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## Management of early blight of tomato (*Alternaria solani*) through new generation fungicides under field condition

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### Abstract

Early blight of tomato is serious threat to tomato cultivation and causes major yield loss. Fungicides application is only the practical way of management of diseases under severe disease incidence condition. In present study, new fungicidal molecules were evaluated against early blight of tomato under field condition. Among different fungicides, Azoxystrobin 11% + Tebuconazole 18.3% SC with 1000 ml/ha dosage (17.14% PDI) showed the least incidence of the early blight compared to other tested fungicides and untreated control (63.63%) after 3<sup>rd</sup> foliar sprays. Maximum fruit yield (418.30 Q/ha) was recorded in treatment Azoxystrobin 11% + Tebuconazole 18.3% SC @ 1000 ml/ha and significantly superior over rest of the treatments.

**Keywords:** Early blight, disease severity, fungicides and C:B ratio

### Introduction

Tomato (*Solanum lycopersicum* L) is the most important fruit and vegetable crop consumed in the world and it is estimated that 124.4 million tons fresh tomato fruits are produced every year in all over the world (Wang *et al.*, 2009) <sup>[1]</sup>. It is one of the largest areas and most widely planted vegetable crops; India is the main production areas after China. Tomato crop is vulnerable to infect by bacterial, viral, nematode and fungal diseases. Among those, early blight incited by *Alternaria solani* (Ellis and Martin) is one of the most serious diseases in Tomato growing areas of the country. Early blight disease is one of the major economic constraints to Tomato production worldwide, especially in subtropical and tropical regions. *Alternaria solani* is a soil inhabiting air-borne pathogen responsible for leaf blight, collar and fruit rot of tomato disseminated by fungal spores (Datar and Mayee, 1981) <sup>[2]</sup>. *Alternaria solani* contains enzymes such as cellulases which degrade the host cell wall and also contain pectin methyl galacturonase which facilitate host colonization (Shahbazi *et al.*, 2011) <sup>[8]</sup>. Disease affect crop production as they cause premature defoliation and result in heavy losses in production by reducing quality and quantity of fruit (Holm *et al.*, 2003) <sup>[4]</sup>. Crowded plantation, high rainfall and extended period of leaf wetness are responsible factors to induce disease development (Gondal *et al.*, 2012) <sup>[3]</sup>. This disease is very difficult to control (Pasche *et al.*, 2005) <sup>[6]</sup>. Failure to control this disease can cause reduction in yield (Malik *et al.*, 2014) <sup>[5]</sup>. It need to develop new effective fungicide and bioagents with mode of action which will be helpful for increase in quality and quantity of tomato production (Sahu *et al.*, 2013) <sup>[7]</sup>. However, the present work was designed to investigate the efficacy of fungicides against the menace of early blight pathogen under field conditions.

### Materials and Methods

The field experiment was laid out in Randomized Block Design (RBD) with seven treatments and three replications at Kawadimatti (Karnataka). The seeds of a local variety of Tomato (JK Desi) were sown in small beds for raising nursery and 25 days old seedlings (at four leaf stage) were transplanted into the field with 60 cm inter and 50 cm intra row spacing in plots measuring 5.0 m x 4.0 m. All other cultural practices were followed as recommended in package of practices. Four replications were maintained for each treatment.

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## Treatment details

S. No.	Treatment	Dosage (per ha)	
		a.i. (g)	Formulation (ml)
1	Azoxystrobin 11% + Tebuconazole 18.3% SC	110+183	1000
2	Azoxystrobin 23% SC	125	500
3	Tebuconazole 25.9% EC	187.5	750
4	Mancozeb 35% SC	175gm/100lt. water	500 ml/100lt. water
5	Control	-	--

**Observations recorded for bio-efficacy**

Observations were recorded on appearance of diseases, disease severity and fruit yield per plot. The data on disease severity was recorded before spray as initial, 10 days after 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> spray. The severity of early blight was recorded on 10 plants were selected at randomly in each replication of the treatment.

Rating scale for assessment of early blight disease (Mayee and Datar, 1986)

Grade	Description of the symptoms
0	No symptoms on the leaf
1	0-5 per cent leaf area infected and covered by spot on leaf
2	6-20 per cent leaf area infected and covered by spot, some spots on petiole
3	21-40 per cent leaf area infected and covered by spot, spots also seen on petiole, branches
4	41-70 per cent leaf area infected and covered by spot, spots also seen on petiole, braches, stem
5	>71 per cent leaf area infected and covered by spot, spots also seen on petiole, branch, stem, fruits

Percent disease index (PDI) was calculated by using the formula given by Wheeler (1969).

$$\text{PDI} = \frac{\text{Sum of numerical values}}{\text{Number of leaves observed}} \times \frac{100}{\text{Maximum disease rating value}}$$

**Observation on Yield:**

The Fruit yields were recorded after harvesting the crop at maturity and expressed in Q/ha. Cost benefit ratio was also calculated and compared with different treatments.

**Statistical analysis**

All the data of diseases incidence and yields were statistically analyzed by the following procedure of RBD. Calculations were made after applying the test of significance of the means. The per cent data of disease incidence was transformed to Arc sine value.

**Results and Discussion****Effect of fungicides on severity of early blight of tomato**

Results revealed that the PDI was in the range of 5.49 to 6.20 in the experimental plots before giving the first fungicidal application. These ranges in the disease incidence were differing significantly in the plots meant for different treatment. But in subsequent sprays, all the fungicides treated plots recorded significantly less severity disease severity over control on different days of observation. The data on Percent disease severity of early blight of Tomato are presented in Table 1. Results clearly revealed that, the foliar spray of Azoxystrobin 11% +Tebuconazole 18.3% SC with 1000 ml/ha dosage (terminal PDI, 17.14%) provided the least incidence of the early blight. In the control plot percent disease severity was as high as 36.40 per cent. However,

maximum per cent disease control (63.63%) was recorded after 3<sup>rd</sup> foliar sprays in the treatment Azoxystrobin 11% +Tebuconazole 18.3% SC @ 1000 ml/ha. The prophylactic sprays of the fungicides under natural field conditions significantly controlled the incidence and intensity early blight of tomato as compared to the control. The present investigation with regard to Azoxystrobin and Mancozeb are in agreement with Tofoli *et al.*, (2003) [9] who evaluated the effectiveness of fungicides for controlling early blight (*Alternaria solani*) as well as their effectiveness on tomato fruit yield. They reported that highest level of disease control, quality and increase in fruit yields were obtained with Azoxystrobin, Difenoconazole followed by Mancozeb and Chlorothalonil. Similarly, Bartlett *et al.*, (2002) [1] noticed good efficacy of Azoxystrobin against tomato early blight. Further, Vloutoglou *et al.*, (2001) [10] showed effectiveness of Azoxystrobin and Chlorothalonil against *Alternaria solani* on tomato and reported superiority of Azoxystrobin over Chlorothalonil.

**Effect of fungicides on yield (Q/ha) of tomato**

Results presented in Table 2, revealed that all the treatments increased the fruit yield quintal per ha with respect to control. Maximum fruit yield (418.30 Q/ha) was recorded in treatment Azoxystrobin 11% +Tebuconazole 18.3% SC @ 1000 ml/ha and significantly superior over rest of the treatments. Next treatment in order of superiority was Azoxystrobin 23% SC @ 500 ml/ha (390.47 Q/ha), Tebuconazole 25.9% EC @ 750 ml/ha (383.73 Q/ha), and Mancozeb 35% EC (372.61 Q/ha) as compared to control plot (369.03 Q/ha). The incremental cost benefit ratio calculated for different fungicides revealed the superiority of treatment Azoxystrobin 11% +Tebuconazole 18.3% SC with dosage 1000 ml/ha (1:6.65) was found to be superior over rest of the treatments (Table 2). The results of the present investigation are comparable with Bartlett *et al.*, (2002) [1] who evaluated effect of strobilurin fungicides such as Azoxystrobin, Kresoxim methyl, Trifloxystrobin and Pyraclostrobin in influencing yield and quality of wheat, barley, tomato, potato, mangoes etc and reported that strobilurin based spray programmes delivered consistently greater yield benefits as compared to triazole based programmes. Tofoli *et al.*, (2003) [9] also evaluated the effectiveness of various groups of fungicides for controlling early blight and on yield of tomato and reported that the highest level of disease control, quality and increase in fruit yields were obtained with Azoxystrobin followed by Mancozeb and Chlorothalonil.

Experimental findings shown that terminal scoring of early blight recorded very low in the plot sprayed with Azoxystrobin 11% +Tebuconazole 18.3% SC @ 1000 ml/ha and found to be superior than other treatments. Hence, field application of Azoxystrobin 11% +Tebuconazole 18.3% SC @ 1000 ml/ha could be recommended for use in Tomato control early blight disease with increased yield, better C: B ratio and no adverse effect on the crop.

**Table 1:** Bio-efficacy of fungicides on percent disease incidence of early blight in tomato

Treatments	Dosage (ml or gm/ha)	Per cent disease incidence of dieback on Tomato				% disease control
		Initial	First spray	Second spray	Third spray (Terminal PDI)	
Azoxystrobin 11% + Tebuconazole 18.3% SC	1000	5.70 (13.81)	7.06 (15.41)	11.03 (19.40)	17.14 (24.45)	63.63
Azoxystrobin 23% SC	500	5.70 (13.80)	9.76 (18.20)	16.70 (24.12)	20.66 (27.03)	56.16
Tebuconazole 25.9% EC	750	6.20 (14.20)	10.02 (18.45)	16.60 (24.03)	21.44 (27.58)	54.50
Mancozeb 35% EC	500 ml/100 lt. water	5.73 (13.83)	11.60 (19.91)	18.90 (25.76)	28.58 (32.27)	39.35
Control		5.95 (14.11)	17.81 (24.95)	27.86 (31.85)	47.13 (43.33)	-
CD 5%		NS	0.95	1.05	1.28	-
S.Em±		-	0.29	0.33	0.39	-

**Note:** The data in the parenthesis are presented in arch sine transformation.

**Table 2:** Bio-efficacy of fungicides on fruit yield Tomato

Treatments	Yield Q/ha	Cost Benefit Ratio
Azoxystrobin 11% + Tebuconazole 18.3% SC	418.30	1:6.65
Azoxystrobin 23% SC	390.47	1:3.22
Tebuconazole 25.9% EC	383.73	1:4.86
Mancozeb 35% EC	372.61	1:4.69
Control	369.03	-
CD 5%	7.16	
S.Em±	2.30	

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