International Journal of Agriculture, Environment and Biotechnology
Citation: *IJAEB*: **15**(01): 61-65, March 2022
DOI: 10.30954/0974-1712.01.2022.7

ASSOCIATION FOR AGRICULTURE ENVIRONMENT AND BIOTECHNOLOGY

PLANT PATHOLOGY

Efficacy of different Fungicide against *Alternaria solani* Caused Early Blight Disease of Tomato under *in vitro* Condition

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Paper No. 958 **Received:** 14-12-2021 **Revised:** 27-02-2022 **Accepted:** 09-03-2022

ABSTRACT

Tomato (*Solanum lycopersicum* L.) is one of the most popular vegetable crops. It is affected by several diseases among them early blight caused by *Alternaria solani* is most destructive foliar diseases of tomato, the present study was conducted to evaluate *in vitro* efficacy of different fungicides with four different concentrations (250, 500, 750 &1000 ppm). Among them highest percent inhibition was found in Propiconazole (90.19%) at 1000 ppm concentration after 120 hrs followed by Tebuconazole (86.52%), Mancozeb (80.63%) and Captan + Hexaconazole (79.40%) against *A. solani*. and Moderately growth was found in Hexaconazole (78.17%), Thiram (76.64%) Captan (74.73%) and Carbendazim (65.54%). Lowest percent inhibition was observed in Copper oxychloride (42.65%) against control (65.30mm).

HIGHLIGHTS

- Early blight disease is painful nerve to tomato growing farmer.
- Propiconazole and Tebuconazole were the best fungicides for effectively managing early blight disease of tomato.

Keywords: Fungicides, tomato, early blight, *Alternaria solani*, mycelial inhibition

Tomato (*Solanum lycopersicum* L.) is one of the most popular vegetable crops cultivated extensively all over the world for its edible fruits. It belongs to family *Solanaceae* and originated from the Andes, in what is now called Bolivia, Central America (Peru), Chili and Ecuador where they grow wild (Mehta 2017). It is a traditional vegetable crop commercially cultivated in India and ranks second in the production of tomato after China. Tomato is a rich source of several nutrients, vitamins (A, B, C) and minerals and antioxidants such as carotenoids. Well drained sandy loam soil with high level of contents is suitable for tomato cultivation.

The crop occupies 8.85 thousand/ha Land in India with 19696 m. tones production and 24.4 m. tones/ ha productivity during 2016-17 (Anon 2017).

Tomato can be affected by many diseases during growing season and is vulnerable for biotic and abiotic stresses. The biotic contributors such as fungi, bacteria, virus and nematodes causing major losses to the crop (Bost 2013; Gleason and Edmunds, 2006). Two common and devastating disease of tomato are early blight & *Fusarium* wilt caused by *Alternaria solani* and *Fusarium oxysporum f. sp. lycopersici* respectively and which produces leaf spots, stem canker and fruit rots, but the foliar phase is the most common & destructive part of the disease. (Maiero and Barksdale 1989). Early blight, incited by *Alternaria solani* (Ellis & Martin) Jones and Grout is one of the most destructive foliar diseases of tomato, causing significant reduction

How to cite this article: Dhaka, S. and Choudhary, A. (2022). Efficacy of different Fungicide against *Alternaria solani* Caused Early Blight Disease of Tomato under *in vitro* Condition. *Int. J. Ag. Env. Biotech.*, **15**(01): 61-65.

Source of Support: None; **Conflict of Interest:** None

in the quality and quantity of fruit yields (Tewari and Vishunavat 2012). The disease is responsible to cause 35.14 percent yield losses under open field and 33.94 to 69.28 Percent in poly house (Soni *et al*. 2017). This disease causes losses in fruit yield from 50-80% (Mathur and Shekhawat 1986). The disease is characterized by the appearance of brown to dark brown necrotic spots with concentric rings on foliage, stem and fruits (Chouhan *et al.* 2015) and oval or angular in shape ranging from 0.3 to 0.4 cm diameter with usually narrow chlorotic zone around the spot (Walker 1952). The first symptom of the Early Blight appears on the lower senescent leaves as dark necrotic lesions. The disease process upward as the plant become older. The infection on fruit causes dark, sunken, leathery and purple lesions on the stem-end. These lesions expand to a significant size and extend deep into the flesh of the fruit. Infected fruits mostly drop prematurely, and those reaching to the maturity also become unmarketable (Chaerani and Voorrips 2006). *A. solani* infect all the above ground parts of the plant at all stage of growth and development (Peralta *et al*. 2005; Verma *et al*. 2007). The plants are more susceptible to infection by the pathogen during fruiting period (Cerkauskas 2005; Momel and Pemezny 2006). Keeping in view the importance of the disease, the present study was conducted to evaluate *in vitro* efficacy of different fungicides against *Alternaria solani.*

MATERIALS AND METHODS

In vitro evaluation of fungicides

Nine fungicides were evaluated under laboratory conditions against *A. solani* by Poisoned Food Techniques (Nene and Thapliyal 1973). Observation on mycelial growth was recorded after 120 hrs incubation.

Table 1: Fungicides used against *A. solani*

Treatment	Fungicides	Concentration (ppm)
T_1	Mancozeb	250,500,750,1000
T_2	Copper oxychloride	250,500,750,1000
T_3	Carbendazim	250,500,750,1000
T_4	Tebuconazole	250,500,750,1000
T_5	Propiconazole	250,500,750,1000
T_6	Captan	250,500,750,1000
T_7	Thiram	250,500,750,1000
T_8	Captan + Hexaconazole	250,500,750,1000
T_9	Hexaconazole	250,500,750,1000
T_{10}	Control	—

Poison Food Technique

Required quantity of each fungicide under study was mixed thoroughly in sterilized 100 ml PDA media filled in 250 ml flask separately under aseptic condition. The medium was supplemented with streptomycin sulphate @ 50 ppm to prevent bacterial contamination. The poisoned medium was then poured in sterilized petri plates (20 ml) and allowed it to solidify. Mycelium discs of 5 mm size from after 120 hrs incubation was cut by a sterile cork borer and one such disc was placed at the center of each agar plate. The plate without any fungicide served as control. Three replications were maintained for each concentration. Such plates were incubated at room temperature and the radial growth was measured when fungus attained maximum growth in control plates. Percent inhibition of mycelial growth over untreated control was calculated by applying the formula given by Vincent (1947).

RESULTS AND DISCUSSION

Nine different fungicides viz., Mancozeb, Copper oxychloride, Carbendazim, Tebuconazole, Propiconazole, Captan, Thiram, Captan + Hexaconazole and Hexaconazole were evaluated on mycelial growth of *A. solani* at different 250, 500, 750, 1000 ppm concentrations.

The data presented table 2, Fig. 1 and Plate 1 indicated that, highest percent inhibition was found in Propiconazole (90.19%) at 1000 ppm concentration after 120 hrs followed by Tebuconazole (86.52%), Mancozeb (80.63%) and Captan + Hexaconazole (79.40%) against *A. solani*. and Moderately growth was found in Hexaconazole (78.17%), Thiram (76.64%) Captan (74.73%) and Carbendazim (65.54%). Lowest percent inhibition was observed in Copper oxychloride (42.65%) against control (65.30 mm). Whereas Tebuconazole and Propiconazole inhibited 71.16% mycelial growth at 250 ppm followed by Captan + Hexaconazole (56.62%), Thiram (56.32%).

The observations are similar observations were also recorded by to Sahu *et al*. (2013), Chouhan

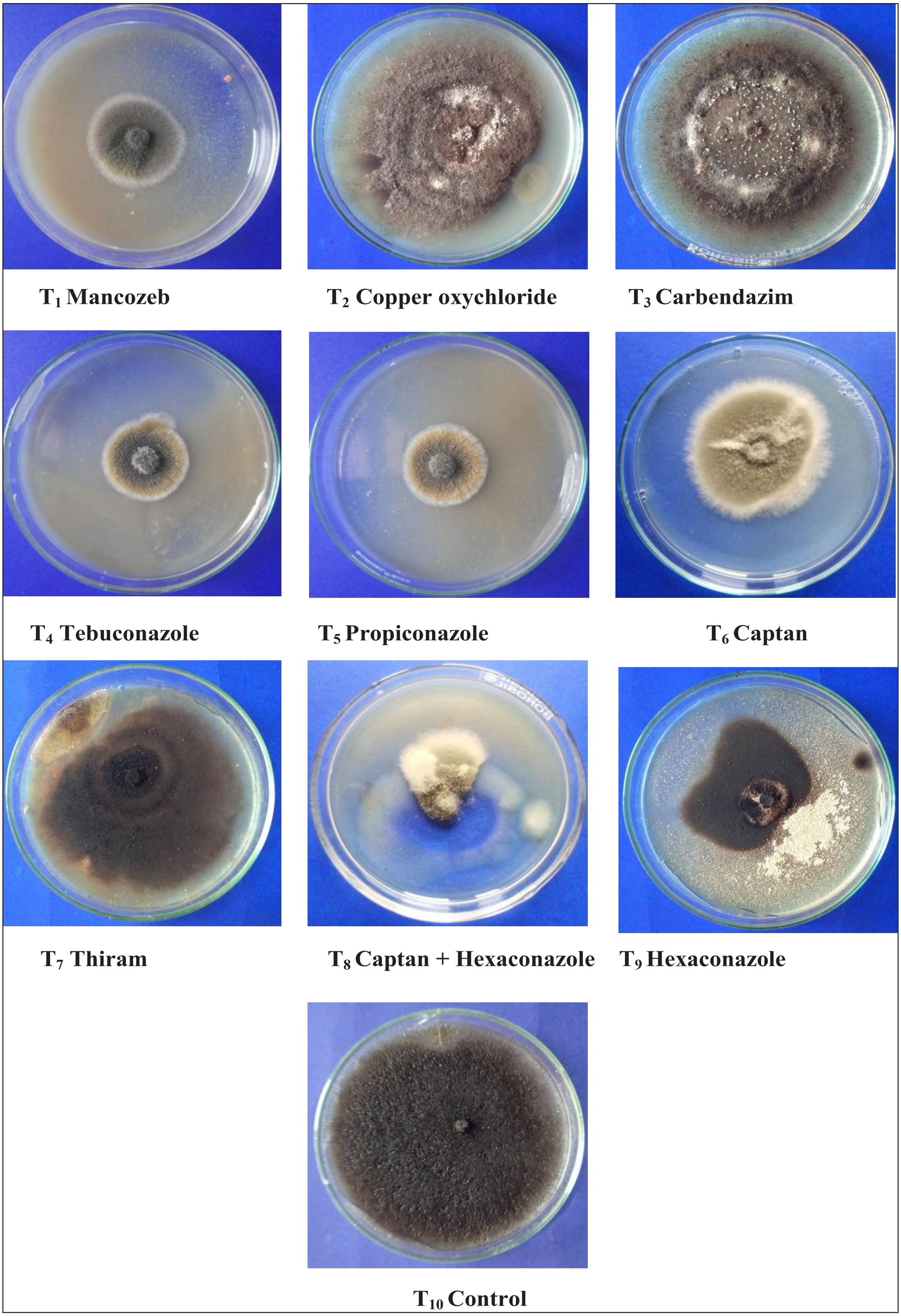

Plate 1: Efficacy of different fungicides against *Alternaria solani*

Table 2: Efficacy of different fungicides against *Alternaria solani*

Treatment	Fungicides	Radial Mycelial Growth (mm) Percent inhibition							
		250 ppm		500 ppm		750 ppm		1000 ppm	
		RMG	PI	RMG	PI	RMG	PI	RMG	PI
T_1	Mancozeb	22.65	65.31	18.83	71.16	14.50	77.79	12.65	80.63
T_2	Copper oxychloride	55.52	15.28	48.25	26.11	45.12	30.90	37.45	42.65
T_3	Carbendazim	46.52	28.75	33.62	48.51	27.45	57.96	22.5	65.54
T_4	Tebuconazole	18.83	71.16	15.97	75.54	12.12	81.44	8.52	86.52
T_5	Propiconazole	18.83	71.16	15.97	75.54	10.15	84.45	6.40	90.19
T_6	Captan	29.65	54.59	20.67	68.35	18.05	72.35	16.50	74.73
T_7	Thiram	28.52	56.32	18.52	71.63	16.50	74.73	15.25	76.64
T_8	Captan + Hexaconazole	28.33	56.62	19.43	70.25	15.45	76.34	13.45	79.40
T_9	Hexaconazole	29.52	54.79	20.52	68.57	17.85	72.66	14.25	78.17
T_{10}	Control	65.30		65.30	—	65.30	—		
	SE(m)±			0.51		0.55			
	CD (P=0.05)			1.42		1.42			

**Mean of three replications.*

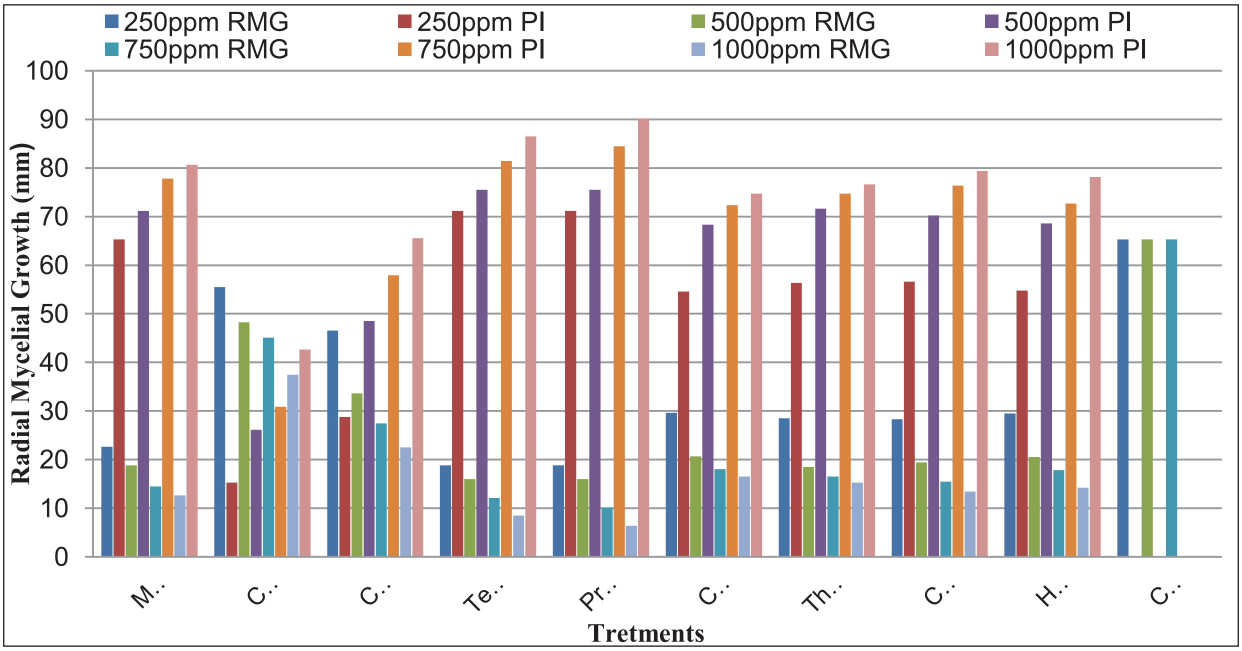

Fig. 1: Efficacy of different fungicides against *Alternaria solani*

et al. (2015) reported that Topsin M was more effective as compare to control., Ghazanfer *et al*. (2016), Kumar *et al*. (2017), Rani *et al*. (2017), Chapei *et al*. (2019), Sreenivasulu *et al*. (2019) evaluated that Tebuconazole was most effective followed by Propiconazole. Sudarshan G.K. (2020) and Sowmya and Chandra (2021). Who observed that Tebuconazole was the most effective fungicide followed by Difenconazole.

CONCLUSION

Among the fungicides Propiconazole was recorded maximum mycelial growth inhibition of *A. solani*, other effective fungicides were Tebuconazole, Mancozeb, Captan + Hexaconazole, and Captan.

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