

Effect of different Homeopathic Medicines on Mycelial Growth of Early Blight of Tomato (*Alternaria solani*)

Naimish Kumar*, Samir Kumar Biswas, Bipin Verma and Gajendra Pratap

Department of Plant Pathology,

Chandra Shekhar Azad University of Agriculture and Technology, Kanpur (Uttar Pradesh), India.

(Corresponding author: Naimish Kumar*)

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ABSTRACT: The early blight disease poses a significant challenge for tomato farmers, inflicting substantial economic losses year after year. Four homeopathic remedies *i.e.* Phosphorus, *Arnica montana*, Sulphur, and *Silicea terra* against *A. solani* was evaluated at different concentrations (0.1%, 0.15%, 0.20%) by poison food technique. Under *in vitro* conditions, it was observed that the radial mycelium growth of these species experienced a notable reduction as the concentration of the homeopathic medicine increased. This phenomenon was evident at the 8 day after inoculation, *Arnica montana*@0.20% (73.67%), Sulphur at 0.20% (71.83%), *Silica terra* at 0.20% (70.02%) and Phosphorus at 0.20% (65.53) had the greatest inhibition of mycelial growth suppression in comparison to the control.

Keywords: Homeopathic medicines, Antifungal activities, Plant pathogenic fungi.

INTRODUCTION

The tomato (*Solanum lycopersicon* L.) a member of the solanaceae family, stands as one of the most profitable and extensively cultivated vegetable crops globally. Tomatoes are the most widely grown processed crops in the world, coming in second to tomatoes among all vegetables. Cultivated for its consumable fruits, the tomato plant offers versatility, being suitable for consumption both in its raw state and after cooking. These fruits serve as excellent repositories of vitamins, organic acids, essential amino acids, and dietary fibers. In the 2021-22 periods, India achieved a tomato production of 20 million metric tonnes, boasting a productivity rate of 24.4 metric tons per hectare. This cultivation covered an extensive area of 840,000 hectares.

Tomatoes can be susceptible to a range of infections, encompassing pests such as worms, microorganisms like bacteria and viruses, as well as fungal pathogens and abiotic factors of all diseases, early blight is one that has the most impact on tomato plants and other members of the Solanaceae family, whether they are grown conventionally or organically. The most harmful symptoms of early blight disease, which infects the leaf, stem, and fruit, are yield losses of up to 79% (Datar 1981; Sherf and MacNab 1986; Mathur and Shekawat 1986; Gwary and Nahunnaro 1998; Choudhary, 2021). Chemical fungicides have been employed to treat these infections, but this practise has been linked to harmful environmental effects, a possibility of fungicide exposure in humans, and residue buildup on fruits. The infections' development of resistance, however, has decreased the efficacy of chemical fungicides.

Homeopathy can therefore be used to start the process of induced resistance. It is one of the methods allowed in organic agriculture for the control of diseases and pests in plants.

Homeopathy involves the utilization of minuscule doses of remedies to treat ailments, adhering to the principle of "similia similibus curantur" or "like cures like". This holistic healing concept gained scientific validation during the early 19th century. Homeopathic theory asserts that the initiation of illnesses in living organisms can be attributed to counterproductive actions that oppose the vital principle (Bellavite *et al.*, 2007).

In the present era, homeopathy is swiftly gaining popularity on a global scale. Particularly in India, it has permeated households due to its reputation for safety and its gentle approach to healing. Approximately 70 percent of homeopathic remedies are sourced from various plant components, including fruits, stems, barks, flowers, leaves, stigmas, and roots, along with non-woody plants and various herbs. The majority of homeopathic medicines are crafted from natural botanical sources. Typically, these remedies manifest as target-specific methods with minimal side effects, embodying environmentally conscious and non-hazardous approaches that serve to prevent or treat human diseases. However, homeopathic therapy works to counteract adverse effects on vital energy and restore equilibrium by strengthening the plant's defence system (Biswas and Bukhsh 2002). According to Conforti *et al.* (1997), it has antibacterial, antifungal, antiseptic, and anti-inflammatory properties. According to Hanif and Dawar (2015) *A. montana* greatly suppressed the mycelial growth of *F. oxysporum*, *Rhizoctonia solani*, and *Macrophomina phaseolina*. *T.*

occidentalis is an evergreen coniferous tree that is heavily utilised in the homeopathic medical system (Hulten and Mistry 1986; Alam and Mistry 2022). It has numerous pharmacological benefits, including antiviral, antifungal, anti diarrheal, and antioxidant qualities (Caruntu *et al.*, 2020).

The utilization of homeopathic remedies to manage diverse pathogens affecting fruits has demonstrated significant efficacy while upholding environmental safety. For example, *T. occidentalis* has been previously documented for its inhibitory effects against various fruit rot pathogens such as *Alternaria solani*, *Fusarium moniliforme*, *Gloeosporium psidii*, *Colletotrichum gloeosporioides*, *Pestalotia* spp., among others (Chandra *et al.*, 1981; Wilson *et al.*, 1991; Khanna and Chandra 1992; Baviskar and Suryawanshi 2015). Arie (2019) highlighted the potency of sulfur, a homeopathic medicine, in combating plant pathogenic fungi like fusarium wilt (caused by *F. oxysporum*), septoria leaf spot (caused by *S. lycopersici*), and phomopsis blight (caused by *P. vexans*). Sinha and Singh (1983) found sulfur to be a complete inhibitor of *Aspergillus parasiticus* growth. Saxena *et al.* (1988) employed 200 ppm of sulfur and noted inhibition of growth across 22 fungal genera. Toledo *et al.*, (2009) reported suppressed mycelial growth of *A. solani* influenced by silicea. The present study seeks to assess the in vitro effectiveness of different concentrations (0.1%, 0.15%, 0.20%, etc.) of homeopathic medicines namely Phosphorus, *T. occidentalis*, Sulphur, and *Silicea terra* against *A. solani*.

MATERIAL AND METHODS

Experimental site. All experiments were carried out within the laboratory of the Department of Plant Pathology at C.S.A. University of Agriculture and Technology in Kanpur, spanning the time frame of the 2020-22 periods.

Isolation and purification of the pathogen. To get rid of dirt and other impurities, the diseased leaf was first rinsed with tap water. Small pieces of the lesions' margins were removed before they were surface sterilised with 10% sodium hypochlorite for 5–10 minutes. The tissue fragments were rinsed three times with sterile distilled water to get rid of any chemical residue. The surface-sterilized sections were placed onto sterile petri dishes containing tomato dextrose agar (PDA) medium. Over a span of seven days, these plates were incubated at room temperature (28±2°C). Following incubation, the cultures underwent purification using the hyphal tip method (Dhingra and Sinclair 1985) and the resulting fungal cultures were individually preserved in agar slants or petri plates. Moreover, the pathogenicity of *A. solani* was substantiated through the application of Koch's postulates on disease free tomato plants.

Identification of the pathogen. The identification of the pathogen was established through an assessment of its morphological, cultural, and pathogenic characteristics with respect to the host. A distinguishing feature of *A. solani* is its transversely and longitudinally septate (muriform) conidia, which differentiate it from

other types. These conidia possess a distinctive beak, varying in length from very short to considerably long. Frequently, the conidia are organized in chains, and in the present case, they exhibited a dark brown hue and a typically obclavate shape (Alhussan, 2012).

Maintenance of the cultures. The fungal pathogen was sub-cultured on PDA slants and allowed to grow at 25 ± 1°C for 10 days. Samples were stored in the refrigerator (at 4°C) and sub-cultured once at regular intervals of a month.

Effect of different homeopathic medicine against *A. solani*. The effectiveness of Phosphorus, *Arnica montana*, Sulphur, and *Silicea terra* at varying concentrations of 0.1%, 0.15%, and 0.20% was assessed in a laboratory setting using the poisoned food technique on tomato dextrose agar (PDA) medium against *A. solani*. The experiment incorporated three replications for each treatment of the homeopathic medicine. The pathogen was cultivated on PDA medium for duration of 10 days prior to commencing the experiment. To initiate the experiment, the PDA medium was prepared, and the respective homeopathic medicines were introduced into the melted medium at the prescribed concentrations. Subsequently, 20 ml of the treated medium was poured into sterilized Petri plates. A suitable control was maintained, devoid of any homeopathic medicine addition. A mycelial disc was extracted from the periphery of an established colony. The actively growing hyphal tip was isolated using a cork borer and positioned at the centre of the Petri plates containing the treated medium, which was then incubated at a temperature of 25 ± 1°C until the control plate was fully colonized. The radial expansion of the fungal growth on the treated medium was monitored daily for a span of 8 days post-inoculation. The colony's diameter was measured in two directions, and the average was recorded to determine the progression of the targeted pathogens. Per cent inhibition of growth will be calculated by following formula as given by Horsfall (1956)

$$I = \frac{C - T}{C} \times 100$$

Where, I = Per cent growth inhibition

C = Growth of fungus in control (mm)

T = Growth of fungus in treatment (mm)

Treatments were as follows: T1: Silica 0.1%; T2: *Arnica* 0.1%; T3: Sulphur 0.1%; T4: Phosphorus 0.1%; T5: Silica 0.15%; T6: *Arnica* 0.15%; T7: Sulphur 0.15%; T8: Phosphorus 0.15%; T9: Silica 0.20%; T10: *Arnica* 0.20%; T11: Sulphur 0.20%; T12: Phosphorus 0.20%; T13: Control.

Statistical analysis. Completely Randomized Design (CRD) used for the experiments will be conducted in laboratory in Petri plates. The data will be statistically analysis by means of critical difference (CD) at five per cent level of significance.

RESULTS AND DISCUSSION

In vitro Impact of Homeopathic Medicines on *A. solani*. Under *in vitro* conditions, the efficacy of four homeopathic medicines like Phosphorus, *Arnica montana*, Sulphur, and *Silicea terra* against *A. solani*

was assessed at varying concentrations (0.1%, 0.15%, and 0.20%). The outcomes revealed notable suppression of the mycelial growth of *A. solani* across all four concentrations tested, as compared to the control group (Table 1, Fig. 1). Among all treatments, the highest mycelial growth inhibition over control was observed in T10: *Arnica montana* @ 0.20% (73.67%), followed by T11: Sulphur @ 0.20% (71.83%), T9: *Silica terra* @0.20% (70.02%) and T12: Phosphorus @0.20% (65.53), corresponding, respectively, to 23.52 mm, 25.16 mm, 26.78 mm, and 30.79 mm mycelial growth at 8 DAI. The lowest mycelial growth inhibition compared to the control was attributed to sulphur@0.1% (29.98%), corresponding to a 62.54 mm mycelia growth at 8 DAI. In their study, Dahiwale and Suryawanshi (2010) documented the antifungal properties of several homeopathic medicines, specifically *T. occidentalis*, sulfur, *A. montana*, *A. phosphoricum*, *Spongia tosta* and *Chelidonium majus*. These remedies were subjected to individual testing as well as combination with mancozeb, an agricultural fungicide. The research focused on their impact on the mycelial growth of *A. alternata*, a fungal species causing plant diseases. The experiments were conducted using tomato dextrose agar (PDA) medium

and involved the food poisoning technique. Dua and Atri (2004) highlighted the antifungal efficacy of specific homeopathic medicines, namely *T. occidentalis* and *Lycopodium* spp. in combatting *A. solani*. This particular fungus is recognized as the primary causal agent responsible for early blight disease in tomatoes and tomatoes. Patil and Suryawanshi (2014) noticed the potential control of strawberry fruit rot caused by *A. alternata* using different homeopathic medicines with promising effects on vegetative and reproductive growth. Kumar *et al.* (2023) conducted research involving the application of specific homeopathic medicines *Arnica montana*, *Thuja occidentalis*, Sulfur and *Silicea terra* against various plant disease causing pathogens, namely *Fusarium oxysporum* f. sp. *lycopersici*, *Ascochyta rabiei*, *A. solani*, *Septoria lycopersici*, and *Phomopsis vexans*. Their findings indicated that the most significant inhibition of mycelial growth in comparison to the control group was achieved with the application of *T. occidentalis* at a concentration of 200 ppm (73.73%), *T. occidentalis* at 200 ppm (76.73%), *A. montana* at 200 ppm (64.22%), silicea at 200 ppm (59.77%), and sulfur at 200 ppm (53.82%).

Table 1: Effect of different Homeopathic medicines on mycelial growth of Early Blight of tomato.

Treatments	Treatments details	Mycelial growth (mm/days)				Percent inhibition nover control
		2 nd Day	4 th Day	6 th Day	8 th Day	
T1	Silica 0.1%	14.66	26.66	40.00	58.88	34.08
T2	Arnica 0.1%	14.66	26.00	38.66	60.10	32.72
T3	Sulphur 0.1%	16.00	26.00	41.12	62.54	29.98
T4	Phosphorus 0.1%	15.33	28.66	39.78	60.78	31.96
T5	Silica 0.15%	13.33	22.00	38.35	50.99	42.91
T6	Arnica 0.15%	12.66	22.00	35.02	46.45	48.00
T7	Sulphur 0.15%	14.00	24.66	41.66	51.32	42.55
T8	Phosphorus 0.15%	14.00	26.66	37.37	55.78	37.55
T9	Silica 0.20%	12.66	16.00	20.91	26.78	70.02
T10	Arnica 0.20%	10.66	12.66	16.04	23.52	73.67
T11	Sulphur 0.20%	12.00	12.66	18.38	25.16	71.83
T12	Phosphorus 0.20%	12.66	18.33	22.72	30.79	65.53
T13	Control	16.66	29.33	56.66	89.33	-
	CD at 5%	2.47	2.46	3.83	4.49	-
	SE (m)	0.84	0.84	1.32	1.52	-

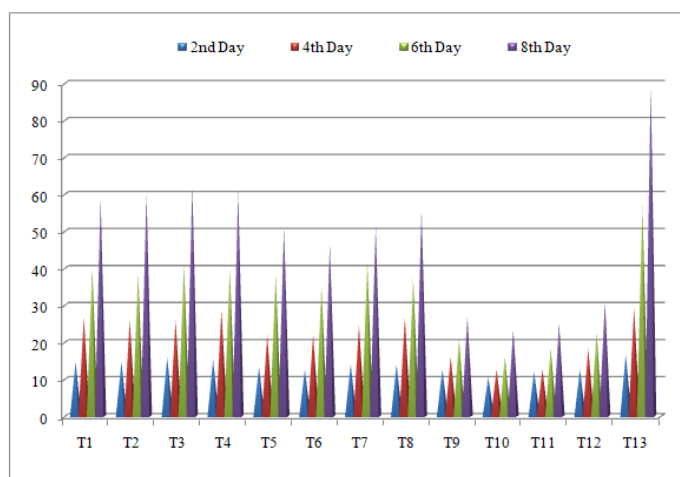
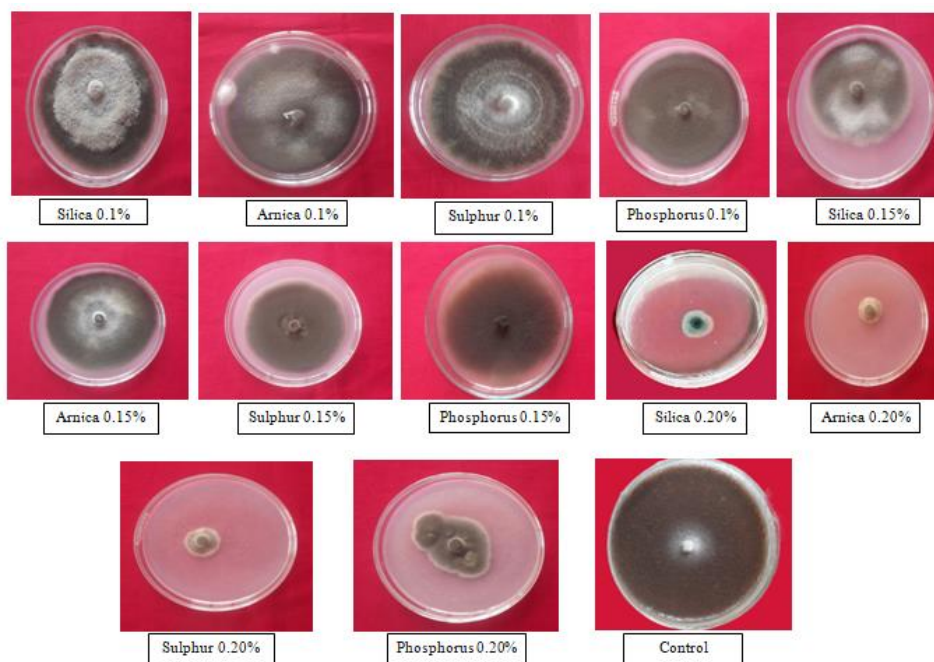


Fig. 1. Effect of different Homeopathic medicines on mycelial growth of Early Blight of tomato.



CONCLUSIONS

Throughout the process of preparing homeopathic remedies, plants generate secondary metabolites. These metabolites are safe for the environment because they don't produce residue and aren't harmful. This study looked at how homeopathic drugs and microbial antagonists worked together to prevent tomato early blight. Homeopathic medications such as phosphorus, *Arnica montana*, Sulphur and *Silica terra* were used to treat pathogens that cause plant diseases. It was discovered that the higher homeopathic medication concentrations considerably slowed the radial mycelial development of *A. solani* under *in vitro* conditions. At 8 DAI, *Arnica montana* at 0.20% (73.67%), Sulphur at 0.20% (71.83%), *Silica terra* at 0.20% (70.02%), and Phosphorus at 0.20% (65.53) had the greatest mycelial growth suppression in comparison to the control. Therefore, these homeopathic medicines can aid plants in protecting themselves from fungal and other pathogen attack. In the future, when more environmentally friendly and sustainable agricultural practises are conceivable, using homeopathic medicines may be a smart strategy to reduce or even replace synthetic products.

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Conflicts of Interest. None.

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