

Evaluation of Fungicides for Suppression of Banded Leaf and Sheath Blight, Maydis and Turcicum Leaf Blight of Maize

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ABSTRACT

The diseases of maize viz. banded leaf and sheath, maydis leaf blight and *Turcicum* leaf blight occurs persistently to cause severe yield loss. New fungicide combination Hexaconazole 4% + Zineb 68% WP with different concentrations was evaluated as spray application to control the diseases. Among the different doses tested application of Hexaconazole 4% + Zineb 68% WP (60 + 1020g/ml a.i./ha) resulted minimum banded leaf and sheath blight disease severity of 6.45 per cent at 7th day and 7.50 percent at 15th days after second spray during *kharif* season while it was 6.87 at 7th and 7.70 per cent at 15th days after second spray during *rabi* season. Similarly minimum disease severity of maydis leaf blight was 6.87 per cent at 7th and 7.70 per cent was reported at 15th days after second spray during *kharif* season and disease severity of maydis leaf blight was 5.84 at 7th and 6.36 at 15th days after second spray during *rabi* season. The disease severity of *Turcicum* leaf blight was 8.10 at 7th and 8.26 at 15th days after second spray during *kharif* season and in *rabi* season disease severity was 5.84 at 7th and 6.38 at 15th days after second spray. Higher growth attributes (plant height and dry matter/plant) and yield attributes (cob weight and grain weight/cob) were recorded with the application of Hexaconazole 4% + Zineb 68% WP (60+1020 g/ml a.i./ha). Maximum gross return of Rs. 45,887, net returns of Rs. 31,437 and B:C ratio of 2.18 were also noted under Hexaconazole 4% + Zineb 68% WP (60+1020 g/ml a.i./ha).

Keywords: Banded leaf and sheath blight, maydis leaf blight, *Turcicum* leaf blight, Maize, Hexaconazole

ARTICLE INFO

Received on	:	23.06.2022
Accepted	:	11.10.2022
Published online	:	29.12.2022



INTRODUCTION

Maize (*Zea mays* L.) is the most versatile crop, adapted to different agro-ecological and climatic condition. In India, maize is 3rd most important cereal crop next to rice and wheat. It is mainly grown in Karnataka, Madhya Pradesh, Bihar, Tamil Nadu, Andhra Pradesh, Maharashtra, Uttar Pradesh and Rajasthan. It has great worldwide significance as human food, poultry feed, piggery feed and as source of large number of industrial products (Khedeka 2009). Maize is grown under diversified environments unmatched by any other crop as the expansion of maize to new areas and environments still continues. In India, it is grown over an area of 8.69 million hectare with total production of about 21.81 metric tonne. The average maize yield in India is 2509 kg/ha. Madhya Pradesh accounts for 1.10 million hectare area with the production of 12.63 metric tonne and 2350 kg/ha productivity (Anonymous 2016).

About 112 diseases of maize have been reported from different parts of the world. Of these, 65 are known to occur in India. The major diseases in different agro climatic regions are: banded leaf and sheath blight, maydis leaf and turcicum blight, seed rots, seedling blight, downy mildews, stalk rots, and smuts and rusts, leading to about 15-20 percent yield losses annually (Saxena 2002). Among them banded leaf and

sheath blight (BLSB) of maize caused by *Rhizoctonia solani* f.sp. *sasakii* Exner (teleomorph) is known to be as a serious constraint to maize production in China, South Asia and Southeast Asia. The disease develops on leaves and sheaths and can spread to the ears. Concentric bands and rings appear on infected leaves and sheaths. Maydis leaf blight (MLB), a fungal disease caused by *Drechslera maydis* (Nisikado) Subram, is an important foliar disease in almost all the maize growing regions of India. Losses up to 40 per cent or more have been demonstrated in inoculated yield trails (Byrnes et al 1989). In India, it was reported for the first by Munjal and Kapoor (1960) from the Maldah, West Bengal. The maydis leaf blight injures or kills the leaf tissues and thereby reduces the area of chlorophyll which involved in photosynthesis. If considerable leaf area is killed, then vigour and yields are reduced drastically. Turcicum leaf blight (TLB) of maize caused by *Exserohilum turcicum* (Pass.) Leonard and Suggs is also an important foliar disease in almost all maize growing regions of India and identified as endemic areas for the disease, where reduction in yield has been to an extent of 98%. Bunker and Mathur (2006) reported 20-30 % reduction in grain yield due to TLB. Payak and Renfro (1968) reported disease epidemics at an early stage causing

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premature death of blighted leaves which lose their value as fodder.

Many scientists have evaluated efficacy of different chemicals for the control of BLSB, MLB and TLB. Puzari *et al.* (1998) found Validamycin (0.1%) followed by Carbendazim (0.1%), Rajput and Harlapur (2015) reported seed treatment with *Pseudomonas fluorescens* (10g/kg) of seeds followed by two sprays with Propiconazole (0.1%) to be most effective to manage BLSB. For the management of MLB, Vaibhav *et al.* (2011) and Hulagappa (2012) reported propiconazole 25 EC (0.1%) to be most effective. TLB reported to be managed by application of Zineb 75 WP 0.25% (Kumar and Mauriyya 2015). The efficacy of Hexaconazole + Zineb as combined application yet not been tested and evaluated against BLSB, MLB and TLB. Hexaconazole inhibits ergosterol biosynthesis. It is systemic triazole fungicide having protective and curative action. Its combination with Zineb is a broad-spectrum fungicide which on exposure to air converted to a fungitoxic compound isothiocyanate. It acts by blocking the metabolism of pathogenic fungi at cellular level at several stages of Krebs cycle. Hence studies need to be undertaken to assess the combination of these fungicides at different concentrations. The information on disease management using new effective fungicides is unknown. Therefore, it is necessary to test the field efficacy of some recently available new fungicides as foliar spray for the effective management of the disease.

MATERIAL AND METHODS

The field experiments were conducted in two consecutive seasons i.e. *kharif* and *rabi* to evaluate new fungicides for suppression of BLSB, MLB and TLB of maize at Research Farm, Zonal Agricultural Research Station, Jhabua (MP). The disease susceptible maize variety JVM-421 was sown at 60 x 25 cm spacing on 27th July and 21st November. The experimental treatments were laid out in randomized block design (RBD) and three replications of seven treatments viz., T₁= Hexaconazole 4% + Zineb 68% WP (40+680 g/ml a.i./ha), T₂= Hexaconazole 4% + Zineb 68% WP (50+850 g/ml a.i./ha), T₃= Hexaconazole 4% + Zineb 68% WP (60+1020 g/ml a.i./ha), T₄= Zineb 75% WP (937.5 g a.i./ha), T₅= Hexaconazole 5% EC (50 ml a.i./ha), T₆= Mancozeb 75 % WP (1125 g a.i./ha) and T₇=

Table 2: Rating scale for Maydis and Turcicum blight diseases given by Wheeler, 1969

0	No symptom
1	Very slight to slight infection, one or two to few scattered lesions on lower leaves.
2	Light infection, moderate number of lesions on lower leaves only
3	Moderate infection, abundant lesions are on lower leaves, few on middle leaves.
4	Heavy infection, lesions are abundant on lower and middle leaves, extending to upper leaves.
5	Very heavy infection, lesions abundant on almost all leaves, plants prematurely dry or killed by the disease.

unsprayed control. The fungicides were applied as two sprays at 15 days interval soon after appearance of the disease. All the standard agronomic practices were adopted as per the recommended package of practices of the crop. Growth and yield attributes were recorded as per standard procedures. The crop was harvested from the individual replicated plots and average grain and stover yield was recorded and converted in q/ha. The produce (grain and stover yield) received under each treatment was multiplied with the prevailing market price of grain and stover to get the gross returns. The cost of cultivation for each treatment was subtracted from the gross returns and net returns were worked out accordingly. The scales used to score disease severity for BLSB was used as given by Ahuja and Payak (1983), for MLB and TLB disease scoring was done by using scale given by Wheeler (1969).

Percent Disease index (PDI) was calculated by using the following formula (Wheeler 1969).

$$\text{PDI} = \frac{\text{Sum of all individual ratings}}{\text{Total no. of leaves observed} \times \text{maximum disease score}} \times 100$$

RESULTS AND DISCUSSION

Effect of fungicides on BLSB

All the treatments of different fungicidal concentrations were found to be significantly superior over control (Table 3). During *Kharif*, treatment with Hexaconazole 4% +Zineb 68% WP @ 1500 g/ha (i.e. 60+1020 g a.i./ha) was reported to cause minimum disease severity of 5.29, 5.50 at 7th and 15th days after first treatment and 6.45 and 7.50 at 7th and 15th days after second spray. The next best treatment was application of Hexaconazole 4% +Zineb 68% WP @ 1250 g/ha (i.e. 50+850 g a.i./ha) which showed disease severity of 5.50, 5.90 at 7th and 15th days after first treatment while 6.50 and 7.85 per cent at 7th and 15th days after second treatment. Whereas, in the case of control plot disease severity was ranged from 11.21, 12.25 at 7th and 15th days after first treatment while 15.18 and 20.17 per cent at 7th and 15th days after second treatment (Table 1). Similarly, in *rabi* minimum PDI of BLSB i.e. 5.00, 5.82, 6.87 and 7.70 per cent was observed in the treated plot with Hexaconazole 4% +Zineb 68% WP @ 1500 g/ha (i.e. 60+1020 g a.i./ha) at 7 days after 1st, 15 days after 1st, 7 days after 2nd and 15 days after 2nd application respectively followed by Hexaconazole 4% +Zineb 68% WP @ 1250 g/ha (i.e. 50+850 g a.i./ha) with 5.22, 6.38, 7.20 and 7.73 PDI, respectively.

Whereas, in the case of control disease incidence ranged from 7.86, 12.42, 15.02 and 18.53 PDI, respectively at different observatory days (Table 1). Over all, the two sprays with Hexaconazole 4% +Zineb 68% WP @ 1500 g/ha (i.e. 60+1020 g a.i./ha) found most effective to cause minimum disease severity of 6.0% as compared with control with an average disease severity of 12.2%. This might be due to effectively and timely in reducing the severity of banded leaf and sheath blight of maize. Similar results have been observed by Kumar *et al.* (2000), Akhtar *et al.* (2011) and Rajput and Harlapur (2015).

Table 3: Bio-efficacy of new fungicides against per cent disease index (PDI) of banded leaf and sheath blight (BLSB) of maize

Treatments	Dosage in a.i (g or ml/ha)	Kharif						Rabi						Avg. % Disease severity
		I st spray		II nd spray		I st spray		II nd spray		I st spray		II nd spray		
		0 th	7 th	15 th	7 th	15 th	0 th	7 th	15 th	7 th	15 th	0 th	7 th	
T ₁ = Hexaconazole 4% + Zineb 68% WP	40+680	6.87 (15.2)	7.91 (16.3)	8.15 (16.6)	9.97 (18.4)	12.90 (21.0)	3.56 (10.8)	5.57 (13.6)	8.50 (16.9)	10.62 (19.0)	12.24 (20.4)	8.6		
T ₂ = Hexaconazole 4% + Zineb 68% WP	50+850	6.50 (14.7)	5.50 (13.5)	5.90 (14.0)	6.50 (14.7)	7.85 (16.3)	4.67 (12.4)	5.22 (13.2)	6.38 (14.6)	7.20 (15.6)	7.73 (16.1)	6.3		
T ₃ = Hexaconazole 4% + Zineb 68% WP	60+1020	6.45 (14.7)	5.29 (13.3)	5.50 (13.5)	6.45 (14.7)	7.50 (15.9)	3.79 (11.2)	5.00 (12.9)	5.82 (13.9)	6.87 (15.2)	7.70 (16.1)	6.0		
T ₄ = Zineb 75% WP	937.5	6.49 (14.7)	10.47 (18.9)	10.50 (18.9)	12.42 (20.6)	14.71 (22.5)	3.51 (10.8)	6.38 (14.6)	9.97 (18.4)	11.59 (19.9)	13.29 (21.3)	9.9		
T ₅ = Hexaconazole 5% EC	50	6.07 (14.2)	8.15 (16.6)	8.40 (16.8)	10.45 (18.8)	12.96 (21.1)	3.78 (11.2)	5.78 (13.9)	8.42 (16.8)	11.38 (19.7)	13.01 (21.1)	8.8		
T ₆ = Mancozeb 75 % WP	1125	6.00 (14.1)	9.78 (18.2)	10.45 (18.8)	11.06 (19.4)	12.42 (20.6)	3.46 (10.7)	6.43 (14.6)	9.87 (18.3)	10.33 (18.7)	12.07 (20.3)	9.2		
T ₇ = Control	--	6.50 (14.7)	11.21 (19.5)	12.25 (20.4)	15.18 (22.9)	20.17 (26.6)	3.21 (10.3)	7.86 (16.3)	12.42 (20.6)	15.02 (22.8)	18.53 (25.5)	12.2		
CD (P=0.05)	--	NS	1.18	1.02	0.89	2.17	NS	0.71	1.18	2.06	1.93	-		

Table 4: Bio-efficacy of new fungicides against per cent disease index (PDI) of maydis leaf blight of maize

Treatments	Dosage in a.i. (g or ml/ ha)	Kharif						Rabi						Avg. % dis. severity
		I st spray		II nd spray		I st spray		II nd spray		I st spray		II nd spray		
		0 th	7 th	15 th	7 th	15 th	0 th	7 th	15 th	7 th	15 th	0 th	7 th	
T ₁ = Hexaconazole 4% + Zineb 68% WP	40+680	4.04 (11.6)	6.07 (14.2)	8.55 (17.0)	10.80 (19.9)	12.42 (20.6)	4.00 (11.5)	6.00 (14.1)	8.10 (16.5)	9.97 (18.4)	10.33 (18.7)	8.0		
T ₂ = Hexaconazole 4% + Zineb 68% WP	50+850	3.25 (10.4)	5.05 (12.9)	6.07 (14.2)	7.20 (15.6)	8.10 (16.5)	4.25 (11.9)	5.05 (12.9)	5.50 (13.5)	6.00 (14.1)	6.50 (14.7)	5.7		
T ₃ = Hexaconazole 4% + Zineb 68% WP	60+1020	5.56 (13.6)	6.00 (14.1)	6.00 (14.1)	6.87 (15.2)	7.70 (16.1)	4.50 (12.2)	4.80 (12.6)	5.00 (12.9)	5.84 (13.9)	6.36 (14.6)	5.8		
T ₄ = Zineb 75% WP	937.5	3.25 (10.4)	6.87 (15.2)	9.97 (18.4)	12.42 (20.6)	14.36 (22.2)	4.40 (12.1)	6.87 (15.2)	9.10 (17.5)	10.00 (18.4)	11.36 (19.7)	8.9		
T ₅ = Hexaconazole 5% EC	50	4.80 (12.6)	6.50 (14.7)	9.10 (17.5)	11.21 (19.5)	13.42 (21.4)	4.80 (12.6)	6.07 (14.2)	8.55 (17.0)	9.87 (18.3)	10.42 (18.8)	8.5		
T ₆ = Mancozeb 75 % WP	1125	5.29 (13.3)	7.86 (16.3)	10.15 (18.6)	15.50 (23.2)	19.25 (25.9)	4.29 (11.9)	6.50 (14.7)	9.67 (18.1)	10.33 (18.7)	11.20 (19.5)	10.0		
T ₇ = Control	--	5.50 (13.5)	9.84 (18.3)	15.50 (23.2)	19.25 (25.9)	24.14 (29.4)	4.50 (12.2)	8.10 (16.5)	13.29 (21.3)	15.50 (23.2)	19.25 (25.9)	13.5		
CD (P=0.05)	--	0.42	1.93	1.07	0.88	0.91	NS	1.14	1.98	1.07	2.28	-		

Effect of fungicides on PDI of maydis leaf blight

Foliar application of fungicides differed significantly with respect to PDI of maydis leaf blight (Table 4). Among the different fungicides, minimum per cent disease index i.e. 6.00, 6.00, 6.87 and 7.70 were recorded with the application of Hexaconazole 4% + Zineb 68% WP @ 1500 g/ha (i.e. 60+1020 g a. i. /ha) at 7th and 15th days after 1st and 2nd spray application, respectively which was statistically at par with Hexaconazole 4%+Zineb 68% WP @ 1250 g/ha (i.e. 50+850 g a. i./ha) with 5.05, 6.07, 7.20 and 8.10 per cent disease index, respectively. Whereas, the maximum average PDI (24.14%) was recorded in control. Further table 2, showed that in *rabi* minimum disease intensity of 4.80, 5.00, 5.85 and 6.36 per cent was recorded in treatment of Hexaconazole 4% +Zineb 68% WP @ 1500 g/ha (i.e. 60+1020 g a.i./ha) at 7 and 15 days after 1st and 2nd spray application, respectively and it was found comparable with Hexaconazole 4% + Zineb 68% WP @ 1250 g/ha (i.e. 50+850 g a.i./ha) with 5.05, 5.50, 6.00 and 6.50 per cent disease intensity respectively. Whereas, maximum PDI (19.25%) was observed at final observation day (15 days after 2nd application). Both these treatments reduced average disease severity by 5.8 and 5.7 % respectively. In the absence of resistant cultivars, use of fungicides to control the disease is in practice, as it reduces the disease intensity caused by pathogens after the appearance of the disease. Similar results have been observed by Hulagappa (2012) and Gowdar *et al.* (2017).

Effect of fungicides on PDI of turcicum leaf blight

The data presented in table 3 showed that minimum disease intensity of 7.20, 7.73, 8.10 and 8.26 per cent was recorded in the treatment of Hexaconazole 4% +Zineb 68% WP @ 1500 g/ha (i.e. 60+1020 g a.i./ha) at 7 and 15 days after 1st spray and 2nd spray application, respectively. Similarly, the application of Hexaconazole 4% +Zineb 68% WP @ 1250 g/ha (i.e. 50+850 g a.i./ha) gave 7.82, 8.00, 8.40 and 8.49 per cent disease intensity. Control gave maximum intensity of *Turcicum* leaf blight (21.80%) at final observation day (Table 5). During *Rabi* season, application Hexaconazole 4% +Zineb 68% WP @ 1500 g/ha (i.e. 60+1020 g a.i./ha) at 7 and 15 days after 1st and 2nd spray were recorded minimum disease intensity of 4.67, 5.00, 5.84 and 6.38 per cent, respectively which was at par with Hexaconazole 4% +Zineb 68% WP @ 1250 g/ha (5.00, 5.29, 6.00 and 6.87 per cent disease intensity, respectively). In control plot gave maximum intensity of *Turcicum* leaf blight (17.50%) at final observation day. Both these treatments produce minimum disease severity of 6.2 and 6.6 % respectively (Table 3). Foliar diseases which rapidly spread and cause epidemics can be managed effectively by developing suitable disease management strategies. The present investigations are also in agreement with these results of Kumar *et al.* (2010) and Reddy *et al.* (2013).

Effect of fungicides on growth and yields.

The result revealed that statistically significant differences among the treatments for growth characters, yield attributes and yields of maize (Table 6). Among the different fungicidal treatments, maximum plant height (171.43 cm) was recorded with the application of Hexaconazole 4% +Zineb 68% WP @

Table 5: Bio-efficacy of new fungicides against per cent disease index (PDI) of Turcicum blight

Treatments	Dosage in a.i (g or ml/ha)	Kharif						Rabi						Avg. % dis. severity
		I st spray			II nd spray			I st spray			II nd spray			
		0 th	7 th	15 th	0 th	7 th	15 th	0 th	7 th	15 th	0 th	7 th	15 th	
T ₁ = Hexaconazole 4% + Zineb 68% WP	40+680	5.57 (13.6)	8.25 (16.7)	9.80 (18.2)	10.72 (19.1)	11.21 (19.5)	3.56 (10.8)	5.67 (13.7)	6.00 (14.1)	6.00 (14.1)	8.00 (16.4)	9.50 (17.9)	7.8	
T ₂ = Hexaconazole 4% + Zineb 68% WP	50+850	5.90 (14.0)	7.82 (16.2)	8.00 (16.4)	8.40 (16.8)	8.49 (16.9)	4.67 (12.4)	5.00 (12.9)	5.29 (13.3)	6.00 (14.1)	6.00 (14.1)	6.87 (15.2)	6.6	
T ₃ = Hexaconazole 4% + Zineb 68% WP	60+1020	5.50 (13.5)	7.20 (15.6)	7.73 (16.1)	8.10 (16.5)	8.26 (16.7)	3.79 (11.2)	4.67 (12.4)	5.00 (12.9)	5.00 (12.9)	5.84 (13.9)	6.38 (14.6)	6.2	
T ₄ = Zineb 75% WP	937.5	6.00 (14.1)	9.67 (18.1)	10.80 (19.2)	12.90 (21.0)	16.31 (23.8)	3.51 (10.8)	6.33 (14.5)	6.87 (15.2)	8.00 (16.4)	8.00 (16.4)	10.00 (18.4)	9.0	
T ₅ = Hexaconazole 5% EC	50	5.56 (13.6)	8.01 (16.4)	10.00 (18.4)	11.06 (19.4)	14.36 (22.2)	3.78 (11.2)	6.33 (14.5)	8.10 (16.5)	8.10 (16.5)	9.21 (17.6)	11.38 (19.7)	8.8	
T ₆ = Mancozeb 75 % WP	1125	5.29 (13.3)	9.25 (17.7)	10.50 (18.9)	11.21 (19.5)	15.39 (23.0)	3.46 (10.7)	7.00 (15.3)	8.10 (16.5)	8.10 (16.5)	9.50 (17.9)	12.00 (20.2)	9.2	
T ₇ = Control	--	6.00 (14.1)	9.50 (17.9)	12.25 (20.4)	18.69 (25.5)	21.80 (27.8)	3.21 (10.3)	8.00 (16.4)	10.00 (18.4)	10.00 (18.4)	12.00 (20.2)	17.50 (24.7)	11.9	
CD (P=0.05)	--	NS	0.75	0.48	1.57	2.03	NS	1.22	2.02	2.02	1.93	1.50	-	

Table 6: Effect of new fungicides on growth, yields and economics of maize (mean data of both seasons)

Treatments	Plant height (cm)	Dry matter/plant	Cob weight/cob	Grain weight/cob	Grain yield (q/ha)	Stover yield (q/ha)	Biological yield (q/ha)	Harvest index (%)	Cost of cultivation (Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ha)	B:C ratio
T ₁ = Hexaconazole 4% + Zineb 68% WP	164.55	313.96	138.73	108.63	20.59	31.13	51.72	39.84	13800	35605	21805	1.58
T ₂ = Hexaconazole 4% + Zineb 68% WP	170.64	327.50	147.20	120.10	25.38	38.01	63.39	40.03	14125	43760	29635	2.10
T ₃ = Hexaconazole 4% + Zineb 68% WP	171.43	330.00	149.50	121.33	26.81	39.19	66.00	40.68	14450	45887	31437	2.18
T ₄ = Zineb 75% WP	160.40	315.67	137.00	107.33	20.13	30.17	50.30	39.99	13375	34716	21341	1.60
T ₅ = Hexaconazole 5% EC	168.62	324.50	146.30	117.35	21.59	32.31	53.90	40.08	14090	37215	23125	1.64
T ₆ = Mancozeb 75 % WP	166.59	317.10	138.70	108.70	20.88	32.78	53.66	38.84	13550	36529	22979	1.70
T ₇ = Control	155.60	296.59	130.45	101.14	17.57	28.00	45.57	38.58	12500	30884	18384	1.47
CD (P=0.05)	9.63	19.33	9.18	9.05	2.69	4.42	6.50	NS	-	4391	4391	0.32

1500 g/ha which was statistically on par with Hexaconazole 4% +Zineb 68% WP@ 1250 g/ha, Hexaconazole 4%+Zineb 68% WP @ 1000 g/ha and Hexaconazole 5% EC @ 50 ml/ha and significantly to rest of the treatments. Higher dry matter (330.0 g/plant) was recorded in Hexaconazole 4% +Zineb 68% WP @ 1500 g/ha which was statistically at par to each other and significantly superior to control plot.

Similarly, maximum cob weight (149.50 g/cob) and grain weight (121.33 g/cob) were recorded with the application of Hexaconazole 4% +Zineb 68% WP @ 1500 g/ha which was comparable with Hexaconazole 4% +Zineb 68% WP @ 1250 g/ha, Hexaconazole 4% +Zineb 68% WP @ 1000 g/ha and Hexaconazole 5% EC @ 50 ml/ha and significantly superior than remaining fungicides. Further mean data of both seasons were presented in table 6, among the fungicidal treatments, application of Hexaconazole 4% +Zineb 68% WP @ 1500 g/ha produced highest grain yield (26.81 q/ha), stover yield (39.19 q/ha) and biological yield (66.0 q/ha) and it was statistically on par with Hexaconazole 4% +Zineb 68% WP @ 1250 g/ha. The increases in grain, stover and biological yield were observed due to treatment with Hexaconazole 4% +Zineb 68% WP @ 1500 g/ha (i.e. 60+1020 g a.i./ha) (52.58, 39.96 and 44.83%) followed by treatment with Hexaconazole 4%+Zineb 68% WP @ 1250 g/ha (i.e. 50+850 g a.i./ha) (44.45, 35.75 and 39.10%) over control (Table 6). Harvest index of maize did not influence by different fungicidal treatments. These results are in accordance with Rajput and Harlapur (2015).

Effect of fungicides on economics

Gross, net returns and B:C ratio significantly differed due to various fungicides treatments during both the seasons (Table 6). Mean data of two seasons showed that the maximum gross returns of Rs. 45,887/ha, net returns of 31,437/ha and B:C ratio of 2.18 were recorded in Hexaconazole 4% +Zineb 68% WP @ 60+1020 g/ml a.i./ha followed by Hexaconazole 4% +Zineb 68% WP @ 1250 g/ha (Rs, 43,760, 29,635 and 2.10, respectively). Similar findings were also reported by Gowdar *et al* (2017). From the above study it is clearly indicated that application of Hexaconazole 4% +Zineb 68% WP @ 60+1020 g/ml a.i./ha was effectively reducing the diseases and also increased the yields and economics of maize in both the seasons.

CONCLUSION

Application of Hexaconazole 4% + Zineb 68% WP (60 + 1020g/ml a.i./ ha) resulted minimum banded leaf and sheath blight disease severity of 6.45 per cent at 7th day and 7.50 percent at 15th days after second spray during *kharif* season while it was 6.87 at 7th and 7.70 per cent at 15th days after second spray during *rabi* season. Higher growth, yield attributes and economics were also noted under Hexaconazole 4% + Zineb 68% WP (60+1020 g/ml a.i./ha).

ACKNOWLEDGEMENT

Authors are very thankful to Director Research Services, RVSKVV, Gwalior and financial support provided by M/s. Indofil Industries Limited.

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Citation:

Yadav R K, Kumawat N, Singh K and Purohit A.2022. Evaluation of fungicides for suppression of banded leaf and sheath blight, maydis and turcicum leaf blight of Maize. *Journal of AgriSearch* **9**(4):303-308