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Efficacy of newer fungicides against maydis leaf blight disease of maize caused by *Helminthosporium maydis*

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Abstract
Maize is major staple food crop grown worldwide. In India, Maize is an important cereal crop next to rice, wheat and sorghum. Maize is known as Queen of cereals because of its high genetic yield potential. Maize is one of the largest consumable cereal in the world. It is not only an important human nutrient but also a basic element of animal feed and raw material for many industrial products. Maydis leaf blight is a serious foliar fungal disease causes considerable losses to the maize crop. The present investigation on "Efficacy of newer fungicides against Maydis leaf blight disease of maize caused by *Helminthosporium maydis"* were undertaken to work out the efficacy of fungicides under both laboratory and field condition for the management of Maydis leaf blight disease of maize. Fungicides were tested against *H. maydis* on the Potato dextrose agar media using Poisoned food technique given by Sharvelle (1961) under *in vitro* condition. Among all tested fungicides evaluated at different concentrations *in vitro* against *H. maydis* by Poisoned food technique, Propiconazole was found highly effective with cent per cent inhibition of mycelial growth of *H. maydis* at the concentrations (150, 200 and 250 ppm). Mancozeb showed 93.88 per cent inhibition at the concentration of 250 ppm at par with Propiconazole followed by Carbendazim (92.03 per cent at 250 ppm). Minimum inhibition of mycelial growth was recorded in Copper Oxychloride (57.41 per cent at 50 ppm). All fungicides screened under *in vitro*, were further evaluated under field condition against Maydis leaf blight disease. Propiconazole 25 EC @ 0.1% and Mancozeb 75%WP@0.2% were found most effective in reducing the Maydis leaf blight (PDI of 18.51% and 29.62% respectively), as compared to control (85.17% PDI).

Keywords: Copper oxychloride, fungicides, *Helminthosporium maydis, in vitro, in vivo,* maize, mancozeb, maydis leaf blight, poisoned food technique, propiconazole

1. Introduction
Maize (*Zea mays* L.) is a native of South America is an important cereal crop belonging to the family graminae grown in 166 countries across the globe (Directorate of Maize Research, 2012) [9]. It is the most versatile crop adapted to different agro-ecological and climatic conditions. Because of its high genetic yield potential it is known as Queen of cereals. It is an important human nutrient, basic element of animal feed and raw material for manufacture of many industrial products. Recently, it is also used as bio fuel.

In India, among the cereals, maize is an important crop occupying fifth place with respect to area and third position in production. Maize is an important cereal crop after rice and wheat contributing almost 9 per cent to India's food basket and 5 per cent to World's dietary energy supply (ASG, 2011) [1]. Maize grains also have sufficient quantities of vitamin A, nicotinic acid, riboflavin and vitamin E. Based on the research efforts for the last few years under the aegis of All India Coordinated Maize Improvement Project, 16 out of 61 diseases adversely affecting this crop have been identified as major ones (Payak and Sharma, 1983) [26].

Southern Corn Leaf Blight (SCLB) or Maydis Leaf Blight (MLB) caused by *Helminthosporium maydis* (Syn. *Bipolaris maydis* (Nisik.) Shoemaker), (teleomorph: *Cochliobolus heterostrophus*) is a serious foliar fungal disease of maize throughout the world where maize is grown under warm, humid conditions (White, 1999) [36]. Three races of *Cochliobolus heterostrophus* known as O, T and C which have been described by (Smith *et al.*, 1970 and Wei *et al.*, 1988). Currently predominantly form of *Cochliobolus heterostrophus* is race O, which can cause yield losses of up to 40 per cent (Fischer *et al.*, 1976, Gregory *et al.*, 1979; Byrnes *et al.*, 1989) [5].

In 1970's an epidemic was caused by race T in maize with Texas male sterile cytoplasm in most maize growing areas of the USA but maize with normal cytoplasm was resistant to the pathogen. However, the most prevalent race in the country still continues to be race O.

The incidence of this disease was first time reported by Drechsler (1925) [10] from United States. In India, it was reported for the first time by Munjal and Kapoor (1960) [22] from Maldah district of West Bengal. Damage is most critical if infection occurs prior to silking and weather conditions are favourable for disease development during the reproductive growth stages. *In vitro* screening of fungicides reveal the efficacy of various fungicides and provide first-hand information confirming fungi toxicity against specific pathogen and therefore it serves as a reliable basis for field testing (Sharvelle, 1961) [32].

Sanjeev Kumar *et al*., (2009c) [29] screened efficacy of Propiconazole (Tilt), Mancozeb (Dithane M-45), Copper Oxychloride (Blitox 50), Thiophanate methyl (Roko), Carbendazim (Bavistin) and Carbendazim + Mancozeb (Companion) at 250, 500 and 1000 ppm inhibited the growth of *H. maydis* by Poisoned food technique *in vitro. In vitro* evaluation of ten fungicides against *E. hawaiiensis* causing leaf blight of wheat revealed that Propiconozole gave complete inhibition followed by Triademorph (Meli and Kulkarni, 1994) [20]. Harlapur *et al*., (2007) [11] reported that, maximum mean per cent inhibition of mycelial growth of *E. Turcicum* was obtained with Mancozeb @ 0.25% followed by Carboxin powder @ 0.1% concentration. Millar (1970) [21] reported that foliar application of fungicides like Manzeb, Propiconazole and Zineb have been found to be effective against southern leaf blight of maize caused by *Helminthosporium maydis*. Kommedahl and Lang (1973) [14] reported that foliar applications of fungicides like Mancozeb, Propiconazole, and Zineb have been found effective against Southern leaf blight of maize. Waghe *et al*., (2015) [35] tested effective treatments on field condition and revealed that fungicide seed treatment with SAAF + two sprays of Mancozeb at 30 and 45 DAS recorded highest disease control over control plot. Keeping in view of the above facts the study has been proposed to work out on the topic “Efficacy of newer Fungicides against Maydis Leaf Blight disease of Maize Caused by *Helminthosporium maydis”* at RPCAU, Pusa, Samastipur, Bihar

2. Materials and Methods

2.1 *In Vitro* evaluation of fungicides

In vitro efficacy of different fungicides against *H. maydis* was studied by Poisoned food technique at Laboratory Department of Plant pathology, T.C.A, Dholi of RPCAU, Pusa. Nine fungicides were tested against *H. maydis* on the potato dextrose agar media using Poisoned food technique under *in vitro* condition listed in table 2.1. The fungicides were evaluated at 50, 100, 150, 200 and 250 ppm concentrations. Details of the fungicides which were tested against *H. maydis* under *in vitro* condition are furnished below.

Table 2.1: List of the fungicides evaluated *in vitro* in this present investigation

Sl. No.	Trade Name	Common name	Active Ingredients (%)	Formulation
1.	Tilt	Propiconazole	25	EC
2.	Dithane M 45	Mancozeb	75	WP
3.	SAAF	(Carbendazim +Mancozeb)	12 + 63	WP
4.	Kavach	Chlorothalonil	70	WP
5.	Bavistin	Carbendazim	50	WP
6.	Score	Difenconazole	25	EC
7.	Contaf	Hexaconazole	5	EC
8.	Folicur	Tebuconazole	25	EC
9.	Blitox 50	Copper Oxychloride	50	WP

2.1.1 Poisoned food technique

Poison food technique (Sharvelle, 1961) [32] was followed to test the efficacy of the above mentioned fungicides. The pathogen *Helminthosporium maydis* was grown on PDA medium in Petri plates for ten days prior to setting the experiment. Fifty ml of stock solution of 10,000 ppm concentration of each fungicide was prepared in the distilled water. Required amount of this solution was added into 100 ml flask containing 100 ml of sterilized melted media to attain required concentrations of 50, 100, 150, 200 and 250 ppm. The medium was mixed well before plating. Twenty ml of poisoned medium was poured in each of the sterilized Petri plates. Mycelial disc of 5 mm was taken from the periphery of ten day old culture and placed in the centre and incubated at 28 ± 20^{0}C. Suitable checks were also maintained without addition of any fungicide and three replications were maintained for each treatment. When growth of the fungus in control plate was complete (90 mm) the diameter of the colony was measured in two directions and average was worked out. The per cent inhibition of growth was calculated by using the formula given by Vincent (1947).

Per cent inhibition = C-T/C × 100

Where,

I = Per cent inhibition of mycelium

C = Growth of mycelium in control

T = Growth of mycelium in treatment

2.2 Evaluation of fungicides against MLB in field condition

All fungicides screened under *in vitro*, were further evaluated under *in vivo* against Maydis leaf blight disease Field trial was conducted at research farm of T.C.A, Dholi, Muzaffarpur (Bihar) of RPCAU, Pusa, Samastipur, Bihar to evaluate the efficacy of newer fungicides. The experiment was conducted in randomized block design with 3 replications. Gross and Net Plot size was 4.2 m x 4.5 m (7 rows) and 3.0 x 4.0 m^2 (5rows) respectively. Plant to plant spacing was 20 cm. The susceptible check variety "CML186" was sown in to provide a uniform source of inoculums. The inoculation for Maydis leaf blight was performed by culturing *Helminthosporium maydis* on sorghum seed. The plants were inoculated on 35 days old plants with a fine powder of these sorghum grains by putting a pinch of these powdered inoculums in the leaf whorl in late afternoon to avoid the maximum day temperature during incubation period and second inoculation was done after a week of first inoculation. The 1st spray scheduled at first appearance of the disease and second spray scheduled after 21 days of 1st spray.

First appearance of disease and further progress of disease was recorded at 10 days interval according to Disease rating scale assessment key of Maydis leaf blight given by Balint-Kurti *et al*., (2006), Chung *et al*., (2010) and Mitiku *et al*., (2014) that is shown in table no. 2.2

2.3 Disease Incidence (DI)

The incidence of Maydis leaf blight was visually assessed in all the plots at weekly interval from first appearance of disease for each treatment. For each plot, the number of infected maize plants were counted and expressed as a percentage of the total number of maize plants in that plot. The mean percentage disease incidence for each treatment was obtained from the three replications. The data was further statistically analyzed. Disease incidence was calculated by following formula (Wheeler, 1969).

Disease incidence = (No. of diseased plant/ total no. of planed examined) × 100

2.4 Per cent Disease index

Observations on the severity of the disease were recorded on 1-5 scale (Payak and Sharma, 1983) [26]. Plants were selected randomly and assessed in each plot for disease rating and the percent disease index was recorded. Percent disease index was calculated by using following formula (Wheeler, 1969).

Disease index = (Sum total of numerical ratings/ Number of plant examined × Maximum grade) × 100

Table No. 2.2: Disease Rating Scale for Maydis leaf blight of Maize

Rating scale	Degree of infection (Per cent DLA*)	PDI**	Disease reaction
1.0	Nil to very slight infection (≤ 10%).	≤11.11	Resistant (R) (Score: ≤3.0) (DLA: ≤ 30%) PDI: ≤33.33)
2.0	Slight infection, a few lesions scattered on two lower leaves (10.1-20%).	22.22	
3.0	Light infection, moderate number of lesions scattered on four lower leaves (20.1-30%).	33.33	
4.0	Light infection, moderate number of lesions scattered on lower leaves, a few lesions scattered on middle leaves below the cob (30.1-40%).	44.44	Moderately resistant (MR) (Score: 3.1- 5.0) (DLA: ≤ 30.1-50%) PDI: 33.34 -55.55)
5.0	Moderate infection, abundant number of lesions scattered on lower leaves, moderate number of lesions scattered on middle leaves below the cob (40.1-50%).	55.55	
6.0	Heavy infection, abundant number of lesions scattered on lower leaves, moderate infection on middle leaves and a few lesions on two leaves above the cob (50.1-60%).	66.66	Moderately susceptible (MS) (Score: 5.1- 7.0) (DLA: ≤ 50.1-70%) PDI: 55.56 -77.77)
7.0	Heavy infection, abundant number of lesions scattered on lower and middle leaves and moderate number of lesions on two to four leaves above the cob (60.1-70%).	77.77	
8.0	Very heavy infection, lesions abundant scattered on lower and middle leaves and spreading up to the flag leaves (70.1-80%).	88.88	Susceptible (S) (Score: > 7.0) (DLA :> 70%) PDI: >77.77)
9.0	Very heavy infection, lesions abundant scattered on almost all the leaves, plants prematurely dried and killed (>80%).	99.99	

***** DLA- Diseased leaf area;
******Per cent disease index (PDI)

3. Results

3.1 *In vitro* evaluation of fungicides against *Helminthosporium maydis*

Efficacies of nine fungicides were tested at different concentration against the growth of pathogen by Poisoned food technique. The per cent inhibition of growth of the test fungus at different concentrations over control was calculated. The results related to the effect of different fungicides on inhibition of *H. maydis* are presented below in table 3.1.

At 50 ppm concentration, Propiconazole EC showed 93.89 per cent inhibition of mycelial growth followed by Mancozeb and SAAF with 83.70 per cent and 79.41 per cent growth inhibition respectively, and least inhibition of mycelial growth was recorded in Copper Oxychloride with 57.41 per cent.

At 100 ppm concentration, Propiconazole EC showed 95.77 percent inhibition of mycelial growth followed by Mancozeb and Chlorothalonil with 86.03 per cent and 82.85 per cent growth inhibition respectively, and minimum inhibition of mycelial growth was recorded in Copper Oxychloride with 60.07 percent.

At 150 ppm concentration, Propiconazole EC showed cent per cent inhibition of mycelial growth followed by Mancozeb and Carbendazim with 87.44 per cent and 85.55 per cent growth inhibition respectively, and minimum inhibition of mycelial growth was recorded in Copper Oxychloride with 64.47 percent.

At 200 ppm concentration, Propiconazole EC showed cent per cent inhibition of mycelial growth followed by Chlorothalonil and Mancozeb with 89.74 per cent and 87.88 per cent growth inhibition respectively, and minimum inhibition of mycelial growth was recorded in Hexaconazole with 69.00 percent.

At 250 ppm concentration, Propiconazole EC showed cent per cent inhibition of mycelial growth followed by Mancozeb and Carbendazim with 93.88 per cent and 92.03 per cent growth inhibition respectively, and minimum inhibition of mycelial growth was recorded in copper oxychloride with 72.96 percent.

Among all the tested fungicides, Propiconazole was found highly effective with cent per cent inhibition of mycelial growth of *H. maydis* at the concentrations (150, 200 and 250 ppm). Mancozeb showed 93.88 per cent inhibition at the concentration of 250 ppm at par with Propiconazole at 50 ppm concentration(i.e. 93.89) followed by Carbendazim (92.03 per cent at 250 ppm and 85.55 per cent at 150 ppm) and Chlorothalonil (89.74 per cent at 200 ppm). Minimum inhibition of mycelial growth was recorded in Copper Oxychloride (57.41 per cent at 50 ppm).

3.2 Evaluation of fungicides under field condition

The result revealed that, statistically significant differences among the treatments for PDI and grain yield. Foliar sprays of fungicides were found more effective against MLB and resulted in decreased PDI and increased grain yield clearly shown in table 3.2. The observations revealed that all the treatments significantly reduced the disease incidence over check (untreated) plot.

Among all tested fungicides T4 (T1 + two sprays with Propiconazole 25 EC @ 0.1%) and T8 (T1+ two sprays with

Mancozeb 75% WP @ 0.2%) were found most effective in reducing the maydis leaf blight (PDI of 18.51% and 29.62% respectively), as compared to control (85.17% PDI). While T3 (T1+ two sprays with Hexaconazole 5 EC @ 0.1%) and T1 (Seed treatment with SAAF @ 3.0g /kg seed) was found least effective in reducing disease (PDI of 66.66% and 74.06% respectively), in comparison to control.

Results revealed that, foliar sprays of fungicides were found more effective against MLB. Among fungicides, spray with Propiconazole (Grain yield of 37.49 q/ha) were found most effective to increase the grain yield among all the treatments followed by spray with Mancozeb (Grain yield of 35.16 q/ha) reduced the disease incidence and increased grain yield and both the fungicides were significantly superior over other sprayed fungicides.

Overall efficacy of various fungicidal treatments is finally assessed and compared on the basis of benefits realized in monetary terms and the data pertaining to this economical parameters. The result showed that the increased yield and added benefit over control (Rs./ha) varied in respect of the average yield obtained in various treatments. All treatments proved profitable over control. The highest benefit cost ratio was recorded in Treatment T_8: T_1 + two sprays with Mancozeb 75% WP @ 0.2% as 26.00 followed by T_4 (T_1+ two sprays with Propiconazole 25 EC @ 0.1% as 22.60. The least benefit cost ratio was recorded in T2: T_1 + two sprays with Difenconazole 25 EC @ 0.1% as -7.59. The negative value is due to its high cost of fungicide.

Table 3.1: Inhibitory effect of different fungicides on growth of *H. maydis* (at 9 days)

	Concentration				
Fungicides	**50 ppm**	**100 ppm**	**150 ppm**	**200 ppm**	**250 ppm**
	Inhibition per cent(I)				
Propiconazole	93.89 (75.78)	95.77 (78.23)	100 (90.00)	100 (90.00)	100 (90.00)
Mancozeb	83.70 (66.17)	86.03 (68.03)	87.44 (69.25)	87.88 (69.60)	93.88 (75.80)
SAAF	79.41 (62.98)	80.74 (63.95)	82.07 (64.95)	83.11 (66.00)	84.18 (66.58)
Chlorothalonil	74.00 (59.32)	82.85 (65.52)	83.44 (65.98)	89.74 (71.31)	90.03 (71.60)
Carbendazim	69.44 (56.43)	77.52 (61.17)	85.55 (67.63)	86.36 (68.31)	92.03 (73.73)
Difenconazole	67.30 (55.09)	71.07 (57.44)	74.63 (59.73)	78.63 (62.44)	79.96 (63.38)
Hexaconazole	63.11 (52.58)	65.36 (53.93)	67.70 (55.34)	69.00 (56.16)	73.22 (58.81)
Tebuconazole	60.47 (51.03)	67.47 (55.21)	73.18 (58.79)	74.33 (59.54)	76.41 (60.92)
COC	57.41 (49.23)	60.07 (50.79)	64.47 (53.39)	72 (58.03)	72.96 (58.65)
Control	0	0	0	0	0
Control for G (mycelial growth)	90 (mm)	90 (mm)	90 (mm)	90 (mm)	90 (mm)
	Fungicide (A)		Concentration (B)		Interaction (AxB)
CD at 5%	0.993		0.702		2.221
SE(m)±	0.353		0.250		0.790
CV%	1.923				

Figures within parenthesis are Angular transformed values.

Table 3.2: Effect of fungicides on the Per cent disease index of Maydis leaf blight disease, grain yield of maize and B: C ratio

Treatments	**Treatment details**	**Mean PDI**	**(%)Disease reduction over control**	**Mean grain yield (q/ha.)**	**% Yield Increase over control**	**ICBR**
T_1	Seed Treatement with SAAF (Mancozeb 63% + Carbendazim 12%) @ 3.0g / kg seed	74.06 (59.39)	12.79 (20.09)	25.10	8.537 (16.97)	2.30
T_2	T1+ two sprays with Difenconazole 25 EC @ 0.1%	55.55 (48.18)	34.58 (35.88)	32.90	34.977 (36.23)	-7.59
T_3	T1+ two sprays with Hexaconazole 5 EC @ 0.1%	66.66 (54.78)	21.79 (27.61)	28.75	17.977 (24.96)	1.31
T_4	T1+ two sprays with Propiconazole 25 EC @ 0.1%	18.51 (25.38)	78.07 (62.18)	35.15	44.513 (41.77)	22.60
T_5	T1+ two sprays with Tebuconazole 25 EC @ 0.1%	59.25 (50.33)	30.16 (33.11)	30.85	26.407 (30.87)	1.04
T_6	T1+ two sprays with Carbendazim 50% WP@ 0.1%	33.33 (35.17)	61.07 (51.41)	31.15	27.847 (31.78)	14.51
T_7	T1+ two sprays with Copper Oxychloride 50% WP @ 0.3%	48.14 (43.91)	43.23 (41.04)	31.50	29.320 (32.64)	5.32
T_8	T1+ two sprays with Mancozeb75% WP @ 0.2%	29.62 (32.93)	65.06 (53.78)	34.10	39.220 (38.75)	26.00
T_9	T1+ two sprays with Chlorothalonil70% WP @ 0.2%	44.44 (41.76)	47.63 (43.61)	31.00	27.067 (31.32)	5.19
T_{10}	Untreated control (water spray)	85.17 (67.45)	0.00 (0.00)	24.50	0.000 (0.00)	-
	SE(m)±	3.359	3.897	1.305	2.252	
	CD at 5%	10.056	11.669	3.909	6.744	
	CV (%)	11.301	17.115	7.413	15.248	

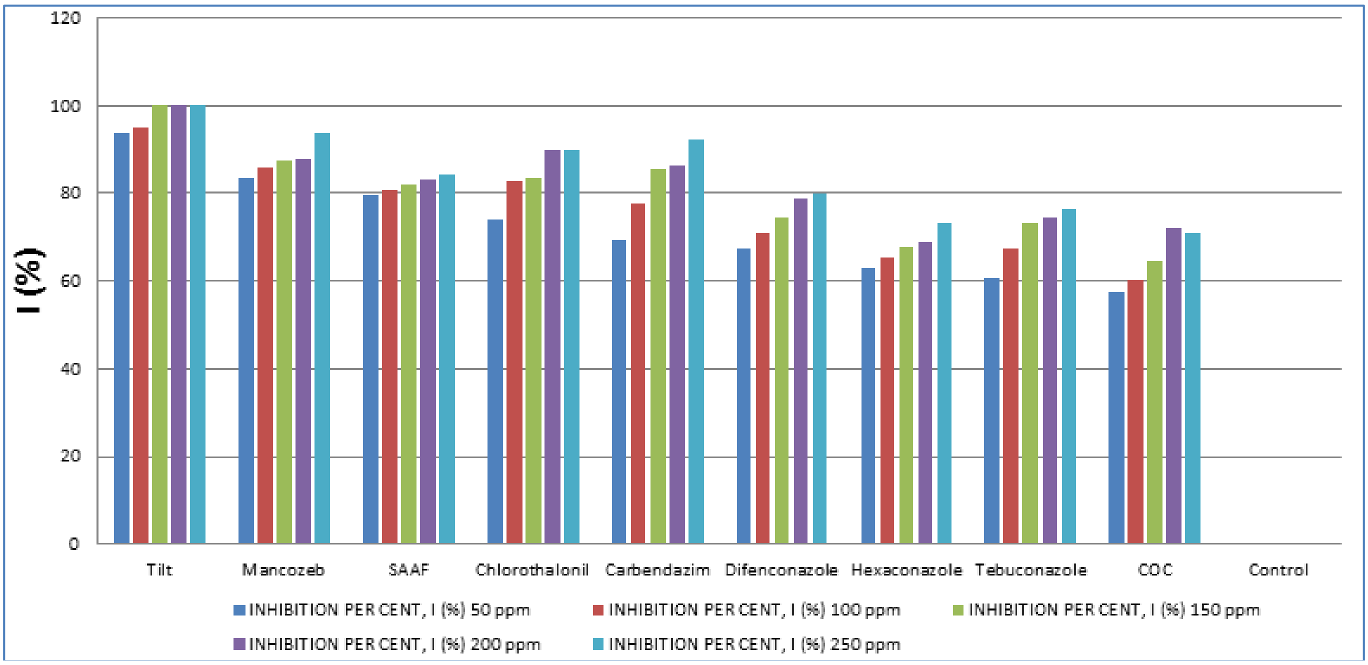

Fig. 3.1: Inhibitory effect of different fungicides on radial growth of *Helminthosporium maydis* (at 9 days)

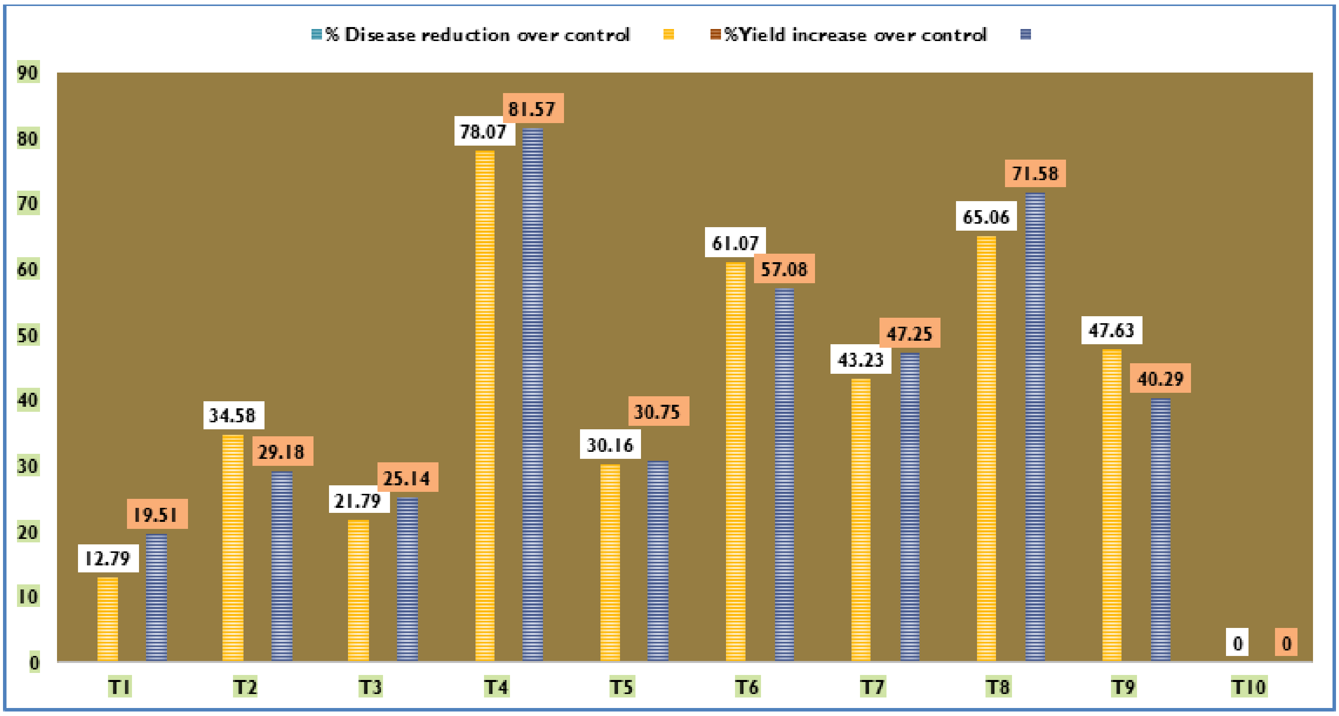

Fig. 3.2: Effect of fungicides on the severity of Maydis leaf blight and grain yield of maize

4. Discussion

4.1 Efficacy of fungicides *in vitro*

In the absence of resistant cultivars, use of fungicides to control the disease is in practice, as it gives relief from the pathogen after the appearance of the disease. Hence, nine fungicides were screened under laboratory conditions. Among nine screened fungicides, Propiconazole was found highly effective with cent per cent inhibition of mycelial growth of *H. maydis*at the concentrations (150, 200 and 250 ppm). Mancozeb showed 93.88 per cent inhibition at the concentration of 250 ppm at par with Propiconazole at 50 ppm concentration followed by Carbendazim (92.03 per cent at 250 ppm and 85.55 per cent at150 ppm), Chlorothalonil (90.03 per cent at 250 ppm and 83.44 at 150 ppm) and SAAF (84.18 per cent at 250 ppm). Minimum inhibition of mycelial growth was recorded in Copper oxychloride (72.96 per cent at 250 ppm and 57.41 per cent at 50 ppm) and Hexaconazole (69 per cent at 200 ppm).

These results were in agreement with the finding of Sanjeev Kumar *et al*., (2009c) [29] who screened efficacy of Propiconazole (Tilt), Mancozeb (Dithane M-45), Copper Oxychloride (Blitox 50), Thiophanate methyl (Roko), Carbendazim (Bavistin) and Carbendazim+Mancozeb (Companion) at 250, 500 and 1000 ppm inhibited the growth of *H. maydis* by Poisoned food technique *in vitro*. Similarly Harlapur *et al*., (2007) [11] reported that Mancozeb and Carboxin powder were effective against *E. turcicum* Similar results were also reported by Meli and Kulkarni (1994) [20], Singh and Gupta (2000) [33], Jha *et al*., (2004) [12].

The effectiveness of the fungicides Propiconazole, Mancozeb, Carbendazim, Chlorothalonil against *H. maydis* has been reported by many scientists (Harlapur *et al.*, 2007; Kumar *et al.*, 2009; Jha *et al.*, 2004; Khedeker *et al.*, 2012; Xlar *et al.*, 2013; Waghe *et al.*, 2015) [11, 12, 35].

4.2 Field evaluation of fungicides

Foliar spray of fungicides were found more effective against MLB and resulted in increased grain yield and reducing disease severity.

The observations revealed that all the treatments significantly reduced the disease incidence over check (untreated) plot where the disease incidence were recorded 85.17 per cent. Among all tested fungicides T_4 - T_1 + two sprays with Propiconazole 25 EC @ 0.1% and T_8 - T_1 + two sprays with Mancozeb 75% WP @ 0.2% were found most effective in reducing the Maydis leaf blight (PDI of 18.51% and 29.62% respectively), as compared to control (85.17% PDI). While T_3 (T1 + two sprays with Hexaconazole 5 EC @ 0.1%) and T_1 (Seed treatment with SAAF @ 3.0 gm /kg seed was found least effective in reducing disease (PDI of 66.66% and 74.06% respectively), in comparison to control.

Among fungicides, spray with Propiconazole (Grain yield of 37.49 q/ha) was found most effective to increase the grain yield among all the treatments followed by spray with Manocozeb (Grain yield of 35.16 q/ha) reduced the disease incidence and increased grain yield and both the fungicides were significantly superior over other sprayed fungicides.

These results are in agreement with finding of Kumar *et al*., (1977) [15] who evaluated eight fungicides and found that Dithane M-45, Unizeb and Dithane Z-78 significantly reduced the maize leaf blight severity by 55, 47.4 and 44.43 per cent, respectively, and increased grain yield by 8.54, 10.12 and 9.90 per cent and also in accordance with Sanjeev *et al*., (2009c) [29] found Propiconazole (Tilt) as the best fungicide against leaf blight of maize with minimum disease intensity (2.3 DI) and highest yield (2.0 q/ha) with highest cost benefit ratio (1:3.1).

Vaibhav *et al*., (2011) also reported that Propiconazole 25 EC was highly effective and it ensured minimum disease intensity (21.40%) and highest yield (29.37 q/ha) followed by Chlorothalonil (27.93% disease intensity and 27.60 q/ha yield). The similar results were recorded by Kommedahl and Lang (1973), Nasir *et al*., (2012) and Waghe *et al*., (2015) [14, 23, 35].

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