

Original Research Article

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Bio efficacy of Selected Systemic and Non Systemic Fungicides *invitro* and *invivo* Condition against Banded Leaf and Sheath Blight Disease of Maize caused by *Rhizoctonia solani* Kühn

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Ten fungicides were tested at different concentrations in *in vitro* and *in vivo* for the management of banded leaf and sheath blight of maize. Thiophanate methyl 70 WP, difenoconazole 25EC, hexaconazole 5 EC and validamycin 3 SL were screened against *Rhizoctonia solani* at 10, 15, 20 and 25 ppm concentrations for their anti fungal activity. where, as mancozeb 75WP, chlorothalonil 75 WP, zineb 75WP and captaf 50 WP of the fungus at 100,200, 300 and 400 ppm concentrations, respectively along with control. At 10 percent concentration difenoconazole, thiophanate methyl, completely check the radial growth of the fungus. Based on effectiveness of fungicides *in vitro*, they were further tested under *in vivo* conditions. carbendazim 50 WP @ 0.1 % applied as seed treatment followed by validamycin 3SL foliar spray showed lower disease severity, highest grain yield followed by 2750Kg/ha @ 0.2 per cent.

Introduction

Maize (*Zea mays* L.) is one of the oldest cereals; which has been under cultivation for thousands of years. It is one of the most versatile emerging crops having wider adaptability under varied agro-climatic conditions. Globally, it is known as ‘Queen of Cereals’ because it has the highest genetic yield potentiality. In Odisha it is grown in many districts like Nabarangpur, Koraput,

Kalahandi, Mayurbhanj, Keonjhar, Jajpur and others. It covers an area of 0.25 m. ha from which it can produces 0.754 m.t at a productivity of 3.03 t ha⁻¹ in Odisha. Among the fungal diseases Banded Leaf and Sheath Blight disease at present is considered as a major setback in production of maize crop in the state. Dhillon and Prasanna (2001) have been reported that, about 13.2 per cent of the economic product of maize is estimates to be lost annually due to BLSB on maize. The first

symptoms appear as sclerotia on the lower leaf. The sclerotia mycelia may be upwards as vertical spread Ahuja and Payak (1992). The present study was conducted to bio efficacy of different systemic as well as non systemic fungicides for effective management of the disease.

Materials and Methods

Cultures of *R solani* was isolated from naturally infected maize leaf, sheath and cob on PDA medium and then it was further purified by hyphal tip method and maintained on PDA in culture tubes at $28 \pm 1^{\circ}\text{C}$ in BOD incubator for further studies

Described concentrations of fungicides were screened using poison food technique Vincent (1947). Stock solution of each fungicide was prepared by dissolving weighted quantity of fungicide in a measured volume of sterilized distilled water and adds to double strength sterilized PDA. The amount was calculated using following formula:

$$C_1V_1 = C_2V_2,$$

Where

C₁= Concentration of stock solution

C₂= Volume (ml) of the of stock solution to be added

V₁= Desired concentration ($\mu\text{g/ml}$) and

V₂= Measured volume (ml) of the medium

Medium amended with desired concentration of selected fungicides, four replications were maintained. After solidification of medium, the plates were centrally inoculated with 5 mm disc of the fungus cut from edge of a fully grown culture with the help of sterilized cork borer. Unamended PDA plates, inoculated with test pathogen, served as a control Lal, Butchiah. and Baruah(1985). Four replications were maintained for each concentration of fungicide and incubated at

$28 \pm 1^{\circ}\text{C}$. Experiment was conducted during *Kharif* seasons of 2015-16 and 2016-17 in RBD with three replication. Seeds of susceptible Vivek hybrid -43 was sown in plots $3 \times 2 \text{ m}^2$ with 30 cm inter row spacing and 10 cm plant to plants.

Bhubaneswar is a hot spot for Banded Leaf and Sheath Blight (BLSB) disease. However, before the spray of fungicides, all the plots were artificially inoculated with mycelia /sclerotia fragments (10 ml / 1 L water) of *R. solani* one day before the fungicides spray.

On the basis of *in vitro* studies effective fungicides were used as seed treatment and foliar spray. The treatments include thiophanate methyl 70WP (0.1%), difenoconazole 25EC(1.5%), hexaconazole 5% EC(2.0%) and validamycin 3%SL (3.0 %). Mancozeb (0.3%), chlorothalonil 75 WP (0.25%), zineb 75WP (0.15 %) and captaf 50 WP (0.1 %) were used as foliar spray with seed treatment with carbndazimat 0.1 % or 1g/Kg of seed. Chemicals were sprayed thrice at 10- day's interval starting from one and half month old crop. Disease severity was recorded on 5 rows of 100 no of plants selected randomly from each plot. Three observations were recorded at 10- day's intervals. Individual selected plants were tagged and divided in to the bottom, middle and top leaves and sheath (5-7) from each portion were recorded the symptoms graded as per the rating scale 1 to 5 (Ahuja and Payak (1978) as: 1.0=Disease on one leaf sheath only; few small, non-coalescent lesions present(Highly Resistant) 2.0 =Disease up to four sheaths; lesions many and always coalescent (Moderately Resistance) 3.0 = Disease on all sheaths except two internodes below the ear(Tolerant) 4.0= Disease up to the internode bearing the ear shoot but shank not affected(Susceptible) 5.0=In addition to disease rating symptoms of 4.5, shrinkage of stalk; reduced ear dimensions, wet rot and

disorganization of ear; kernel formation absent or rudimentary; prematurely dead plants common; abundant sclerotial production on husk leaves, kernels, ear tips and stalk fibres (Highly Susceptible). Yield data (Kg/ha) and 100 grain weight (g) were further used for calculating of PDI (Per cent disease index).

Results and Discussion

Bio efficacy of systemic fungicides on *Rhizoctonia solani* in *in-vitro*

The data given in (Table 1 and 2) revealed that all the four fungicides were found significantly superior over check by inhibiting the radial growth of test pathogen.

Among systemic fungicides, difenoconazole 25EC was found the most effective followed by validamycin 3 SL, thiophanate methyl 70 WP and hexaconazole 5% EC. Difenoconazole 25EC, thiophanate methyl 70 WP were completely inhibited of radial growth is 100% at 10 and validamycin at 15 ppm concentrations, respectively.

Among non-systemic mancozeb 75WP was found the most effective followed by fungicides captaf 50 WP, chlorothalonil 75 WP and zineb 75 WP. Mancozeb 75WP was completely inhibited of radial grow this at 20 ppm concentration.

Apparently it is evident that all the systemic fungicides were more effective than non systemic fungicides when compared under *in vivo* conditions. It is also observed under *in vitro* conditions.

It is also observed that increased in per cent inhibition was invariably proportional to the increase in the concentration of respective fungicides.

Bio efficacy of systemic fungicides on *Rhizoctonia solani* in *in-vivo*

The data given in table 3 and 4 revealed that all the treatments significantly decreased disease severity, increased grain yield as compared to control plots.

During 2015-16 and 2016-17 crop season, among systemic fungicides seed treatment with carbendazim at 0.1 % and difenoconazole 25EC, validamycin 3 SL two prophylactic sprays at 10 - days interval was found superior over the other treatments. Validamycin 3 SL 90.99% reduction in the disease severity followed by difenoconazole 25EC and hexaconazole 5 % C.

Among systemic fungicides seed treatment with carbendazim 0.1 % and two prophylactic sprays at 10 days interval was found superior over the other treatments giving validamycin reduction in disease severity followed by difenoconazole 25 EC, hexaconazole 5 EC and thiophanate methyl 75 WP. Maximum increase in grain yields 27500 Kg/ha with validamycin 3 SL @ 0.2 followed by difenoconazole 25EC, 2366 Kg/ha with two years pooled data.

Among non systemic fungicides seed treatment with captan and two prophylactic sprays at 10 - days interval zineb 75 WP was found superior over the other treatments giving 99.30 per cent reduction in disease severity. Mancozeb 75 WP which was similar to chlorothalonil 75 WP followed by captaf 50 WP. Maximum increase in grain yield with mancozeb 75 WP 2133 Kg/ha was recorded and chlorothalonil 75 WP 2083 Kg/ha were followed by zineb 75 WP 1933 Kg/ha and captaf 50 WP 1833 Kg/ha during 2015 and 2016.

Table.1 Bio efficacy of systemic fungicides against *Rhizoctonia solani* in-vitro

Fungicide	Radial growth (mm)					Per cent inhibition of mycelial growth (mm)				
	10 ppm	15 ppm	20 ppm	25 ppm	Mean	10 ppm	15 ppm	20 ppm	25 ppm	Mean
Thiophanate methyl 70 WP	0.0	5.00	10.0	15.0	7.5	100.0	95.0	90.0	85.0	92.5
Difenoconazole 25EC	0.0	0.0	0.0	0.0	0.0	100.0	100.0	100.0	100.0	100.0
Hexaconazole 5% EC	5.0	10.0	15.0	20.0	12.0	95.0	90.0	85.0	80.0	87.5
Validamycin 3 SL	0.1	0.1	0.1	0.0	0.5	99.5	99.9	99.8	99.8	99.8
Control	90.0	90.0	90.0	90.0	90.0	-	-	-	-	-
Sem_±	0.22	0.43	0.48	0.81	1.72					
CD	0.64	1.27	1.44	2.40	5.24					

Table.2 Bio efficacy of non-systemic fungicides against *Rhizoctonia solani* in in-vitro

Fungicide	Radial growth (mm)					Per cent inhibition of mycelial growth (mm)				
	100 ppm	200 ppm	300 ppm	400 ppm	Mean	100 ppm	200 ppm	300 ppm	400p pm	Mea n
Mancozeb 75WP	0.1	0.2	0.3	0.4	0.2	99.0	99.8	99.7	99.6	99.5
Chlorothalonil 75 WP	5.0	10.0	15.0	20.0	12.5	95.0	90.0	85.0	80.0	87.5
Zineb 75 WP	5.0	15.0	20.0	10.0	87.5	95.0	85.0	80.0	90.0	87.5
Captaf 50 WP	5.0	6.0	7.0	9.00	93.2	95.0	94.0	93.0	91.0	93.2
Control	90.0	90.0	90.0	90.0	90.0	-	-	-	-	-
Sem_±	0.55	0.92	0.87	1.83	1.88					
CD	1.63	2.73	2.59	5.45	5.58					

Table.3 Bio efficacy of systemic fungicides against *Rhizoctonia solani* in vivo

Fungicide	Mean					
	PDI			Yield (q/ha)		
	2016-17	2017-18	Polled	2016-17	2017-18	Polled
Thiophanate methyl 70 WP @ 0.1%	18.0	16.0		28.3	15.3	21.8
Difenoconazole 25EC @ 0.15 %	10.0	9.0		22.0	25.3	23.6
Hexaconazole 5% EC @ 0.2 %	12.0	10.0		21.0	26.0	23.5
Validamycin 3 SL @ 0.2 %	10.0	8.0		26.6	28.3	27.5
Control	59.0	64.0		24.3	14.0	19.1
Mean	21.80	21.40	-	24.4	21.8	-
Sem_±	0.85	1.34		1.74	2.22	
CD	2.56	4.04		5.22	6.69	
CD for Seasons			0.42			2.20
CD for Treatments			0.49			1.99
CD for Season X Treatments			0.69			2.82

Table.4 Bio efficacy of non-systemic fungicides against *Rhizoctonia solani* in vivo

Fungicide	Mean					
	Disease score compared to control			Yield (q/ha)		
	2016-17	2017-18	Polled	2016-17	2017-18	Polled
mancozeb 75WP @ 0.3 %	48.0	39.0		24.0	18.6	21.3
Chlorothalonil 75WP@ .15%	40.0	37.0		25.0	16.6	20.8
zineb 75 WP @ @ 0.1 %	42.0	40.0		22.0	16.6	19.3
captaf 50 WP @ 0.25 %	40.0	36.0		19.6	17.0	18.3
control	69.0	74.0		17.6	16.6	17.6
Mean	47.80	45.20		21.67	17.13	-
Sem_±	2.97	3.16		1.42	1.36	
CD	8.94	9.53		4.27	4.08	
CD for Seasons			0.61			2.08
CD for Treatments			0.44			2.79
CD for Season X Treatments			0.62			3.95

The 'control' consisted of spray application of water only. The trial was sown in randomized block design in which row to row distance was 75 cm and plant distance was 25 cm. The pathogen was multiplied on maize grains and inoculations were carried out by inserting four such grains (25-d old culture) between the rinds and the enclosing sheaths at second or third basal internode of 30 days old test plant. In all, two spray applications of the chemicals, first after two days of inoculation followed by the second after 15 days, were made.

Observations on intensity of the disease were recorded after 45 days of inoculation following 1-5 scale devised by Ahuja and Payak (1983). Intermediate ratings were also recorded and the mean of 50 inoculated plants were calculated.

Harvesting was done as soon as the husk-covers turned brown and the silks became completely dry. Yield of grain wt. at 15% grain moisture after shelling was presented in q/ha after thorough drying in the sun.

Several other workers also reported the bio efficacy of fungicides in maize as well as in other crops like urd bean, ground nut, cowpea, mung, rice, bean (Santosh *et al.*, (2014),

It can be concluded that application of 10 ppm concentration difenoconazole 25EC, validamycin 3 SL, thiophanate methyl 75 WP

completely checked the growth of the fungus. Based on bio efficacy of fungicides *in vitro*, they were further tested under *in vivo* conditions. Validamycin 3 SL @ 0.2 % was applied as foliar spray showed lowest disease severity, highest grain yield 27500 Kg/haas followed by difenoconazole 25 EC, hexaconazole 5 EC and thiophanate methyl 75 WP 0.15 %, 0.2 % and 0.1 per cent.

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