Research Article

Evaluation of Fungicides Against *Rhizoctonia solani* f.sp *sasakii* Inciting Banded Leaf and Sheath Blight Disease of Maize *In vitro*

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Abstract

Rhizoctonia solani f.sp *sasakii* Kuhn inciting banded leaf and sheath blight disease is one of the most important fungal disease of maize in several parts of the world. The disease is commonly controlled by spraying fungicides because no resistant variety/ hybrid is available. The objective of the experiment was to evaluate the new fungicides for the management of blsb disease. Six fungicides viz., propiconazole250 EC, tebuconazole 430SC, trifloxystrobin 25per cent W/W + tebuconazole 50 % W/W, 75 WG, azoxystrobin 250 SC, carbendazim 50 % DF, carbendazim12 % + mancozeb 63 % WP and Control were tested against *R. solani* by confrontation tests in *in vitro* in three concentrations @100,500,1000 ppm. It was found that propiconazole, tebuconazole, trifloxystrobin + tebuconazole, azoxystrobin, carbendazim completely inhibited the growth of the pathogen at all the concentrations *i.e*, at 100, 500 and 1000 ppm tested. Carbendazim 12 per cent + mancozeb 63 per cent showed a significant inhibition of the growth of fungus compared to control and the inhibition was above 80 per cent in all the three concentrations tested.

Keywords: Maize, Blsb, fungicides

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Introduction

Maize (*Zea mays* L.) is one of the most important emerging crops having wider adaptability under varied agro-climatic conditions. Globally, maize is known as the queen of cereals due to its high genetic yield potential. In Latin America and Africa the main use of maize is for food where as in Asia, this crop is grown for both for food and feed. Maize is the third most important food grain in India after wheat and rice. Among the potential factors that limit maize production, fungal diseases are reported to cause huge crop losses in many countries and are considered as a priority in disease management practice [1]. Of different fungal diseases affecting maize cultivation, banded leaf and sheath blight (BLSB) incited by *Rhizoctonia solani* f.sp. *sasakii* Exner (*Thanatephorus sasakii* (Shirai) Tu& Kimbrough) [2] is an economically significant disease causing huge losses in all crop growing areas of the world. The disease was first reported from Sri Lanka [3]. The disease causes direct losses, includes premature death, stalk breakage and ear rot, indirect losses by not only yield reduction but also in grain quality in terms of human consumption. In India, BLSB disease was first recorded in the Terai region of Uttar Pradesh [4]. In early sixties BLSB was considered only as a disease of minor importance until it assumed epidemic form in the foot hills of Himalayas especially in the district of Mandi in Himachal Pradesh [5]. In India, it is known to be present in the states of Himachal Pradesh, Uttar Pradesh, Haryana, Punjab, Madhya Pradesh, Rajasthan, West Bengal, Meghalaya, Assam, Orissa and Andhra Pradesh with an estimated grain yield losses ranging from11 to 40 % [5]. However, when the ear rot phase predominates, 100 per cent losses were also reported [6]. Increased incidence of BLSB has been observed in rice fallow maize crop (zero tillage) in different districts of Andhra Pradesh. Effective management of BLSB in maize is possible only when the pathogen is eliminated completely or the propagules are brought down below economic threshold limits at field level. Control measures used were partially effective because *R. soiani* is able to produce sclerotia that can persist in the soil for at least two years [7]. The pace of development and durability of resistant varieties had been slow and unreliable despite tremendous advancements in the field of plant genetic engineering. The disease is mainly controlled by chemical sprays because of theabsence of resistant sources. Validamycin (0.1%) followed by Carbendazim (0.1%) sprays were found to be the best management options [8]. Carbendazim (0.2%) was most effective as seed treatment, and as a foliar spray (0.1%) with disease reduction 68.0% over the control, and disease severity(25.7%) and the highest grain yield (31.5 q/ha).The present study was proposed to test the new fungicide molecules for their efficacy against the fungus *R. solani*in in vitro conditions [9].

Materials and Methods

Isolation of R. solani

The BLSB diseased specimens were collected from the field then thoroughly washed in tap water (**Figure 1**). Small sections of 5 mm pieces from an advancing BLSB lesion on each diseased sample were cut and surface sterilized by dipping in 5% sodium hypochloride solution for about 1-2minutes, followed by rinsing 3 times in sterilized distilled water (SDW). The leaf pieces were later placed on sterile filter paper until excess moisture was absorbed and then transferred aseptically onto Petri dishes containing Potato Dextrose Agar (PDA) and incubated at 27 $\pm$ 2º C. The incubated Petri dishes were monitored daily for fungal growth. The visibly grown colonies were later purified by single hyphal tip method [10] and then transferred onto PDA slants, and maintained by periodical sub-culturing (**Figure 2**).

Figure 1 Maize plants showing typical symptoms of Banded Leaf and Sheath blight Disease under field conditions

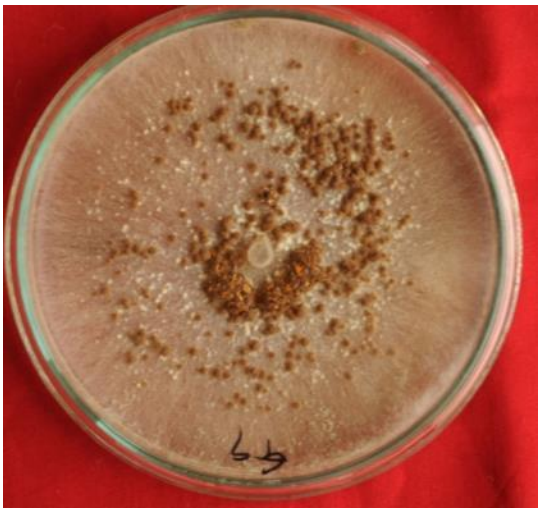

Figure 2 Pure culture of *Rhizoctonia solani* f. sp. *sasakii*

Evaluation of different fungicides against R. solani f. sp. Sasakii in vitro

Efficacy of six fungicides *viz*., propiconazole (Tilt 250 EC), tebuconazole (Folicure 430 SC), carbendazim (Bavistin 50 WP), azoxystrobin (Amistar 250 SC), trifloxystrobin 25%W/W+ tebuconazole 50%W/W (Nativo), carbendazim 12% + mancozeb 63% WP (Saaf) at 100, 500 and 1000 ppm concentration were evaluated against *R. solani* by using poisoned food technique. Twenty millilitre of molten medium amended with different concentrations of the test fungicides were poured in 90 mm sterilized petriplates and allowed to solidify. The solidified agar plates in triplicates were inoculated at the centre with 5 mm diameter mycelial disc of pathogen and incubated at 28 ºC for 7 days. Suitable control without fungicides were also maintained simultaneously. The plates without filtrate served as control.

The colony diameter of *R. solani* was measured and per cent inhibition of radial growth was calculated as per the formula given by [11].

Results and Discussion

Evaluation of different fungicides against R. solani f.sp. sasakii in vitro

Six fungicides *viz.*, propiconazole, tebuconazole, trifloxystrobin + tebuconazole, azoxystrobin, carbendazim and carbendazim12 per cent+mancozeb 63 per cent (at 100ppm, 500ppm and 1000ppm) were tested for their efficacy against *R. solani f. sp. sasakii* and the results are presented in Table 1. Propiconazole, tebuconazole, trifloxystrobin+ tebuconazole, azoxystrobin, carbendazim completely inhibited the growth of the pathogen at all the concentrations *i.e*, at 100, 500 and 1000 ppm tested (**Table 1**)

Carbendazim 12 % +mancozeb 63 % showed a significant inhibition of the growth of fungus compared to control and the inhibition was above 80 per cent in all the three concentrations tested.

All the tested fungicides are highly effective in inhibiting the sclerotial production of *R. solani* at all the 3 concentrations i.eat 100, 500 and 1000 ppm tested (**Table 2**). Sclerotia are the secondary source of inoculum hence the fungicides which can prevent the production of sclerotia may contain the disease successfully even under field conditions also.

Table 1 Evaluation of different fungicides against *R. solani* radial growth of mycelium *in vitro*

Fungicides	**Fungicide concentrations (ppm)**					
	100		**500**		**1000**	
	Radial growth of *R. solani* (mm)	**Inhibition (%)**	**Radial growth of *R. solani* (mm)**	**Inhibition (%)**	**Radial growth of *R. solani* (mm)**	**Inhibition (%)**
Propiconazole250 EC	0	100	0	100	0	100
Tebuconazole 430SC	0	100	0	100	0	100
Trifloxystrobin25per centW/W + tebuconazole 50 % W/W, 75 WG	0	100	0	100	0	100
Azoxystrobin 250SC	0	100	0	100	0	100
Carbendazim 50 %DF	0	100	0	100	0	100
Carbendazim12 %t + mancozeb 63 % WP	18	80	14	84.4	9.3	89.6
Control	90		90		90	
SEm±	0.20		0.26		0.19	
CD(0.05%)	0.67		0.82		0.59	

Table 2 Evaluation of different fungicides against *R. solani* sclerotial production *in vitro*

Fungicides	**Fungicide concentrations (ppm)**					
	100		**500**		**1000**	
	No. of sclerotia / petri plate	**Inhibition (%)**	**No. of sclerotia/ petri plate**	**Inhibition (%)**	**No. of sclerotia / petri plate**	**Inhibition (%)**
Propiconazole250 EC	0	100	0	100	0	100
Tebuconazole 430SC	0	100	0	100	0	100
Trifloxystrobin25per centW/W + tebuconazole 50 % W/W, 75 WG	0	100	0	100	0	100
Azoxystrobin 250SC	0	100	0	100	0	100
Carbendazim 50 %DF	0	100	0	100	0	100
Carbendazim12 %t + mancozeb 63 % WP	0	100	0	100	0	100
Control	152		155		150	
SEm±	0.40		0.56		0.32	
CD(0.05%)	1.20		1.68		0.96	

Fungicides are being exploited as an effective tool in IDM of plant diseases. Application of fungicides has been a

common practice in the management of BLSB of maize in Andhra Pradesh. Considering the potential role of chemical control in the integrated management of BLSB of maize, efforts have been made in the present study to evaluate the efficacy of different fungicides. Accordingly the efficacy of six fungicides was tested *in vitro* and found that all the fungicides were effective in inhibiting the growth of the pathogen.

Many attempts have been made to control BLSB of maize through fungicides. Fungicides with multiple effects on the pathogen like sclerotial germination, mycelial growth inhibition and reduction of the disease spread would be most ideal. Most of the fungicides like benomyl, carbendazim, chloroneb, captafol, mancozeb, zineb, edifenphos, iprobenphos, thiophanate methyl, carboxin etc. have been found effective for the control of BLSB under field conditions [12]. Fungicides *viz*., Bavistin, Rhizolex, and Thiophanate Methyl, which showed absolute control of mycelial growth with 100 per cent inhibition [13].

Evaluated the efficacy of a new fungicide nativo- a combination of two systemic fungicides *viz.*,trifloxystrobin 25 per cent (Strobilurin compound) and tebuconazole 50 per cent (Triazole compound) along with two other commercially available fungicides hexaconazole and validamycin against sheath blight of rice caused by *Rhizoctonia solani* Kuhn under challenge inoculation condition [14]. The new fungicide was most effective in decreasing disease severity (37.61per cent lower over control) and increasing grain yield (50per cent higher over control). Azoxystrobin at 1, 2, and 4 ppm, completely inhibited mycelial growth of *R. solani* [15]. The results of the present study are in conformity with the above reports.

Several new fungicides like dicarboximide group strobilurin or quinine outside inhibitor (QoI) group and demethylation inhibitor (DMI) group are available in the market and farmers are going for up to 3–4sprays for the control of BLSB under field conditions [16, 17]. Carbendazim, kitazin and bulb extract of garlic (*Allium sativum*) @ 5 % (w/v) completely inhibited the mycelia growth of *Rhizoctoniasolani* f. sp. *sasakii* at 1 ppm concentration [18]. These fungicides and plant extracts were also found promising in pot culture and field trials.

Conclusion

It is, therefore, envisaged that a high level of BLSB control using the above six fungicides could be achieved under field conditions,

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