E-ISSN: 2618-0618
P-ISSN: 2618-060X

www.agronomyjournals.com
2024; 7(10): 632-635
Received: 05-07-2024
Accepted: 08-08-2024

DP Narvate
Department of Plant Pathology, College of Agriculture, Latur, Maharashtra, India

Dr. RA Chavan
Associate Professor, Department of Plant Pathology, College of Agriculture, Ambajogai, Maharashtra, India

AN Kavale
Department of Plant Pathology, College of Agriculture, Latur, Maharashtra, India

SB Kapare
Department of Plant Pathology, College of Agriculture, Latur, Maharashtra, India

SA Ghutukade
Department of Plant Pathology, College of Agriculture, Latur, Maharashtra, India

Corresponding Author:
DP Narvate
Department of Plant Pathology, College of Agriculture, Latur, Maharashtra, India

Post harvest eco-friendly management of fruit rot of tomato caused by *Alternaria solani*

DP Narvate, Dr. RA Chavan, AN Kavale, SB Kapare and SA Ghutukade

DOI: https://doi.org/10.33545/2618060X.2024.v7.i10i.1869

Abstract
Tomato (*Lycopersicon esculentum*), from the Solanaceae family and native to South America, faces productivity challenges in India due to various biotic and abiotic stresses, including infections from fungi, bacteria, and nematodes. Early blight, caused by *Alternaria solani*, is a major issue leading to significant pre- and post-harvest losses, impacting storage, transportation, and marketing. Due to this effective management of this disease is essential. A comprehensive investigation was conducted focusing on evaluating the *in vitro* efficacy of various GRAS chemicals, botanicals, and essential oils. Among the tested treatments, Calcium chloride (1%) proved to be the most effective chemical, followed by Salicylic acid (1%). For botanicals, Garlic (10%) and Ginger (20%) were notably effective. Essential oils like Nilgiri oil and Mint oil (500 ppm) were less effective but still better than no treatment. The combination of Calcium chloride and Mint oil resulted in the least spoilage and lowest physiological loss in weight (PLW) percentages, demonstrating their potential in post-harvest management strategies for controlling tomato fruit rot.

Keywords: Tomato, fruit rot, *Alternaria solani*, GRAS chemicals, essential oils and post-harvest, treatments

Introduction
Tomato (*Lycopersicon esculentum* Mill.), a member of the Solanaceae family and native to tropical America, is one of the world's largest vegetable crops. Introduced to India by the Portuguese in the 18th century, tomatoes are now widely grown year-round, with India cultivating them on about 8.15 lakh hectares. They are rich in nutrients, including vitamins A and C, minerals, lycopene, and antioxidants, and are consumed both fresh and processed. Tomato crops face numerous diseases, including Early blight (*Alternaria solani*), which is highly damaging. Early blight causes symptoms like dark brown lesions with concentric rings, resulting in significant economic losses by affecting storage and transportation. It thrives in humid climates and severely impacts tomato yield by causing fruit rot, leaf spots, stem lesions, and damping-off in seedlings.

Materials and Methods
The harvested fruits were transferred to the laboratory and selected based on size uniformity, maturity (semi-ripe), and absence of physical injuries. Healthy fruits were surface sterilized with 1% Sodium hypochlorite and rinsed with sterilized water. The sterilized fruits were then dipped in various concentrations of the tested GRAS chemicals, botanicals, and essential oils and then pin- pricked followed by inoculation of test pathogen in post inoculation method while the fruit is inoculated first by test pathogen and then by GRAS chemicals in pre- inoculation method. After treatment, the fruits were air-dried on filter paper at room temperature. Three sets of ten fruits were maintained for each treatment, along with a control set. Both treated and untreated fruits were stored in plastic baskets at room temperature for further observation. The likely effect of chemical treatment on the final quality of fruits was evaluated on 8th day using the effectiveness of GRAS chemicals, botanicals, and essential oils for controlling fruit rot of tomato caused by *Alternaria solani* using both pre- and post-infection treatment methods. Also, the physiological weight loss and spoilage were calculated.

Standard disease score chart for accessing PDI of fruit rot of tomato (0-5 scale)

Rating scale	Per cent disease on fruit surface
1.	No disease
2.	0.1-5
3.	5.1-10
4.	10.1-25
5.	25.1-50
6.	More than 50

Per cent Disease Intensity (PDI) was calculated by using following formula proposed by Wheeler, (1969).

$$PDI = \frac{\text{Total numerical ratings}}{\text{No of samples} \times \text{maximum disease grade}} \text{ x100}$$

For per cent weight loss the fruits under each treatment were weighed before treatment. It was recorded as initial weight (g) and final weight was recorded at the time of termination of the experiment. Per cent loss in each treatment was calculated by using the formula,

$$\text{Per cent loss in weight} = \frac{\text{Initial weight} - \text{Final weight}}{\text{Initial weight}} \times 100$$

Table 1: Treatment details

Sr. No.	Treatments	Concentration
T_1	Salicylic acid	1%
T_2	Calcium chloride	1%
T_3	Ginger phytoextract	20%
T_4	Garlic phytoextract	10%
T_5	Eucalyptus oil	500 ppm
T_6	Mint oil	500 ppm
T_7	Control	

Table 2:

Sr. No.	Treatments
1.	Bleaching, rinsing and air dried.
2.	Washing and immersion in Salicylic acid 1% for 5 min
3.	Washing and immersion in Calcium chloride 1% for5 min.
4.	Washing and immersion in Ginger rhizome extract @ 20% for 5 min
5.	Washing and immersion in Garlic clove extract @ 10% for 5 min
6.	Washing and immersion in Eucalyptus oil @ 500 ppm for 5 min
7.	Washing and immersion in Mint oil @ 500 ppm for 5 min
8.	Rinsing and air dried
9.	Control

Results and Discussion

The effectiveness of GRAS chemicals, botanicals, and essential oils was evaluated for controlling fruit rot of tomato caused by *Alternaria solani* using both pre- and post-infection treatment methods. The results showed that all tested treatments significantly reduced fruit rot severity compared to the control.

In the pre-inoculation method, Calcium chloride (1%) was the most effective, reducing fruit rot severity to 45.55% by the 8th day. Other effective treatments included Mint oil (51.58%), Garlic (54.34%), Salicylic acid (58.99%), Nilgiri oil (66.11%), and Ginger (67.03%). Similarly, in the post-inoculation method, Calcium chloride (1%) again proved most effective, reducing fruit rot severity to 17.85% by the 8th day. Other treatments like Mint oil (18.51%), Garlic (19.62%), Salicylic acid (21.10%), Nilgiri oil (22.68%), and Ginger (25.92%) also showed significant effectiveness. These findings align with previous studies, such as those by Chavan and Tawade (2012) [4] on Garlic bulb extracts, Senevirathna and Daundasekera (2010) [8] on various $CaCl_2$ concentrations, and Perveen and Bokhari (2020) [7] on the effectiveness of Mentha oil against *Alternaria alternata.* Effect of fruit dip treatments with chemical, botanicals and essential oils on the quality of fruits was evaluated on 8th day of treatment using indices *viz.*, spoilage and physiological loss weight. (Table 3, Fig. 1)

Impact on Spoilage

Fruit was considered spoiled when it showed dehydration, rotting or other abnormal symptoms on more than 10% of its surface. The study assessed the effectiveness of dipping healthy, fresh tomato fruits in various concentrations of chemicals, botanicals, and essential oils to minimize spoilage compared to the control (73.55% spoilage). The most effective treatment was washing and immersing the fruits in Calcium chloride (1%) for 5 minutes, which reduced spoilage to 26.32%. The next best treatment was Mint oil (500 ppm), resulting in 30.75% spoilage. Other treatments also showed effectiveness: Garlic clove extract (10%) resulted in 32.96% spoilage, Salicylic acid (1%) in 40.96%, Nilgiri Oil (500 ppm) in 43.96%, and Ginger rhizome extract (20%) in 47.00% spoilage. Bleaching and rinsing with air drying (2%) and simple rinsing and air drying recorded higher spoilage rates of 65.76% and 73.38%, respectively. (Table 4, Plate 1 and Fig. 2)

Impact on Physiological Weight

The study examined the effects of various treatments on the physiological weight loss of tomato fruits after 8 days. The control group experienced a weight loss of 71.73%. The most effective treatment was washing and immersing the fruits in 1% Calcium chloride for 5 minutes, which resulted in the least weight loss at 23.82%. Mint oil (500 ppm) was the next best, with a 28.19% weight loss. Other treatments showed the following weight losses: Garlic clove extract (10%) at 36.43%, Salicylic acid (1%) at 37.50%, Nilgiri Oil (500 ppm) at 42.31%, and Ginger rhizome extract (20%) at 55.26%. Bleaching, rinsing, and air drying (2%) and simple rinsing and air drying had the highest weight losses of 66.38% and 69.84%, respectively. These findings align with previous research. Vir *et al.* (1967) [9] reported that aureofungin as a post-harvest dip extended tomato fruit life by 11-12 days compared to 2-3 days for untreated fruits. Bengerth *et al.* (1972) [2] found that post-harvest Calcium treatment extended the storage life of many fruits by maintaining firmness and reducing respiration and rotting. Nasrin *et al.* (2008) [6] noted that treating tomatoes with Chlorine, packing in perforated polyethylene bags, and storing at room temperature reduced decay and weight loss, extending shelf life up to 17 days. Senevirathna *et al.* (2010) [8] observed that vacuum infiltration with 6% CaCl2 at 20 kPa was most effective in extending the shelf life and maintaining post-harvest quality of tomatoes. (Table 4, Plate 1and Fig. 2)

Table 3: Effect of pre and post infection treatment of GRAS chemicals, botanicals and essential oil on intensity of fruit rot of tomato incited by *Alternaria solani*

Tr. No.	Treatment	Per cent disease intensity			
		Pre-Inoculation	Per cent Disease control	Post Inoculation	Per cent Disease control
T_1	Salicylic acid	58.99 (50.17)	22.02 (27.98)	21.10 (27.34)	69.97 (56.77)
T_2	Calcium chloride	45.55 (42.44)	39.78 (39.10)	17.85 (24.99)	74.59 (59.72)
T_3	Garlic	54.34 (47.48)	28.16 (32.05)	19.62 (26.29)	72.02 (58.06)
T_4	Ginger	67.03 (54.95)	11.39 (19.72)	25.92 (30.60)	63.11 (52.60)
T_5	Nilgiri oil	66.11 (54.39)	12.61 (20.79)	22.68 (28.43)	67.72 (55.37)
T_6	Mint oil	51.58 (45.90)	31.81 (34.33)	18.51 (25.48)	73.65 (59.11)
T_7	Control	75.65 (60.43)	00.00 (00.00)	70.27 (56.68)	00.00 (00.00)
S.E. ±		0.47	-	0.50	-
C.D. (P = 0.01)		1.45	-	1.55	-

Table 4: Impact of post-harvest treatment of GRAS chemicals botanicals and essential oils on spoilage of tomato fruits and physiological weight loss (PWL) of marketable fruits

Tr. No.	Treatments	Spoilage (%)	Per cent PWL
T_1	Bleaching, rinsing and air dried.	65.76 (54.18)	66.38 (54.56)
T_2	Washing and immersion in Salicylic acid 1% for 5 min.	40.96 (39.79)	37.50 (37.76)
T_3	Washing and immersion in Calcium chloride 1% for 5 min.	26.32 (30.86)	23.82 (29.21)
T_4	Washing and immersion in Ginger rhizome extract @ 20% for 5 min.	47.00 (43.28)	55.26 (48.01)
T_5	Washing and immersion in Garlic clove extract @ 10% for 5 min.	32.96 (35.07)	36.43 (37.12)
T_6	Washing and immersion in Nilgiri oil @ 500 ppm for 5 min.	43.96 (41.53)	42.31 (40.57)
T_7	Washing and immersion in Mint oil @ 500 ppm for 5 min.	30.75 (33.67)	28.19 (32.06)
T_8	Rinsing and air dried	73.38 (58.93)	69.84 (56.68)
T_9	Control	73.55 (59.04)	71.73 (57.87)
	S.E. ±	0.49	0.50
	C.D. (P = 0.01)	1.46	1.50

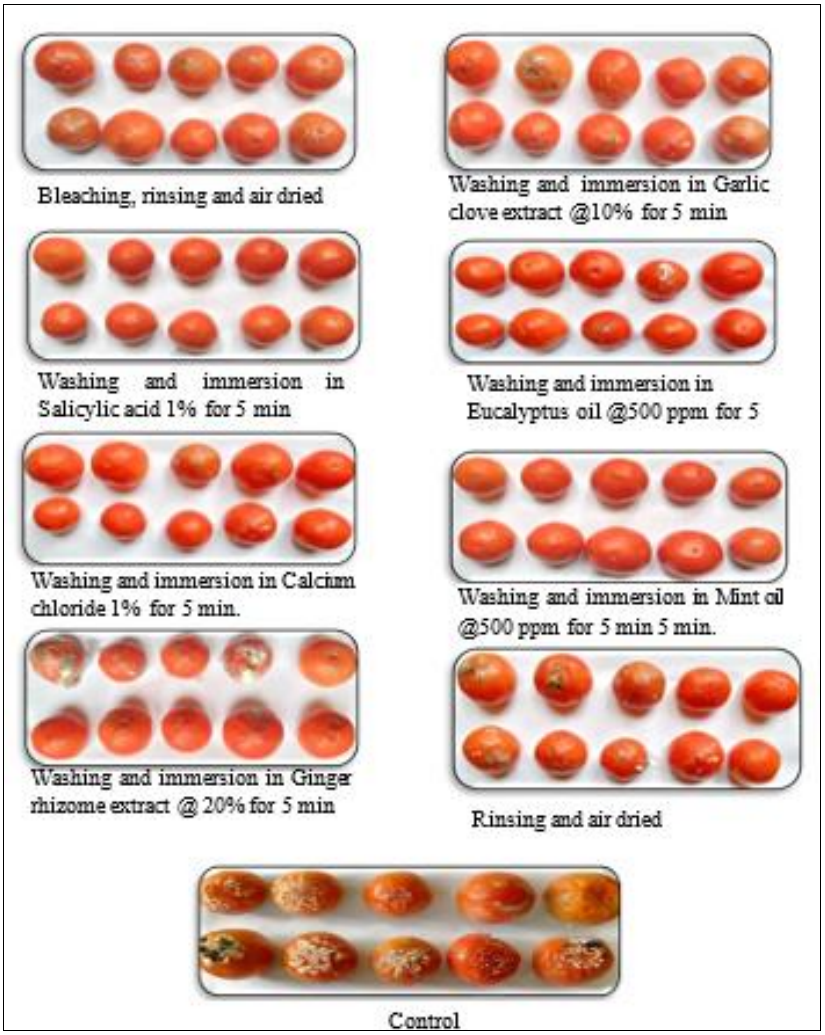

Plate 1: Impact of post-harvest treatment of GRAS chemicals, botanicals and essential oils on spoilage of tomato fruits and physiological weight loss (PWL) of marketable fruits

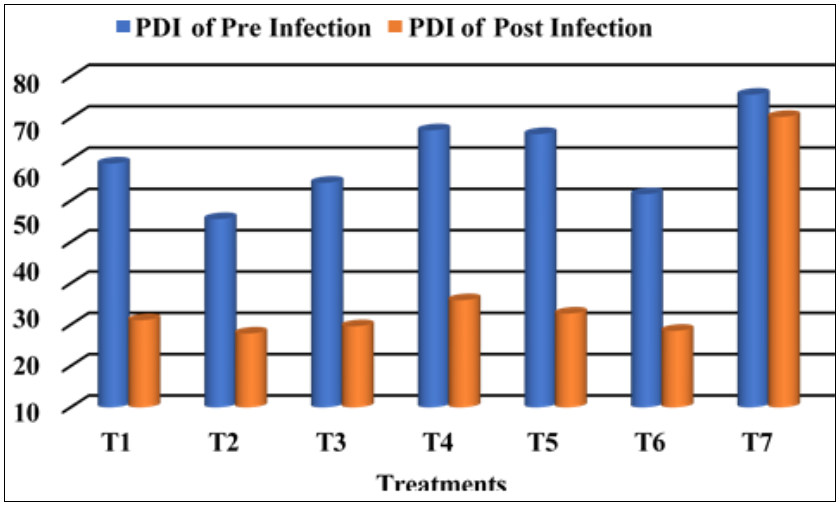

Fig. 1: Effect of pre and post infection treatment of GRAS chemicals, botanicals and essential oils on intensity of fruit rot of tomato incited by *Alternaria solani*

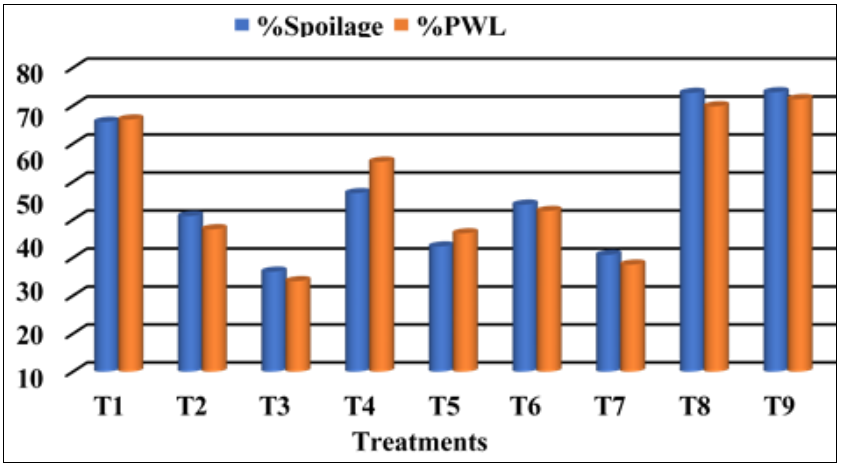

Fig. 2: Impact of post-harvest treatment of GRAS chemicals, botanicals and essential oils on spoilage of tomato fruits and physiological weight loss (PWL) of marketable fruits

Conclusion

Fruit dip with Post inoculation method gave least fruit rot intensity with Calcium chloride and mint oil as compared to pre inoculation fruit dip method, whereas Garlic extract, Salicylic acid, Nilgiri oil and Ginger extract were least effective in controlling fruit rot caused by post-harvest fungi. Post harvest treatment of harvest fruit with Calcium chloride and Mint oil gave least spoilage and physiological weight loss.

References

1. Afifi MA, Sahar AZ. Antifungal effect of neem and some medicinal plant extracts against *Alternaria solani*, the cause of tomato early blight. Aspects Appl Biol. 2009;96:251-257.
2. Bangerth F, Dilley DR, Dwe DH. Effect of post-harvest calcium treatments on internal quality of fruits. [Details incomplete; please provide complete reference for accurate formatting.]
3. Bhalerao JB, Chavan RA, Dharbale BB, Kendre AH, Mete VS. Study on *in vitro* efficacy of botanicals and chemicals against Alternaria solani associated with post-harvest rot of tomato (*Lycopersicon esculentum* Mill.). J Pharmacogn Phytochem. 2019;8:2045-9.
4. Chavan RA, Tawade SV. Effect of post-harvest treatments of fungicides, chemicals and plant breakdown on respiration of apple fruits. J Am Soc Hortic Sci. 2012;97(5):679-82.
5. Devi NO, Singh NI, Devi RT, Chanu WT. *In vitro* evaluation of *Alternaria solani* (Ellis and Mart.) Jones and Grout causing fruit rot of tomato by plant extracts and bio-control agents. Int J Curr Microbiol App Sci. 2017;6(11):652-61.
6. Nasrin TAA, Molla MM, Hossaen MA, Alam MS, Yasmin L. Effect of postharvest treatments on shelf life and quality of tomato. Bangladesh J Agric Res. 2008;33(4):579-585.
7. Perveen K, Bokhari NA. Management of Alternaria leaf blight in tomato plants by Mentha essential oil. Plant Protect Sci. 2020;56(3):191-196.
8. Senevirathna PAWAN, Daundasekera WAM. Effect of postharvest calcium chloride vacuum infiltration on the shelf life and quality of tomato (cv. 'Thilina'). Ceylon J Sci (Biol Sci). 2010;39(1).
9. Vir D, Raychaudhuri SP, Batra SK, Bajaj BS. Aureofungin as fruit dip and wrap treatment for the control of Diplodia rot of mango and Alternaria rot of tomato fruits during transit. Indian Phytopathol. 1967;20:301-303.