



# MANAGEMENT OF TOMATO EARLY BLIGHT DISEASE USING MANGORVE LEAF EXTRACT

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## Abstract

The efficacy of *R. apiculata* tested @15% concentration against early blight disease in pot and field trials. The study revealed that seed treatment as well as foliar spray with *R. apiculata* @ 15% at 30 and 45 DAT ( $T_7$ ) recorded minimum percent disease incidence (15.24%), maximum plant height (79.87cm) and fruit yield (311.54g/plant) over control in pot trial. Also, the same treatment recorded minimum PDI (12.71%) maximum number of fruits per plant (45.67), maximum individual fruit weight (82.63g) and maximum fruit yield (69.33 t/ha) over control in field trial. It was followed by the treatment  $T_6$  and  $T_5$  in respect of reducing the disease incidence and enhanced the biometric of tomato.

**Key words:** Tomato; early blight; *Rhizophora apiculata*; control.

## Introduction

Tomato (*Lycopersicon esculentum* Mill.) is one of the most remunerative and widely grown vegetables in the world. India ranks in second in the total world tomato production of 163.96 million tones and an average yield of 34.66 tones.ha<sup>-1</sup> after China (FAOSTAT, 2017). In Tamil Nadu, it is cultivated throughout the year during rainy, winter and summer seasons and occupies an area of 38.73 lakh ha with production of 840.32 million tonnes in 2016-2017 (Indian Horticulture Database, 2017).

Among the several diseases suffering tomato early blight caused by *Alternaria solani* is one of the most devastating disease very difficult to be controlled by using regular fungicides are not economically feasible in different weather conditions (Herriot *et al.*, 1986; Smith and Kotcon, 2002; Patil *et al.*, 2002). Beside, *A. solani* has low sensitive with fungicides because of its production of dark brown to black pigment called melanin which enhanced survival and competitive abilities of the pathogen under certain environmental conditions (Bell and Wheeler, 1986). However, in the recent years, huge use of fungicides in agriculture has been the subject of growing concern for both environmentalist and public health

authorities. Hence, much attention is being focused on the alternative methods of pathogen control which are eco-friendly and also enhance crop yield. Towards this direction use of botanicals which are inexhaustible resources fits well with in the biological/alternative crop disease management strategy. Also, plant extract has huge amount of antioxidant/antimicrobial compounds have been used against plant pathogens or microbe (Jun-Dong *et al.*, 2006).

However, among the botanicals, mangroves are mainly distributed around seashores and mangrove swamps in coastal proximal and middle zones (Prabhakaran and Kavitha, 2012) are known to be a rich source of various secondary metabolites and are widely used in the traditional medicine practices. The antifungal activity of some mangrove species has been well documented against plant pathogens *viz.*, *Avicennia marina* against *Alternaria citri*, *Avicennia marina* and *Rhizophora mucronata* against *A. alternata*, *Rhizophora apiculata* against *Macrophomina phaseolina* (Mehdi *et al.*, 2000; Muthukumar *et al.*, 2014; Behbahani *et al.*, 2016; Rastegar and Mohsen Gozan, 2016). More than 200 bioactive compounds identified from mangroves with antibacterial and antifungal properties belong to steroids, triterpenes, saponins,

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flavonoids, alkaloids, tannins and phenolics (Bandaranayake, 2002; Bose and Bose, 2008; Chandrasekaran *et al.*, 2009; Vengadeshkumar, 2017). Therefore, the present study was undertaken to investigate the effect of leaf extract of *R. apiculata* for managing tomato early blight disease under both pot and field experiment.

## Materials and Methods

### Source of the pathogen and plant extract

The test pathogen *Alternaria solani* (AS<sub>5</sub>) and the mangrove species *Rhizophora apiculata* that have being used in this study, were selected based on their previous results in the study of Mahalakshmi, (2019), where they demonstrated potent pathogenicity and *in vitro* antifungal potential, respectively.

### Pot culture experiment

The efficacy of *R. apiculata* tested @ 15% concentration against early blight disease in pot culture experiment. The early blight susceptible variety PKM 1 grown in earthen pots of 30 cm diameter was used for this study. The plants were inoculated with *A. solani* by the standard spray inoculation technique (Sorensen *et al.*, 2016). *R. apiculata* leaf extract @15% conc. was sprayed immediately after first appearance of the disease symptom and a second spray was given at fortnightly interval. The crop was maintained in a green house with frequent spraying of water to provide adequate moisture and relative humidity to enable successful infection by the pathogen. The experiments were conducted in a randomized block design with three replications for each treatment and a suitable control. The fungicide Mancozeb 75% WP @ 0.25 percent was used for comparison and the standard agronomic practices as recommended by the State Agricultural Department were followed. The

observations on percent disease index, plant height and fruit yield were assessed at harvest. The details of the treatments are given below.

### Treatment schedule

T<sub>1</sub>- Seed treatment with *R. apiculata* @ 15%

T<sub>2</sub>- Foliar spray with *R. apiculata* @15% at 30 DAT

T<sub>3</sub>- Foliar spray with *R. apiculata* @15% at 45 DAT

T<sub>4</sub>- Foliar spray with *R. apiculata* @15% at 30 & 45 DAT

T<sub>5</sub>- T<sub>1</sub>+ T<sub>2</sub>

T<sub>6</sub>- T<sub>1</sub>+ T<sub>3</sub>

T<sub>7</sub>- T<sub>1</sub>+ T<sub>4</sub>

T<sub>8</sub>- Mancozeb as ST (2g/kg) + FS (0.25%) at 30 & 45 DAT

T<sub>9</sub>- Control

### Field trial

A separate field trial was conducted to test the efficacy of *R. apiculata* (15%) for assessing their influence on the incidence of early blight of tomato. The same treatments schedule followed in pot culture were evaluated in field trial during Kharif 2018 at Royakottai, Dharmapuri district, Tamil Nadu. The early blight susceptible variety PKM 1 was used for this study. The experiment was conducted in a randomized block design with three replications for each treatment with a suitable control. Each plot was separated from the adjacent bed by 0.5m alley. A plot size of 3×3.5m comprising of two rows and 5 plants per row, was maintained for each treatment and the crop was raised with a spacing of 60×40cm and all the standard agronomic practices as recommended by the State Agricultural Department were followed. The fungicide Mancozeb 75% WP @ 0.25

**Table 1:** Effect of *R. apiculata* at different concentration on early blight incidence and biometric of tomato variety PKM 1 (Pot culture).

Treatments	Percent disease index	Percent reduction over control	Plant height (cm)	Fruit yield (g/plant)
T <sub>1</sub> -Seed treatment with <i>R. apiculata</i> @ 15%	27.48 <sup>c</sup> (31.61)	50.00	64.92 <sup>e</sup>	197.48 <sup>c</sup>
T <sub>2</sub> - Foliar spray with <i>R. apiculata</i> @15% at 30 DAT	33.64 <sup>f</sup> (35.45)	38.79	60.65 <sup>f</sup>	195.33 <sup>e</sup>
T <sub>3</sub> - Foliar spray with <i>R. apiculata</i> @15% at 45 DAT	37.59 <sup>e</sup> (37.81)	31.60	59.42 <sup>g</sup>	194.37 <sup>h</sup>
T <sub>4</sub> - Foliar spray with <i>R. apiculata</i> @15% at 30 & 45 DAT	28.93 <sup>c</sup> (32.53)	47.36	67.13 <sup>d</sup>	197.12 <sup>f</sup>
T <sub>5</sub> - T <sub>1</sub> + T <sub>2</sub>	20.52 <sup>d</sup> (26.93)	34.44	71.41 <sup>c</sup>	243.13 <sup>c</sup>
T <sub>6</sub> - T <sub>1</sub> + T <sub>3</sub>	17.64 <sup>c</sup> (24.83)	54.63	75.64 <sup>b</sup>	257.16 <sup>b</sup>
T <sub>7</sub> - T <sub>1</sub> + T <sub>4</sub>	15.24 <sup>b</sup> (22.97)	72.27	79.87 <sup>a</sup>	311.54 <sup>a</sup>
T <sub>8</sub> -Mancozeb as seed treatment (2g/kg)+foliar spray (0.2%) at 30 & 45 DAT	11.73 <sup>a</sup> (20.02)	78.65	63.74 <sup>f</sup>	226.72 <sup>d</sup>
T <sub>9</sub> - Control	54.96 <sup>h</sup> (47.84)	-	69.18	165.76 <sup>i</sup>

Values in the column followed by same letters not differ significantly by DMRT (P=0.05)

**Table 2:** Effect of *R. apiculata* at different concentration on early blight incidence and biometric of tomato variety PKM 1 (Field trial).

Treatments	Percent disease index	Percent reduction over control	No. of fruits /plant	Fruit weight (g)	Fruit yield (t/ha)
T <sub>1</sub> -Seed treatment with <i>R. apiculata</i> @ 15%	21.92 <sup>c</sup> (27.91)	23.72	28.49 <sup>c</sup>	62.33 <sup>f</sup>	51.86 <sup>f</sup>
T <sub>2</sub> - Foliar spray with <i>R. apiculata</i> @15% at 30 DAT	24.33 <sup>f</sup> (29.55)	15.34	22.13 <sup>s</sup>	58.17 <sup>s</sup>	58.27 <sup>e</sup>
T <sub>3</sub> - Foliar spray with <i>R. apiculata</i> @15% at 45 DAT	25.26 <sup>f</sup> (30.17)	12.10	19.96 <sup>h</sup>	54.81 <sup>h</sup>	47.69 <sup>h</sup>
T <sub>4</sub> - Foliar spray with <i>R. apiculata</i> @15% at 30 & 45 DAT	21.72 <sup>c</sup> (27.77)	24.42	26.32 <sup>d</sup>	65.59 <sup>e</sup>	44.64 <sup>i</sup>
T <sub>5</sub> - T <sub>1</sub> + T <sub>2</sub>	18.41 <sup>d</sup> (25.40)	35.94	39.26 <sup>c</sup>	74.11 <sup>c</sup>	61.23 <sup>d</sup>
T <sub>6</sub> - T <sub>1</sub> + T <sub>3</sub>	15.38 <sup>c</sup> (23.03)	46.48	42.48 <sup>b</sup>	78.37 <sup>b</sup>	65.28 <sup>b</sup>
T <sub>7</sub> - T <sub>1</sub> + T <sub>4</sub>	12.71 <sup>b</sup> (20.88)	55.77	45.67 <sup>a</sup>	82.63 <sup>a</sup>	69.33 <sup>a</sup>
T <sub>8</sub> -Mancozeb as seed treatment (2g/kg) + foliar spray (0.2%) at 30 & 45 DAT	7.57 <sup>a</sup> (15.97)	73.66	37.64 <sup>c</sup>	71.32 <sup>d</sup>	67.52 <sup>c</sup>
T <sub>9</sub> - Control	28.74 <sup>s</sup> (32.41)	-	26.01 <sup>f</sup>	53.12 <sup>i</sup>	50.49 <sup>s</sup>
Values in the column followed by same letters not differ significantly by DMRT (P=0.05)					

percent was used for comparison. Observation as on PDI, number of fruits per plant, average single fruit weight and fruit yield per hectare were assessed and recorded. Ten plants from each replication were tagged for data collection.

### Statistical analysis

The statistical analysis of the experimental results was performed employing the computer software package 'SPSS', by Duncan Multiple Range Test (DMRT) and the values are expressed as mean (Gomez and Gomez, 1976).

### Results

The extract of *R. apiculata* @ 15% was evaluated under pot culture experiment. The results revealed that seed treatment as well as foliar spray with *R. apiculata* @ 15% at 30 and 45 DAT (T<sub>7</sub>) recorded minimum percent disease incidence (15.24%) which accounted for 72.27% percent reduction of early blight incidence. Also, the same treatment was considerably increased the biometric of tomato crop and recorded the maximum plant height (79.87cm) and fruit yield (311.54g/plant) over control. This was followed by the treatments with T<sub>6</sub> and T<sub>5</sub>. The least effect was recorded with foliar spray of *R. apiculata* @ 15 % at 45 DAT (T<sub>3</sub>). Mancozeb 75 WP (0.25%) as seed treatment and foliar spray at 30 and 45 DAT proved its superiority and recorded only 11.73 % percent early blight incidence (Table 1).

In field trail, the treatment (T<sub>7</sub>) with *R. apiculata* @15% as seed treatment as well as foliar spray at 30 and 45 DAT significantly reduced the early blight incidence and produced at par results with test fungicide Mancozeb 75% WP in respect of reducing disease incidence with minimum PDI (12.71%) with maximum

percent disease reduction (55.77%) which was on par with Mancozeb 75% WP (0.25%) which recorded 73.66 percent reduction of early blight incidence over control. Also, the same treatment recorded maximum number of fruits per plant (45.67), maximum individual fruit weight (82.63g) and maximum fruit yield (69.33 t/ha) over control. It was followed by the treatment T<sub>6</sub> (Seed treatment @15% and foliar spray @ 15% at 45DAT) with 46.48 percent and T<sub>5</sub> (Seed treatment @15% and foliar spray @ 15% at 30 DAT) with 35.94 percent disease incidence. The control treatment recorded maximum PDI (28.74 %), minimum number of fruits per plant (26.01), minimum fruit weight (53.12g) and least yield (50.49 t/ha). Whereas, the test fungicide Mancozeb 50% WP recorded minimum no of fruits per plant (37.64), minimum fruit weight (71.32g) and minimum fruit yield (67.52 t/ha) (Table 2).

### Discussion

In the present study leaf extract of *R. apiculata* at 15% conc. as seed treatment as well as foliar spray (30 and 45 DAT) recorded significant reduction in the early blight incidence under both pot and field trials. Recently, the control of pest and diseases with the use of botanical derivatives is gaining more importance. Biological active compounds which are present in plants act as elicitors to induce resistance in host plants resulting in a reduction of plant disease development (Vidhyasekaran, 1992). The presence of antimicrobial compounds (aliphatic alcohols aldehydes, carboxylic acid, carotenoids, tannins, benzoquinones, lipids, n-alkanes, phenolic compounds, polysaccharides, steroids and triterpenes) in the extract of *R. apiculata* could have inhibited the pathogen and also induced resistance in host plants resulting in

considerable reduction of early blight incidence observed in the present study.

Efficacy of plant extracts *viz.*, *Clerodendron* (Kishore Varma *et al.*, 2008), *A. sativum* (Ahmad *et al.*, 2017), *Datura* (Ankurverma *et al.*, 2018) for the control of early blight of tomato have been reported. Gangopadhyay *et al.*, (2010) reported that the extract of the *C. procera* effectively reduced the incidence of *Alternaria* blight of cumin and considerably increased the seed yield. Also, ethanolic extract of *A. marina* was found to significantly suppressed root-rot and root-knot diseases in tomato and *R. mucronata* used with *Paecilomyces lilacinus* showed better results in the suppression of root-rot and root-knot diseases of tomato (Mehdi *et al.*, 2000). These earlier reports corroborate and add value to the present observations. Several studies were reported that management of fungal diseases by using various botanicals *viz.*, extract of *Lawsonia inermis* against seed borne fungi of sorghum seeds (Satish *et al.*, 2010) garlic bulb extract against paddy blast (Netam *et al.*, 2011), neem extract against rice sheath rot (Lalan Sharma *et al.*, 2013), eucalyptus extract against rice sheath rot (Meera, 2014), *Clerodendrum* against rice sheath blight (Depjani *et al.*, 2017).

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