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In vitro Evaluation of Botanicals against *Fusarium* Wilt of Coriander Caused by *Fusarium oxysporum* f. sp. *Coriandrii* (L.)

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Authors' contributions

This work was carried out in collaboration between both authors. Author KRB designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author BPD managed the analyses of the study and managed the literature searches. Both authors read and approved the final manuscript.

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Original Research Article

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ABSTRACT

Efficacy of six plant extracts *viz*., NSKE (Neem Seed Kernel Extract), *Mentha arvensis, Allium sativum, Zingiber officinalis,* Neem oil, *Allium cepa* were tested against the pathogen by dual culture technique in the laboratory of College of agriculture, Latur. The extract of each plant species was diluted in order to achieve respective concentrations *viz*., 5 and 10 per cent. Of the botanicals tested, *Allium sativum* was found to be significantly the most effective with least mycelial growth (0.00 mm) and highest mycelial growth inhibition (100 %) of the test pathogen(*Fusarium oxysporum* f.sp *coriandrii*), followed by Neem oil with mycelial growth of 8.00 mm and inhibition percent of 82.22. The highest colony growth and lowest percent inhibition was observed with NSKE which was 37.33 mm and 17.04 per cent respectively.

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Keywords: Coriander; botanicals; Fusarium wilt; F. oxysporum f. sp coriandrii.

1. INTRODUCTION

Fusarium wilt, caused by the soil-borne fungus *Fusarium oxysporum*, is a major problem on many crops [1]. *Fusarium* wilt diseases attack many popular garden and green house flowers, numerous vegetables, fruits, field crops, and trees plus a wide range of other plants [2].

India is known as the land of spices. According to the Spices Board of India, 52 spices are grown in the country. Next to cumin, coriander is the second most important seed spice with respect to exports and foreign exchange earnings [3].

Coriander is believed to be native to the Mediterranean region and is extensively grown in India, the USSR, Central Europe and Asia minor. In India, it is grown in all the states. In Tamil Nadu, nearly 40,000 ha are under the cultivation of coriander.

Coriander is an annual herb, about 0.5-1 metre high, with small white or pinkish-purple flowers borne on compound terminal umbels. Fresh leaves and fruits have a pleasant aromatic odour. When young entire plant and very often leaves are used for flavouring curries and other food dishes and preparation of chutneys. Seeds are generally used after mild roasting. They have a distinct fragrant odour and aromatic taste and are used extensively as a condiment. Seeds have medicinal value, being carminative, diuretic and invigorating in properties. Volatile oil is used as a flavouring agent.

It is a tropical crop which requires a cool and comparatively dry and frost - free climate particularly at the time of flowering and seed formation, for good quality and high yields. Frost following the flowering stage reduces production drastically. High temperature and high wind velocity during anthesis and seed formation enhances sterility and reduces yield. Cloudy weather at the time of flowering increases the number of aphids and diseases. Coriander is grown as an irrigated crop on loamy to moderately heavy soils. It is also cultivated as an unirrigated crop with conserved moisture on black cotton or heavy soil types with high moisture retention capacity. Saline, alkaline and sandy soils are not suitable for coriander cultivation.

The major diseases in coriander are Tumour *(Protomyces macrosporus)*, Wilt *(Fusarium oxysporum* f. sp. *corianderi),* Stem rot *(Sclerotinia sclerotiorum),* Powdery mildew *(Erysiphae polygoni)* and Root-rot *(Curvularia pallescens).*

Coriander wilt is a soil borne disease. Affected plants exhibit very poor and stunted growth. Root infection results in drooping of terminal shoots, followed by withering and drying of leaves. Black discolouration of vascular tissues is diagnostic symptom of the disease. Partial infection shows yellow to pink foliage as the disease progresses, plants eventually die [4].

Several practices have been suggested including the use of resistant cultivars, crop rotation and fumigation to reduce the damage of *Fusarium* wilt [5]. Although the use of resistant cultivars is a viable opportunity, the occurrence and development of new pathogenic races is a continuous problem [6]. Moreover, crop rotation has been traditionally proved to control many soil-borne diseases, but because most of these pathogens (like *F. oxysporum*) can survive for long periods of time, the effectiveness of this practice is limited once disease outbreak occurs [7]. Hence, application of fungicides is a normal practice, which may not be very effective since the disease appears late in the crop growth and the persistence of fungicides throughout the crop growth is always doubtful [8]. Thus, biocontrol is an alternative strategy and it has a potential for the management of *Fusarium* wilt disease [9]. Furthermore, it is ideal, safe, cheap, long lasting and eco-friendly as compared with chemicals.

The objective of the present study is to evaluate the efficacy of some botanicals against wilt disease of coriander.

2. MATERIALS AND METHODS

Fresh healthy plant parts (leaves or cloves of prospective biocontrol sources) were collected from fields. Leaves of plants were separately washed two-three times in tap water then in distilled water and allowed to dry at room temperature (25±1°C) for six hours. Prior to extraction, leaves of each plant (100 g) were crushed separately with 100 ml sterilized distilled water except for cloves of *Allium sativum* which were crushed in acetone which is helpful in reducing the loss of volatility of garlic extract. The crushed product was tied in muslin cloth and filtered and the filtrate was collected and centrifuged at 5000 rpm for 15 min. The prepared solution gave 100 per cent, which was further diluted to required concentrations of 5 and 10 per cent. The extracts were heated upto 62^0C for a period of 15 minutes to avoid microbial contamination (Fig. 2). Finally the prepared extracts were tested against *F. oxysporum f. sp. corianderi* on the PDA using poisoned food technique under *in vitro* conditions. Plates containing PDA supplemented with different phyto-extracts, at the respective concentrations and replicated three times were inoculated with 7 day old culture (5 mm dia disc). A suitable check was also maintained. Fungal colonies were measured after 7 days of incubation at 25±1°C. The per cent inhibition of growth of the test fungus was calculated by using the formula [10].

Percent inhibition = (C – T) / C x 100

Whereas,

C = Diameter of the colony in check (average of both diagonals)
T = Diameter of colony in treatment (average of both diagonals)

2.1 Experimental Details

Design : CRD
Replications : Three
Treatments : Six botanicals

2.2 Treatment Details

The treatments were given in vitro with the six botanicals. Three replications were maintained for each treatment. Treatments with NSKE and neem oil were given at 5 per cent concentration. Other treatments were given at 10 per cent concentration. A control was also maintained to compare the growth of pathogen.

Table 1. Treatment details showing the different concentrations of botanicals at which they were tested against the pathogen

Treatments	Botanicals	Concentration
T1	NSKE	5%
T2	*Mentha arvensis*	10%
T3	*Allium sativum*	10%
T4	*Zingiber officinalis*	10%
T5	Neem oil	5%
T6	*Allium cepa*	10%
T7	Control	----------------

3. RESULTS AND DISCUSSION

The results presented in Table 2 and Fig. 1 revealed that all the botanicals suppressed the colony growth of *Fusarium* spp. The suppression of the growth of the pathogen was significantly higher with *Allium sativum* with significantly less mycelial growth (0.00 mm) and highest mycelial growth inhibition (100 %) of the test pathogen. This was followed by neem oil with mycelial growth of 8.00 mm and inhibition percent of 82.22. The treatments with the extracts of *Zingiber officinalis*, *Mentha arvensis*, *Allium cepa* showed the mycelial growth of 27.66 mm, 32 mm, 33 mm and inhibition percent of 38.53, 28.88, 26.66 respectively. The highest colony growth and lowest percent inhibition was observed with NSKE 37.33 mm and 17.04% respectively.

Table 2. *In vitro* efficacy of botanicals against *F. oxysporum f. sp. Corianderi*

Treatments	Colony radial growth in mm (mean)	Percent of growth inhibition (%)
T1 *Allium sativum*	0 (0)	100 (90)
T2 *Zingiber officinalis*	27.66 (31.73)	38.53 (38.36)
T3 *Mentha arvensis*	32 (34.44)	28.88 (32.50)
T4 *Allium cepa*	33 (35.06)	26.66 (31.08)
T5 Neem oil	8 (16.42)	82.22 (65.06)
T6 NSKE	37.33 (37.66)	17.04(24.38)
T7 Control	45 (42.13)	0
SE+	0.678	-----
CD	2.856	----

Figures in the parenthesis are arcsine transformed values

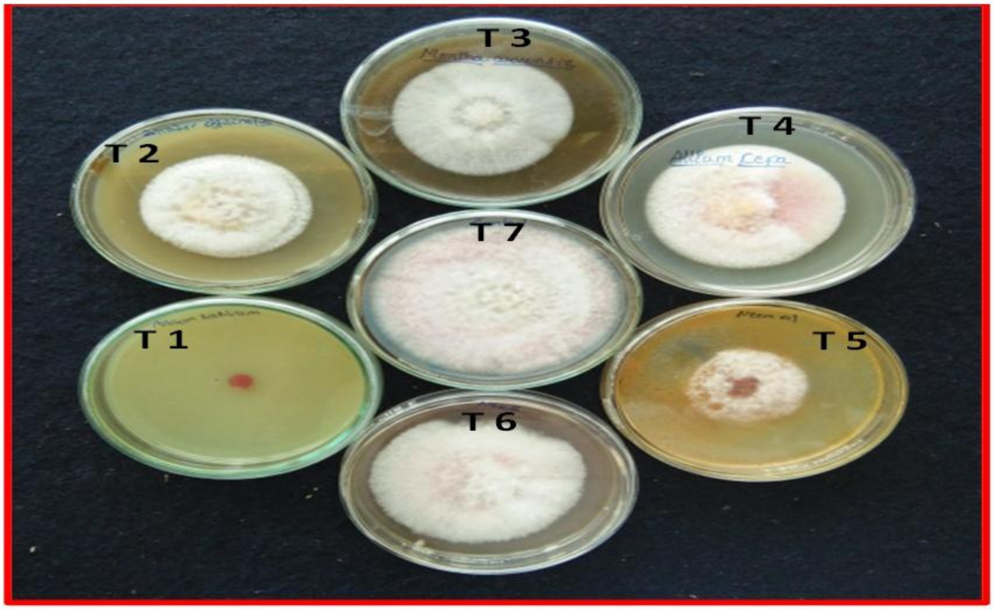

Fig. 1. Efficacy of botanicals against *F. oxysporum* f. sp *corianderi*
T1: Allium sativum, T2: Zingiber officinalis, T3: Mentha arvensis, T4: Allium cepa, T5 : Neem oil
T6 : NSKE, T7 : Control

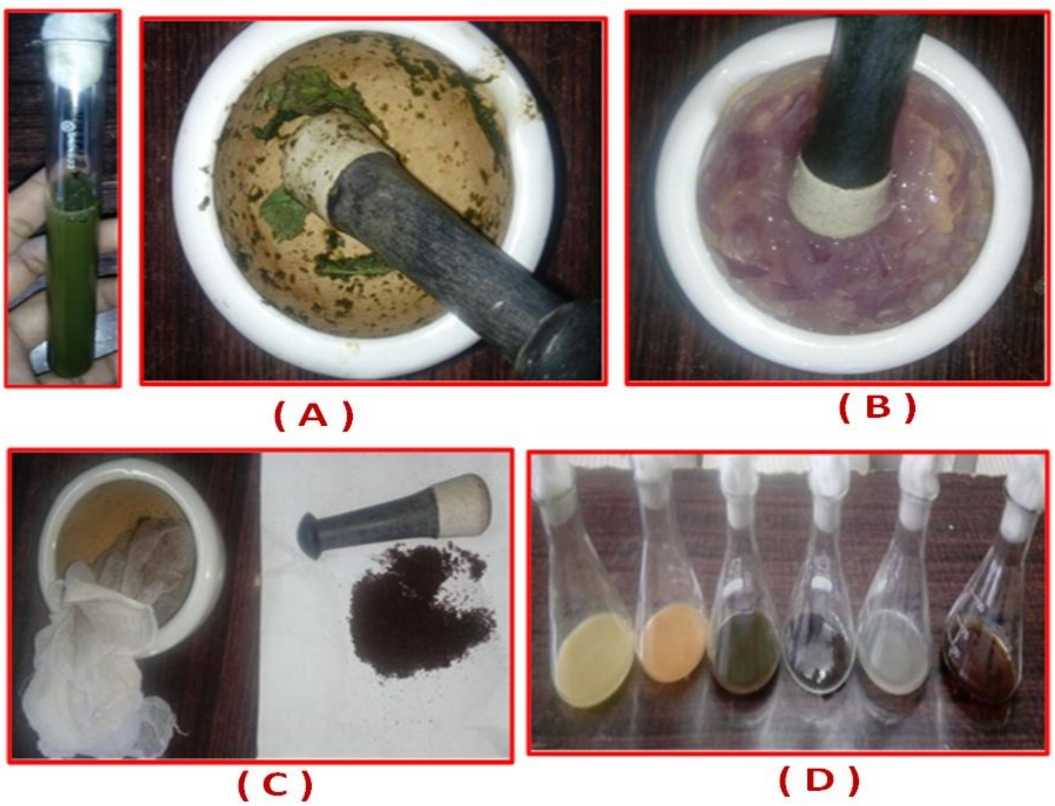

Fig. 2. Preparation of botanicals
A: Preparation of Mentha arvensis extract; B: Preparation of Allium cepa extract
C: Preparation of Neem seed kernel extract; D: Different botanicals prepared

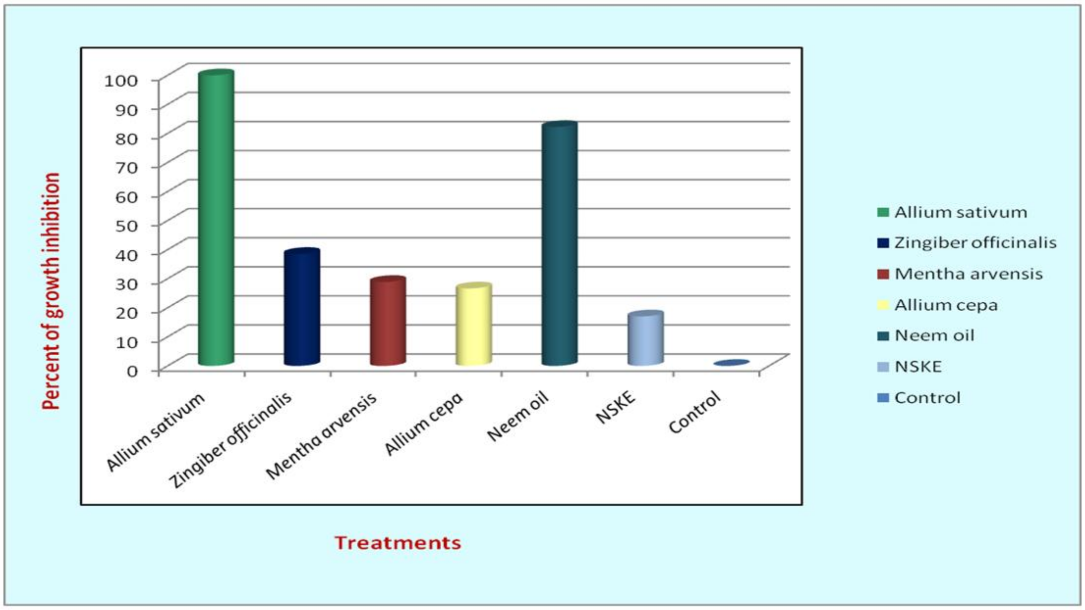

Fig. 3. *In vitro* efficacy of six botanicals against *Fusarium oxysporum* f. sp. *Corianderi*

Among the six botanicals tested treatment with *Allium sativum* was proved to be best followed by neem oil because of their antifungal properties. The presence of antifungal compounds in higher plants has long been recognized as an important factor to disease control [11]. Such compounds being biodegradable and selective in toxicity are considered valuable for controlling some plant diseases [12,13]. Therefore the above findings have close concurrence with the references quoted.

4. CONCLUSION

From the above results and references it was inferred that though chemicals are highly spectacular, impressive, quick and convincing even to an uneducated farmers in developing countries with low gross national product (GNP) cannot beneficially use capital intensive chemical control without economic strain. Fungicides as soil and seed treatment chemicals are being used for the management of different plant pathogens and the number of effective fungicides with negligible effect on the environment is rare. Fungicides are expensive, can cause environmental pollution and may cause the selection of pathogen resistance. Due to escalated use of hazardous pesticides will force us to further retract the chemicals and use sustainable agriculture attainable through biological control. Plant metabolites and plant based pesticides appear to be one of the better alternatives as they are known to have minimal environmental impact and danger to consumers in contrast to synthetic pesticides. For this reason, biological antagonistic interactions have been emphasized sufficiently so that economic threshold densities required for predicting diseases development and potential crop loss can accurately be determined.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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