

Efficacy of Strobilurin group fungicides against Turcicum leaf blight and Polysora rust in maize hybrids

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ABSTRACT: Turcicum leaf blight (TLB) and Polysora rust diseases are taking heavy shiver in all maize growing regions of Karnataka. Several new fungicides are used to control the diseases, among them strobilurin group fungicides in combination with triazolefungicides are found effective in management of diseases. A mixture of Trifloxystrobin 50 WG + Tebuconazole 250 EC and mixture of Azoxystrobin 25 SC + Difenoconazole 25 EC were used in this study to manage the TLB and Polysora rust. The two combination fungicides were evaluated in different days against TLB and Polysora rust on two susceptible varieties namely 219J and CM 202. Results revealed that mixture of Trifloxystrobin 50 WG + Tebuconazole 250 EC @ 0.7 g/lit and mixture of Azoxystrobin 25 SC + Difenoconazole 25 EC @ 2.5 ml/lit were found effective in the management of TLB (15.0 % and 11.0 % respectively) and mixture of Trifloxystrobin 50 WG + Tebuconazole 250 EC @ 0.7 g/lit were found effective in controlling Polysora rust (13.2 %). Allied to yield, more significant increase in yield was recorded in treatment Trifloxystrobin 50 WG + Tebuconazole 250 EC @ 0.7 g/lit (5131.1kgs/ha). While, mixtures of Azoxystrobin 25 SC + Difenoconazole 25 EC @ 2.5 ml/lit recorded yield of 5913.0 kgs/ha, this was significantly superior with respect to disease control and yield aspects.

Key Words: Maize, Turcicum leaf blight, Polysora rust, disease, chemical control.

INTRODUCTION

Between now and 2050, the demand for maize in the developing world will double and, by 2025, it will have become the crop with the greatest production globally and in the developing world (Rosegrant et. al., 2008). Rice, wheat and maize are the most important food crops in developing countries (CIMMYT and IITA, 2011). Maize is currently produced on nearly 100 million hectares in 125 developing countries and is among the three most widely grown crops in 75 of those countries (FAOSTAT, 2010). Turcicum leaf blight also called as Northern leaf blight caused by *Exserohilum turcicum* (Pass.) Leonard and Suggs. (syn. *Helminthosporium turcicum* Pass.) is of worldwide importance (Carlos, 1997). In India, the disease is prevalent in almost all the maize growing areas. Severe losses in grain yield due to epiphytotics have been reported in various parts of India and these losses vary from 25 to 90 per cent depending upon the severity of the disease (Chenulu and Hora, 1962; Jha, 1993). The disease is responsible for the untimely death of blighted leaves and results in substantial yield reductions (Fig. 1A). Polysora rust (Southern rust) is a major disease of maize in tropical and subtropical regions worldwide. The fungus causing southern corn rust is *Puccinia polysora*. Unlike common rust, Polysora rust is most severe in warm growing conditions (Fig. 1B). In some seasons characterized by warm growing conditions, Polysora rust can become a major constraint to maize production in temperate regions.

In 2007, use of fungicides increased in corn and now a day's corn crop is typically produced with higher fungicide inputs compared to last five years (Wise and Mueller, 2011). Foliar fungicides have seen the most drastic increase in use over the past 10 years compared to other pesticides in corn (Gianessi and Reigner, 2006). Prior to 2008, a total of six trials were published that examined the efficacy of fungicides on corn. In between 2008 and 2010, a total of 33 trials were published, which showed the increased interest for research data on corn fungicides

(Wise and Mueller, 2011). Several fungicides are registered for use on maize for the control of TLB and Polysora rust. In the present investigation, two new fungicides were used to evaluate (Trifloxystrobin 50 WG + Tebuconazole 250 EC and Azoxystrobin 25 SC + Difenconazole 25 EC) their efficacy against the management of TLB and Polysora rust at different concentrations and their effect on disease and yield.

MATERIALS AND METHODS

Source of fungicides and maize varieties

In the present investigation, two fungicides were used to assess their efficacy against Turcicum leaf blight and (Trifloxystrobin 50 WG + Tebuconazole 250 EC and Azoxystrobin 25 SC + Difenconazole 25 EC) Polysora rust (Trifloxystrobin 50 WG + Tebuconazole 250 EC), the fungicides were procured from Bayer and Syngenta India Limited companies and two susceptible maize varieties developed at ZARS, V.C. Farm, Mandya i.e., 219J and CM 202 were used to evaluate the fungicides.

Active ingredient and formulation details of fungicides

1. Nativo – 75 WG: Active ingredients – Trifloxystrobin 50 WG + Tebuconazole 250 EC
Formulation – 250 g/kg and 500 g/kg respectively.
2. Amistar Top 32.5 SC: Active ingredients – Azoxystrobin 25 SC + Difenconazole 25 EC
Formulation – Suspension Concentrate.

Assessment of percentage yield enhancement over to control

Yield enhancement of each fungicide treatment was calculated by using the modified method of Cramer (1967) formula as follows,

$$\% \text{ enhancement of yield} = \frac{\text{Yield differences}}{(\text{Yield of untreated check} + \text{Yield difference})} \times 100$$

Mandya during Kharif, 2012 with three replications. The plot size of 112 m² was maintained for individual treatment. The experiment was designed as per RCBD. The experiment was carried out with two hybrids. Each hybrid was sown in four rows of five meter row length with row to row spacing of 70 cms and plant to plant spacing of 20 cms. Required agronomic practices were adopted to establish a good crop stand. Artificial inoculums were given four times in 10 days intervals, first when the crop was 30th day old and last when 70th day old. The fungicide spray schedule was given when the first lesions appear on the leaf beneath the ear. Three sprays were given at 15 days interval. Untreated check (Positive control) was recommended with no fungicide application. The observations recorded on TLB & Polysora rust disease incidence and grain yield. The Percentage Disease Incidence (PDI) and yield differences between the treatments of the fungicides at different concentrations and between the fungicides were calculated.

The weight of the harvested ears and moisture percentage of shelled grain were determined and grain yields were computed on a per hectare basis. The disease severity was recorded on an individual plant basis at dough stages. The data thus obtained was subjected to statistical analysis following RCBD.

Preparation of artificial inoculums

To isolate the disease causing pathogen, collect the naturally occur disease infected plant materials from the maize fields and isolate the disease causing pathogen from the collected plant materials on Potato Dextrose Agar (PDA) medium. After isolation, identify the isolated pathogen under microscope by using fungal identification manuals and keys. After confirming identification of the pathogen, it was subjected to multiplication on PDA under aseptic condition. For preparation of artificial inoculums, about an inch layer of sorghum grains (nearly 40 to 45 g) is dispense in a conical flask (500 ml), soaked in water for about 3-4 hours and excess water is drained off. The flask containing sorghum grains is autoclaved twice, seeded with fungus under aseptic condition and kept for incubation at 25-27°C. The flasks are shaken once in 2-3 days to facilitate uniform growth on grains. After incubation of about a fortnight the material is ready for inoculation.

Data analysis

The experimental data was analyzed by Random Complete Block Design Analysis of Variance (RCBD ANOVA) technique.

RESULTS

Efficacy of Trifloxystrobin 50 WG + Tebuconazole 250 EC against *Turicum* leaf blight and *Polysora* rust diseases.

Trifloxystrobin 50 WG + Tebuconazole 250 EC @ 0.7 g/lit and 0.6 g/lit recorded lowest *Turicum* leaf blight disease incidence (15 % and 19.3% respectively). While, high % of disease incidence were observed in the treatments like Trifloxystrobin 50 WG + Tebuconazole 250 EC @ 0.5 g/lit concentration (21.7%), Tebuconazole (Folicur) 250 EC (23.7 %) at 1.4 ml/lit concentration and Propiconazole (Tilt) 25 EC (25.7%) at 1.0 ml/lit concentration when compared with the control (Untreated check) (94.3%) and Mancozeb 75 % WP treatment (38.9 %) at 3.0 g/lit concentration. A treatments Trifloxystrobin 50 WG + Tebuconazole 250 EC @ 0.7 g/lit and 0.6 g/lit showed 79.3 % and 75 % of disease control over the untreated check (T1) (Table 1).

Moderate disease incidence were recorded (25 %, 44.9 %, 27.6 % and 28.3 %) in the plots treated with Trifloxystrobin 50 WG + Tebuconazole 250 EC @ 0.5 g/lit, Trifloxystrobin (Flint) 50 WG @ 0.4 g / lit, Tebuconazole (Folicur) 250 EC @ 1.4 ml/ lit and Propiconazole (Tilt) 25 EC @ 1.0 ml / lit respectively, except Trifloxystrobin 50 WG + Tebuconazole 250 EC @ 0.7 g/lit (13.2 %) and 0.6 g/lit (17%) compared with the untreated check (Positive control) and Mancozeb 75 % WP @ 3.0 g / lit (Negative control)(78.7 % and 23.6 % respectively). Trifloxystrobin 50 WG + Tebuconazole 250 EC @ 0.7 g/lit and 0.6 g/lit showed 65.5 % and 61.7 % of disease control over the untreated check (T1) (Table 1).

Highest grain yield 5131.1 kgs/ha and 4135.3 kgs/ha was recorded in Trifloxystrobin 50 WG + Tebuconazole 250 EC @ 0.7 g/lit and 0.6 g/lit treatments respectively followed by the treatments Trifloxystrobin 50 WG + Tebuconazole 250 EC @ 0.5g/lit (3564.8 kgs/ha), Tebuconazole (Folicur) 250 EC @ 1.4 ml/ lit (3163.5 kgs/ha), Propiconazole (Tilt) 25 EC @ 1.0 ml / lit (2980.5 kgs/ha) and Trifloxystrobin (Flint) 50 WG @ 0.4 g / lit (2280.7 kgs/ha) compared with untreated check (1448.6 kgs/ha) and negative control (2361.4 kgs/ha) (Table 1).

Efficacy of Azoxystrobin 25 SC + Difenconazole 25 EC against *Turicum* leaf blight and *Polysora* rust disease.

The results presented in Table 2 revealed that Azoxystrobin 25 SC + Difenconazole 25 EC @ 1.3 ml/lit and 2.5 ml/lit was highly effective against Maize leaf blight disease, which recorded PDI of 11%. This was followed by Azoxystrobin 25 SC + Difenconazole 25 EC @ 0.7 ml/lit (13% disease incidence). Difenconazole 25 EC @ 0.5ml/lit and Mancozeb 75% WP @ 2.7 g/lit have recorded a PDI of 25% and 77% as compared with 100% PDI in untreated control plot at 25 days after 3rd spray (Fig. 2A and 2B). A treatments Azoxystrobin 25 SC + Difenconazole 25 EC @ 1.3 ml/lit and Azoxystrobin 25 SC + Difenconazole 25 EC @ 2.5 ml/lit showed 89 % of disease control over the untreated check (T1) followed by Azoxystrobin 25 SC + Difenconazole 25 EC @ 0.75 ml/lit treatment, it showed 87 % of disease control over untreated check.

The percentage disease incidence coated in Table 2, clearly reveals that all the treatments except the treatment Azoxystrobin 25 SC @ 1 ml/lit (25% disease incidence) were showed not significant in *Polysora* rust disease management. It is sustained by the percentage control of disease over untreated check is high (75%) in this treatment, it is followed by the treatment Azoxystrobin 25 SC + Difenconazole 25 EC @ 1.0 ml/lit) it showed 72% of disease control over untreated check.

All the doses of Azoxystrobin 25 SC + Difenconazole 25 EC @ 1.3 ml/lit and 2.5 ml/lit recorded significantly higher grain yields of 5670 kgs/ha and 5913 kgs/ha was recorded respectively followed by Azoxystrobin 25 SC + Difenconazole 25 EC @ 1.0 ml/lit (4720 kgs/ha) and 0.7 ml/lit (3980 kgs/ha). Difenconazole 25 EC @ 0.5ml/lit recorded 2300 kg/ha and Mancozeb recorded 1870 kgs/ha (Table 2).

Comparative analysis

Comparative analysis of yield between Trifloxystrobin 50 WG + Tebuconazole 250 EC and Azoxystrobin 25 SC + Difenconazole 25 EC treatments (Fig 3) revealed that the Azoxystrobin 25 SC + Difenconazole 25 EC @ 2.5 ml/lit treatment is more efficient compared with the treatment Trifloxystrobin 50 WG + Tebuconazole 250 EC, in increasing the yield.

DISCUSSION

Increased corn residues can serve as a source of primary inoculums for several important foliar diseases (Wise and Mueller, 2011). Hence, in recent years the need for disease management in corn is augmented and crucial. Development of new fungicides is very essential to manage the *Turicum* leaf blight and *Polysora* rust for low disease severity with increase in yield. Disease severity has a profound effect on grain yield loss and it could be passed along to farmers that by using fungicides at the appropriate dosage and time, farmers can get a higher

grain yield and high earnings. In the present investigation, two fungicides (Trifloxystrobin 50 WG + Tebuconazole 250 EC and Azoxystrobin 25 SC + Difenoconazole 25 EC) were assessed against the 219J and CM 202 maize hybrids under the different concentrations and the results revealed that Azoxystrobin 25 SC + Difenoconazole 25 EC @ 2.5 ml/lit was more significant in the TLB disease control with increase in yield and Trifloxystrobin 50 WG + Tebuconazole 250 EC @ 0.7 g/lit was more effective in Polysora rust disease management.

Foliar application of several fungicides has been found to be effective against leaf blight of corn. Mancozeb (0.25%), Propiconazol (32%) and Hexaconazole were found effective against Phytophthora leaf blight, fruit rot of bell pepper, foliar diseases of mustard Fusarium head blight in wheat and root rot/wilt of soybean as reported (Jyoti et. al., 2006; Paul et. al., 2008; Gupta and Jarial, 2010; Sangeetha and Shamarao, 2013). However, efficacy of strobilurin and its combination with triazole group fungicides has not been evaluated in India against Turicum leaf blight and Polysora rust in maize. Strobilurin fungicides are effective fungicides against many diseases in different crops. Due to problem of resistance to strobilurin fungicides against different group of fungal pathogens, a combination with other groups has emerged in the market. Azoxystrobin and trifloxystrobin are effective against whole range of pathogens. Similarly with tebuconazole and triazole group fungicides is also effective and has broad activity (Pinto, 1997). Hence, trifloxystrobin + tebuconazole forms a good combination with increased efficacy, as reported against sheath blight of rice (Bag M.K., 2009). Utpal Dey et al., 2012 observed similar results of earlier fungicide reports and they testified that maximum grain yield was obtained from the treatment where crop received six sprays of Hexaconazole. Pinto in 1997, reported that the infection of the common rust pathogen was effectively controlled by six sprays of Tebuconazole (0.1%) at 10 days interval and also increase grain yield. In the present investigation, thrice treatment of Tebuconazole at 10 days interval resulted that 23.7 % and 27.6 % of TLB and Polysora rust disease was recorded respectively.

Compiling and analyzing published data allows researchers to examine the effect of a fungicide on yield over many locations and comparisons, but it is limited by the amount of published data on Trifloxystrobin 50 WG + Tebuconazole 250 EC and Azoxystrobin 25 SC + Difenoconazole 25 EC efficacy in disease management and yield enhancement after applying this fungicide.

CONCLUSIONS

Strobilurin group fungicides in combination with triazole fungicides are found effective in management of diseases. Mixture of Trifloxystrobin 50 WG + Tebuconazole 250 EC @ 0.7 g/lit and mixture of Azoxystrobin 25 SC + Difenoconazole 25 EC @ 2.5 ml/lit were found effective in the management of TLB and mixture of Trifloxystrobin 50 WG + Tebuconazole 250 EC @ 0.7 g/lit were found effective in controlling Polysora rust. More significant increase in yield was recorded in treatment Trifloxystrobin 50 WG + Tebuconazole 250 EC @ 0.7 g/lit. While, mixtures of Azoxystrobin 25 SC + Difenoconazole 25 EC @ 2.5 ml/lit recorded yield was significantly superior with respect to disease control and yield aspects.

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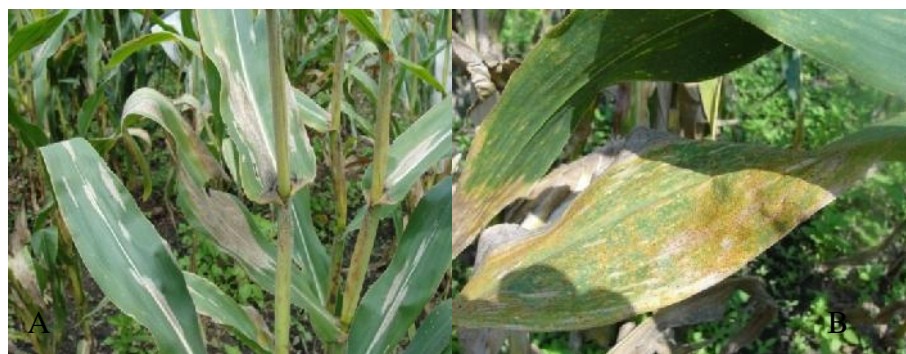


Figure 1. Disease symptoms of Turcicum leaf blight (A) and Polysora rust (B).



Figure 2. Fungicide treated maize plants (A) and untreated check (B).

Table 1. Effect of Trifloxystrobin50 WG + Tebuconazole250 EC against TLB and Polysora rust diseases in maize.

Tr. No.	Particulars	Turcicum Leaf Blight ¹ (PDI ²) 25 days after III spray	% control over untreated check	Polysora rust ¹ (PDI ²) 25 days after III spray	% control over untreated check	Grain yield (kg/ha) Mean	Increase of yield (kg/ha) over control
T1.	Untreated check (Positive control)	94.3	-	78.7	-	1448.6	-
T2.	Trifloxystrobin50 WG+ Tebuconazole250 EC@ 0.5 g / lit	21.7	72.6	25	53.7	3564.8	2116.2
T3.	Trifloxystrobin50 WG+ Tebuconazole250 EC@ 0.6 g / lit	19.3	75	17	61.7	4135.3	2686.7
T4.	Trifloxystrobin50 WG+ Tebuconazole250 EC@ 0.7 g / lit	15	79.3	13.2	65.5	5131.1	3682.5
T5.	Trifloxystrobin (Flint) 50 WG @ 0.4 g / lit	38.3	56	43.9	34.8	2280.7	832.1
T6.	Tebuconazole (Folicur) 250 EC @ 1.4 ml/ lit	23.7	70.6	27.6	51.1	3163.5	1714.9
T7.	Propiconazole (Tilt) 25 EC @ 1.0 ml / lit	25.7	68.6	28.3	50.4	2980.5	1531.9
T8.	Mancozeb 75 % WP @ 3.0 g / lit (Negative control)	38.9	55.4	23.6	55.1	2361.4	912.8
	³ SEm±	2.680		1.350		138.16	
	⁴ CD (5%)	8.129		4.096		419.08	
	⁵ CV (%)	13.41		7.27		7.64	

¹Values are mean of triplicates.

² Percent Disease Index(0-10% = Resistant, 11-25% = Moderately resistant, 26-50% = Moderately susceptible, 51-75% = Susceptible and 76-100% = Highly susceptible).

³Sem± - Standard error mean ⁴CD – Critical difference. ⁵Co-efficient of variance.

Table 2. Effect of Azoxystrobin 25 SC + Difenconazole 25 EC on Turcicum leaf blight and Polysora rust diseases of Maize.

Tr. No.	Particulars	Turcicum Leaf Blight ² (PDI ¹) 25 days after III spray	% control over untreated check	Polysora rust ² (PDI ¹) 25 days after III spray	% control over untreated check	Grain yield (kg/ha) Mean	Increase of yield (kg/ha) over control
T1	Untreated Check	100%	-	100%	-	1540	-
T2	Azoxystrobin 25 SC + Difenconazole 25 EC @ 0.75 ml/lit	13%	87%	49%	51%	3980	2440
T3	Azoxystrobin 25 SC + Difenconazole 25 EC @ 1.0 ml/lit	15%	85%	28%	72%	4720	3180
T4	Azoxystrobin 25 SC + Difenconazole 25 EC @ 1.3 ml/lit	11%	89%	45%	55%	5670	4130
T5	Azoxystrobin 25 SC + Difenconazole 25 EC @ 2.5ml/lit	11%	89%	44%	56%	5913	4373
T6	Azoxystrobin 25 SC @ 1 ml/lit	57%	43%	25%	75%	2824	1284
T7	Difenconazole 25 EC @ 0.5 ml/lit	25%	75%	96%	04%	2300	760
T8	Mancozeb 75 WP @2.67 g/lit	77%	23%	85%	15%	1870	330
	SEm±	2.861		1.157		280.665	
	CD (5%)	8.677		3.510		851.298	
	CV (%)	12.58		3.40		13.50	

¹PDI – Percent Disease Incidence. ²Values are mean of triplicates.

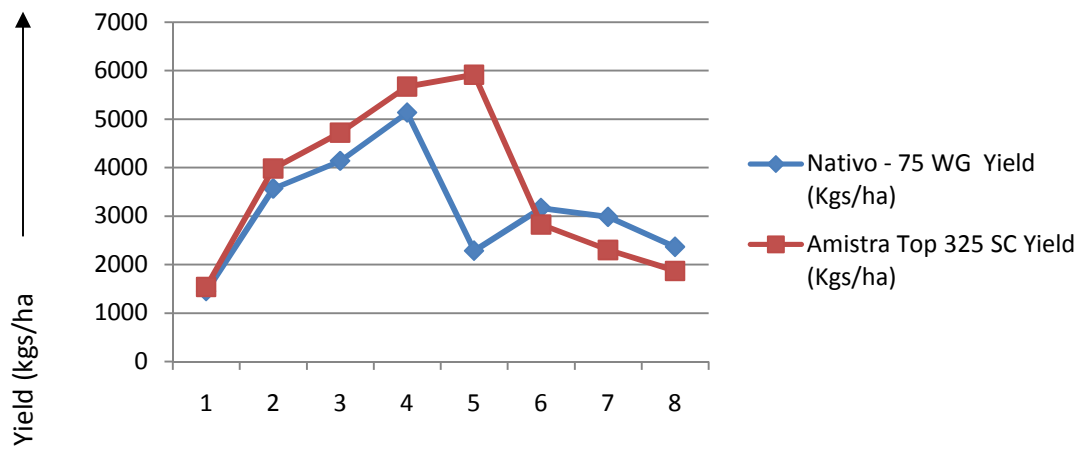


Figure 3. Comparison of yield between Trifloxystrobin50 WG +Tebuconazole250 EC and Azoxystrobin 25 SC + Difenconazole 25 EC treatments.