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Bioefficacy of Phytoextracts Against *Fusarium oxysporum* f.sp. *lycopersici*, causing wilt of Tomato in *in vitro* Conditions

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ABSTRACT: *Fusarium* wilt is one of the distructive disease of tomato caused by *Fusarium oxysporum* f.sp. *lycopersici* is one of the most widespread disease of the tomato. The fungus *Fusarium* causes the vascular wilt disease in tomato known as fusariosis and in case of severe disease incidence its resulting in total and complete loss of yield under field and greenhouse condition. Therefore, present study was undertaken during, *kharif*, 2021-22 in the Department of Plant Pathology, VNMKV, Parbhani to assess the bioefficacy of seven phytoextracts against *F.oxysporum* f.sp. *lycopersici*. Results revealed all seven test plant extracts (each @10 and 20 %) were found fungistatic to *F. oxysporum* f.sp. *lycopersici* and significantly inhibited mycelia growth of the test pathogen, over untreated control. Among plant extracts *Allium sativum* was recorded complete mycelial growth inhibition of *F. oxysporum* f.sp. *lycopersici* with cent percent inhibition over control and significantly superior over all the treatments followed by *Zingeber officinale* (86.78% and 87.66% at respective concentration) with mycelial growth of 13.23 mm and 11.89 mm respectively. whereas, the least effective phytoextract was found *Mentha piperita* (54.26% and 55.37%) with maximum mycelial growth of 45.17 mm and 41.16 mm at respective concentration.

Keywords: *F. oxysporum* f.sp. *lycopersici, Lycopersicion esculentum,* Phytoextracts, *Allium sativum, Zingeber officinale, Oscimum sanctum, Mentha piperita, Azardirachta indica.*

INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill.) is the second most important vegetable crop grown in India belongs to the family solanaceae and genus solanum (Hassan, 2020). Tomato is an important vegetable crop grown all over the world for its fleshy fruits due to its varied climatic tolerance and high nutritive value. Botanically it is a berry fruit, used as a vegetable for culinary purposes. The fruit is rich in lycopene which has beneficial health effects (Gadhave *et al*., 2020). In Indian Tomato was grown in about 27.48 million ha area with an annual production of 334.60 million tonnes during 2020-21 (PIB, 2020). The tomato growing states in India are MP, Orissa, Karnataka, West Bengal, Chhattisgarh, Bihar, Maharashtra and Tamil Nadu which accounted for 91 per cent of the total production of the country (NHB, 2017). In Maharashtra tomato was cultivated on an area of 0.43 million ha with 9.57 million tonnes of annual production and productivity of 21.93 million tonnes per hectares (Shreejana, 2021). Wilt of Tomato caused by *Fusarium oxysporum* f.sp. *lycopersici* is one of the destructive disease of tomato causes upto 30-40% yield losses and it can reach up to 80% under adverse weather conditions (Gulya *et al*., 2023).

Therefore, present study was attempted to assess the bioefficacy of seven phytoextracts against *F. oxysporum* f.sp. *lycopersici*

MATERIALS AND METHODS

***In vitro* evaluation of phytoextracts.** Plant extracts of the seven locally available higher plant species were separately evaluated *in vitro* (each @ 10 and 20 %) against *Fusarium oxysporum* f.sp. *lycopersici* applying Poisoned food technique (Nene and Thapliyal 1993) and using PDA as basal medium.

Details of the experiment:
Design : CRD
Replications : Three
Treatments : Eight

Treatment details:

Tr. No.	Botanical Name	Common Name	Plant Part Used
T_1	*Zingiber officinale*	Ginger	Rhizome
T_2	*Azardirachta indica*	Neem	Leaves
T_3	*Allium sativum*	Garlic	Bulb
T_4	*Oscimum sanctum*	Tulsi	Leaves
T_5	*Allium cepa*	Onion	Bulb
T_6	*Mentha arvensis*	Mint	Leaves
T_7	*Curcuma longa*	Turmeric	Rhizome
T_8	Control	—	—

Fresh samples were washed under tap water and washed 3 times using sterilized distilled water. They were crushed in a sterilized mortar and pastle by adding a little quantity of sterile distilled water just enough to crush the sample easily. The extract was collected by filtering from double layer of muslin cloth. Finally filtrate thus obtained from the leaves, bulb, clove and rhizome was used as stock solution. To study the antifungal mechanism of plant extract the poisoned food technique was followed as suggested by (Nene and Thapliyal 1993).

For this, 10 and 20 ml of stock solution was taken separately and will be mixed with 90 and 80 ml sterilized mortle and pastle, so as to get 10 and 20 percent concentrations. The medium was shaken thoroughly for uniform mixing of phytoextract.20 ml medium was poured in each of the 90 ml sterilized petri plates. Three replications were maintained for each treatment including control. Each plate was seeded with 5 mm mycelial discs aseptically taken from the periphery of 7 days old culture and incubated at 27°C till the growth of the colony touched the periphery in control plate. Mean colony diameter in each treatment was recorded. The efficacy of botanicals were expressed as percent inhibition of mycelial growth over control which was calculated by using the formula as given by Vincent (1927).

$$\text{Per cent inhibition (R)} = \frac{C - T}{C} \times 100$$

Where,

C= growth of the test fungus in untreated control plates

T= growth of the test fungus in treated plates

Observations on radial mycelial growth/diameter of colony of *Fusarium oxysporum* was recorded at an interval of 24 hours and continue till untreated control plates was fully covered with mycelial growth. Per cent mycelial growth inhibition of the pathogen with the botanicals, over untreated control was calculated (Arora and Upadhyay 1978).

RESULTS AND DISCUSSION

***In vitro* efficacy of plant extracts against *Fusarium oxysporum* f.sp. *lycopersici*, causing wilt of tomato.**

Aqueous extracts (leaf, rhizome and bulb) of seven plant species were evaluated *in vitro* (each @ 10% and 20%) against *Fusarium oxysporum* f.sp. *lycopersici* and the results obtained on its mycelial growth and inhibition are presented in (Table 1, Fig. 1 and Plate 1).

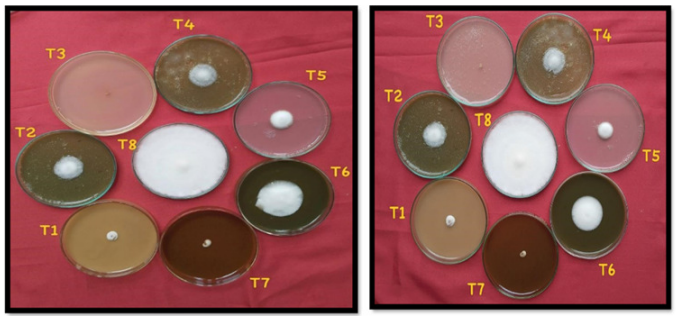
Effect on radial mycelial growth: At 10 per cent, radial mycelial growth of *Fusarium oxysporum* f.sp. *lycopersici* was ranged from 00.00 mm to 45.17 mm. However, it was numerically least with *Allium sativum* (00.00 mm) which was significantly superior over all the treatments, followed by *curcuma longa* (9.88 mm), *Zingiber officinale* (13.23 mm), *Allium cepa* (23.05 mm), *Ocimum sanctum* (27.94 mm) and *Azardiractin indica* (29.63 mm). The plant extracts of *Mentha piperita* found least effective with maximum mycelial growth (45.17 mm).

At 20 per cent, radial mycelial growth of *Fusarium oxysporum* f.sp. *lycopersici* was ranged from 00.00 mm to 41.16 mm. However, it was numerically least with *Allium sativum* (00.00 mm) which was significantly superior over all the treatments, followed by *Curcuma longa* (8.17 mm), *Zingiber officinale* (11.89 mm), *Allium cepa* (18.15 mm), *Ocimum sanctum* (26.22 mm), *Azadirachta indica* (29.10 mm). The plant extract of *Mintha piperita* (41.16 mm) found less effective with maximum mycelial growth.

Table 1: *In vitro* efficacy of plant extracts/botanicals against mycelial growth/colony diameter of *Fusarium oxysporum* f.sp. *lycopersici*.

Tr. No.	Treatment	Radial mycelial growth/colony diameter (mm)*		Inhibition (%) #	
		10%	20%	10%	20%
T_1	Ginger (*Zingiber officinale*)	13.23	11.89	86.78 (67.42)	87.66 (69.40)
T_2	Neem (*Azadirachta indica*)	29.63	29.10	67.66 (54.95)	68.11 (55.59)
T_3	Garlic (*Allium sativum*)	00.00	00.00	100.00 (90.00)	100.00 (90.00)
T_4	Tulsi (*Ocimum sanctum*)	27.94	26.22	70.86 (56.11)	63.30 (57.18)
T_5	Onion (*Allium cepa*)	23.05	18.15	79.83 (59.57)	80.55 (63.80)
T_6	Mint (*Mintha piperita*)	45.17	41.16	54.26 (44.87)	55.37 (48.06)
T_7	Turmeric (*Curcuma longa*)	9.88	8.17	90.92 (70.61)	93.66 (75.38)
T_8	Control (untreated)	90.00	90.00	00.00 (00.00)	00.00 (00.00)
S.E.(m)±		**0.32**	**0.28**	**0.25**	**0.24**
CD at 1%		**1.35**	**1.19**	**0.77**	**0.73**

*Mean of three replications, #: Figures in parentheses are angular transformed value.



(A) @ 10% (B) @ 20%

T_1 *Zingiber officinale,* T_2 *Azardirachta indica,* T_3 *Allium sativum,* T_4 *Ocimum sanctum,* T_5 *Allium cepa,* T_6 *Mintha piperita,* T_7 *Curcuma longa,* T_8 Control

Plate 1: *In vitro* efficacy of different plant extracts/botanicals against mycelial growth and inhibition against *Fusarium oxysporum* f.sp. *lycopersici.*

Fig. 1. *In vitro* efficacy of plant extracts/botanicals against mycelial growth/colony diameter of *Fusarium oxysporum* f.sp. *lycopersici.*

Effect on mycelial growth inhibition: Results (Table 1, Fig. 1 and Plate 1) revealed that all the plant extracts tested (each @ 10 and 20%) significantly inhibited mycelial growth of *Fusarium oxysporum* f.sp. *lycopersici* over untreated control. Further, it was found that percent mycelial growth inhibition of *Fusarium oxysporum* f.sp. *lycopersici* was increased with increase in concentration of the plant extracts tested.

At 10 per cent, mycelial growth inhibition was ranged from 0.00% to 100%. However, it was numerically highest with *A. sativum* (100%) which was found significantly superior over all the treatment, followed by *C. longa* (89.02%), *Z. officinale* (86.37%), *A. cepa* (75.48%), *A. indica* (67.22%) and *O. sanctum* (69.82%). The botanical *Mentha piperita* (50.55%) was found least effective with least mycelial growth inhibition.

At 20 per cent, mycelial growth inhibition was ranged from 0.00% to 100%. However, it was numerically highest with with *A. sativum* (100%) which was found significantly superior over all the treatments, followed by *C. longa* (90.92%), *Z. officinale* (86.78%), and *A. cepa* (79.83%), *O. sanctum* (70.86%) and *A. indica* (67.66%). The botanical *Mentha piperita* was found least effective with significantly minimum mycelial growth inhibition of 54.26%.

These findings are in conformity with the earlier findings of those workers who reported these plant extracts had significantly inhibited mycelial growth of *Fusarium oxysporum* f.sp. *lycopersici* causing wilt of Tomato. Chohan and Parveen (2015) studied the effect of three different plant extract *viz.*, *Curcuma longa*, *Allium sativum* and *Zingiber officinale* at 20%, 40% 60% and 80% concentrations and reported that *Allium sativum* completely inhibited the mycelial growth of *Fusarium oxysporum* f.sp. *lycopersici (*Khan *et al.*, 2017) evaluated effect of four different plant extract *viz.*, *Syzygium aromaticum, Allium sativum, Eucalyptus globulus* and *Lantana camara* Among these *Allium sativum* maximum mycelial growth inhibition followed by *E. globulus, Lantana camera.* The efficacy of botanicals/plant extracts were similar with the findings of earlier workers (Nisa *et al*., 2011; Chaity *et al.,* 2012; Cherkupally *et al.* 2017; Islam *et al*., 2017).

CONCLUSIONS

It is concluded from above result that, the plant extracts evaluated *in vitro, Allium sativum, C. longa, Z. officinale* and *A. cepa* were proved to be most efficient in inhibiting significant mycelial growth of *F. oxysporum* f.sp. *lycopersici*. Thus, locally available plant species with antimicrobial properties and antagonistic microorganisms can be used as an alternative to the chemicals, to manage wilt of tomato.

FUTURE SCOPE

The promising systemic phytoextract *viz., Allium sativum* and *Zingiber officinale* which shows 100%

mycelial growth inhibition under the laboratory condition, which can be used further in future for controlling devastation of *Fusarium* wilt of tomato.

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