Biological Forum – An International Journal **14(2): 1016-1020(2022)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Management of Early Blight of Tomato (*Solanum lycopersicum* Mill.) Incited by *Alternaria solani* through Micronutrients (*in vitro and in vivo*)

Ranjana Meena[1*], Shailesh Godika[1], Pinki Devi Yadav[2], Kewal Chand[1] and Anuradha Jajoriya[1]
[1]Department of Plant Pathology, SKN College of Agriculture, Jobner, Jaipur (Rajasthan), India.
[2]Rajasthan Agricultural Research Institute, Durgapura, SKNAU, Jobner, Jaipur (Rajasthan), India.

(Corresponding author: Ranjana Meena)*
(Received 23 March 2022, Accepted 18 May, 2022)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: Early blight caused by *Alternaria solani* is a serious disease of Tomato (*Solanum lycopersicum* L., syn. = *lycopersicon esculentum* Mill.). Five micronutrients Zinc (Zinc sulphate); Boron (Borax); Copper(Copper sulphate); Manganese (Manganese sulphate); Iron (Ferrus sulphate) were tested at 250 ppm, 500 ppm, 1000 ppm and 1500 ppm concentrations to inhibit the mycelial growth of *A. solani* under *in vitro* conditions. Among these Copper sulphate (38.75%) gave maximum inhibition of mycelial growth at each concentration followed by Zinc sulphate (35.26%). Study of micronutrient under *in vivo* condition through foliar spray resulted that Copper sulphate recorded minimum per cent disease intensity (30.26%) and maximum per cent disease control (49.83%) followed by Zinc sulphate with 32.58%, 45.98%, both PDI and per cent disease control, respectively. They found minimum disease severity of both White rust (31.3%) and Alternaria blight (26.03%). when $ZnSO_4$ @15 kg/ha + borax @ 10 kg/ha + gypsum @250kg/ha applied as basal dose.

Keywords: Alternaria, Intensity, Inhibition, Spray, Micronutrient.

INTRODUCTION

Tomato (*Solanum lycopersicum* L., syn.=*lycopersicon esculentum* Mill.) belongs to the family *Solanaceae* and it is the second most important vegetable crop next to potato and first among processing crops. Tomato is said to be the native-born of Tropical America. Among the fungal diseases of tomato crop mostly affected by early blight of tomato disease incurring loss under field and post harvest stages causing 50 to 86 percent reduction in fruit yield (Mathur and Shekhawat 1986). Every one percent increase in disease intensity can reduce yield by 1.36 per cent, and complete crop failure can occur when the disease is most severe yield loss up to 79 percent in India which is caused by *Alternaria solani* (Ellis and Martin 2013). Saha and Das (2012) reported losses in yield 0.75 to 0.77 tonnes/hectares with 1per cent increase in disease severity. It is common disease wherever tomatoes are grown and is one of the most destructive disease causing significant qualitative and quantitative losses at any stage of plant growth including fruit and seed production. The pathogen is also responsible for causing storage losses during transit. Disease is favored by warm temperature and extended period of leaf wetness from dew, rainfall and crowded plantation. The plants are more susceptible to infection by the disease during fruiting period (Momel and Pemezny 2006). In India, the disease is more severe during June to July sown crop than in the winter crop (Datar and Mayee 1981).

MATERIAL AND METHODS

Effect of micronutrients on mycelial growth of the pathogen (*in vitro*)

The test fungus was grown on PDA in which the desired quantity of five micro nutrients was incorporated to obtain four different concentrations *viz.*, 250, 500, 1000 and 1500 ppm. Desired quantity of chemical was mixed thoroughly in 100 ml of Potato Dextrose Agar (PDA), just before pouring in sterilized petri plates and allowed to solidity. A mycelial disc of 5 mm diameter of the pathogen taken from a 7 day old culture with the help of sterilized cork borer was then placed at the centres of the Petri plate. The inoculated Petri plates were incubated at 25 ± 1°C temperature in BOD. Three replications were maintained for each treatment. Colony diameter was measured after 7 days of inoculation. Per cent growth inhibition was calculated as per formula (Bliss, 1934).

Per cent growth inhibition = $\frac{C - T}{C} \times 100$

Where,

C = Diameter of the colony in check (average of both diagonals)

T = Diameter of the colony in treatment (average of both diagonals)

Table 1: List of micronutrients used under *in vitro* study.

Sr. No.	Micronutrient	Source	Concentration (ppm)
1.	Zinc	Zinc Sulphate	250, 500, 1000, 1500
2.	Boron	Borax	250, 500, 1000, 1500
3.	Manganese	Manganese Sulphate	250, 500, 1000, 1500
4.	Iron	Ferrous Sulphate	250, 500, 1000, 1500
5.	Copper	Copper Sulphate	250, 500, 1000, 1500
6.	Control	-	-

Management of early blight of tomato through micronutrients (*in vivo*). The present investigation was carried out using following different micronutrients, *i.e.* Fe, Mn, Zn, Cu and B. First spray was given 10 days after transplanting (DAT) and second spray at 25 DAT. Disease intensity was recorded at 60 DAT as mentioned elsewhere.

Experimental layout. The experiment was laid out in Completely Randomized Design (CRD) with five treatments and four replications (Fig. 1).

Table 2: List of micronutrients used under *in vivo* study.

Sr. No.	Micronutrient	Source	Concentration (%)
1.	Zinc	Zinc Sulphate	0.5
2.	Boron	Borax	0.5
3.	Copper	Copper Sulphate	0.5
4.	Manganese	Manganese Sulphate	0.5
5.	Iron	Ferrous Sulphate	0.5
6.	Control	-	-

Boron		Fe		Mn		Cu		Zn		Control	
T_1R_1	T_2R_3	T_1R_1	T_2R_3	T_1R_1	T_2R_3	T_1R_1	T_2R_3	T_1R_1	T_2R_3	T_1R_1	T_2R_3
T_1R_2	T_1T_4	T_1R_2	T_1T_4	T_1R_2	T_1T_4	T_1R_2	T_1T_4	T_1R_2	T_1T_4	T_1R_2	T_1T_4

Fig. 1. Layout of pot experiment on management of early blight of tomato through micronutrients.

Experimental details

Number of treatments: Five

Number of replications: Four

Treatment Details:

T1=Boron (Borax)

T2=Iron (Ferrus sulphate)

T3=Manganese (Manganese sulphate)

T4=Copper(Copper sulphate)

T5=Zinc (Zinc sulphate)

RESULTS AND DISCUSSION

Effect of micronutrients on mycelial growth and sporulation of pathogen (*in vitro*). The efficacy of five micronutrients (Table 3, Fig. 2 and Plate 1) were tested *in vitro* at four levels of concentrations *viz.*, 250 ppm,500 ppm, 1000 ppm and 1500 ppm against mycelial growth and sporulation of *Alternaria solani* on Potato Dextrose Agar (PDA) by poisoned food technique.

Among five micronutrients *viz.*, Zinc (Zinc sulphate); Boron (Borax); Copper (Copper sulphate); Manganese (Manganese sulphate); Iron (Ferrussulphate), Copper sulphate ($CuSO_4$) was found most effective in inhibiting mycelial growth (16.15, 25.38, 49.72 and 63.76%) of *Alternaria solani* at 250 ppm, 500 ppm, 1000 ppm and 1500 ppm, respectively followed by Zinc sulphate ($ZnSO_4$) (14.96, 22.74, 44.33 and 59.04%) over control. Borax was found least effective in inhibiting mycelial growth of *Alternaria solani* over control (90.00 mm). All the concentrations (250 ppm, 500 ppm, 1000 ppmand 1500 ppm) of Copper sulphate were found significantly superior over other treatments.

As we consider the results regarding with sporulation of pathogen Copper sulphate ($CuSO_4$) which was most effective in inhibiting mycelial growth of the pathogen exhibited very poor sporulation (+) followed by Zinc sulphate ($ZnSO_4$) poor sporulation under *in vitro* condition which showed poor sporulation (++). Borax that was least effective in inhibiting mycelial growth of the pathogen exhibited better sporulation (+++++) as compared to control in which excellent sporulation (++++++++) was occurred.

Five micronutrients Zinc (Zinc sulphate); Boron (Borax); Copper(Copper sulphate); Manganese (Manganese sulphate); Iron (Ferrus sulphate) were tested at 250 ppm, 500 ppm, 1000 ppm and 1500 ppm concentrations by poisoned food technique to inhibit the mycelial growth of *A. solani* under *in vitro* conditions. Copper sulphate (38.75%) gave maximum inhibition of mycelial growth at each concentration

followed by Zinc sulphate (35.26%). Similar work done by Shoaib *et al.* (2015) against phytopathogenic Leaf spot by *Alternaria alternata*. They assessed different doses of Copper metal *in vitro* in terms of growth and physiology. Amongst nitrate, chloride and sulphates salts of Copper, the maximum inhibition in radial growth of the fungus was observed with increase concentrations of Copper salts in order of: $CuSO_4$> $CuNO_3$>$CuCl_2$. Kumar *et al.* (2015) observed K_2SO_4(1000ppm) showed maximum inhibition of mycelia growth (64.28%) of *Alternaria brassicae* in comparison to check followed by $ZnSO_4$ (1000ppm) (63.88%) in their studies of effect of eco-friendly chemicals on Alternaria blight disease of mustard.

Table 3: Effect of micro nutrients on mycelial growth inhibition and sporulation of pathogen (*in vitro*).

Sr. No.	Micronutrients	Source	Percent inhibition of mycelial growth* (*in vitro*)					Sporulation
			250 ppm	500 ppm	1000 ppm	1500 ppm	Mean	
1	Zinc	Zinc Sulphate	14.96 (22.75)	22.74 (28.48)	44.33 (41.74)	59.04 (50.21)	35.26	++
2	Boron	Borax	2.07 (8.27)	8.60 (17.05)	18.72 (25.64)	26.76 (31.15)	14.03	+++++
3	Manganese	Manganese Sulphate	6.43 (14.69)	13.94 (21.92)	28.34 (32.16)	39.44 (38.90)	22.03	++++
4	Iron	Ferrous Sulphate	10.81 (19.20)	17.23 (24.53)	37.66 (37.86)	51.30 (45.74)	29.25	+++
5	Copper	Copper Sulphate	16.15 (23.70)	25.38 (30.25)	49.72 (44.84)	63.76 (52.99)	38.75	+
6	Control	-	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)		++++++++
	SEm±		1.00	1.04	1.28	1.50		
	CD (p=5 %)		3.08	3.20	3.93	4.62		

*Average of three replications

Sporulation	Category
+	Very poor
++	Poor
+++	Moderate
++++	Good
+++++	Better
++++++++	Excellent

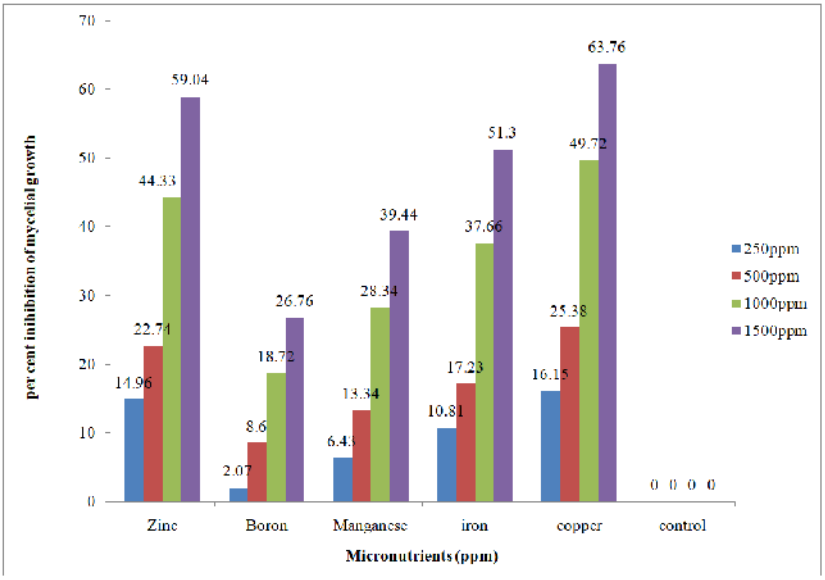

Fig. 2. Effect of micronutrients on mycelia growth and sporulation of pathogen (*in vitro*).

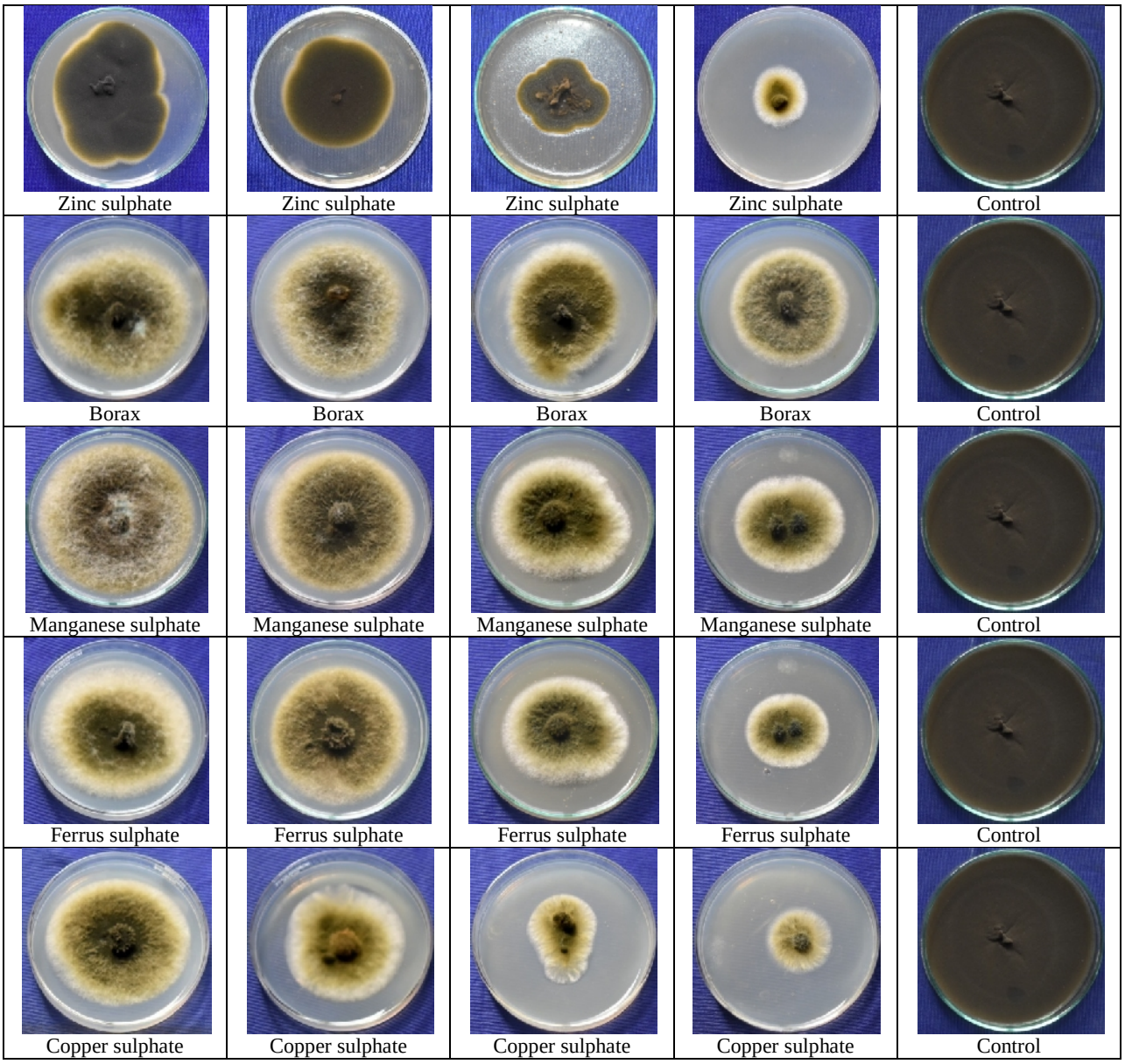

Plate 1. Efficacy of different micronutrients against *Alternariasolani.*

Management of early blight of tomato through micronutrients (*in vivo*). Effect of five micronutrients *viz.*, Zinc (Zinc sulphate); Boron (Borax); Copper (Copper sulphate); Manganese (Manganese sulphate); Iron (Ferrus sulphate), were studied against Early blight of tomato under pots conditions through two foliar sprays (10 DAT and 25 DAT) at 0.5 % concentration. Results presented in Table 4 and Fig. 3 revealed that minimum disease intensity was observed with Copper sulphate ($CuSO_4$) (30.26%) followed by Zinc sulphate ($ZnSO_4$) (32.58%) as compared to control (60.32%). Maximum reduction in disease over control (per cent disease control) was observed with Copper sulphate ($CuSO_4$) (49.83%) followed by Zinc sulphate ($ZnSO_4$) (45.98%). Per cent disease intensity with Borax (48.37%) was found statistically at par with Manganese sulphate ($MnSO_4$) (43.1%). Minimum reduction in disease (per cent disease control) was observed with Borax (19.81%).

Five micronutrients were used *in vivo* conditions through foliar spray applications (0.5%) in a pot experiment. Among these, all micronutrients were able to reduce disease intensity significantly over control. In pot condition minimum disease intensity (30.26%) was recorded with Copper sulphate followed by Zinc sulphate (32.58%). Similar work done by Kumar *et al.* (2015) *Alternaria brassicae* causing Alternaria blight of Indian mustard. They reported significantly minimum disease index on leaf or check by foliar spray with 0.5% $CaSO_4$ (23.58%) followed by 1.5% $CaSO_4$ (24.00%). Rathi *et al.* (2015) evaluated role of soil application of micronutrients in defense to white rust and Alternaria blight in Indian mustard. They found minimum disease severity of both White rust (31.3%) and Alternaria blight (26.03%). when $ZnSO_4$ @15 kg/ha + borax @ 10 kg/ha+ gypsum @250kg/ha applied as basal dose.

Table 4: Management of early blight of tomato through micronutrients (*in vivo*).

Sr. No.	Micronutrients	Source	Per cent Disease Intensity* (PDI)	Per cent DiseaseControl
1.	Copper	Copper Sulphate	30.26 (33.37)	49.83 (44.90)
2.	Zinc	Zinc Sulphate	32.58 (34.81)	45.98 (42.69)
3.	Iron	Ferrous Sulphate	39.42 (38.89)	34.64 (36.05)
4.	Manganese	Manganese Sulphate	43.1 (41.03)	28.54 (32.29)
5.	Boron	Borax	48.37 (44.07)	19.81 (26.43)
6.	Control		60.32 (50.96)	0.00 (0.00)
	SEm+		0.95	
	CD (P= 5%)		2.92	

*Average of four replications

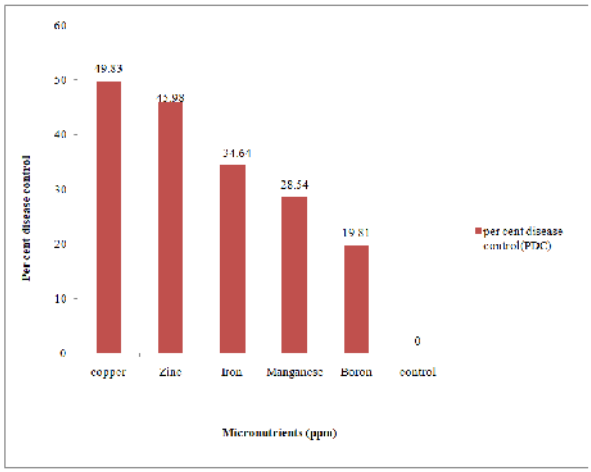

Fig. 3. Management of early blight of tomato through micronutrients.

CONCLUSION

Early blight caused by *Alternaria solani* is a serious disease of Tomato (*Solanum lycopersicum* L., syn. = *lycopersicon esculentum* Mill.). Under *in vitro* condition among five micronutrients Copper sulphate was found most effective in per cent inhibition of mycelial growth followed by Zinc sulphate. Effect of different micronutrients on disease were tested under *in vivo* condition in which Copper sulphate showed minimum per cent disease intensity and highest per cent disease control followed by Zinc sulphate.

REFERENCES

Bliss, C. L. (1934). The method of probits. *Science, 79*: 38.

Datar, V. V. and Mayee, C. D. (1981). Assessment of loss in tomato yield due to early blight. *Indian Phytopathology, 34*: 191-195.

Ellis, M. B., and Martin, M. (2013). *Dematiaceous hypomycetes*. Commonwealth *Mycological Institute, kew, Surry, England*, p 608.

Kumar, A., Kumar, S., Kumar, R., Chand, G., and Kolte, S. J., (2015). *In vitro* and *in vivo* effect of eco-friendly chemicals on Alternaria blight disease (*Alternaria brassicae*) and yield attributes in Indian mustard.

Mathur, K., and Shekhawat, K. S. (1986). Chemical control of early blight in *Kharif*sown tomato. *Indian Journal of Mycology Plant Pathology, 16*: 235-238.

Momel, T. M., and Pemezny, K. L. (2006). Florida plant disease management guide Tomato. Florida Cooperation Extensive Service, *Institute of Food and Agriculture Sciences, Gaineville,* 32611.

Rathi, A S., Singh, D., Avtar, R., and Kumar, P. (2015). Role of micronutrient in defense to white rust and Alternaria blight infecting Indian mustard. *Journal of Environmental Biology, 36*(2): 467-471.

Saha, P., and Das, S. (2012). Assessment of yield loss due to early blight (*Alternariasolani*) of tomato. *Indian Journal of Plant Protection, 40*(3): 195-198.

Shoaib, A., Akhtar, S., and Akhtar, N. (2015). Copper tolerance, protein and catalytic activity in phytopathogenic fungus *Alternariaalternata*. *Global NEST Journal, 17*(4): 664-672.

How to cite this article: Ranjana Meena, Shailesh Godika, Pinki Devi Yadav, Kewal Chand and Anuradha Jajoriya (2022). Management of Early Blight of Tomato (*Solanum lycopersicum* Mill.) Incited by *Alternaria solani* through Micronutrients (*in vitro and in vivo*). *Biological Forum – An International Journal, 14*(2): 1016-1020.