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SB SanapDepartment of Plant Pathology,
College of Agriculture, Latur,
Maharashtra, India**VS Mete**Department of Plant Pathology,
College of Agriculture,
Badnapur, Maharashtra, India**KL Jaiswal**Department of Plant Pathology,
College of Agriculture, Latur,
Maharashtra, India**SB Sanap**Department of Plant
Biotechnology, M.G.M. Institute
of bioscience and technology,
Aurangabad, Maharashtra, India**VG Mulekar**Department of Plant Pathology,
College of Agriculture, Latur,
Maharashtra, India**Corresponding Author:****KL Jaiswal**Department of Plant Pathology,
College of Agriculture, Latur,
Maharashtra, India

Evaluation of different essential oils against *Fusarium oxysporum* f. sp. *lycopersici* causing wilt in tomato

SB Sanap, VS Mete, KL Jaiswal, SB Sanap and VG Mulekar

Abstract

Tomato (*Lycopersicon esculentum* Miller) crop suffers from several diseases, among which wilting caused by *Fusarium oxysporum* f. sp. *lycopersici* is one of the serious diseases observed regularly in tomato growing areas. Therefore, efforts were made to evaluate bio efficacy of the different essential oils *in vivo* (pot culture) condition against *Fusarium oxysporum* f. sp. *lycopersici* by root immersion method. Among six essential oils tested *in vivo*, the per cent disease reduction of test pathogen decreased with the increase in concentrations of the essential oils tested against *Fusarium oxysporum* f. sp. *lycopersici*. The highest average disease reduction was recorded with clove oil (91.19%), followed by citronella oil (88.23%), neem oil (79.06%), mustard oil (73.52%) and garlic oil (44.11%), respectively. The eucalyptus oil was found less effective with (38.24%) disease reduction of the test pathogen over untreated control.

Keywords: Tomato, wilt, *Fusarium oxysporum* f. sp. *lycopersici*, essential oils and pot culture

Introduction

Tomato (*Lycopersicon esculentum* M.) is one of the most important vegetable crops cultivated for its fleshy fruit and also considered as important commercial and dietary vegetable crop. India is the second largest producer and consumer of tomato in the world after China. In India, tomato was grown in about 0.797 million ha with an annual production of 207.08 million tonnes and productivity of 25.98 tonnes per ha during 2017 (FAOSTAT, 2019) [3]. The major tomato growing states in India are Madhya Pradesh, Orissa, Karnataka, West Bengal, Chhattisgarh, Andhra Pradesh, Telangana, Gujarat, Bihar, Maharashtra and Tamil Nadu which accounted for 91 per cent of the total production of the country (Anonymous, 2017) [1]. Among various factors responsible for low production and productivity of tomato, the diseases caused by biotic agents are major one. The crop is vulnerable to number of diseases such as Bacterial wilt (*Ralstonia solanacearum*), Fusarium wilt (*Fusarium oxysporum*), Early blight (*Alternaria solani*), Late blight (*Phytophthora infestans*), Damping off (*Pythium* and *Rhizoctonia*) and Yellow leaf curl. Among all these diseases, *Fusarium* wilt caused by *Fusarium oxysporum* f. sp. *lycopersici* is the most devastating fungal disease. Joshi *et al.* (2013) [4] reported that the soil borne fungus *F. oxysporum* is the causal agent of vascular wilt, the disease that affects a large variety of economically important crops worldwide. Considering these issues, present study was planned and conducted with the aim to evaluate the different essential oils *in vivo* condition against *F. oxysporum* f. sp. *lycopersici* causing wilt in tomato.

Material and Methods

In this study, six essential oils each @ 5% and 10% concentration were used as a natural resistance inducer treatment for treating 4 weeks old tomato (*Solanum lycopersicon*) seedlings of available varieties immediately before transplanting into pots. Each containing natural soil mixture consisted of sterilized clay and sterilized sand @ 2:1 (by weight). Each inducer treatment performed by immersing roots (IR) for 10 minutes. The plain water was used instead of inducer treatments for treating tomato seedlings in the control treatment. Conidial suspension of pathogen, which was isolated from wilted tomato plants grown under greenhouse conditions was prepared. A prepared suspension @ 20ml/plant was inoculated one week after transplanting of tomato seedling in pot soil. After one month of inoculation the wilt disease severity (DS) for each treatment was calculated by using visual scale of 0-4 as following; 0 = No wilting symptoms; 1= plant slightly wilted, vascular discoloration found in main root region; 2=, plant moderately wilted, yellowing of old leaves spreading vascular browning; 3= plant severely wilted, dying of all leaves; 4= dead plant, seedling entirely wilted (Vakalounakis and Fragkiabakis, 1999) [9].

to Song *et al.* (2004) [18]. Meanwhile; % of disease reduction efficacy was calculated according to Elhanawy, *et al.* (2007) [2].

Result and Discussion

Per cent disease incidence

A pot culture experiment was conducted to know the efficacy of different essential oils as disease resistance inducer by root

immersion method, @ 5% and 10% concentrations on incidence of tomato wilt caused by *Fusarium oxysporum* f. sp. *lycopersici* and data are presented in Table 1, Plate I & Fig. 1 a. The data presented in Table 1 revealed that all the essential oils tested exhibited wide range of wilt incidence but amongst 5% and 10% concentrations, wilt incidence was more in 10% concentration.

Table 1: *In vitro* efficacy of essential oils against *Fusarium oxysporum* f. sp. *lycopersici* by root immersion method (Pot culture)

Tr. No.	Treatment details	*Mean of PDI @ 5%	(%) Disease Reduction @ 5%	*Mean of PDI @ 10%	(%) Dis. Red. @ 10%	Ave. of 5&10% Mean PDI	Ave. disease reduction
T1	Clove oil	4.16 (11.76)	94.12	8.33 (16.77)	88.23	6.24 (14.46)	91.19
T2	Citronella oil	8.33 (16.77)	88.23	8.33 (16.77)	88.23	8.33 (16.77)	88.23
T3	Eucalyptus oil	41.66 (40.19)	41.16	45.83 (42.60)	35.29	43.74 (41.40)	38.24
T4	Garlic oil	37.50 (37.76)	47.05	41.66 (40.19)	41.18	39.58 (38.98)	44.11
T5	Neem oil	12.50 (20.70)	82.35	16.66 (24.08)	76.47	14.58 (22.44)	79.06
T6	Mustard oil	12.50 (20.70)	82.35	25.00 (30.00)	64.70	18.75 (25.65)	73.52
T7	Control	70.83 (57.31)	0.00	70.83 (57.31)	0.00	70.83 (57.31)	0.00
	S.E.+	0.19		0.77			
	C.D (P=0.01)	0.59		2.29			

* = Mean of three replications, Figure in parenthesis are arc sine transformed values

At 5% concentration, The highest wilt incidence (70.83%) was recorded from untreated control followed by (41.66%) eucalyptus oil, (37.50%) garlic oil, (12.50%) neem oil, which is at par with mustard oil; (8.33%) citronella oil and least wilt (4.16%) incidence was recorded with clove oil as compared to highest wilt incidence (70.83%) in untreated control. All the treatments were statistically significant over untreated control. At 10% concentration, The highest wilt incidence (70.83%) was recorded from untreated control followed by (45.83%) eucalyptus oil, (41.66%) garlic oil, (25.00%) mustard oil, (16.66%) neem oil and least wilt incidence (8.33%) was recorded with citronella and clove oils as compared to highest wilt (70.83%) incidence in untreated control. All the treatments were statistically significant over untreated control. Average per cent disease incidence recorded with all the essential oils tested was ranged from 6.24 per cent (clove oil) to 70.83 per cent (untreated control). The highest average wilt incidence was recorded from untreated control (70.83%) followed by eucalyptus oil (43.74%), garlic oil (39.58%), mustard oil (18.75%), neem oil (14.58%) and citronella oil (8.33%) and least average wilt incidence (6.24%) was recorded with clove oil.

Percent disease reduction

Results (Table 1) revealed that all the six essential oils tested (@ 5% and 10% concentration each) reduced the disease incidence of *Fusarium oxysporum* f. sp. *lycopersici* over untreated control (70.83%). But the per cent disease reduction of test pathogen increased with the increase in concentrations of the essential oils tested.

At 5% concentration, per cent disease reduction was recorded

in the range of 41.16 per cent in eucalyptus oil to 94.12 per cent in clove oil. The highest disease reduction was recorded with clove oil (94.12%), followed by citronella oil (88.23%), neem oil and mustard oil (82.35%), garlic oil (47.05%) and the eucalyptus oil was found less effective with 41.16% disease reduction of the test pathogen over untreated control.

At 10% concentration, per cent disease reduction was recorded in the range of 35.29 per cent eucalyptus oil to 88.23 per cent in clove oil and citronella oil. The highest disease reduction 88.23% was recorded with clove oil and citronella oil, followed by neem oil (76.47%), mustard oil (64.70%) and garlic oil (41.18%). The eucalyptus oil was found less effective with 35.29% disease reduction of the test pathogen over untreated control.

Average per cent disease reduction with all the essential oils tested (@ 5% and 10% concentration each) ranged from 38.24 per cent (eucalyptus oil) to 91.19 per cent (clove oil) over untreated control. The highest average disease reduction was recorded with clove oil (91.19%), followed by citronella oil (88.23%), neem oil (79.06%), mustard oil (73.52%) and garlic oil (44.11%). The eucalyptus oil was found less effective with (38.24%) disease reduction of the test pathogen over untreated control.

Thus, all the essential oils tested were found disease resistance inducer against *Fusarium oxysporum* f. sp. *lycopersici* and reduced per cent disease incidence over untreated control. Essential oils found most effective in the order of merit were clove oil, citronella oil, neem oil, mustard oil, garlic oil and eucalyptus oil.

Similar results were obtained earlier by Sharma *et al.* (2017); Sagitov *et al.* (2011) and Serife *et al.* (2013) [7, 5, 6].

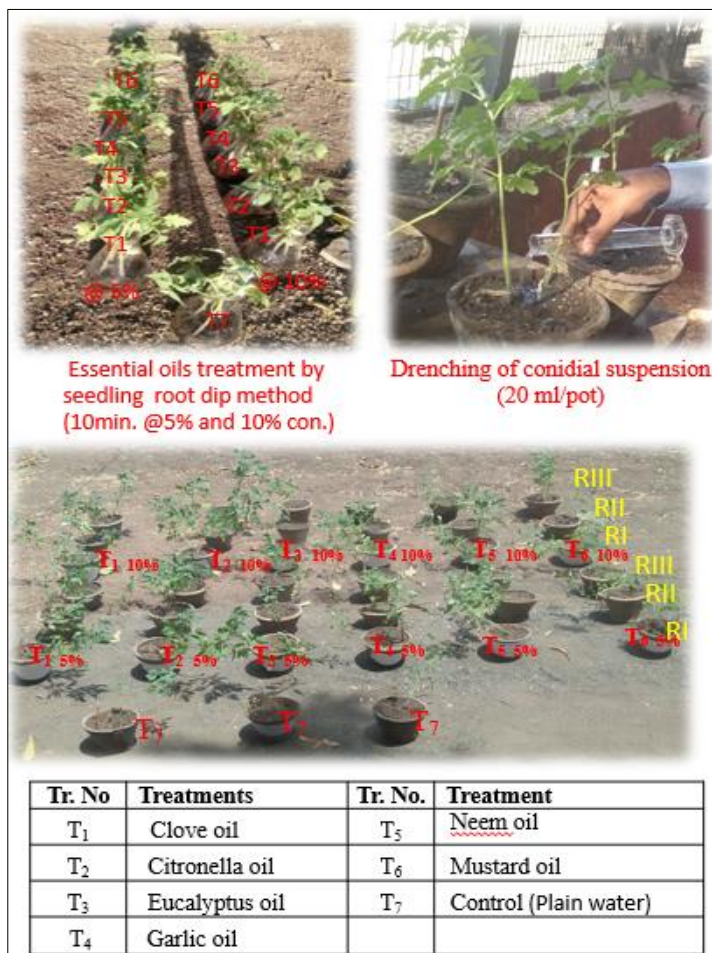


Plate 1: Photograph showing steps and effect of essential oils treatment (pot culture) on incidence of *F. oxysporum* f. sp. *lycopersicon*

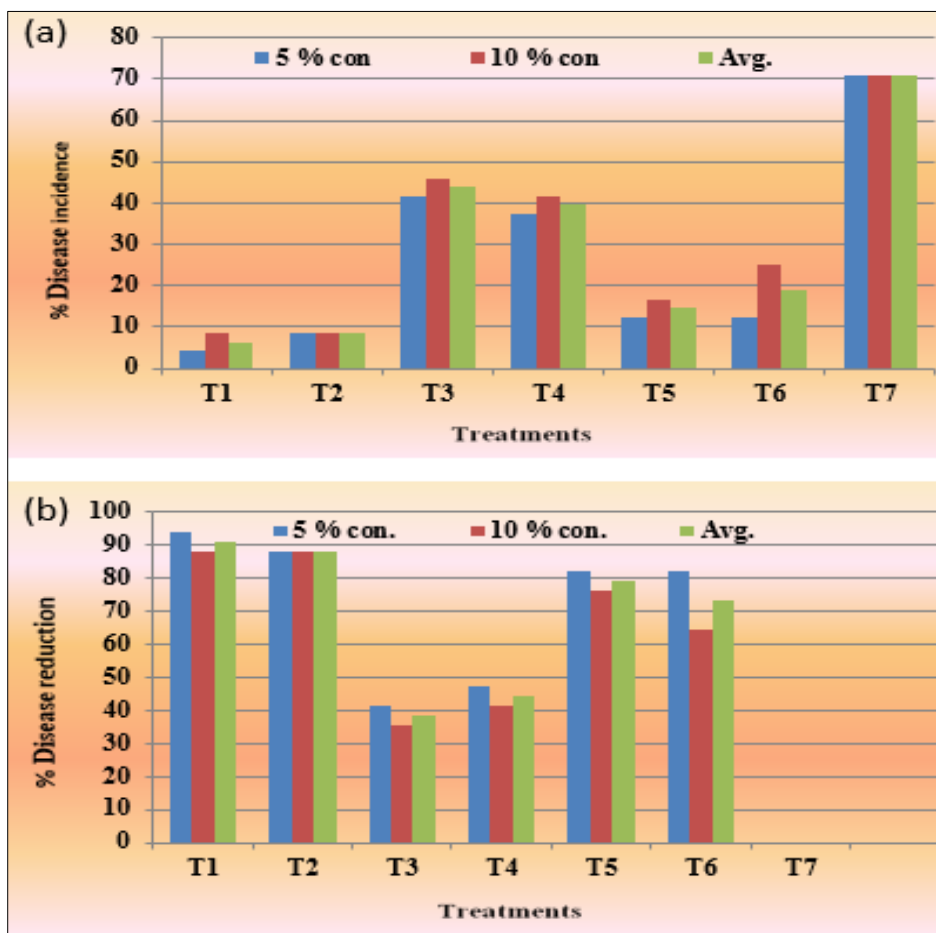


Fig 1: *In vitro* bio efficacy of essential oils on incidence and reduction of *F. oxysporum* f. sp. *lycopersicon* (pot culture)

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