To find out the efficacy of different bio-agents, botanicals, fungicides andnano-fungicides against *Pyricularia oryzae*.

ABSTRACT

A study entitled 'To find out the efficacy of different bio-agents, botanicals, fungicides andnano-fungicides against *Pyricularia oryzae*'was conducted during the period 2021-2023 at, Department of Plant Pathology, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur and the field experiments at Student Instructional Farm, Chandra Shekhar Azad University of agriculture and Technology, Objectives are to evaluate bio-agent, botanicals, Azotrix(Azoxystrobin 16.7 % + Tricyclazole 33.3% SC) and nanofungicidesalone to evaluatethere efficacy in reduction of mycelial growth of *Pyricularia oryzae* causing rice blast in Completely randomised design (CRD) under in-vitro condition by adopting principle of dual culture technique and foodpoision technique. All the selected treatments proved effective and reduce mycelial growthof pathogen among bioagents *T. viride* were superior over *T.harzianum*, and *Pseudomonasfluorescence* was better than *Bacillussubtilis*, in botanicals bael leaf extract superior over neem leaf extract, Azotrix alone can reduce growth upto 85% over control and among nanofungicides Silver nanoparticles was found best.These two paragraphs in red indicate contributions; the information is very limited. I suggest expanding this section.

Keywords: Rice blast, *pyricularia oryzae*, botanicals, bioagents, Nanofungicides.

Resumenmuydeficiente: la aportación se restirnge a

Introduction

Rice (*Oryza sativa* L.) is belongs to the family *Poaceae* and sub-family *Oryzoideae*. It is an essential food crop grown worldwide and gaining importance for more than half of world population. Rice is an annual crop which flourishes comfortably in hot and humid climates. It is good nutritional source of carbohydrate which provides an instant energy. It is the major source of food for more than 2.7 billion peoples of the world and by the year of 2025, this number will grow to 3.9 billion peoples. Human consumption accounts for 85% of total production for rice. More than 90% of the world's rice is produced and consumed in the Asia-Pacific region.Rice has shaped the

culture, diets and economic of thousands of millions of peoples. For more than half of the humanity “Rice is life”. Considering its importance position, the United Nation designated year 2004 as the “International Year of Rice”. There are numbers of cultivar in rice crop but Basmati rice hold prime position for public demand due to its unique aroma, taste and features. The word 'Basmati' is derived from two Sanskrit roots: (“vas” fragrance) and (may be entrenched or present from the beginning). Basmati, a unique fragrance rice, is a natural gift to the Indian subcontinent. It is the queen of rice. Epicureans praised its exquisite scent, taste, and texture, deeming it the most aromatic rice in the world. Aromatic rice emits a particular aroma in fields, during harvesting, storage, milling, cooking and eating. (Efferson, 1985).

The estimated total volume of milled rice produced worldwide reached over 502 million metric tons in the 2022/2023 crop year.India is the largest rice producing country accounting for about one third of the world acreage under the crop. The major rice growing states of India are West Bengal, Uttar Pradesh, Madhya Pradesh, Bihar, Odisha, Karnataka, Chhattisgarh, Andhra Pradesh and Gujarat. As per the Indian Agriculture Ministry, the area for rice production in 2023 is 411.52 lakh hectare, which is higher than 404.72 lakh hectare during 2022.India's estimated a production volume of rice was over 135 million metric tons having yield of 4.3 T/ha (Ministry of Agriculture & Farmers Welfare,2023).

India is the largest exporter of rice globally. In 2022, the production of basmati rice was down 15 percent in 2021 due to heavy rainfalls during the harvesting seasons. However, overall rice exports increased to 46 percent as compared to the previous year because of an increase in the purchase of rice by neighbouring countries such as Bangladesh, Vietnam, and China.India is the leading exporter of Basmati Rice to the global market. The country has exported 4558972.23 MT of Basmati Rice to the world for the worth of Rs. 38524.11 Crores (4787.50 US$ Mill.) during the year 2022-23 (APEDA).

This disease is extremely important in rice cultivation.: ¿¿¿How much are the losses in Basmati rice due to this disease??

MATERIALS AND METHODS

A study entitled To find out the efficacy of different bio-agents, botanicals, fungicides andnano-fungicides against *Pyricularia oryzae’*was conducted during the period 2021-2023 at, Department of Plant Pathologyand Student Instructional Farm, Chandra

Shekhar Azad University of Agriculture and Technology,~~Kanpur and the field experiments at Student Instructional Farm, Chandra Shekhar Azad University of agriculture and Technology, Kanpur.~~The suitable concentrations of botanical extract (@ 10 %, 20%, 40%, 60 %), bio-agents (*Trichoderma viride*, *Trichoderma harzianum*, *Pseudomonas fluorescens*,*Bacillus subtilis*), fungicides and nanofungicides~~willbe~~wereused against mycelial growth of *Magnoporthae grisea* by the poison food technique (Shravelle,1961) and dual culture technique (Dickinson and Skidmore, 1976) respectively. Per cent inhibition of growth ~~will be~~werecalculated by following formula as given by (Horsfall, 1956) and data obtained on per cent inhibition were subjected to statistical analysis-

$$X = \frac{Y-Z}{Y} X100$$

Where, X=Percentgrowthinhibition
Y=Growthoffungusincontrol(mm)
Z=Growthoffungusintreatment(mm)

The 40 and 60% extract doses using the poisoned food technique are very high and impractical.In my opinion they should be discarded.

Recording observations:

The present investigation was conducted under the laboratory conditions to study the "Development of Biointensive Integrated Disease Management (BIDM) practices against blast of basmati rice caused by *Magnoporthae grisea*" The findings are presented to focus the research of other scientists' that has a direct or indirect relationship with the current topic.

Results And Discussion

1. In vitro screening of the bioagent antagonists

Dual culture technique was used for studying the mechanism of parasitism of the bioagentson *P.oryzae*. When fungal and bacterial isolates were paired with *P. oryzae*, among Trichoderma species, the percentage inhibition of fungal growth was recorded (Table 1). The percentage inhibition was significantly superior for *Trichoderma Viride* (46.47 per cent), compared

to*Trichoderma harzianum*(43.26 per cent) and hence *Trichoderma Viride* was selected for further studies (Table 1).The effectiveness of the potential bio control agent, This observation is in line with findings of (Singh *et al.*, (2005) and (Nayar (1996) where it could reduce the leaf blast by treatment with *Trichoderma* sp. and *Psuedomonasfluroscence* respectively.Based on the data of Table, the *Psuedomonasfluroscence* which had higher percentage of inhibition on *P. oryzae* (57.71 per cent) than *Bacillus subtilis* (48.54 per cent) was selected as the bacterial antagonist for further studies (Table 1).

Present the percentage from highest to lowest of the inhibition or antagonism effect. The metabolites or active ingredients that produce the antagonists and how they affect P. oryzae are not mentioned. What is the identity of the P. oryzae isolate used in the present study??? The formation and production of P oryzae conidia was also affected???

Table 1. Efficacy of different bio agents against *M. grisea*

Radial mycelial growth(mm)					
Name of Bioagents	**3rd Day**	**5th Day**	**7thDay**	**Percent inhibition over control**	
Control	**90**	**90**	**90**		
Psuedomonasfluroscence	24.31	32.96	38.06	57.71	
Bacillus subtilis	29.21	40.13	46.31	48.54	
Trichoderma Viride	10.51	17.31	48.17	46.47	
Trichoderma harzianum	8.56	18.61	51.06	43.26	
~~***Trichoderma Viride***~~	~~10.51~~	~~17.31~~	~~48.17~~	~~46.47~~	
~~***Psuedomonasfluroscence***~~	~~24.31~~	~~32.96~~	~~38.06~~	~~57.71~~	
~~***Bacillus subtilis***~~	~~29.21~~	~~40.13~~	~~46.31~~	~~48.54~~	
~~**Control**~~	~~90~~	~~90~~	~~90~~		
C.D.	**2.317**	**3.298**	**5.288**		
SE(m)	**0.657**	**0.935**	**1.499**		

?? Que indica C.D??? Anotar:

?? Que indica SE (m)??? Anotar:

1.2 In vitro evaluation of botanicals on the inhibition of mycelial growth of *P. oryzae*

1.2.1 Evaluation of Bael leaf extract against *M. grisea* in vitro

The efficacy of Bael leaf extract against *M. grisea*, at 10%, 20%, 40% and 60% concentrations is shown in table (Table 2). The results of in vitro study evinced that, at 10% concentration the mycelium growth inhibition was 65.28% of *M. grisea*while, at 20% concentration it was 72.37% inhibition of *M. grisea* and at 40% concentration mycelium inhibition was 79.62% however, at 60% concentration maximum mycelium growth inhibition was recorded 86.32% of *M. grisea*.The evaluated data are in favour of findings of previous researcher work done like Dutta and Kalha (2011); Routa*et al.*, (2012)

Table 2Efficacy of Bael leaf extract against *M. grisea*

		Radial mycelial growth (mm)			
Name of Botanicals	**Cocentration**	**3rd Day**	**5th Day**	**7thDay**	**Percent inhibition over control**
Bael leaf extract	10%	20.12	26.12	31.06	65.49
	20%	16.43	19.56	24.86	72.37
	40%	12.89	14.21	18.34	79.62
	60%	7.53	8.91	12.31	86.32
Control		90	90	90	
C.D.		**1.753**	**2.133**	**2.644**	
SE(m)		**0.497**	**0.605**	**0.75**	

1.2.2 Evaluation of Neem leaf extract against *M. grisea* in vitro

Another botanical i.e., Neem leaf extract also used against *M. grisea*at 10%, 20%, 40% and 60% concentrations is shown in table (Table 3). The results of in vitro study revealed out that, at 10% concentration the mycelium growth inhibition was 62.82% of *M. grisea*while, at 20% concentration it was 67.95% inhibition of *M. grisea* and at 40% concentration mycelium inhibition was 74.43% however, at 60% concentration maximum mycelium growth inhibition was recorded 80.92% of *M. grisea* and result are in line of Amadioha (2000) and Kishore *et al.*, (2007).

Table 3Efficacy of Neem leaf extract against *M. grisea*

Radial mycelial growth (mm)					
Name of Botanicals	**Cocentration**	**3rd Day**	**5th Day**	**7thDay**	**Percent inhibition over control**
Neem leaf extract	10%	26.21	29.12	33.46	62.82
	20%	18.31	23.56	28.84	67.95
	40%	14.29	19.54	23.01	74.43
	60%	11.98	14.61	17.17	80.92
Control		90	90	90	
C.D.		**2.116**	**2.601**	**3.069**	
SE(m)		**0.6**	**0.737**	**0.87**	

1.2.3 Evaluation of Fungicide against *M. grisea* in vitro

Azotrix(Combination of Azoxystrobin 16.7 % + Tricyclazole 33.3% SC) fungicides were evaluated at 25~~ppm~~, 50 ~~ppm~~ and 100ppm, the percentage of inhibition of all of them were significantly different from each other (Table 4). The highest percent inhibition 85.03% over control was recorded at 100ppm, after that 61.87% at 50ppmand least inhibition percentage observed at 25ppm was 17%. The increase in per cent of inhibition was significantly increases with increase in concentration of fungicide.The similar results were also reported byNaik *et al.*, 2014; Kunova*et al.*, 2013 and Surapu*et al.*,2017 against *P. oryzae.* Ravikumar *et al.,* 2022 in his research concluded that Azoxystrobin 16.7% + Tricyclazole 33.3% SC @ 750 ml/ha was best in controlling the sheath blight, blast and brown spot disease of paddy.

Table 4Efficacy of Azotrixagainst *M. grisea*

Radial mycelial growth (mm)					
Name of Fungicide	**Cocentration(ppm)**	**3rd Day**	**5th Day**	**7thDay**	**Percent inhibition over control**

Azotrix(Azoxystrobin 16.7 % + Tricyclazole 33.3% SC)	25	39.21	53.96	74.7	17
	50	18.12	24.13	34.31	61.87
	100	7.23	11.12	13.47	85.03
Control		90	90	90	
C.D.		**3.417**	**4.708**	**6.49**	
SE(m)		**0.848**	**1.168**	**1.61**	

1.2.4 Evaluation of Nanofungicide against *M. grisea* in vitro

Among three synthetic nanofungicide namely silver nanoparticles, copper chitosan and salicylic acid nanoparticles having concentration 10, 20 and 100 respectively (Table 5). Silver nanoparticles show the maximum percent inhibition of mycelium over control i.e., 61.87% at 10 ppm while copper chitosan inhibit upto48.55% percent of mycelium growth at 20 ppm. However salicylic acid significantly inhibit 43.21% mycelium growth at 100ppm with respect to other nanoparticles (Table 5).The above finding are in favour ofElamawi*et al*., 2013;Silva *et al*., 2018 and Gaderer*et al*., 2014.

Table 5Efficacy of Different nanofungicidesagainst *M. grisea*

Radial mycelial growth (mm)					
Name of Nanofungicide	**Cocentration(ppm)**	**3rd Day**	**5th Day**	**7thDay**	**Percent inhibition over control**
silver nanoparticles	10	12.96	23.56	34.31	61.87
Copper chitosan	20	17.13	32.12	46.3	48.55
salicylic acid	100	14.54	29.36	51.12	43.21
Control		90	90	90	
C.D.		**2.175**	**4.147**	**6.435**	
SE(m)		**0.539**	**1.029**	**1.596**	

Conclusion

Our findings showed that radial growth of fungal mycelium were inhibited as influenced by different treatments. Among the bio-agents and botanicals *Pseudomonas fluorescens*, *Trichoderma viride*, bael leaf extract and neem leaf extract suppressed the growth of *P. oryzae* and proved its potential as bio-control.More studies are therefore needed to confirm the current findings and to determine the most effective formulation against *P. oryzae*.

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