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Research Article

FUNGICIDAL MANAGEMENT OF LATE BLIGHT DISEASE OF TOMATO IN RED AND LATERITIC ZONE OF WEST BENGAL

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Abstract- Late blight disease of tomato caused by *Phytophthora infestans* is one of the most destructive diseases which cause considerable loss in tomato production. In the absence of resistant cultivars, the management of tomato late blight disease has relied principally on the application of chemical fungicides. The present study evaluated the effects of chemical fungicides on tomato late blight disease and investigated the efficacy of the yield of tomato plants. The field experiment used a randomised block design, with five treatments and four 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. Three times foliar spray at an interval of 10 days with Cymoxanil 8% + Mancozeb 64% WP @ 3.0 g/litre of water was best followed by Famoxadone 16.6% + Cymoxanil 22.1% SC @ 2.0 ml/litre of water and Iprovalicarb 5.5% + Propineb 61.25% WP @ 2.0 g/litre of water. The findings of the present study demonstrated a promising approach of management of late blight disease of tomato with chemical fungicides.

Keywords- *Fungicides, Late blight, Management, Tomato*

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Introduction

Tomato (*Lycopersicon esculentum* Mill) is the world's second most important consumed vegetable crop after potato and it has the first position among processing crops in India [1]. Its fruits are famed for their attractiveness, nutritional value, and various medicinally uses. It is cultivated throughout the world and is a rich resource of lycopene, β-carotene, α-tocopherol and mineral nutrients [2]. The tomato plant belonging to the Solanaceae family is a short duration remunerative vegetable with high nutritive value and antioxidant properties [3]. It exerts several beneficial effects on health and it is rich in vitamin A, B, C, minerals, organic acids, and sugar [4]. Tomato is also used as various food products, such as ketchup, soup, paste, and powder [5].

This vegetable crop is also severely affected by thelate blight disease (*Phytophthora infestans* Mont) is not a true fungus. It is one of the most devastating diseases of tomato and potato crops worldwide. Late blight tomato identified by, pale green to brownish-black lesions on leaves and stems that may be small at first and appear indefinite, water-soaked spots that enlarge rapidly and become necrotic. During humid weather, the leaf may be covered grayish white moldy growth on the abaxial surface and produces sporangia and sporangiophores on the surface of the infected tissue. As the disease progresses, the many lesions accumulate, the entire plant can be destroyed in only a few days after the first lesions are observed. But on tomato fruits, Late blight infections produce dark brown, firm lesions develop on green fruit which may enlarge and destroy the entire tomato fruit. Late blight lesions on tomato fruit are often followed by soft rot and disintegration as a tinny layer of white mycelium may be observed during wet weather. A most notorious late blight pathogen anticipates the tomato where it is cultivated in moist, cool, rainy, and humid environments. Tomato late blight disease was controlled by a number of ready mixture fungicides by De and Sengupta [6]. In the absence of resistant cultivars, the treatment of tomato late blight disease has primarily relied on the use of synthetic fungicides.

The present study evaluated the effects of chemical fungicides on tomato late blight disease and investigated the efficacy of the yield of tomato plants. Results of this work could be used as an effective strategy for the management of late blight disease of tomatoes.

Materials and Methods

The trial was taken up to evaluate the effectiveness of some chemical fungicides in managing *Phytophthora infestans* causing late 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. 25 days old seedlings were transplanted in the main field. Tomato leaves showing typical late blight symptoms were collected from the field and examined microscopically to confirm the presence of the fungus *Phytophthora infestans*. Fungicides were sprayed after the first appearance of symptoms of late blight disease in the plant parts. Three spraying at 10 days interval were done. Disease severity assessment was carried out on a scale of 0 to 9 according to Malcolmson, 1970 [7]. 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 [8].

Variety	:	Patharkuchi
Design	:	RBD
Plot size	:	5 × 4 sq. m
Spacing	:	60×45 cm
Treatment	:	Five
Replication	:	Four

Table-1 Treatments details of fungicides

Treatments	Fungicides	Dosage (per litre of water)
T_1	Iprovalicarb 5.5% + Propineb 61.25% WP	2.0 g
T_2	Famoxadone 16.6% + Cymoxanil 22.1% SC	2.0 ml
T_3	Cymoxanil 8% + Mancozeb 64% WP	3.0 g
T_4	Metalaxyl 8% + Mancozeb 64% WP	2.5 g
T_5	Control (Water only)	--

Table-2 Effect of fungicides for control of Purple blotch disease of onion during 2020-21 and 2021-22 under natural condition

Treatments	Fungicides	Dose	Pooled analysis of 2020-21 and 2021-22		
		(per litre of water)	PDI (before spray)	PDI (10 days after 3rd spray)	Per cent reduction over control
T_1	Iprovalicarb 5.5% + Propineb 61.25% WP	2 g	3.25(10.39)	28.28(32.13)	67.35
T_2	Famoxadone 16.6% + Cymoxanil 22.1% SC	2 ml	2.15(8.43)	25.86(30.57)	70.15
T_3	Cymoxanil 8% + Mancozeb 64% WP	3 g	2.3(8.72)	23.19(28.79)	73.23
T_4	Metalaxyl 8% + Mancozeb 64% WP	2.5 g	3.5(10.78)	34.54(35.99)	60.12
T_5	Control (Water only)	--	2.65(9.37)	86.62(68.54)	0
	S Em (±)		0.539	1.017	
	CD 5%		NS	3.14	

Table-3 Effect of fungicidal management on bulbs yield of onion during 2020-21 and 2021-22

			Pooled analysis of 2020-21 and 2021-22	
Treatments	Fungicides	Dose (per litre of water)	Fruits Yield (t/ ha)	Yield increase over control (%)
T_1	Iprovalicarb 5.5% + Propineb 61.25% WP	2 g	9.65	65.81
T_2	Famoxadone 16.6% + Cymoxanil 22.1% SC	2 ml	10.24	75.95
T_3	Cymoxanil 8% + Mancozeb 64% WP	3 g	11.02	89.35
T_4	Metalaxyl 8% + Mancozeb 64% WP	2.5 g	7.89	35.57
T_5	Control (Water only)	--	5.82	0
	S Em (±)		0.526	
	CD 5%		1.62	

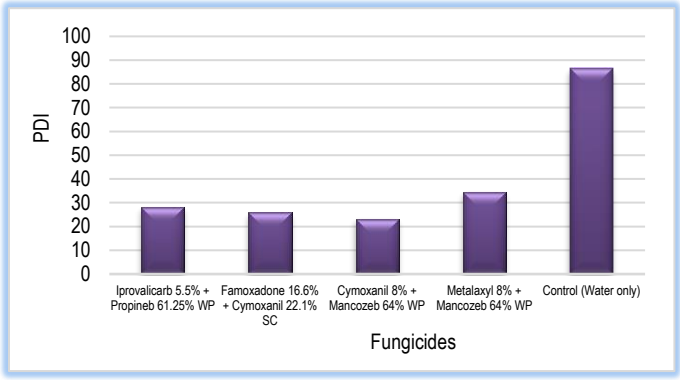

Fig-1 Percent disease index (PDI) in different fungicides against Late blight disease of tomato

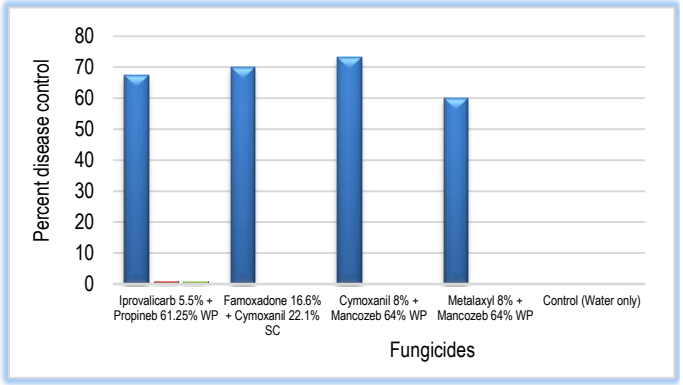

Fig-2 Influence of fungicides on Late blight disease control in tomato

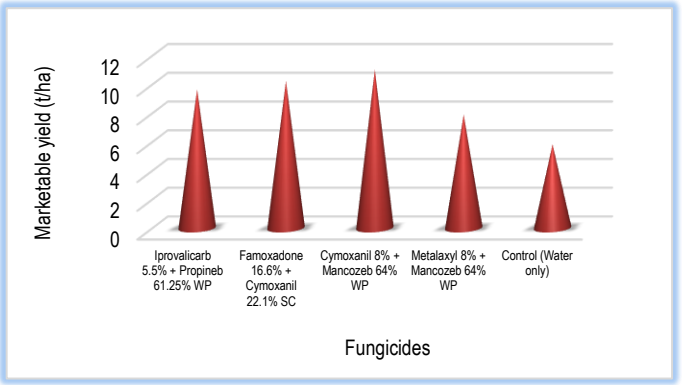

Fig-3 Effect of fungicides on yield of tomato

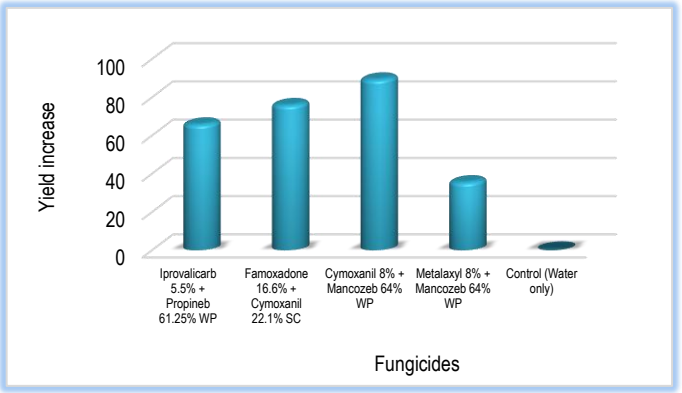

Fig-4 Influence of fungicides on yield increase in tomato

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 late blight disease over control (T_5). Depending on the prevailing weather conditions, maximum disease severity (86.62%) was recorded in control. Among the treatments the lowest disease severity was observed from T_3: Cymoxanil 8% + Mancozeb 64% WP @ 3.0 g/litre of water (23.19%) followed by T_2: Famoxadone 16.6% + Cymoxanil 22.1% SC @ 2.0 ml/litre of water (25.86%), T_1: Iprovalicarb 5.5% + Propineb 61.25% WP @ 2.0 g/litre (28.28 %) and T_4: Metalaxyl 8% + Mancozeb 64% WP @ 2.5 g/litre of water (34.54 %) at 10 days after 3rd spray. Results among these four treatments (T_3, T_2, T_1 & T_4) were found good efficacy against the disease over control. 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_3: Cymoxanil 8% + Mancozeb 64% WP @ 3.0 g/litre of water (73.23%) followed by T_2: Famoxadone 16.6%+ Cymoxanil 22.1% SC @ 2.0 ml/litre of water (70.15%), T_1: Iprovalicarb 5.5% + Propineb 61.25% WP @ 2.0 g/litre (67.35 %) and

T_4: Metalaxyl 8% + Mancozeb 64% WP @ 2.5 g/litre of water (60.12 %) at 10 days after 3rd spray. All treatments controlled effectively the late blight disease in tomato. The results agree with findings of Kavya (2016) [9] conducted field study to evaluate different fungicides and result revealed that, the treatment Fenamidone 10% + Mancozeb 50% found to be highly effective in managing late blight of potato with least percent disease severity of 16.67 and highest yield of 28.42 t/ha. Whereas, the control treatment recorded 100% disease severity with lowest yield of 7.12 t/ha. Similar results also obtained by Harisha (2017) [10]. Some researcher suggested that the severe late blight disease could be effectively managed with prophylactic spray of Mancozeb @ 0.25% followed by Cymoxanil+Mancozeb or dimethomorph+ mancozeb @ 0.3% at the onset of disease and one more spray of Mancozeb @ 0.25% seven days after application of systemic fungicides [11]. The yield data has been presented in [Table-3] and [Fig-3]. The results revealed that maximum fruit yield was obtained from T_3: Cymoxanil 8% + Mancozeb 64% WP @ 3.0 g/litre of water (11.02 t/ha) followed by T_2: Famoxadone 16.6% + Cymoxanil 22.1% SC @ 2.0 ml/litre of water (10.24 t/ha), T_1: Iprovalicarb 5.5% + Propineb 61.25% WP @ 2.0 g/litre (9.65 t/ha) and T_4: Metalaxyl 8% + Mancozeb 64% WP @ 2.5 g/litre of water (7.89 t/ha) at 10 days after 3rd spray. The lowest yield was recorded in control (5.82 t/ha). Highest increase of fruit yield was calculated from T_3: Cymoxanil 8% + Mancozeb 64% WP @ 3.0 g/litre of water (89.35%) followed by T_2: Famoxadone 16.6% + Cymoxanil 22.1% SC @ 2.0 ml/litre of water (75.95%), T_1: Iprovalicarb 5.5% + Propineb 61.25% WP @ 2.0 g/litre (65.81 %) and T_4: Metalaxyl 8% + Mancozeb 64% WP @ 2.5 g/litre of water (35.57 %) at 10 days after 3rd spray presented in [Table-3] and [Fig-4]. Other worker also reported that spraying of a mixture of Cymoxanil 8% and Mancozeb 64%-72%WP produced higher fruit yield [12]. Our results substantiated with earlier observations of [13], who reported that the good control of tomato late blight disease with increased yield was obtained with combination products of fungicides. Similar research finding was also reported by Asit *et al*. [14].

Conclusion

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 three times foliar spray at an interval of 10 days with Cymoxanil 8% + Mancozeb 64% WP @ 3.0 g/litre of water was best followed by Famoxadone 16.6% + Cymoxanil 22.1% SC @ 2.0 ml/litre of water and Iprovalicarb 5.5% + Propineb 61.25% WP @ 2.0 g/litre of water which may be recommended to control of the late blight disease in tomato in West Bengal condition.

Application of research: The fungicide Cymoxanil 8% + Mancozeb 64% WP @ 3.0 g/litre of water will be very effective for management of late blight disease of tomato.

Research Category: Plant disease management by chemical fungicide.

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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 (*Lycopersicon esculentum* Mill) Patharkuchi

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

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