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Efficacy of Botanical Extracts on Early Blight Disease (*Alternaria solani*) in Tomato (*Solanum lycopersicum* L.)

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ABSTRACT: Tomato having botanical name *Solanum lycopersicum* L. belongs to family Solanaceace which is one of the widely grown vegetables in the world. Early blight disease caused by *Alternaria solani* is one of the commonly found pathogen in tomato. It becomes wide spread and serious disease causing large economic loss at every stage of plant development. To reduce the use of chemical fungicides and its negative impact on environment and soil health, the management has been made to evaluate the effect of selected botanical leaf extracts *in vivo* during Rabi 2020-2021. Selected botanical leaf extracts *viz*., neem, eucalyptus, calotropis, datura at 5% concentration and mancozeb @0.2% were tested against the pathogen for their efficacy against the disease, plant growth and yield parameters. Among the all treatments, it was found that the plant height (28.84cm), number of leaves per plant (24.197) and yield (42.61 qha^{-1}) significantly increased at 75 DAT in the treatment T_2 - eucalyptus leaf extract. The disease intensity (%) (41.36%) significantly decreased in the treatment T_2. Higher gross return value (Rs. 84,368 ha^{-1}), net return value (Rs. 55,164 ha^{-1}) and B:C ratio (2.89) was also found in the treatment T_2-eucalyptus leaf extract @5% as compared to T_5 -mancozeb and T_0-control.

Keywords: *Alternaria solani*, early blight, calotropis, datura, eucalyptus, neem, tomato.

INTRODUCTION

One of the most profitable and ubiquitous vegetables cultivated worldwide is the tomato (*Solanum lycopersicum* L.). It is little annual or short-lived perennial herb widely present to "Peru-Equador". Portuguese introduced in India in the early 16th century. It is a staple food in the Indian diet and is consumed as both raw and cooked, in the form of sauce, pickle, ketchup, and other processed foods. About 95% of tomato fruit comprises of water, with the remaining 5% made up mainly of carbs and fibre. Vitamins A and C as well as a large number of antioxidants are present in its fruit (Bhatia *et al.,* 2004). Tomato farming has become more and more popular recently attributed to the diversity of climate environments and the excellent nutritional content (Chourasiya *et al*., 2013). Brazil, China, India, Turkey, Egypt, Iran, and the United States are the world's top tomato producers. It has a global production of 163.96 million tonnes and occupies around 4.73 million hectares of acreage (FAOSTAT, 2010). It is cultivated under a range of circumstances in the Indian states of Andhra Pradesh, Odisha, Karnataka, Maharashtra, West Bengal, Bihar, Gujarat, Uttar Pradesh, Madhya Pradesh, and Chhattisgarh. According to data from various states, India produced 186.08 lakh tonnes in 2019–20, accounting for a total production of 18,732 thousand tonnes from an area of 774 thousand hectares with an average productivity of 24.20 tonnes per ha. In U.P. It is grown in a number of districts such as Jaunpur, Sultanpur, Varanasi, Bhadohi, Prayagraj, Chandauli, Basti, Hardoi, Gorakhpur, Ballia, Sonbhadra, Mirzapur Ghazipur, Pratapgarh, Faizabad, Lucknow, Balrampur and Kanpur etc. It is cultivatedon 10.48Mha with an annual production of 529.00M tonnes perha in Uttar Pradesh (Anonymous, 2020).

The most significant tomato disease in the Prayagraj region is Alternaria blight, which causes 80–86% annual losses due to early blight and average disease intensities ranging from 35–40% (Pandey and Pandey 2003). This disease had led to a 79% decrease in fruit production brought on by early leaf blight (Saad *et al*., 2014). In the absence of its primary host, *Alternaria solani* has the capacity to persist for a considerable amount of time on soil-borne plant detritus. It spreads by fungal spores and causes foliage (leaf blight), stem

(collar rot), and fruit (fruit rot) type of disease which can cause significant harm at any stage of plant maturation (Foolad *et al*., 2008; Datar and Mayee 1981). If the infection is encouraged by high temperatures and humidity (overcrowding of the plantation, heavy rains, and extended wetting of the leaves owing to dew) during fruiting, it is more sensitive to epidemic infection (Sadana and Didwania 2015). A single technique is used in a short-term disease management approach, however integration of two or more disease control methods is typically used for long-term fruitful management (Fazil and Ishtiaq 2010). Farmers solely use chemical fungicides to treat the illness, but this has an adverse effect on the ecosystem and breeds pathogen resistance. As a result of these factors, using botanicals does not affect the environment and is also successful in treating sickness (Yadav *et al*., 2014). In *in vitro* and *in vivo* circumstances, plant extracts have demonstrated antibacterial efficacy against fungi pathogens (Kagale *et al*., 2004). Plant extracts may be a useful substitute for chemical pesticides in the management of many plant diseases.

METHOD AND MATERIALS

Experimental sites: During the Rabi season of 2020–2021, CRF (Central Research Field) the experimented site under department of plant pathology at SHUATS in Prayagraj.

Methodology:

Collecting disease sample: The tomato plant portions that were infected were the ones that were exhibiting the normal signs in a field of standing crops. These diseased plant samples were delivered to the lab for additional research.

Slide preparation for fungal identification. Through microscopic analysis, the properties of the fungal colony were examined. A small part of the diseased sample was extracted using a sterile needle and put on a sterile glass slide. Cotton blue and lactophenol were used to stain it. Next, the morphological traits of the fungal pathogen were studied under the microscope (Grahovac *et al*., 2012).

Morphological characters of *Alternaria solani*: Long-beaked, and uncatenated spores are produced by *Alternaria solani* (Simmsons, 2007). It was discovered that the mycelium was composed of septate, branching, light brown hyphae that darkened over time. Conidiophores ranged in length from 50 to 90 m and were dark in colour. Conidia was a muriform, beaked, dark-colored, singly-borne organism that ranged in size from 120 to 296 m. Conidia has 1–5 longitudinal septa and 5–10 transverse septa (Singh and Singh 2006).

Evaluation of fungicides and botanical extracts: Field tests were conducted to identify the effectiveness of non-systemic fungicides and botanical extracts against *Alternaria solani*.

Botanical extract preparation: Using sterile distilled water, fresh leaves were mashed in a pestle and mortar. The extracts were produced to the necessary concentration by adding distilled water after being filtered through two layers of muslin cloth.

Disease intensity: The formula of Disease intensity (%) was given by Wheeler (1969). Calculation should be followed by using below formula:

Disease intensity (%) =

$$\frac{\text{Sum of all disease ratings}}{\text{Total number of ratings} \times \text{Maximum disease grade}} \times 100$$

Observation recorded: At the period of the experiment, before and after harvesting observations were made. Plant height(in cm), the number of leaves per plant, and the degree of disease severity were examined before to harvest. The yield (qha^{-1}) and benefit cost ratio were based on post-harvest observations.

RESULT AND DISCUSSIONS

Plants height. The plant height of tomato was maximum, recorded in treatments T_2 Eucalyptus @5% (27.80 cm) was found significantly increased the plant height of tomato followed by T_3 - Calatropis leaf extract @5% (26.19 cm), T_1- Neem leaf extract @5% (25.52 cm), T_4 - Datura leaf extract @5% (22.22 cm) as compared to T_5 - Mancozeb @ 0.2% (28.84 cm) and untreated control T_0 (21.63 cm) (21.63 cm). Among the treatments (T_1, T_5) and (T_2, T_4) are discovered non-significant from each other.

Number of leaves. The maximum number of leaves of tomato was recorded in the treatments T_2 Eucalyptus leaf extract @5% (22.233) was found significantly increased in number of leaves followed by T_1 -Neem leaf extract @5% (20.930), T_3-Calatropis leaf extract @5% (19.68), T_4-Datura leaf extract @5% (19.53) as compared to T_5-Mancozeb @ 0.2% (24.197) and untreated control T_0 (18.443). Among the treatments (T_5, T_1, T_4), (T_1, T_4, T_2) and (T_2, T_3) are found non-significant from each other.

Table 1: Effect of fungicide and botanical extract on plant height(cm) and number of leaves per plant.

Sr. No.	Treatments	Plant height (cm)			Number of leaves per plant
		45 DAT	60 DAT	75 DAT	Mean
T_0	Control (untreated check)	14.69	19.97	21.63	18.443
T_1	Neem leaf extract @5%	17.77	21.54	26.13	20.930
T_2	Eucalyptus leaf extract @5%	18.90	24.23	27.80	22.233
T_3	Calatropis leaf extract @5%	16.64	20.82	25.52	19.687
T_4	Datura leaf extract @5%	15.64	21.16	22.22	19.530
T_5	Mancozeb treated check @0.2%	20.87	26.16	28.84	24.197
	S. Ed (±)	0.507	0.618	0.490	0.769
	C.D. (5%)	1.135	1.378	1.093	1.716

Table 2: Effect of botanical extracts and fungicide on disease intensity, yield and B:C ratio.

Sr. No.	Treatments	Disease Intensity (%)			Yield (qha^{-1})	B:C ratio
		45 DAT	60 DAT	75 DAT	Mean	
T_0	Control (untreated check)	26.40	41.23	53.10	27.85	1:1.93
T_1	Neem leaf extract @5%	20.30	37.76	46.56	38.06	1:2.58
T_2	Eucalyptus leaf extract @5%	18.76	32.65	41.36	42.61	1:2.89
T_3	Calatropis leaf extract @5%	22.10	35.56	48.36	36.17	1:2.44
T_4	Datura leaf extract @5%	24.70	33.43	48.90	31.24	1:2.09
T_5	Mancozeb treated check @0.2%	17.33	28.20	37.86	50.47	1:3.26
	S. Ed. (±)	0.472	0.660	0.960	0.49	
	C.D. (5%)	1.053	1.471	2.139	1.10	

Disease intensity. The treatments T_2 -Eucalyptus @5% (41.36) was found significantly having minimum disease intensity in tomato followed by T_1- Neem leaf extract @5% (46.56), T_3-Calatropis leaf extract @5% (48.36), T_4 - Datura leaf extract @5% (48.90) as compared to T_5 - Mancozeb @ 0.2% (37.86) and intensity were highest at untreated control T_0 (53.10). Among the treatments (T_2, T_4) and (T_4, T_5) was found non-significant from each other.

Yield(qha^{-1}). Treatments T_2 -Eucalyptus @5% (42.61 qha^{-1}) was found significantly having maximum yield in tomato followed by T_1 - Neem leaf extract @ 5% (38.06 qha^{-1}), T_3-Calatropis leaf extract @5% (36.17 qha^{-1}), T_4 - Datura leaf extract @5% (31.24 q ha^{-1}) as compared to T_5 -Mancozeb @ 0.2% (50.47 q ha^{-1}) and minimum yield in untreated control T_0 (27.85 q ha^{-1}). Among the treatments (T_4, T_2) was found non-significant from each other.

Results of the benefit-to-cost analysis of the various therapies were seen. Treatment T_2 had the highest cultivation costs (Rs. 29,204/ha), gross returns (Rs. 84,368/ha), and net returns (Rs. 55,164/ha). The untreated control group with T_0 had the lowest gross returns (Rs. 55,143/ha), cultivation costs (Rs. 28,600/ha), and net returns (Rs. 26,543/ha).

The probable findings demonstrate that Eucalyptus leaf extract has been tested for antifungal action against human pathogenic fungus and bacteria, but there are relatively few reports on plant pathogenic fungi, particularly early blight brought on by *Alternaria solani*. It has been reported that organic compounds have antifungal properties (Mehta and Sharma 2016). Depending on the results of earlier studies, the plant's height, number of leaves, disease severity, and yields from plant extracts will determine the outcome. Among the plant extracts tested, fresh *Eucalyptus obliqua* aqueous extract effectively inhibited *Alternaria solani* mycelial development by 88 percent. Thus, the current research concluded that plant extracts for the treatment of *Alternaria solani* had considerable inhibition, were economical and environmentally acceptable, and were competitive to fungicides (Sadana and Didwania 2016). Six plant extracts have antifungal properties. Each plant's extract was tested in vitro and in vivo at two concentrations, 5% and 10%, against *Alternaria solani*. With *Eucalyptus globulus*, *Alternaria solani's* mycelium growth demonstrated the highest reduction and the least amount of disease was present in vivo (Sowmya and Chandra 2021). The botanical treatment described as Eucalyptus leaf extract was also successful in lowering the prevalence of diseases and enhancing fruit productivity. Extract from eucalyptus leaves showed promise for producing greater returns (Chaurasiya *et al*., 2013). The present study's findings demonstrate unequivocally that eucalyptus leaf extract can effectively manage Alternaria blight by lowering Alternaria populations, preventing the spread of disease, and increasing yield potential (Patni *et al.,* 2005).

Plate 1: Rating for disease intensity.

Plate 2: Botanical treatments.

CONCLUSIONS

In vivo results revealed that the minimum disease intensity (%) in tomato at 45, 60 and 75 DAT, maximum plant height (cm) at 45, 60 and 75 DAT, maximum number of leaves per plant, maximum yield (qha^{-1}) and higher gross return value, net return value and B:C ratio was recorded in treatment T_4 – eucalyptus leaf extracts @ 5%. Since chemicals have many detrimental effects on the environment as well as the human health, they would be viewed as better as they are eco-friendly and may also be supplied to the farmers for the efficient treatment of early blight disease of tomato. The findings of the present experiment are restricted to one crop season (December 2020 to March 2021) under Prayagraj agro-climatic condition, as such to confirm the present findings more such experiments need be carried out in future.

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Conflict of Interest. None.

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