheath rot disease of rice

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DOI: https://doi.org/10.33545/26174693.2024.v8.i7h.1566

Abstract
Rice (*Oryza sativa* L.) belongs to the grass Poaceae family known as the Gramineae, is the second most important cereal crop grown throughout the world. Sheath rot, caused by *Sarocladium oryzae* (Sawada) Gams and Hawksworth has achieved the status of a major disease of rice and yield loss reported up to 3 to 85%. Efficacy of botanical extracts, essential oils were tested against the sheath rot pathogen *S. oryzae* under *in vitro* condition. Three botanical plants extract in combinations to each other were test for their anti-fungal activity against the pathogen, among the treatments Karanj + Garlic + Neem extract was recorded significantly reduced the mean mycelial growth (21.31 mm) and maximum inhibition (54.30%). The essential oils i.e. Clove, and Neem oils were completely (100%) inhibiting the mycelial growth (00.00 mm) at 0.1%.

Keywords: Sheath rot, botanicals, essential oils

Introduction
Rice is a versatile crop which is cultivated for its grain and used as staple food in most parts of the world. About 90 percent of the world's rice is grown and consumed in Asia and 60 percent of world's population depends on rice for their half of the calorie intake (Anon, 2021) [3]. It serves as the primary staple food, feeds more than half of the world's population and is harvested over an area of 163 million hectares in over 100 countries to meet the needs of the world's 3.5 billion people. Rice crop suffers from a large number of fungal, bacterial, and viral diseases. Among all the fungal diseases, sheath rot caused by *Sarocladium oryzae* (Sawada) Gams and Hawksworth, has a major problem in most the country's rice-growing regions including India and Chhattisgarh region. Agnihothrudu (1973) [1] first time reported this disease in India. Sheath rot is one such example which has emerged as of a major threat during the panicle initiation or booting stage. The yield losses have been reported to be 20-85 per cent (Peeters *et al.*, 2021) [8].

Materials and Methods
The efficacy of botanical plants extract, and essential oils was test against sheath rot disease under *In vitro* condition. The sheath rot pathogen *Sarocladium oryzae* was isolated from experimental rice fields department of Plant Pathology, IGKV, Raipur, (C.G.).

In vitro evaluation of botanical / essential oils
The efficacy of different plants extract, and essential oils was tested by using poisoned food technique. The required concentration of botanicals and essential oils were prepared and mixed with PDA medium then poured 20 ml into each Petri dishes and allowed to solidify at room temperature. Ten days old culture of *S. oryzae* cut 8mm mycelial disc by using of sterilized cork borer and placed in the centre of culture medium. The untreated control PDA plates maintain without botanical extract and essential oils. Three replications of each treatment were maintained and incubated at 28±2 °C. The observations of mycelial growth were recorded by using the formula given by Vincent (1927) [11].

$$I = \frac{C - T}{C} \times 100$$

Where,
I = Per cent inhibition of mycelial growth
C = Radial growth in control
T = Radial growth in treatment

Table 1: *In vitro* evaluation of plant extracts against *Sarocldium oryzae*

Treatment	Botanicals	Dose
T1	Karanj (leaves)	5%, 10%
T2	Neem (leaves)	
T3	Garlic (bulb)	
T4	Karanj (leaves) + Neem (leaves)	
T5	Karanj (leaves) + Garlic (bulb)	
T6	Garlic (bulb) + Neem (leaves)	
T7	Karanj (leaves) + Garlic (bulb)+ Neem (leaves)	
T8	Control	

Table 2: *In vitro* evaluation of Essential oils against *Sarocldium oryzae*

Treatment	Essential oils	Dose
T1	Peppermint	0.05%, 0.1%
T2	Basil	
T3	Clove	
T4	Lemon grass	
T5	Eucalyptus	
T6	Neem	
T7	Control	

Results and Discussion

The experimental result of *in vitro* condition the botanicals treatment Karanj + Garlic + Neem extract was recorded significantly reduced the mean mycelial growth (21.31mm) and maximum inhibition (54.30%) of *S. oryzae* over control treatment which is statistically at par with Garlic + Neem (21.41 mm), Karanj + Garlic (22.01 mm), Karanj + Neem (22.04 mm), Garlic (22.67 mm), Neem (22.85 mm), Karanj (23.43 mm) extract and minimum inhibition (47.87%), whereas the maximum mycelial growth was recorded with control treatment (46.87 mm) (Table -3 Plate -1) Fig. 1.

The above findings supported by Sunil Kumar and Patibanda (2015) [10] and Sanjeev Kumar *et al.*, (2015) [9] reported that bulb extract of *Allium sativum* and Neem (*Azadirachta indica*) extract was effective in inhibiting the growth of *S. oryzae* (63.4%) and (48.3%) respectively.

In vitro experimental result of the essential oils i.e. Clove and Neem oils were completely (100%) inhibiting the mean mycelial growth (00.00 mm) of *S. oryzae* over control treatment are followed by the treatment of Lemongrass (9.92 mm), Eucalyptus (10.08 mm), Peppermint (17.81mm) oil, Basil (28.49 mm) and minimum inhibition (39.76%), whereas the maximum mycelial growth was recorded with control treatment (46.87 mm) (Table 4- Plate -2) Fig. 2.

The highest mycelial growth inhibition was obtained by Clove, Neem (*Azadirachta indica*) extract containing eugenol and azadirachtin compound respectively which reduced fungal ability to produce mycotoxins and mycelial growth. The present finding was supported by Nayak Meghana Suresh *et al.*, (2022b) [7] among the treatment's neem oil was recorded maximum inhibition (91.17%) at 0.5%.

Table 3: Evaluation of botanicals against *S. oryzae* under *in-vitro* condition

Treatments	Botanicals	Radial growth (mm)		Mean Radial growth (mm)	% inhibition of mycelial growth in different concentration		Mean (%) inhibition
		5%	10%		5%	10%	
T_1	Karanj	25.00	23.86	23.43	46.66	49.09	47.87
T_2	Neem	23.36	22.33	22.85	50.16	52.35	51.25
T_3	Garlic	22.87	22.47	22.67	51.20	52.05	51.62
T_4	Karanj + Neem	22.50	21.58	22.04	51.90	53.95	52.92
T_5	Karanj + Garlic	22.36	21.66	22.01	52.29	53.78	53.03
T_6	Garlic + Neem	22.43	20.40	21.41	52.14	56.47	54.30
T_7	Karanj + Garlic + Neem	22.30	20.32	21.31	52.42	56.64	54.53
T_8	Control	46.87	46.87	46.87			
SE(m)±		0.78	0.70	0.74			
CD at 1%		2.04	2.45	2.24			
CV		4.07	5.42	4.74			

* Average three replication days after inoculation
** Percent growth inhibition

Table 4: Evaluation of essential oils against *S. oryzae* under *in-vitro* condition

Treatments	Essential oils	Radial growth (mm)*		Mean Radial growth (mm)	(%) ** inhibition of mycelial growth in different concentration		(%) mean inhibition
		0.05%	0.1%		0.05%	0.1%	
T_1	Peppermint	24.83	10.80	17.81	47.02	76.95	61.98
T_2	Basil	31.15	25.83	28.49	33.51	46.02	39.76
T_3	Clove	00.00	00.00	00.00	100	100	100
T_4	Lemongrass	19.84	00.00	9.92	57.69	100	78.84
T_5	Eucalyptus	20.16	00.00	10.08	56.98	100	78.49
T_6	Neem	00.00	00.00	00.00	100	100	100
T_7	Control	46.87	46.87	46.87			
SE(m)±		0.89	0.84	0.86			
CD at 1%		2.28	2.15	2.21			
CV		3.88	5.25	4.56			

* Average three replication days after inoculation
** Percent growth inhibition

Plate 1: Evaluation of botanicals against *S. oryzae* under *in-vitro* condition

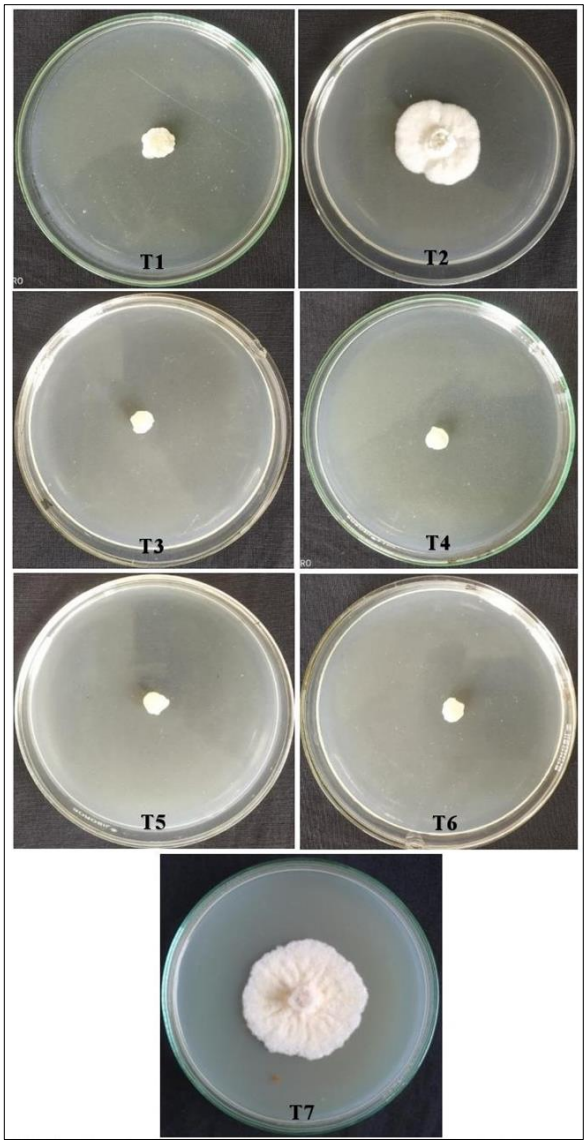

Plate 2: Evaluation of essential oils against *S. oryzae* under *in-vitro* condition

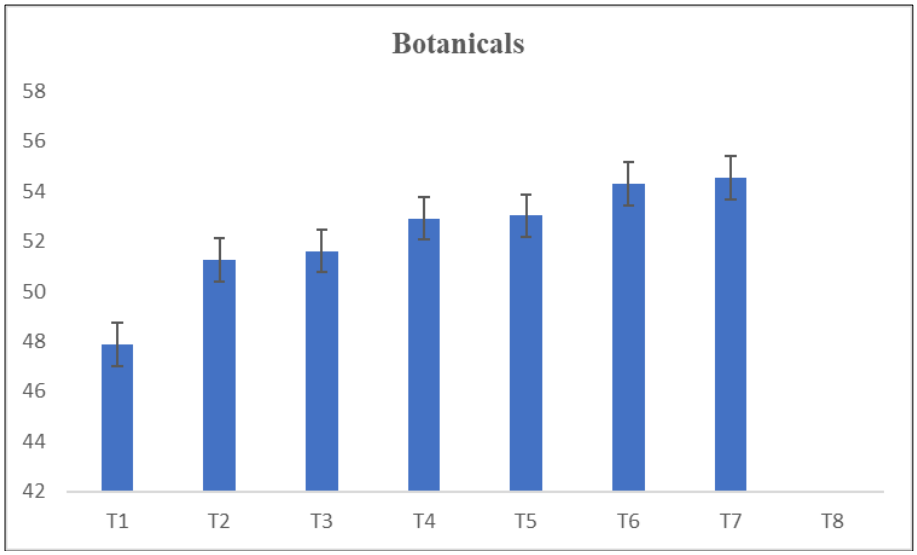

Fig 1: Evaluation of botanicals against *S. oryzae* under *in-vitro* condition (percent mean inhibition)

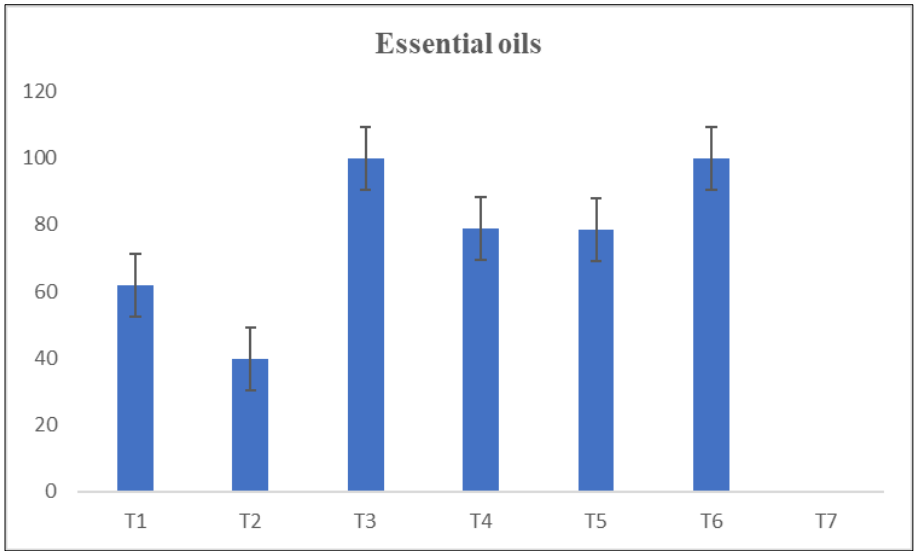

Fig 2: Evaluation of essential oils against *S. oryzae* under *in-vitro* condition (percent mean inhibition)

Conclusion

Sheath rot of rice caused by *Sarocladium oryzae* is an important disease of rice. The present study was to evaluate the efficacy of some ecofriendly approaches (botanicals, essential oils,) for management of sheath rot disease of rice. The results were concluded that all the treatments significantly reduced the mycelial growth of *S. oryzae*. The botanicals treatment Karanj + Garlic + Neem extract was recorded significantly reduced the mean mycelial growth (21.31mm) and maximum inhibition (54.30%) of *S. oryzae* over control treatment. The treatment of essential oils i.e. Clove and Neem oils were completely (100%) inhibiting the mean mycelial growth (00.00 mm) of *S. oryzae* over control treatment.

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