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Research Article

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In vitro Analysis of Rhizobacteria against *Macrophomina phaseolina* (Tassi) Goid. Causing Charcoal Rot of Sorghum

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ABSTRACT

A total of seven rhizobacterial isolates (AUDT 240, AUDT 248, AUDT 502, AUDT 801, AUDT 807, AUDT 811and AUDP 139) and one reference isolate of Trichoderma harzianum were examined for antagonistic activities against five different isolates of Macrophomina phaseolina viz., Belavadi, Dharwad, Kalaburagi, Savanur and Vijayapura. The isolate AUDP 139 (Pseudomonas fluorescens) showed maximum mean per cent inhibition (56.50 %) followed by AUDT 240 (47.24 %) and AUDT 801(46.33 %). Results indicated that the isolates AUDP 139, AUDT 240 and AUDT 801 could be a novel biocontrol agents for the management of charcoal rot of sorghum.

Keywords: *Sorghum, Charcoal rot, Rhizobacteria*

INTRODUCTION

Sorghum bicolor (L.) Moench commonly known as "Jowar" is a standout amongst the most vital millets of India belonging to the family "Poaceae". The major sorghum cultivating states are Maharashtra, Karnataka, Rajasthan, Tamil Nadu and Andhra Pradesh. It is being grown in two seasons: *kharif* season as a rainfed crop while in *rabi* season under residual soil moisture conditions. In Karnataka, it is cultivated on 9.48 lakh hectares of which 1.11 lakh hectares in *kharif* and 8.37 lakh hectares in *rabi* with production and productivity of 7.17 lakh tons and 857 kg ha^{-1} respectively (Anonymous., 2017). Charcoal rot caused by *Macrophomina phaseolina* (Tassi) Goid. is major disease among biotic stresses in post rainy season and it cause major losses in grain and fodder yield. In India, almost all the cultivated hybrids and varieties are susceptible to charcoal rot (Jahagirdar, 2007). Charcoal rot pathogen, *M. phaseolina* causes 100 % lodging and significant yield losses up to 64 % in India under post-rainy conditions in sorghum (Mughogho & Pande, 1984). The disease is well characterized by poor grain filling, premature leaf senescence and crop lodging.

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Internally, the stem pith of infected plants become disintegrated and the separated fibrovascular bundles are covered with the small black sclerotial bodies of the fungus which give the stem a blackened appearance, hence the name charcoal rot.

Biological control can be viewed as an alternative and safe method to control this disease as it also has additional benefit of plant growth-promotion (PGP) traits (Labuschagne, et al., 2010). Plant disease management by plant growth promoting rhizobacteria (PGPR) is one of the most effective and eco-friendly approach compared to conventional chemical control methods, and PGPRs as biocontrol agents possess certain advantages, because PGPR does not harm the environment and their application is sustainable in long run.

MATERIALS AND METHODS

***In vitro* screening by dual culture technique**

A total of seven rhizobacterial cultures were collected from Department of Agricultural Microbiology, College of Agriculture, Dharwad, were screened *in vitro* for their efficacy against all the five isolates of *M. phaseolina* by dual culture technique (Plate 1 and Plate 2).

A five mm culture disc from five days old fungal growth was placed at one end of tryptic soy agar plates. On the other end of the plate rhizobacteria was streaked in a straight line perpendicular to the fungal disc. The inoculated plates were incubated at 28 ± 1˚C for eight days. After four days of incubation, the radius of the fungal colony was measured and percentage of growth inhibition was calculated by using the formula of Vincent (1947) in comparison to control.

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

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

List of rhizobacteria strains used for the *in vitro* study

Actinobacteria	AUDT 240
	AUDT 248
	AUDT 502
	AUDT 801
	AUDT 807
	AUDT 811
Pseudomonas fluorescence	AUDP 139

Trichoderma harzianum from Institute of Organic Farming, Dharwad was used as reference isolate.

RESULTS

Belavadi isolate

Among seven rhizobacteria and the test culture of *Trichoderma harzianum* tested against Belavadi isolate of *M. phaseolina*, the maximum per cent inhibition was observed in strain AUDP 139 (51.66 %) and was superior over other strains tested and found statistically significant. The next best strains which showed good per cent inhibition were AUDT 240 (44.16 %) followed by AUDT 801 (43.33 %). The least per cent inhibition was observed in the strain AUDT 811 (25.83 %) (Table 1, Figure 1 and Plate 3).

Dharwad isolate

Among seven rhizobacteria and the test culture of *T. harzianum* tested against Dharwad isolate of *M. phaseolina*, the maximum per cent inhibition was observed in strain AUDP 139 (61.67 %) and was superior over other strains tested and found statistically significant. The next best strains which showed good per cent inhibition were AUDT 801 (52.91 %) followed by *T. harzianum* (50.83 %). The least

per cent inhibition was observed in the strain AUDT 811 (32.08 %) (Table 1, Figure 1 and Plate 3).

Kalaburagi isolate

Among seven rhizobacteria and the test culture of *T. harzianum* tested against Kalaburagi isolate of *M. phaseolina*, the maximum per cent inhibition was observed in strain AUDP 139 (56.67 %) and was superior over other strains tested and found statistically significant. The next best strains which showed good per cent inhibition were AUDT 502 (51.25 %) followed by *T. harzianum* (50.00 %). The least per cent inhibition was observed in the strain AUDT 811 (32.08 %) (Table 1, Figure 1 and Plate 3).

Savanur isolate

Among seven rhizobacteria and the test culture of *T. harzianum* tested against Savanur isolate of *M. phaseolina*, the maximum per cent inhibition was observed in strain AUDP 139 (60.83 %) and was superior over other strains tested and found statistically significant. The next best strains which showed good per cent inhibition were AUDT 240 (51.25 %) followed by AUDT 801 (46.67 %). The least per cent inhibition was observed in the strain AUDT 811 (37.91 %) (Table 1, Figure 1 and Plate 3).

Vijayapura isolate

Among seven rhizobacteria and the test culture of *Trichoderma harzianum* tested against Vijayapura isolate of *M. phaseolina*, the maximum per cent inhibition was observed in strain AUDP 139 (51.67 %) and was superior over other strains tested and found statistically significant. The next best strain which showed good per cent inhibition were AUDT 240 (47.24 %) followed by AUDT 801 (46.33 %). The least per cent inhibition was observed in the strain AUDT 811 (25.83 %) (Table 1, Figure 1 and Plate 3).

Considering the effect of rhizobacteria to different *M. phaseolina* isolates ,the mean per cent inhibition by the strain AUDP 139 was significantly superior over all other treatments with a per cent inhibition of 48.74. The next best strains with better mean per cent inhibition were AUDT 240 (43.39 %) followed by AUDT 801 (42.87 %), *T. harzianum* (46.16 %) and the least mean per cent inhibition was noticed in strain AUDT 811 (33.60 %). There was no significant difference among the treatments and they were found to be on par with each other (Table 1, Figure 1 and Plate 3).

DISCUSSION

The results obtained are in confirmation with the work done by Das et al., (2007), who isolated the rhizobacteria from sorghum rhizosphere and evaluated for charcoal rot suppression in sorghum.

Similar works were carried out by Mohammed et al., (2014), and Baker and Cook (1974)) whose works reported that for biological control of soil borne pathogens microbial antagonism is an important factor and it has positive impact on soil microflora and macrofauna. Thus, there is an immense scope for plant pathologists and soil microbiologists to work on the area of control of soil borne phytopathogens with isolation of rhizobacteria from varied sources and screening against various soilborne pathogens.

Table 1: *In vitro* analysis of rhizobacteria against *Macrophomina phaseolina* by dual culture technique

Sl. No.	Rhizobacteria	Per cent mycelial inhibition for different isolates					
		Belavadi	Dharwad	Kalaburagi	Savanur	Vijayapura	Mean per cent inhibition
1	AUDT 240	44.16 (41.54) *	49.58 (44.76)	47.08 (43.32)	51.25 (45.71)	44.16 (41.64)	47.24 (43.39)
2	AUDT 248	33.33 (35.17)	42.91 (40.91)	47.08 (43.32)	39.58 (38.98)	31.89 (34.31)	38.95 (38.53)
3	AUDT 502	40.00 (39.23)	42.50 (40.68)	51.25 (45.71)	37.91 (38.00)	40.00 (39.23)	42.33 (40.57)

4	AUDT 801	43.33 (41.16)	52.91 (46.68)	45.41 (42.37)	46.67 (43.00)	43.33(41.16)	46.33 (42.87)
5	AUDT 807	43.33 (41.16)	47.08 (43.32)	42.91(40.92)	42.08 (40.44)	43.33 (41.16)	43.74 (41.40)
6	AUDT 811	25.83 (30.54)	32.08 (34.47)	32.08 (34.47)	37.91 (38.00)	25.83 (30.54)	30.74 (33.60)
7	AUDP 139	51.66 (45.95)	61.67 (51.74)	56.67 (48.83)	60.83 (51.25)	51.67 (45.95)	56.50 (48.74)
8	*Trichoderma harzianum* (IOF)	41.66 (40.20)	50.83 (45.47)	50.00 (45.00)	46.67 (43.08)	41.67 (40.20)	46.16 (42.79)
	S.Em. ±	1.13	1.17	0.89	0.56	1.00	0.95
	C.D. at 1%	4.74	4.91	3.74	2.34	4.19	3.98

* Arc sine values

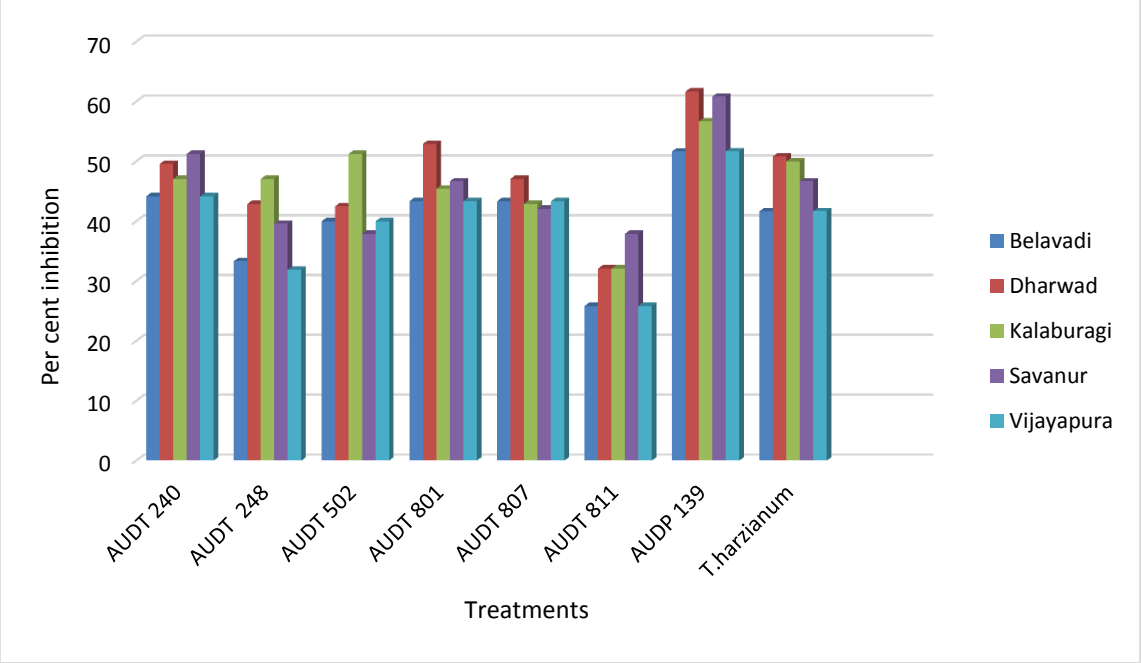

Fig. 1: *In vitro* evaluation of rhizobacteria against *M. phaseolina*

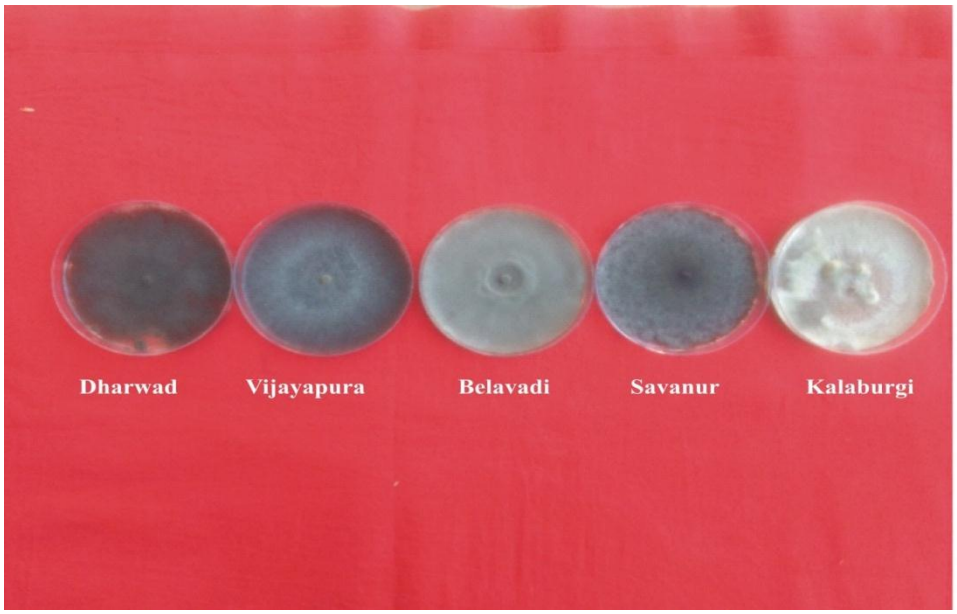

Plate 1: Isolates of *Macrophomina phaseolina*

Plate 2: Rhizobacterial isolates

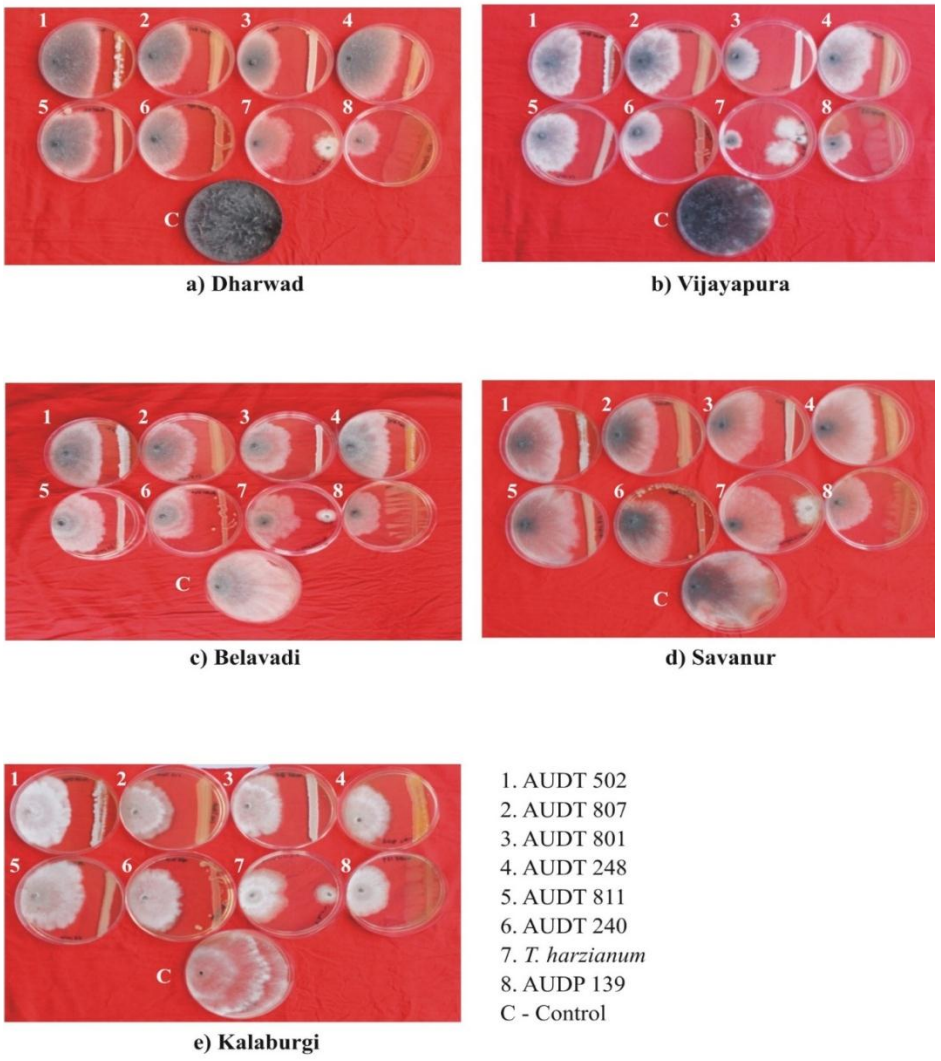

Plate 3: *In vitro* evaluation of rhizobacteria against *M. phaseolina*

REFERENCES

Anonymous., (2017). Selected state/season-wise area, production and productivity of jowar in India. Ministry of Agriculture and Farmers' Welfare, Govt. of India, New Delhi, 97-99.

Baker, K. F., & Cook, R. J. (1974). Biological control of plant pathogens. S. Chand and co. New Delhi, 433.

Das, I. K., Indira, S., & Annapurna, A. (2007). Early growth promotion and charcoal rot suppression in sorghum by plant growth promoting rhizobacteria. *J. Biol. Contr*., *21*(1), 137-144.

Jahagirdar, S., (2007). Present status and future research needs on the management of charcoal rot of sorghum. *Agric. Rev*., *28*(3), 197-206.

Labuschagne, N., Pretorius, T., & Idris, A. H. (2010). Plant growth promoting rhizobacteria as biocontrol agents against soil borne plant diseases. *Academia*, 1-13.

Mohammed, A., Holger, H., & Johannes, H. (2014). Bacterial antagonists of fungal pathogens also control root knot nematodes by induced systemic resistance of tomato plants. *Plos One*, *9*(2), 401-402.

Mughogho, L. K., & Pande, S. (1984). Charcoal rot of sorghum. In: Sorghum Root and Stalk Rots, Critical Review. Proceedings of Consultative Group Discussion of Research on Enemies and Strategies for Control of Sorghum Root and Stalk Rot Diseases, 27 November - 2 December, 1983, Bellagio, Italy, ICRISAT, Patancheru, Andhra Pradesh, India, 11-24.

Vincent, J. M. (1947). Distortion of fungal hyphae in the presence of certain inhibitors. *Nature*, 159, 850-850.