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In-vitro Efficacy of Fungicides against *Rhizoctonia solani* Causing Banded Leaf and Sheath Blight of Maize

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

An experiment was carried out to find out the *in-vitro* efficacy of systemic and contact fungicides against the pathogen of maize banded leaf and sheath blight (*Rhizoctonia solani f. sp. sasakii*) by using poisoned food technique. The present experiment was conducted in College of Post Graduate Studies in Agricultural Sciences, Central Agricultural University, Umiam, Meghalaya for the evaluation of different fungicides against the pathogen *R. solani f. sp. sasakii*. Eight systemic (Carbendazim, Tebuconazole, Propiconazole, Myclobutanil, Azoxystrobin, Metalaxyl, Tricyclazole, Pyraclostrobin), three contact (Mancozeb, Captan and Chlorothalonil) and combination of systemic and contact fungicide (Carbendazim + Mancozeb) were used for the experiment with different concentrations. Among twelve fungicides, Carbendazim was found to be the most effective at concentration of 0.1 % with 95.96 % growth inhibition. Suimilarly, Metalaxyl at concentration of 0.28 % was found to be the least effective with growth inhibition of 55.55 %. The results showed significant differences between different fungicides to inhibit the growth of *R. solani.*

Keywords: Efficacy; fungicides; in-vitro; Rhizoctonia solani.

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1. INTRODUCTION

Rhizoctonia solani f. sp. *sasakii* Kuhn is a soil borne pathogen having a wide host range and causes diseases in a variety of crops, including agronomical, ornamental and forestry species [1,2,3]. It is a Basidiomycete fungus which does not produce any asexual spores [4]. The pathogen can persist in soils for long period of time producing dark brown sclerotia which are the survival structures of the pathogen [5]. The fungus is usually found in soils all over the world and is regarded as a highly damaging plant pathogen. It produces symptoms like root rot, collar rot, damping off, wire stem, web blight and sheath blight depending on the affected host. [2]. Since, the pathogen causes diseases like damping off, root rots, seed decay, stem rot and cankers it can lead to serious economic losses**.** Chemical fungicides are widely used for its control as the pathogen has vast variety of host**,** lack of in-built resistance in host plant and absence of practical method for natural repression. As a result, an *in-vitro* assay of numerous fungicides were performed in plant pathology laboratory of College of Post Graduate Studies in Agricultural Sciences, Central Agricultural University, Umiam, Meghalaya in order to find out how to manage *R. solani*.

2. MATERIALS AND METHODS

2.1 Collection and Isolation of *R. solani*

The maize plants showing typical symptom of banded leaf and sheath blight were collected from farmer's field located at Ri-bhoi district of Meghalaya. Collected samples were brought to the laboratory of Plant Pathology, School of Crop Protection (SCP), College of Post-Graduate Studies in Agricultural Sciences, Central Agricultural University (CAU-Imphal), Umiam, Meghalaya.

For isolation, small sections from an advancing lesion of collected diseased leaf and sheath along with healthy portions were cut using sterilized steel scissors. The pieces were surface sterilized with 1% sodium hypochloride (NaOCl) solution for 1 minute, followed by three times serial washing in sterilized distilled water (SDW). Surface sterilized pieces were then aseptically placed on solidified and cooled PDA (Potato Dextrose Agar) medium in 90 mm diameter sterile Petri plates. Inoculated plates were incubated at $28\pm1^{\circ}C$ for 5-7 days. Plates were observed constantly for growth and development of associated micro-organisms. After five (5) days of incubation, the organisms were subcultured for purification by selecting the desired colonies. The developing hyphal tips were then carefully sub-cultured onto potato dextrose agar (PDA) medium for purification by hyphal tip cut method. The pure fungal isolate was identified based on morphological characters. Pure culture of each isolate was made by transferring them to fresh sterile PDA slants. Isolated and purified cultures were maintained by periodical transferring in fresh PDA medium and stored in refrigerator at 4°C for further studies.

2.2 *In -vitro* Efficacy of Fungicides against *R. solani*

Twelve fungicides with three different concentrations were evaluated against *R. solani* f. sp. *sasakii* on the PDA medium by poisoned food technique described by [6] under *in vitro* conditions. List of fungicides and concentration are provided in Table 1. Required quantity of fungicides were added separately into 100ml sterile molten and warm PDA medium taken in 250 ml conical flasks which was thoroughly mixed so as to dissolve the chemical and get appropriate concentrations of each fungicide. 20 ml of poisoned medium from each specific concentration were poured into each sterilized Petri plate separately. Mycelial discs of 5mm size from five day old culture of the pathogen was picked and inoculated at the centre of each Petri plate. Three replications were maintained for each treatment with appropriate control (without fungicide). The plates were incubated at 28±1°C. Mean colony diameter for each treatment was recorded after the mycelia attained full growth in control plates. Control plate was maintained without adding any fungicide to the medium. Then plates were incubated at 28 ± 1°C in BOD incubator and observation was recorded at seven days after inoculation for radial growth or until the pathogen covers the entire plate. The efficacy of a fungicide was expressed as per cent inhibition of mycelial growth over control that was calculated by using the formula [7] which is mentioned below.

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

Where, I= percent inhibition of fungal growth
C= radial growth of control
T= radial growth of treated Petridish

The experiment was statistically analyzed by using Completely Randomized Design (CRD) to test the efficacy of different fungicides (Table 1) against *R. solani* pathogen.

3. RESULTS AND DISCUSSION

Twelve fungicides at three different concentrations were evaluated against maize banded leaf and sheath blight pathogen (*R. solani)* under *in-vitro* condition by poisoned food technique. The fungicides showed inhibition of *R. solani* in the range of 55 – 96% against *R. solani*, though their efficacy varied among fungicides. Among the twelve fungicides tested in the experiment, highest growth inhibition was observed by Carbendazim followed by Tebuconazole, Propiconazole, Mancozeb, Myclobutanil, Chlorothalonil, Tricyclazole, Saaf, Captan, Pyraclostrobin, Azoxystrobin and least in Metalaxyl according to the recommended doses. Carbendazim 50 % WP in the concentration of 0.1% showed the highest growth inhibition of 95.96 % and lowest growth of pathogen (0.50 cm) when tested with *R. solani*. Similar observation was recorded in a study where bavistin was effective against *R. solani* at lower concentration in inhibiting the mycelia growth and sclerotial production [8]. It was also reported that carbendazim inhibited radial growth of *R. solani* by 95-100 % [9]. The inhibitory effect of carbendazim on *R. solani* has also been reported [10]. Carbendazim 50% WP and tebuconazole 25.9% EC gave maximum mycelial growth inhibition of 83.83 % and 81.70 %, respectively under laboratory conditions [11]. Highest growth of pathogen (5cm) with lowest growth inhibition (55.55 %) in 0.28 % concentration was observed with Metalaxyl 35 % WS respectively (Table 1 and Table 2). The results obtained are presented in Table 2. The inhibitory effect of all fungicides generally increased with increase in concentration. Similarly, in a study by [12] it was noted that as the concentration of fungicides increased, the mycelial inhibition also increased.

Table 1. List of fungicides evaluated against *R. solani*

Common Name	Concentration (%)
Carbendazim 50% WP	0.1%
Tebuconazole 25.9% EC	0.2%
Propiconazole 25% EC	2%
Myclobutanil 10% WP	1%
Azoxystrobin 23% SC	0.43%
Metalaxyl 35% WS	0.28%
Tricyclazole 75% WP	0.13%
Pyraclostrobin 20% WG	0.5%
Captan 50% WP	0.4%
Mancozeb 75% WP	0.26%
Chlorothalonil 75% WP	0.26%
Carbendazim 12% + Mancozeb 63% WP	0.2%
Control (Media without chemical)	

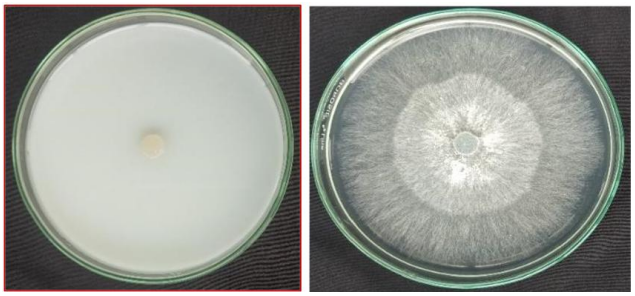

Plate 1a. Efficacy of carbendazim against *R. solani* at 0.1% concentration; 1b: Control (*Rhizoctonia solani*)

Table 2. *In vitro* evaluation of different fungicides against maize banded leaf and sheath blight pathogen (*Rhizoctonia solani)*

Fungicides	Dose	
	RG (cm)	GI (%)
Myclobutanil 10%	1.33	83.44 (65.99)
Azoxystrobin 23% SC	4.46	58.66 (49.99)
Carbendazim 50% WP	0.50	95.96 (78.99)
Tricyclazole 75% WP	1.52	82.48 (65.26)
Pyraclostrobin 20% WG	3.26	64.33 (53.32)
Metalaxyl 35% WS	5.00	55.55 (48.18)
Propiconazole 25% EC	1.12	86.92 (68.80)
Tebuconazole 25.9% EC	0.73	91.21 (72.77)
Captan 50% WP	3.13	64.66(53.52)
Mancozeb 75% WP	1.30	86.22(68.21)
Chlorothalonil 75% WP	1.30	85.11 (67.30)
Saaf (Carbendazim 12% + Mancozeb 63% WP)	2.13	75.99 (62.02)
Control	9.00	0.00(0.286)
SEm	0.12	0.74 (0.86)
CD (p=0.05)	0.34	2.16 (2.512)

Note: Figures in the table are mean values of three replications
Data in parentheses are angular transformed values
SEm: Standard error mean
CD: Critical difference
RG: Radial growth
GI: Growth inhibition

4. CONCLUSION

Rhizoctonia solani f. sp. sasakii kuhn is considered as severe fungal pathogen in maize as in banded leaf and sheath blight disease. Efficacy of twelve fungicides were tested *in -vitro* against *R. solani*. Among all the fungicides, carbendazim at 0.1 % exhibited the maximum inhibition of R. solani (95.96 %) followed by tebuconazole at 0.2% (91.21 %) was found effective to inhibit the growth of *R. solani* f. sp. *sasakii*. Chemical application may be required for managing this destructive disease in many areas due to non availability of complete resistant varieties. The fungicides which were found inhibiting mycelial growth of *R. solani* should be further tested in multilocational field trials to confirm their efficacy and standardize their optimum doses of application.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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