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Efficacy of Bio-agents against *Exserohilum turcicum* (Pass.) Leonard and Suggs. Causing Turcicum Leaf Blight of Sorghum

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A B S T R A C T

Efficacy of different isolates of *Trichoderma* spp, *Pseudomonas fluorescens* and *Bacillus subtilis* against *Exserohilum turcicum* the fungus causing turcicum leaf blight of sorghum was done employing poison food technique. The results revealed that, among the isolates of *Trichoderma* spp, maximum inhibition of mycelial growth of 83.04 per cent was noticed in *T. harzianum* (*Th*-5). Among the isolates of *Pseudomonas fluorescens* studied, maximum inhibition of mycelial growth of 71.48 per cent was noticed in *Pf*-3. Among the isolates of *Bacillus subtilis* maximum inhibition of mycelial growth of 77.27 per cent was noticed in *Bs*-8.

Keywords

Bio-agents, Turcicum leaf blight, *Exerohilum turcicum*, Efficacy

Introduction

Sorghum (*Sorghum bicolor* Linn. Moench) ranks fifth and popularly known as Jowar, is the major cereal consumed in India a r wheat, rice, maize and pearl millet. The world production of grain sorghum is 70.83 million tons from 44.8 million ha area of land (Faostat, 2014). India is major producer of sorghum, ranks fifth after, wheat, rice, maize and pear millet cultivated in 6.16 million hectares in both *kharif* (2.26m.ha) and *rabi* (3.89m.ha) with an annual production of 5.44 million tons of grain with productivity of 8.44 kg per hectare (Indiastat, 2015).

In India the sorghum is cultivated in Maharashtra, Karnataka and Andhra Pradesh as rainfed crop to an extent of 85 per cent (4.93m.ha). In Karnataka sorghum production is about 1.32 million tons in an area of 1.04 million ha with the average productivity of 1180 kg per ha. The sorghum is the main food crop of Hyderabad-Karnataka region and occupies an area of 5.6 lakh hectares with production of 5.5 lakh tons and productivity of 1122kg per ha (Anon., 2014-15).

As the *rabi* sorghum produces the white pearly grains which is mainly used for food in India for the preparation of roti. It is also an important animal feed (swine, poultry and cattle) used in countries like U.S., Mexico, South America and Australia. Sorghum, as a food, feed and bio fuel crop with excellent drought resistance compared to other cereals, is considered as a “failsafe crop” (Burke *et al*., 2010).

Sorghum grain is a principal source of energy, protein, vitamins and minerals for the poor people living in the semi-arid tropics. It is nutritionally superior to rice because of its high mineral and fiber content. Starch (60-75%) is the main component of sorghum grain, followed by proteins (7-15%), non-starch polysaccharides (2-7%) and fat (1.5-6%).The average energetic value of whole sorghum grain flour is 356 kcal/100gm (Dicko *et al*., 2006). Sorghum is a good source of vitamins, notably the B vitamins (thiamin, riboflavin, pyridoxine and niacin) and the liposoluable vitamins A, D, E and K. Unique property of sorghum grain makes it well suited to prepare various food items such as porridge, unleavened bread, cookies, cakes, couscous and malted beverages, *etc*.

Even though the crop is robust and versatile, it has faced drawbacks in terms of yield and reduction in acreage due various diseases. The major diseases that affect sorghum include downy mildew, turcicum leaf blight, anthracnose and sorghum smuts (covered kernel smut, loose smut, long smut and head smuts). Turcicum leaf blight (TLB) is one of the most destructive foliar diseases of maize and sorghum. It can cause yield reduction more than 50 % in susceptible varieties and is favoured by mild temperatures and humid weather conditions with heavy dews (Bergquist, 1986). The disease occurs as long elliptic tan lesions that develop on lower leaves and progress upwards. Susceptibility to *Exserohilum turcicum* is reported to decrease with crop maturity (Frederiksen, 1980). Hence evaluating efficacy of bio-agents against TLB will help to develop effective management practices.

Materials and Methods

Bio-agents were evaluated to know their efficacy under *in vitro* condition by using dual culture technique against *E. turcicum*. The details of treatments and source of bio-agents are listed in table. The fungal bio-agent and the test pathogen were inoculated in the periphery of the opposite direction of the single Petri plate containing solidified PDA medium. Whereas, the bacterial bio-agents were streaked one day earlier to the test pathogen.

Three replications were maintained for each treatment with one control by maintaining only pathogen. The plates were incubated for nine days at 27±2 ^{o}C. The colony diameter of pathogen was measured in two directions and average was recorded. Per cent inhibition of growth of test pathogen was calculated using the formula given by (Vincent, 1927).

Results and Discussion

Efficacy of *Trichoderma* spp. isolates against *E. turcicum*

The results pertaining to the efficacy isolates of *Trichoderma* spp on inhibition of *E. turcicum* are presented in Table 1. Among the different isolates tested, *Th*-5 was found more effective and statistically significant over other bio-control agents in inhibiting the mycelial growth (83.04%) of *E. turcicum* followed by *Tv*-5 (66.93%). The least mycelial inhibition was recorded in *Th*-1 (55.16%) and *Tv*-1 (55.12 %). However other isolates inhibiting growth were in between 55.12 % and 83.04%. The results of the present study were supported by Mahamood *et al.,* 1995, Harlapur *et al.,* (2007), Khedekar, 2009 and Vaibhav and Yogendra 2014 who reported *T. harzianum* was most effective in inhibiting the mycelial growth of *E. turcicum* among the *Trichoderma spp* they evaluated.

Efficacy of *Pseudomonas fluorescens* isolates against *E. turcicum*

The results pertaining to the effect of *P. fluorescens* isolates on inhibition of *E. turcicum* are presented in Table 2. Among the different isolates tested, *P. fluorescens* (*Pf*-3) was found more effective and statistically significant over other bio-control agents in inhibiting the mycelial growth (71.48%) of *E. turcicum* followed by *P. fluorescens* (*Pf*-1) (62.97%) and rest of other treatments. The least mycelial inhibition was recorded in *P. fluorescens* (*Pf*-10) (13.79%) and *P. fluorescens* (*Pf*-9) (10.86%). However other isolates inhibiting growth were in between 10.86 % and 62.97%. The results of the present study was supported Mahamood *et al.*, (1995),Harlapur *et al.*, (2007), Khedekar (2009) and Vaibhav and Yogendra (2014) who reported *P. fluorescens* was next best after *Trichoderma* spp in inhibiting the mycelial growth of *E. turcicum*.

Table.1 Efficacy of *Trichoderma* spp. against *E. turcicum*

Trichodema spp.	**Isolate number**	**Per cent inhibition**
T. viride	*Tv*-1	55.22 (48.00)
	Tv- 2	60.82 (51.25)
	Tv- 3	62.97 (52.52)
	Tv- 4	66.06 (54.37)
	Tv- 5	66.93 (54.90)
T. harzianum	*Th*- 1	55.16 (47.96)
	Th- 2	66.24 (54.48)
	Th- 3	60.87 (51.28)
	Th- 4	59.82 (50.66)
	Th- 5	83.04 (65.68)
	S.Em±	**0.29**
	C.D. at 1%	**1.18**

* Mean of three replications
Figures in the parentheses are arcsine transformed values

Table.2 Efficacy of *Pseudomonas fluorescens* isolates against *E. turcicum*

Sl. No.	Isolates	Per cent inhibition*
1	*P f*-1	62.97 (52.52)
2	*P f*-2	19.82 (26.44)
3	*P f*-3	71.48 (57.73)
4	*P f*-4	60.37 (50.99)
5	*Pf*-5	28.42 (32.20)
6	*P f*-6	16.30 (23.81)
7	*P f*-7	21.96 (27.95)
8	*P f*-8	15.12 (22.88)
9	*P f*-9	10.86 (19.24)
10	*P f*-10	13.79 (21.77)
	S.Em±	**0.48**
	C.D. at 1%	**1.92**

* Mean of three replications
Figures in the parentheses are arcsine transformed values

Table.3 Efficacy of *Bacillus subtilis* isolates against *E. turcicum*

Sl. No.	Isolates	Per cent inhibition*
1	*Bs*-1	30.82 (33.72)
2	*Bs*-2	49.08 (44.47)
3	*Bs*-3	38.35 (38.26)
4	*Bs*-4	26.24 (30.81)
5	*Bs*-5	63.08 (52.58)
6	*Bs*-6	27.30 (31.50)
7	*Bs*-7	22.93 (28.61)
8	*Bs*-8	77.27 (61.53)
9	*Bs*-9	25.16 (30.10)
10	*Bs*-10	17.30 (24.58)
	S.Em±0	**0.32**
	C.D. at 1%	**1.27**

*Mean of three replications
Figures in the parentheses are arcsine transformed values

Efficacy of *Bacillus subtilis* isolates against *E. turcicum*

The results pertaining to the effect *B. subtilis* isolates on inhibition of *E. turcicum* are presented in Table 3. Among the different isolates tested, *B. subtilis* (*Bs*-8) was found more effective and statistically significant over other bio-control agents in inhibiting the mycelial growth (77.27 %) of *E. turcicum* followed by *B. subtilis* (*Bs*-5) (63.08 %) and rest of other treatments. The least mycelial inhibition was recorded in *B. subtilis* (*Bs*-7) (22.93%) and *B. subtilis* (*Bs*-

10) (17.30 %). However other isolates inhibiting growth were in between 22.93 % and 77.27%. The results of the present study was supported by Mahamood *et al.*, 1995, Harlapur *et al.*, (2007), Khedekar (2009) and Vaibhav and Yogendra (2014) who reported *B. subtilis* was next best after *P. fluorescens* in inhibiting the mycelial growth of *E. turcicum*. The inhibitory effect of these bio-agents was probably due to competition and / or antibiosis.

It is concluded that among the two species of *Trichoderma* isolates tested against *E. turcicum*, *Th*-5 was found more effective and statistically significant over other bio-control agents in inhibiting the mycelial growth (83.04%). Among the different *P. flurorscens* isolates tested against *E. turcicum*, *Pf*-3 was found more effective and statistically significant over other bio-control agents in inhibiting the mycelial growth (71.48%). Among the different *B. subtilis* isolates tested against *E. turcicum*, *Bs*-8 was found more effective and statistically significant over other bio-control agents in inhibiting the mycelial growth (77.27 %).

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