Journal of Advances in Biology & Biotechnology

Volume 27, Issue 6, Page 492-497, 2024; Article no.JABB.116963
ISSN: 2394-1081

Optimizing Tomato Health: Holistic Approach to Early Blight Disease Management

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: https://doi.org/10.9734/jabb/2024/v27i6909

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/116963

Short Research Article

Received: 11/03/2024
Accepted: 13/05/2024
Published: 17/05/2024

ABSTRACT

An experiment was conducted to evaluate the effect of fungicide (mancozeb) and botanicals against early blight of tomato caused by Alternaria solani at the experimental field and glasshouse of Plant Pathology department, College of Agriculture, Pune, Maharashtra, during Kharif season (2019-2020). Six treatments including control with four replications were taken up using Randomized Block Design RBD. Growth inhibition of fungus Alternaria solani causing early leaf blight of tomato was studied in vivo for determining the efficacy of one fungicide and eight botanicals. Exploring possibility of managing A. solani by use of botanicals revealed that the clove extract of garlic was the best followed by neem leaf and ginger rhizome extract showing highest growth inhibition of the fungus. Among the plant leaf extracts, garlic clove extract @10% was found effective to inhibit the growth of pathogen i.e. 64.60% Per cent disease control PDC (glasshouse

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***Cite as: Dole** P. D, Gaikwad S. D, & Digvijay, C. (2024). Optimizing Tomato Health: Holistic Approach to Early Blight Disease Management. Journal of Advances in Biology & Biotechnology, 27(6), 492–497. https://doi.org/10.9734/jabb/2024/v27i6909*

trial) and 51.85% PDC (open Field trial). The contact fungicide Mancozeb@0.25% showed disease control of 75.52% (Glasshouse trial) and PDC of 70.34% (Field trial) in in vivo condition. Presently many farmers are using chemicals for control of early blight of tomato however, they cause health hazards. Therefore, this investigation provides valuable insights for farmers in selecting suitable plant extracts to control early blight of tomatoes.

Keywords: Alternaria solani; tomato; botanicals; glass house; field trial.

1. INTRODUCTION

"Tomato (*Lycopersicon esculantum* L.) crop is subjected to several diseases caused by fungi, bacteria, viruses, nematodes and abiotic factors. Tomato plants are affected by many root and aerial fungal infections throughout the cropping phases" [1]. The main root-related ailments are wilt brought on by *Rhizoctonia solani* and *Fusarium oxysporum* f. sp. *lycopersici* and damping-off caused by *Pythium aphanidermatum*. The main foliage fungal diseases are ALB brought on by *Alternaria solani* or *A. alternata* [2,1,3], Septoria leaf spot caused by *Septoria lycopersici*, and late blight induced by *Phytophthora infestans* [3]. "Among the above diseases, ALB is one of the worst for tomatoes, accounting for 50–90% of global output losses in ideal growing conditions"[3]. "The disease becomes wide spread and serious, causing large economic loss to the growers when the season begins with abundant moisture or frequent rain followed by warm and dry weather which are unfavorable for the host and help in rapid disease development" [2]. "The causal organism is air borne and soil inhabiting cause disease on foliage (leaf blight), stem (collar rot) and fruit (fruit rot) and can result in severe damage during all stages of plant development" [4]. "Disseminated by fungal spores" [5]. "This disease is controlled mainly by the application of agrochemicals. However, the worldwide trend towards environmentally safe methods of plant disease control in sustainable agriculture calls for reducing the use of these synthetic chemical fungicides" [6, 7]. "Recent efforts have focused on developing environmentally safe, long-lasting, and effective biocontrol methods for the management of plant diseases" [8, 9, 10, 11]. "Natural plant products are important sources of new agrochemicals for the control of plant diseases. Furthermore, biocides of plant origin are non-phytotoxic, systemic and easily biodegradable. It is now known that various natural plant products can reduce populations of foliar pathogens and control the disease development, and then these plant extracts have a potential as environmentally safe alternatives and as components in integrated disease management programs. Not much light has been shed on the biological control and use of botanicals which are effective against *A. solani".* [8, 9, 10, 11] Hence, an attempt has been made to test some of the commonly available botanicals against the pathogen *In vivo* condition.

2. MATERIALS AND METHODS

The present investigation was carried out at the experimental field and glasshouse of Plant Pathology department, College of Agriculture, Pune, Maharashtra, during Kharif season (2019-20). Six treatments including control with four replications were taken up using RBD. Treatments were randomly arranged in each replication divided into 24 plots. The recommended agronomical practices were followed to raise the crop healthy. Foliar spray of chemicals and botanicals were started at onset of the disease and repeated two sprays. The twelve treatments were taken as: *Azadiracata indica* (10%), *Allium cepa* (10%), *Allium sativum* (10%), *Zingiber offincinale* (10%), *Eucalyptus chamadulonsis* (10%), *Lantena camara* (10%), *Aegle marmelos* (10%), *Withania somnifera* (10%), Mancozeb @ (0.2%) and control were used for management of disease. Data was recorded at every spraying and PDI was calculated at every 10 days after each spray by using 0-9 disease rating scale on the basis of percentage area of foliage infected by the pathogen. Disease rating scale for scoring the intensity of tomato leaves: 0 = No infection; 1 = 1 or less percent; 3 = 1-10 percent; 5 = 11-25 percent; 7 = 25-50 percent and 9 = > 51 percent infection on foliage and fruit.

2.1 Isolation of the Pathogen

"The pathogen was isolated from the disease infected plants and it was identified as the *Alternaria solani. Alternaria* leaf spot of tomato infected leaves were collected from experimental field of college of Agriculture, Pune. The infected leaves were cut into small pieces and surface sterilized with mercuric chloride (0.1%) for 15-30

seconds, rinsed with three changes of sterile distilled water to remove the disinfectant and blotted dry. The sterilized pieces were plated (4 pieces/dish) on potato dextrose agar (PDA) medium in Petri dishes under aseptic conditions and incubated at 24 ^{0}C for 2 weeks. For obtaining sufficient quantity of inoculums, pure cultures were obtained by sub culturing. For this purpose, small bits of the fungus were taken at the tip of a sterilized needle and transferred aseptically to the centre of fresh PDA medium in Petri dishes. The dishes were incubated for 2 weeks at 24 ^{0}C in the dark" [12].

2.2 Preparation of Extract

"Extracts from four plants namely, *A. indica*, *A. sativum*, *Z*. *offincinale* and *E. chamadulonsis* were collected from different parts. For preparation of extract 10gm leaves were taken in a clean blender and blended without water, the pulverized leaves tissue was filtered through three-fold of muslin cloth and 100% pure filtrate was used as an extract in the ratio of 1:1(W/V) of solution" [12].

3. RESULTS AND DISCUSSION

3.1 Evaluation of Botanicals and Fungicide against Early Blight of Tomato (After Third Spray)

From the data recorded in the Table 1 which showed that all the treatments were found to reduce the disease intensity significantly over control. The results indicated that Mancozeb (0.25%) with minimum 10.13% PDI was found the best and significantly superior in reducing the disease intensity over rest of the treatments. The treatment of Garlic (10%) showed 14.65 Per cent disease index and Neem (10%) 16.91 Per cent disease intensity of early blight of tomato and these treatments were found at par with each other. In case of third spraying, the maximum percentage disease control (PDC) was noticed in Mancozeb (75.94%) followed by Garlic clove (58.32%), Neem leaf (52.15%), Ginger rhizome (50.36%) and it was minimum in case of spraying with Eucalyptus leaf extract (44.53%). The results indicated that Mancozeb was most effective and Garlic clove extract was found the best in reducing the disease intensity over the rest of plant extracts and significantly superior over Neem leaf extract.

3.2 Open Field Trial

3.2.1 Evaluation of botanicals and fungicide against early blight of tomato (After Third Spray)

From the data recorded in the Table 2 it is observed that all the treatments were found to reduce the disease intensity significantly over control. The treatment of Garlic (10%) with 21.84 PDI was found the best and significantly superior in reducing the disease intensity over rest of the botanicals and Neem (10%) 24.03 Per cent disease intensity of early blight of tomato and these treatments were found at par with each other. In case of third spraying, the maximum per cent disease control (PDC) was noticed in Mancozeb (70.34%) followed by Garlic clove (51.85%) which was at par with Neem leaf (47.02%) and Ginger rhizome (42.40%) [13]. The results indicated that Mancozeb @0.25% was most effective and Garlic clove extract @10% was found best in reducing the disease intensity of early blight of tomato over the rest of plant extracts and superior over Neem leaf extract. The result of present study is in accordance to the finding of Nashwa and Sallam [14], Sahu [11], Deshmukh [5,15], Naik et al [16, 17] and Biradar et al [18].

Table 1. Evaluation of effective treatments of botanicals and fungicide against early blight of tomato (After Third spray)

Treatment No.	Treatments	Concentration (%)	Per cent Disease Intensity*	Per cent Disease Control*
1	Ginger	10	19.38(26.85)	53.17
2	Garlic	10	14.65(22.76)	64.60
3	Neem	10	16.91(24.93)	59.15
4	Eucalyptus	10	20.78(28.07)	49.79
5	Mancozeb	0.25	10.13(18.44)	75.52
6	Control	-	41.38(44.24)	0.00
SE(m)±			**0.82**	
CD (5%)			**2.47**	

** = Mean of four replications, Figure in parenthesis are Arcsine transfer values*

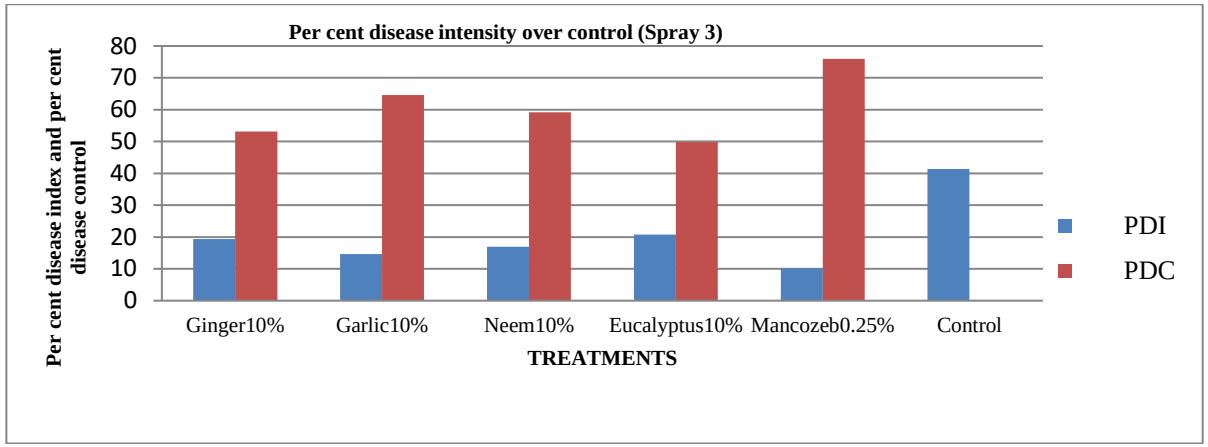

Fig. 1. Evaluation of effective botanicals and fungicide against *Alternaria solani* causing early blight disease of tomato (After Third Spray)

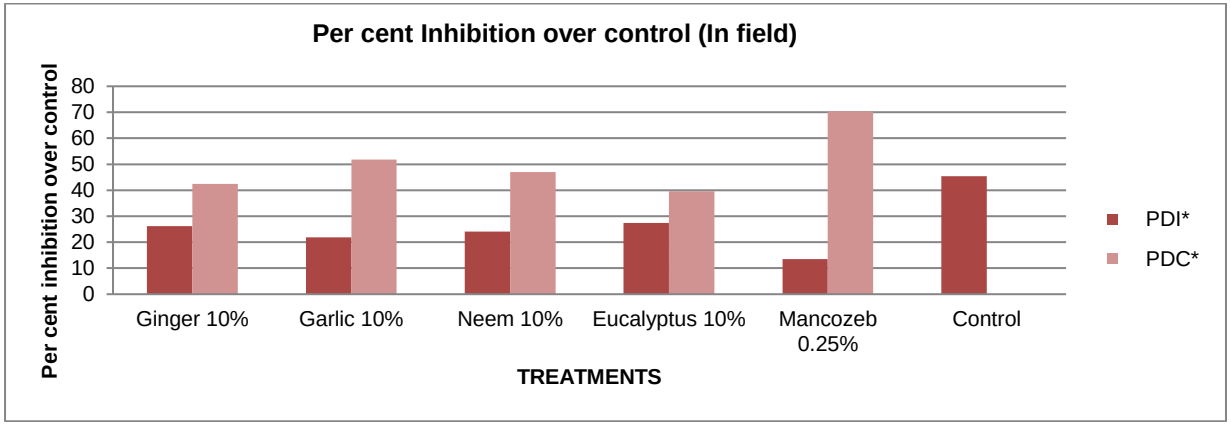

Fig. 2. Evaluation of effective treatments against *Alternaria solani* causing Early blight disease of tomato (After Third Spray- In Open field trial)

Table 2. Evaluation of effective treatments of botanicals and fungicide against early blight disease of tomato (In field condition – After Third spray)

Treatment No.	Treatments	Concentration (%)	Per cent Disease Intensity*	Per cent Disease Control*
1	Ginger	10	26.13(30.69)	42.40
2	Garlic	10	21.84(27.82)	51.85
3	Neem	10	24.03(29.28)	47.02
4	Eucalyptus	10	27.40(31.51)	39.59
5	Mancozeb	0.25	13.45(21.47)	70.34
6	Control	-	45.36(45.34)	00
SE(m)±			**0.78**	
CD (5%)			**2.38**	

** = Mean of four replications, Figure in parenthesis are Arcsine transfer values*

4. CONCLUSION

The result allows to conclude that the improvement of local knowledge about the use of botanicals, can permit to propose new alternatives of pathogen fungi management. *Allium sativum* (10%) concentrations were found as best treatment to control of early blight leaf spot of tomato and also is as par compared with mancozeb. Hence, *Allium sativum* can be recommended and keeping a point view of environmental safety others botanicals *A. indica* can also be recommended to the farmers for the efficient management of early blight leaf spot of tomato.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
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