Original Research Article

Integrated management of blast disease in finger millet

ABSTRACT

Aims: To test the effect of bacterial biocontrol agents (*Pseudomonas*-TNAU-Pf1) and fungicides (Tricyclazole) individually and their integration as seed treatment and foliar spray against finger millet blast under field conditions.

Study Design: The field experiments were conducted in a Randomized Block design.

Place and Duration of Study: The experiments were conducted at the Regional Research Station farm, Tamil Nadu Agricultural University, Paiyur, Krishnagiri District, Tamil Nadu, India, during 2016-17 and 2017-18.

Methodology: Two field experiments were conducted to evaluate the efficacy of talc-based formulation of *Pseudomonas* -TNAU-Pf1 and Tricyclazole individually and in combination as seed treatment and foliar application for the management of finger millet blast with five treatments and four replications using a variety Paiyur 2. The bioagent and the fungicide were applied as seed treatment and foliar spray.

Results: The results revealed that seed treatment with talc-based formulation of *Pseudomonas* -TNAU-Pf1 (10g/kg) plus two sprays of tricyclazole (0.1%) one at the maximum tillering phase and another at the heading phase was significantly most effective in reducing leaf, neck and finger blast in both the seasons. The treatment recorded 1.65 and 1.25PDI of leaf blast, 0.33 and 0.22% of neck and 2.55 and 1.33% of finger blast in the first and second season, respectively. The treatment also recorded highest grain yield of 2663 and 2543 kg/ha with BC ratio of 1:3.94 and 1:3.85 in the first and second season, respectively.

Conclusion: Seed treatment with *Pseudomonas* TNAU-Pf1 (10g/kg) plus two sprays of tricyclazole (0.1%) was found to be effective in reducing the incidence of blast disease and increasing grain yield in finger millet.

Key words: Blast, finger millet, integrated disease management, *Pseudomonas*, tricyclazole

1. INTRODUCTION

Finger millet (*Eleusine coracana* Gaertn.), popularly known as 'Ragi', is an important small millet crop in the world, supporting millions of people around the globe and particularly in developing countries. The crop is mostly grown under rainfed conditions by small and marginal farmers of India ensuring their food security. Even though finger millet is renowned for its ability to withstand a variety of biotic and abiotic stresses, under favourable conditions, some diseases can cause significant losses and even destroy the entire crop. Among the various fungal diseases that affect finger millet crops, blast disease caused by *Pyricularia grisea* Sacc. (perfect stage = *Magnaporthe grisea* [Hebert]). Barr. is one of the most devastative and destructive foliar disease. The pathogen attacks all aerial parts of finger millet plant causing leaf, neck and finger blast (1). In the endemic areas, the average loss due to blast disease in finger millet was reported to be around 28% and was reported as high as 80-90% (2). In India, the blast disease is known to occur almost every year in all major finger millet growing areas in the rainy season or in the humid weather, and is considered to be one of the major diseases causing recurrent yield losses in all the Indian states (3).

Management of finger millet blast is mainly depends on chemical fungicides. Among the various fungicides tested against blast disease both in rice and finger millet, tricyclazole was found to be very effective against blast disease (4-7). Similarly, three sprays of carbendazim (0.05%) have been reported to be effective against pearl millet blast (8). However, information on the use of biocontrol agents with fungicides remains very limited, although it is shown that chemical fungicides such as tricyclazole and carbendazim are highly effective in combating blast disease. In addition, the development of integrated disease management strategies is now viewed not only as environmentally friendly but also as sustainable agriculture. Keeping these facts in view, a study was conducted to test the efficacy of bacterial biocontrol agent (*Pseudomonas*-TNAU-Pf1) and a fungicide (Tricyclazole) individually and in combination against leaf, neck and finger blast under field conditions.

2. MATERIALS AND METHODS

A field experiment was conducted at Regional Research Station, Tamil Nadu Agricultural University, Paiyur, Krishnagiri District, Tamil Nadu during November 2016 to February 2017 and December 2017 to March 2018 to evaluate the efficacy of talc-based formulation of bacterial biocontrol agent (*Pseudomonas* -TNAU-Pf1) and a fungicide (Tricyclazole) individually and their integration as seed treatment and foliar spray for the management of finger millet blast with five treatments and four replications under randomized block design using a variety Paiyur 2. The treatments of the experiment were T1: Seed Treatment (ST) with TNAU-Pf1@ 10g/kg of seed +two sprays of TNAU-Pf1@ 10g/litre (l) of water; T2: ST with Tricyclazole @ 2 g/kg of seed + two sprays of Tricyclazole @ 1 g/l; T3: ST with TNAU-Pf1@ 10g/kg of seed + two sprays of Tricyclazole @ 1 g/l; T4: ST with Tricyclazole @ 2 g/kg of seed + two sprays of TNAU-Pf1@ 10g/l and T5: Untreated control.

The seeds were treated with talc-based formulation of TNAU-Pf1 @ 10 g/kg and tricyclazole @ 2g/kg of seeds. Foliar application of *Pseudomonas* (1%) and fungicide (0.1%) was given during the maximum tillering and heading phase using high volume backpack knapsack sprayer. The incidence of leaf blast was recorded after first spray by visual observation following 0-5 scale as: 0 **=** No symptoms on the leaves, 1 **=** Small brown specks of pin head size spot to slightly elongated, necrotic grey spots with brown margin less than 1% leaf area affected, 2 **=** A typical blast lesion, elliptical 5-10 mm long, 1-5% of leaf area affected, 3 **=** A typical blast lesion, elliptical 1-2 cm long, 5-25% of leaf area affected, 4 = 25-50% of leaf area affected and 5 **=** More than 50% leaf area affected and per cent disease index (PDI) was calculated. Percent neck and finger blast were recorded as the percentage of ears showing blast fungus infection on the peduncle and percent of fingers with infection, respectively, at dough stage of the crop (9). The data on plant height (cm) and number of productive tillers/hill was also recorded at heading phase. At crop maturity, the ears were harvested, dried, thrashed, cleaned and per plot yield was recorded from which yield per hectare was computed.

3. RESULTS AND DISCUSSION

The results of the experiment conducted during 2016-17 (Trial I) revealed that all the treatments were significantly effective in reducing the blast disease when compared to untreated control. However,

minimum incidence of leaf (1.65 PDI), neck (0.33%) and finger blast (2.55%) was recorded in seed treatment with talc-based formulation of TNAU-Pf1 plus two sprays of tricyclazole (T3) followed by T2 and T1. Untreated control plots recorded the maximum incidence of 20.25 PDI of leaf blast and 10.24 and 16.29% neck and finger blast, respectively (Table 1). Similarly, the results of the experiment conducted during 2017-18 (Trial II) revealed that the same treatment T3-ST with TNAU-Pf1 plus two sprays of tricyclazole recorded lesser incidence of leaf blast (1.25 PDI), neck blast (0.22%) and finger blast (1.33%) compared to untreated control which recorded 19.00 PDI of leaf blast, 9.66% of neck blast and 14.88% of finger blast.

The results on growth and yield attributes of trial I (2016-17) also revealed that the treatment T3 recorded higher plant height (94.74 cm), number of productive tillers/hill (5.50) and grain yield (2663kg/ha) with BC ratio of 1:3.94 followed by T2 and T1 when compared to untreated control recorded only 1954 kg/ha of grain yield with plant height of 77.44 cm and 3.92 number of productive tillers/hill. The treatment T2 recorded higher grain yield (2544 kg/ha) compared to T1 (2425 kg/ha), however treatment T1 recorded higher BC ratio (1:3.53) followed by T2 (1: 3.27) (Table 2). In the field trial II (2017-18) also, the same trend of results were obtained. Seed treatment with TNAU-Pf1@ 10g/kg + two sprays of Tricyclazole (0.1%) treated plots recorded significantly higher plant height (91.67cm), number of productive tillers/hill (5.40) and grain yield (2543 kg/ha) with the BC ratio of 1:3.85 compared to other treatments.

The present investigation demonstrates that the integrated approach using the bacterial biocontrol agent and fungicide have the potential to suppress different types of blast in finger millet under field conditions. Similarly, Kumar and Kumar (10) reported that seed treatment with *Pseudomonas fluorescens* Pf 2 (0.6%) plus its two foliar sprays (0.6%) followed by two sprays of ediphenphos (0.1%) were significantly most effective in reducing the incidence of blast disease and also increased the grain yield. The fungicides tricyclazole and propiconazole could be effective in controlling blast disease of rice and finger millet (11-12). Seed treatment with carbendazim plus two sprays of tricyclazole was found effective in reducing the incidence of finger millet blast (13). The efficacy of TNAU-Pf1 against blast disease may be attributed to the induction of systemic resistance. The reduction in disease incidence and increase in grain yield might be due to induction of resistance and growth promotion in the plant system

by the *Pseudomonas* seed treatment. Fluorescent pseudomonads have been considered as one of the major groups of bacterial bioagents that induce ISR. However, induced resistance is not the only mode of action but a direct action of a fungicide on the pathogen is also involved which is necessary for protecting the finger millet crop against blast disease.

4. CONCLUSION

Based on the present studies, it can be concluded that seed treatment with a talc-based formulation of TNAU-Pf1 (10g/kg) plus two sprays of tricyclazole (0.1%) one at the maximum tillering phase and another at the heading phase, can be effectively exploited for the management of blast diseases of finger millet.

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Table 1. Effect of bioagent and fungicide on the incidence of finger millet blast

Treatments	Trial I			Trial II		
	Leaf blast (PDI)	Neck blast (%)	Finger blast (%)	Leaf blast (PDI)	Neck blast (%)	Finger blast (%)
T1: ST with TNAU-Pf1@ 10g/kg of seed +two sprays of TNAU-Pf1@ 10g/l	4.75	3.69	6.80	4.00	2.95	4.92
T2: ST with Tricyclazole @ 2 g/kg of seed + two sprays of Tricyclazole @ 1 g/l	3.75	1.95	5.05	3.25	1.66	3.85
T3: ST with TNAU-Pf1@ 10g/kg of seed + two sprays of Tricyclazole @ 1 g/l	1.65	0.33	2.55	1.25	0.22	1.33
T4: ST with Tricyclazole @ 2 g/kg of seed + two	6.50	4.60	7.40	6.00	3.98	5.66

sprays of TNAU-Pf1@ 10g/l						
T5: Untreated control	20.25	10.24	16.29	19.00	9.66	14.88
CD (0.05%)	1.05	1.53	1.65	1.11	1.29	1.50
S ED	0.50	0.72	0.77	0.58	0.61	0.74

ST: Seed treatment

Values are mean of four replications

Table 2. Effect of bioagent and fungicide on the growth and yield attributes of finger millet

Treatments	Trial I				Trial II			
	Plant height (cm)	**No. of productive tillers/hill**	**Grain yield Kg/ha**	**BCR**	**Plant height (cm)**	**No. of productive tillers/hill**	**Grain yield Kg/ha**	**BCR**
T1: ST with TNAU-Pf1@ 10g/kg of seed +two sprays of TNAU-Pf1@ 10g/l	94.60	5.44	2425	1:3.53	89.65	4.7	2340	1:3.32
T2: ST with Tricyclazole @ 2 g/kg of seed + two sprays of Tricyclazole @ 1 g/l	83.20	4.96	2544	1:3.27	80.47	4.9	2412	1:3.23
T3: ST with TNAU-Pf1@ 10g/kg of seed + two sprays of Tricyclazole @ 1 g/l	94.74	5.50	2663	1:3.94	91.67	5.4	2543	1:3.85
T4: ST with Tricyclazole @ 2 g/kg of seed + two sprays of TNAU-Pf1@ 10g/l	85.35	5.04	2375	1:3.01	82.27	4.5	2298	1:3.04
T5: Untreated control	77.44	3.92	1954	-	75.52	3.4	1904	-
CD (0.05%)	2.40	0.60	70.65	-	2.55	0.48	69.12	-
S ED	1.17	0.28	32.65	-	1.26	0.23	33.74	-

ST: Seed treatment

Values are mean of four replications