International Journal of Agriculture Sciences
ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 15, Issue 11, 2023, pp.-12754-12756.
Available online at https://bioinfopublication.org/pages/jouarchive.php?id=BPJ0000217

Research Article

EFFECT OF PLANT ACTIVATORS AGAINST *Alternaria solani* CAUSING EARLY BLIGHT DISEASE OF TOMATO UNDER FIELD CONDITIONS

R. DAS*
Department of Plant Pathology, Regional Research Sub-Station (Red & Laterite Zone), Sekhampur, Birbhum, 731129, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, 741252, West Bengal, India
*Corresponding Author: Email - rajudas05@gmail.com

Received: October 23, 2023; Revised: November 26, 2023; Accepted: November 28, 2023; Published: November 30, 2023

Abstract: Early blight disease of tomato caused by *Alternaria solani* is one of the most destructive diseases which cause considerable loss in tomato production. The present study evaluated the efficacy of plant activators on tomato early blight disease and investigated the effects on the yield of tomato plants. The field experiment used a randomised block design, with seven treatments and three replications in subtropical climatic condition of West Bengal at Regional Research Sub-Station (R & L Zone), Bidhan Chandra Krishi Viswavidyalaya, Sekhampur, Birbhum, West Bengal, India during *Rabi,* 2020-21 and *Rabi*, 2021-22. Among the plant activators, two foliar sprays at 30 DAS and 60 DAS with Chitosan @ 0.1 % were best followed by Salicylic acid @ 150 ppm and Benzoic acid @ 0.15 % to manage the early blight disease of tomato. The findings of the present study demonstrated a promising approach of management of early blight disease of tomato with plant activators.

Keywords: *Early blight, Management, Plant activators, Tomato*

Citation: R. Das (2023) Effect of Plant Activators Against *Alternaria solani* Causing Early Blight Disease of Tomato Under Field Conditions. International Journal of Agriculture Sciences, ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 15, Issue 11, pp.- 12754-1256.

Academic Editor / Reviewer: Dr R. S. Umakanth, Dr Rajmohan Sharma

Introduction

The tomato (*Solanum lycopersicum*) plant belonging to the Solanaceae family is a short duration remunerative vegetable with high nutritive value and antioxidant properties [1]. It exerts several beneficial effects on health and it is rich in vitamin A, B, C, minerals, organic acids, and sugar [2]. Tomato is also used as various food products, such as ketchup, soup, paste, and powder [3]. *Alternaria solani* is known to cause early blight of tomato [4] that is economically one of the most important diseases of tomato in the world over, where it causes significant reductions in yield of 35 to 78 % [5]. Early blight is widespread throughout the tropics and temperate zones [6]. The disease occurs in all parts of the country causing a loss in yield. The yield loss due to early blight disease in tomatoes ranged from 0.75 to 0.77 t/ha for every 1% increase in disease severity [7]. As high as 86 percent yield loss has been reported (50- 86%) in tomatoes [8]. One percent increase in disease intensity can reduce yield by 1.36 percent, and severe disease can result in crop failure [9]. Among fungal diseases, early blight caused by *Alternaria* species was the most predominant with the crop loss in the field ranging from 70-100 percent as reported from a survey and assessment of losses in West Bengal, India [10].

The disease is the most damaging to tomato because of its complete defoliation [11]. The most important hosts of the disease are tomato, potato, brinjal, chili, and black nightshade [12]. Other non-solanaceous hosts are cucumber, zinnia, wild cabbage, and horsenettle [13]. Thomma (2003) [14] identified that the *Alternaria* sp. produced melanin in the spores and the production of host-specific toxins and nonspecific toxins such as Alternaric acid. This disease is very difficult to control [15]. In the absence of resistant cultivars, the treatment of tomato early blight disease has primarily relied on the use of synthetic fungicides. However, many of these fungicides have a significant negative impact on the environment, harming non-target species and negatively affecting the agro-ecosystem. The goal of the current research is to determine whether environmentally friendly methods of disease management are effective.

Materials and Methods

The trial was taken up to evaluate the effectiveness of some chemical fungicides in managing *Alternaria solani* causing early blight in tomato crop. The field experiment was set up in a randomised block design with seven treatments and three replications in West Bengal's subtropical climate at Regional Research Sub-Station (R & L Zone), Bidhan Chandra Krishi Viswavidyalaya, Sekhampur, Birbhum, West Bengal, India during *Rabi*, 2020-21 and *Rabi*, 2021-22. The crop was maintained with judicious irrigation, and all agronomic practices and fertilizer schedules were followed according to standard procedures. Twenty-five-day-old seedlings were moved into the main field. We collected tomato leaves from the field that exhibited early-blight symptoms and examined them under a microscope to confirm the presence of the *Alternaria solani* fungus. Two sprays in case of plant activators were applied on 30 and 60 days after sowing and three sprays of each recommended fungicide were applied fortnightly on 60,75 and 90 days after sowing. According to Latha et al. (2009) [16], the assessment of disease severity was done on a scale from 0 to 9, where: 0 = healthy; 1 = 1-5%; 2 = 6-10%; 3 = 11-25%; 5 = 26-50%, 7 = 51-75%, and 9 = > 76% of the leaf area infected with early blight symptoms. Percentage Disease Index was worked out using the formula, *PDI = [Sum of all numerical rating/total number of observations taken x maximum disease score] x 100* [17].

Variety : Amlik
Design : RBD
Plot size : 5 × 4 sq. m
Spacing : 60 × 45 cm
Treatment : Seven
Replication : Three

Results and Discussion

Results presented in [Table-2] and [Fig-1] from the experimental trials revealed that all the treatments reduced the disease severity of early blight disease over (T_7) control.

Table-1 Treatments details of plant activators

Treatments	Plant activators	Dosage
T_1	Salicylic acid	150 ppm
T_2	Chitosan	0.10%
T_3	Benzoic acid	0.15%
T_4	Methyl Salicylate	200 ppm
T_5	Jasmonic acid	0.5 mM
T_6	Difenoconazole 25% EC	1ml/litre
T_7	Control (Water only)	--

Table-2 Effect of plant activators against early blight disease of tomato during 2020-2021 and 2021-2022 under field condition

Treatments		Dose	PDI on leaves	
	Plant activators	(ml/g per ha)	15 days after Final spray	Per cent reduction over control
T_1	Salicylic acid	150 ppm	21.16 (27.39)	57.81
T_2	Chitosan	0.1 %	19.76(26.39)	60.61
T_3	Benzoic acid	0.15 %	24.18(29.45)	51.79
T_4	Methyl Salicylate	200 ppm	31.43(34.10)	37.34
T_5	Jasmonic acid	0.5 mM	39.51(38.94)	21.23
T_6	Difenoconazole 25% EC	1ml/litre	15.38(23.09)	69.34
T_7	Control (Water only)	--	50.16(45.09)	0.00
	S Em (±)		0.965	
	CD 5%		2.97	

Table-3 Effect of fungicidal management on yield of tomato during 2020-2021 and 2021-2022 under field condition

Treatments		Dose	PDI on leaves	
	Plant activators	(ml/ha)	Fruits Yield (t/ ha)	Yield increase over control (%)
T_1	Salicylic acid	150 ppm	31.24	39.78
T_2	Chitosan	0.1 %	33.18	48.46
T_3	Benzoic acid	0.15 %	29.47	31.86
T_4	Methyl Salicylate	200 ppm	27.19	21.66
T_5	Jasmonic acid	0.5 mM	26.23	17.36
T_6	Difenoconazole 25% EC	1ml/litre	36.12	61.61
T_7	Control (Water only)	--	22.35	0.00
	S Em (±)		0.62	
	CD 5%		1.90	

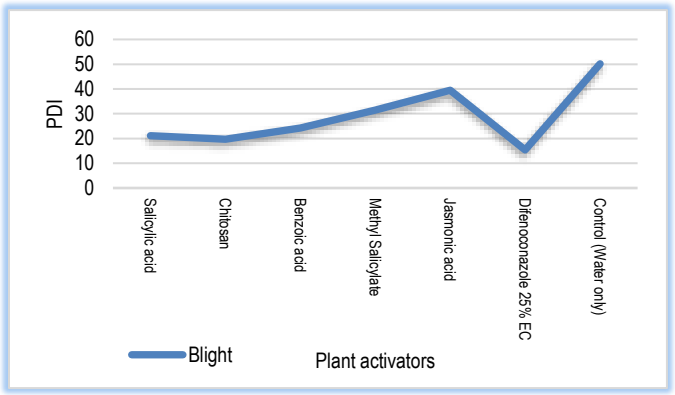

Fig-1 Percent disease index (PDI) in different Plant activators against Early blight disease of tomato

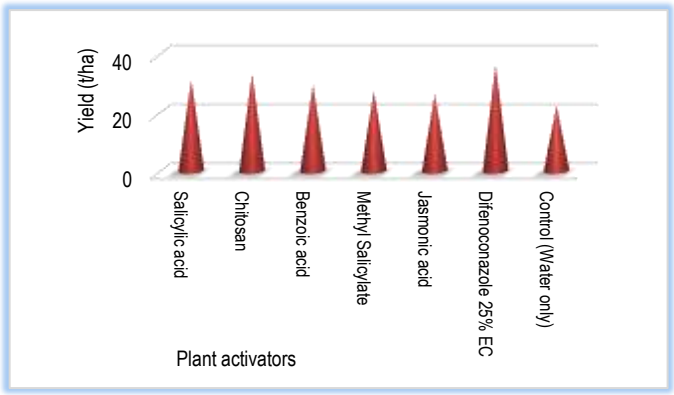

Fig-3 Effect of Plant activators on yield of tomato

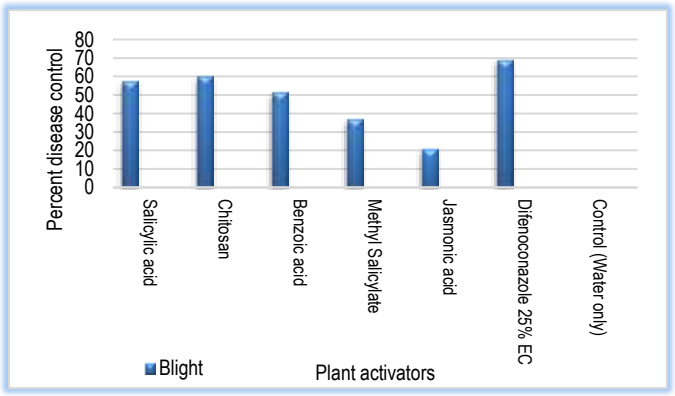

Fig-2 Influence of Plant activators on Early blight disease control in tomato

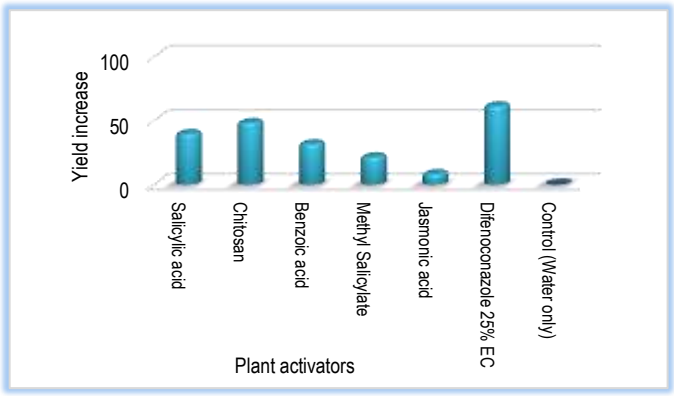

Fig-4 Influence of Plant activators on yield increase in tomato

Depending on the prevailing weather conditions, maximum disease severity (50.16%) was recorded in control. Among the treatments the lowest disease severity was observed from T_6: Difenconazole 25% EC@1 ml/l of water (15.38%).

Among the plant activators, T_2: Chitosan 0.1 % gave the lowest disease severity (19.76%) followed by T_1: Salicylic acid @ 150 ppm (21.16%), T_3: Benzoic acid 0.15 % (24.18%), T_4: Methyl salicylate @ 200 ppm (31.43%) and T_5: Jasmonic

acid 0.5 mM (39.51%). The per cent reduction in PDI was also calculated over control [Table-2] and [Fig-2]. The data revealed that highest disease control was in T_6: Difenconazole 25% EC @ 1 ml/l of water (69.34 %). Among the plant activators, T_2: Chitosan 0.1 % gave the highest disease control (60.61%) followed by T_1: Salicylic acid @ 150 ppm (57.81 %), T_3: Benzoic acid 0.15 % (51.79 %), T_4: Methyl salicylate @ 200 ppm (37.34 %) and T_5: Jasmonic acid 0.5 mM (21.23%). The yield data has been presented in [Table-3] and [Fig-3]. The results revealed that maximum yield was obtained from T_6: Difenconazole 25% EC @ 1 ml/l of water (36.12 t/ha). Among the plant activators, T_2: Chitosan 0.1 % gave the highest yield (33.18 t/ha) followed by T_1: Salicylic acid @ 150 ppm (31.24 t/ha), T_3: Benzoic acid 0.15 % (29.47 t/ha), T_4: Methyl salicylate @ 200 ppm (27.19 t/ha) and T_5: Jasmonic acid 0.5 mM (26.23 t/ha). The lowest yield was recorded in control (22.35 t/ha).

Fig-5 Symptoms of early blight disease on foliage of tomato crop

Highest increase of yield was calculated from T_6: Difenconazole 25% EC @ 1 ml/l of water (61.61 %). Among the plant activators, T_2: Chitosan 0.1 % gave the highest yield increase (48.46 %) followed by T_1: Salicylic acid @ 150 ppm (39.78 %), T_3: Benzoic acid 0.15 % (31.86 %), T_4: Methyl salicylate @ 200 ppm (21.66 %) and T_5: Jasmonic acid 0.5 mM (17.36 %) presented in [Table-3] and [Fig-4].

Effective disease management involves inducing resistance in plants to ward off the pathogen infection. In plants that are often sensitive to pathogen infection, exogenous or endogenous stimuli may have a considerable impact on host physiology, resulting in the rapid and coordinated activation of defense-genes [18]. This pathogen-induced resistance can be stimulated by using several abiotic agents (chemical inducers/ elicitors) such as Jasmonic acid, Salicylic acid, β-amino butyric acid and Chitosan [19]. Responses were observed both in the originally injured plant organ (local response) and in far away unaffected portions of the plant (systemic response). Induced Systemic Resistance (ISR) is one of these responses according to Hunt *et al.,* (1996) [20].

So, the result of the present investigation is comparable with the findings of the previous researchers. Based on findings of the present study, it may be concluded that two times foliar spray 30 DAS and 60 DAS with Chotosan @ 0.1 % was potential as ecofriendly alternate management strategy for early blight disease of tomato followed by Salicylic acid @ 150 ppm and Benzoic acid @ 0.15 %.

Conclusion

This study demonstrates the ability of plant activators to be used as an alternative plant protection strategy in cropping systems. A significant reduction in the disease with an increase in yield. Plant activators' ability to reduce disease increases the activity of a broad range of defense systems. This research supports integrating plant activators for sustainable disease management and enhancing yield in tomatoes where there is a high use of pesticides.

Application of research: Using of plant activators for ecofriendly management of early blight disease of tomato.

Research Category: Plant disease management

Acknowledgement / Funding: Author is thankful to Department of Plant Pathology, Regional Research Sub-Station (Red & Laterite Zone), Sekhampur, Birbhum, 731129, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, 741252, West Bengal, India

****Principal Investigator or Chairperson of research: Dr Raju Das**
University: Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, 741252, West Bengal, India
Research project name or number: Research station study

Author Contributions: Sole Author

Author statement: Author read, reviewed, agreed and approved the final manuscript. Note- Author agreed that- Written informed consent was obtained from all participants prior to publish / enrolment

Study area / Sample Collection: Regional Research Sub-Station (Red & Laterite Zone), Sekhampur, Birbhum, 731129

Cultivar / Variety / Breed name: Tomato (*Solanum lycopersicum*)

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.
Ethical Committee Approval Number: Nil

References

[1] Azeez L., Segun A.A., Abdulrasaq O.O., Rasheed O.A., Kazeem O.T. (2019) *J Saudi Soc*., 18, 120-126.
[2] Salim H.A., Sobita S., Abhilasha A.L., Sagheer A., Yasir M., Sohail A. (2017) *J Environ Agric Sci*., 11, 29-34.
[3] Manivannan M., Tholkappian P. (2013) *Int J Recent Sci Res.,* 4(10), 1610-13.
[4] Rotem J. (1994) *The genus Alternaria, biology, epidemiology, and pathogenicity. American Phytopathological Society, St. Paul, MV.*
[5] Jones J.P. (1991) *Early Blight. Compendium of plant diseases. J.B. Jones, J.P. Jones, R.E. Stall and T.A. Zitter. American Phytopathological Society, St. Paul, USA*, 13-14.
[6] Waals J.E., Vender K.L. and Slipper B. (2004) *Plant Dis*., 88, 959-964.
[7] Saha P. and Das S. (2012) *Indian J. Plant Prot*., 40, 195-198.
[8] Mathur K. and Sekhawat K.S. (1986) *Indian J.Mycol. Pl. Pathol*., 16, 235-238.
[9] Ngoc N.K., Narendrapa T. and Chaudhary M. (2013) *Mysore. J. Agric. Sci.,* 47, 241-245.
[10] Kanjilal S., Samaddar K.R. and Samajpati N. (2000) *J.Mycopathol. Res*., 38, 121-123.
[11] Peralta I.E., Knapp S. and Spooner D.M. (2005) *Systematic Botany*, 30, 424-434.
[12] Pscheidt J.W. 1985) *PhD Dissertation. University of Wisconsin-Madison.*
[13] Neergaard P. (1945) *Danish species of Alternaria and Stemphylium, taxonomy, parasitism, economic significance. Oxford University Press, London*, 260-287.
[14] Thomma B.P. (2003) *Molecular Plant Pathology*, 4, 225-236.
[15] Pasche J.S., Piche L.M., Gudmestad N.C. (2005) *Plant Dis*., 89, 269-278.
[16] Latha P., Anand T., Ragupathi N., Prakasam V., Samiyappan R. (2009) *Biological Control*, 50, 85-93.
[17] McKinney H.H. (1923) *J. Agri. Res*., 26, 195-217.
[18] Smith C.J. (1996) *New Phytol*., 132, 1-45.
[19] Yigal R.C. (2002) *Pl. Dis*., 86, 448-457.
[20] Hunt M.D., Neuenschwander U.H., Delaney T.P., Weymann K.B., Friedrich L.B. and Lawton K.A., et al. (1996) *Gene*, 179, 89-95.