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Evaluation of Different Treatments on the Management of Black Gram Powdery Mildew Disease Caused by *Erysiphe polygoni* (De Candolle)

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Abstract

Black gram (*Vigna mungo* L.), is one of the most important short duration pulse crops grown in India. Powdery mildew caused by *Erysiphe polygoni* is a major destructive disease causing drastic economic yield loss upto 50 per cent. In this present study to evaluation of different treatments on the management of powdery mildew on Black gram. Among five mangrove species tested, the leaf extract of *Rhiphora apiculata* out performed well recording maximum inhibition of conidial germination. In case of fungicides, Azoxystrobin @ 0.1% significantly reduced the conidial germination. The bio-agent *Ampelomyces quisqualis* was found to be effective at 0.5 per cent concentration against the pathogen. The susceptible variety ADT-3 was raised in both pot and field for management practices. The treatment involving combination of bio-agent and botanical i.e., foliar spraying of A. quisqualis @ 0.5% on 43 DAS AND 53 DAS + foliar spraying of R. apiculata @ 15% on 43 DAS+ 53 DAS recorded minimum per cent disease index in both pot (18.94 %) and field trial (14.50%). The synergistic effect of *A. quisqualis* and *R. apiculata* significantly reduces the disease incidence and considerably improve the biometric of blackgram in both pot and field trials are approximately equal to fungicide application.

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Keywords

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Azoxystrobin;
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Rhiphora Apiculata.

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Introduction

Black gram (*Vigna mungo* L.) is one of the most important short-duration pulse crops grown in India. The pulse 'Black gram' plays an important role in the Indian diet, as it contains a high amount of protein and it is a supplement to a cereal-based diet. The green pods are eaten as a vegetable and they are highly nutritious. Black gram is rich in easily digestible protein 25.21 per cent, contains about 58 per cent of carbohydrate, 2 per cent of fat, 0.273 mg of vitamin B1, 0.254 mg of vitamin B2, 1.447 mg of Vitamin Niacin, 138 mg of calcium, 379 mg of phosphorus, 7.57 mg of iron per 100 gram of seeds (USDA National Nutrient data base). Since it serves as a cheaper source of protein for the poor, it is rightly called the "Poor man's meat" and can also be used as green manure.

Black gram originated from South Asia, later it has been in cultivation in many parts of Asia, Australia, West Indies, South and North America, and tropical and subtropical Africa. In India, it is primarily grown in Madhya Pradesh, Maharashtra, Orissa, Andhra Pradesh, Uttar Pradesh, and Tamil Nadu. Asia alone contributes about 90% of the world's total black gram production. In India, black gram is cultivated around an area of 4.6 m ha with a total production of 24.5 lakh t and productivity of 543 kg ha^{-1} whereas, in Tamil Nadu, it holds an area of 3.7 lakh ha with a production of 2.7 lakh t and productivity of 650 kg / ha.[1]

In the case of its vast growing area and production, its productivity is low due to various biotic and abiotic stresses.[2] Among all the fungal diseases, powdery mildew caused by *Erysiphe polygoni* is the major one. The pathogen was reported by de Candolle and found to be one of the most economically important diseases in black gram which occurs at the later stages of the crop growth causing high yield loss.

Powdery mildew is usually noticed in 45 days old crops in black gram.[3] In the powdery mildew disease white, powdery patches appear on leaves and other green parts and later become dull in color. These patches gradually increase in size and become circular, covering the lower surfaces as well. Severely affected parts become shriveled and distorted. In severe infections, the foliage turns yellow, causing premature defoliation. Powdery mildew results in qualitative and quantitative loss of grains. The reduction in photosynthetic activity and physiological changes takes place leading to 40-90% yield loss depending on the stage and the occurrence of the disease.[4]

Many systemic and non-systemic fungicides were reported to manage the powdery mildew of black gram. However, the application of chemicals causes environmental pollution and is injurious to the soil ecosystem. The information on the efficacy of new generation fungicide, botanical and organic amendment against powdery mildew of black gram is insufficient. Hence bio-control agents and botanicals are used against *E. polygoni*.

In the present study to screening the efficacy of different treatments to management of black gram powdery mildew under pot and field trial.

Materials And Methods

Experimental Details

Management practices were carried out against *E. polygoni* in black gram variety ADT-3. The leaf extract and *A. quisqualis* were prepared as per the recommended dosage. The treatments were sprayed on all aerial parts of the plant using a hand sprayer. The first spraying was taken up before the initial appearance of the disease in the crop i.e., 43 DAS and further spray was given at 10 days intervals on 53 DAS.[2] The pot trial and field trial was conducted with nine treatments including control. The cultivation practices have been carried out following righteous procedures uniformly.

Layout (Experimental farm, Annamalai University)

Season	:	*Kuruvai*
Design	:	RBD
Replications	:	3
No. of. pots	:	27
Duration	:	70-75 days
Variety	:	ADT-3

Field Layout

T_2	IRRIGATION	T_7	IRRIGATION	T_8
T_5	CHANNEL	T_6	CHANNEL	T_2
T_4		T_1		T_9
T_8		T_9		T_3
T_1		T_2		T_5
T_9		T_5		T_1

T_3	T_4	T_7
T_6	T_8	T_4
T_7	T_3	T_6

Treatment Details

T_1 : *Ampelomyces quisqualis* @ 0.5% on 43 DAS
T_2 : *Ampelomyces quisqualis* @ 0.5% on 53 DAS
T_3 : *Rhizophora apiculata* @ 15 ml on 43 DAS
T_4 : *Rhizophora apiculata* @ 15 ml on 53 DAS
T_5 : $T_1 + T_2$
T_6 : $T_3 + T_4$
T_7 : $T_5 + T_6$
T_8 : Azoxystrobin @ 0.1%
T_9 : Control

Since, Azoxystrobin is effective against powdery mildew disease, it is used as standard check for further studies. In case of compatibility, *in vitro* study is tedious since it is an obligate parasite. Hence, field study was carried out and both bio agent and botanical were found to be compatible as they showed significant better result in combined application than individual.

Observations on Powdery Mildew Incidence

Observations were made on the prevalence and severity of powdery mildew at different stages to record the prevalence of disease after 1st spray and 2nd spray.

Statistical Analysis

Statistical evaluation was done using the analysis of variance (ANOVA) followed by the Duncan's Multiple Range Test (DMRT). The statistical significance was expressed at p≥ 0.05. Here we used Replicator software and Wasp software for statistical analysis.

Result and Discussion

Evaluation of Different Treatments on Management of Black Gram Powdery Mildew Disease (Pot Trial & Field Trial)

A pot trial was conducted to evaluate the efficacy of bio-agents, botanicals and fungicides against powdery mildew of black gram during 2022 with bio-agent, botanical and a fungicide. Observations on per cent disease index was recorded. In the present investigation, Azoxystrobin 25% SC @ 0.1 % was found to be effective against *E. polygoni.* The fungicide recorded PDI of 19.30 per cent after 1st spray and 9.37 per cent after 2nd spray followed by foliar application of *A. quisqualis* @ 0.5% on 43 DAS + A. quisqualis @ 0.5% on 53 DAS + *R. apiculata* @ 15% on 43 DAS + *R. apiculata* @ 15% on 53 DAS with PDI 23.25 per cent after 1st spray and 14.63 per cent after 2nd spray. The untreated plants showed higher PDI of 51.76 per cent to 67.47 per cent (Table 1).

Table 1: Evaluation of different treatments on management of blackgram powdery mildew disease (Pot trial)

Treatment number	Treatment	Disease Index (%)		Mean	Disease control (%)		Mean
		After 1st spray	After 2nd spray		After 1st spray	After 2nd spray	
T_1	*Ampelomyces quisqualis* @ 0.5% on 43 DAS	36.17^e -36.95	30.71^e -33.63	33.44	30.11	54.48	42.19
T_2	*Ampelomyces quisqualis* @ 0.5% on 53 DAS	41.90^f -40.32	36.39^f -37.08	39.14	19.04	46.06	32.42
T_3	*Rhizophora apiculata* @ 15% on 43 DAS	45.42^g -42.35	41.48^g -40.07	43.45	12.24	38.52	25.24
T_4	*Rhizophora apiculata* @ 15% on 53 DAS	49.31^h -44.58	45.35^h -42.31	47.33	4.73	32.78	18.6
T_5	$T_1 + T_2$	27.45^c -31.58	20.48^c -26.89	23.96	46.96	69.64	58.22
T_6	$T_3 + T_4$	32.90^d -34.98	25.62^d -30.39	29.26	36.43	62.02	49.13

T_7	$T_5 + T_6$	23.25[b] (-28.81)	14.63[b] (-22.47)	18.94	55.08	78.31	66.62
T_8	Azoxystrobin @ 0.1%	19.30[a] (-26.04)	9.37[a] (-17.81)	14.33	62.71	86.11	74.35
T_9	Control	51.76[i] (-45.99)	67.47[i] (-55.21)	59.61			

*Figures in parentheses are arc sin transformed value

A field trial was conducted to evaluate the efficacy of bio-agents, botanicals and fungicides against powdery mildew of black gram during 2022 with bio-agent, botanical and a fungicide. Observations on per cent disease index was recorded. In the present investigation, Azoxystrobin 25% SC @ 0.1 % was found to be effective against *E. polygoni.* The fungicide recorded PDI of 15.50 per cent after 1st spray and 6.98 per cent after 2nd spray followed by foliar application of *A. quisqualis* @ 0.5% on 43 DAS + *A. quisqualis* @ 0.5% on 53 DAS+ *R. apiculata* @ 15% on 43 DAS+ *R. apiculata* @ 15% on 53 DAS with PDI 19.95 per cent after 1st spray and 9.06 per cent after 2nd spray. The untreated plants showed higher PDI of 48.17 per cent to 64.37 per cent (Table 2).

Table 2: Evaluation of different treatments on management of blackgram powdery mildew disease (Field trial)

Treatment number	Treatment	Disease Index (%)		Mean	Disease control (%)		Mean
		After 1st spray	After 2nd spray		After 1st spray	After 2nd spray	
T_1	*Ampelomyces quisqualis* @ 0.5% on 43 DAS	32.46[e] (-34.71)	28.49[e] (-32.24)	30.47	32.61	55.74	44.17
T_2	*Ampelomyces quisqualis* @ 0.5% on 53 DAS	37.89[f] (-37.97)	32.37[f] (-34.66)	35.13	21.34	49.71	35.52
T_3	*Rhizophora apiculata* @ 15% on 43 DAS	41.38[g] (-40.02)	37.91[g] (-37.98)	39.64	14.09	41.1	27.59
T_4	*Rhizophora apiculata* @ 15% on 53 DAS	44.26[h] (-41.68)	43.76[h] (-41.39)	44.01	8.11	32.01	20.06
T_5	T1 + T2	23.35[c] (-28.88)	18.82[c] (-25.69)	21.08	51.52	70.76	61.14
T_6	T3 + T4	29.63[d] (-32.96)	23.35[d] (-28.88)	26.49	38.48	63.72	51.1
T_7	T5 + T6	19.95[b] (-26.52)	9.06[b] (-17.51)	14.5	58.58	85.92	72.25
T_8	Azoxystrobin @ 0.1%	15.50[a] (-23.17)	6.98[a] (-15.3)	11.92	67.82	87.04	77.43
T_9	Control	48.17[i] (-43.93)	64.37[i] (-53.34)	56.27			

*Figures in parentheses are arc sin transformed value

Similarly, among various fungicides evaluated, Penconazole 10% EC @ 1 ml per litre of water is the minimum dose required for effective management of urdbean powdery mildew with disease incidence 10.51 per cent4. Taqat 7 WP was found to be significantly effective for managing black gram powdery

mildew with disease incidence 1.48 per cent due to the presence of triazole and hexaconazole components than other fungicides like Tridemorph, Karathane.[5]

An experiment was conducted to assess the efficacy of bio-control agent, botanical and a fungicide.[2] The mean per cent disease incidence ranged from 15.80 to 47.70 in different treatments. The maximum reduction of disease incidence was recorded in wettable sulphur 0.25% (15.80%) followed by carbendazim 0.1% (58.91%) and castor oil 1% with *A. quisqualis* (48.53 per cent).

A field experiment was conducted for testing fungicides and botanicals at IGKV, Raipur during *rabi*, for the management of powdery mildew of black gram.[6] Five treatments are tested *viz*., neem leaf extract @ 3%, eucalyptus leaf extract @ 3%, neem oil @ 3%, *Trichoderma harzianum* @ 3% and *Pseudomonas fluorescence* @ 0.2% against garden pea powdery mildew.[7]

Conclusion

Among the various treatments tested, Azoxystrobin 25% SC @ 0.1 % was found to be effective against *E. polygoni* in both pot and field trial. However, the synergistic effect of *A. quisqualis* and *R. apiculata* was significantly reduced the disease incidence and considerably improve the biometric of blackgram. Thus, it may be consider as an effective bioproduct for the successful management of blackgram powdery mildew disease for future concern instead toxic chemical pesticides.

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Conflict of Interest

I am to state that authors of this study have no conflict of interest.

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