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Bioefficacy of Plant Extracts to Control *Fusarium solani* F. Sp. Melongenae Incitant of Brinjal Wilt

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Abstract: Wilt is an important disease of brinjal crop causing significant reduction in yield. In present study, the pathogenic fungus was isolated from infected plant parts and identified based on morphological and cultural characters as *Fusarium solani* f. sp. melongenae. The *in vitro* efficacy of different plant extracts viz., *Azardiachta indica, Artemessia annua, Eucalyptus globulus; Ocimum sanctum and Rheum emodi* were tested to control brinjal wilt pathogen. Different concentrations 5, 10, 15 and 20% of plant extracts was used in the study. All the plant extracts showed significant reduction in the growth of pathogen. Among the different extracts 20% of *Azardiachta indica* was found most effective followed by *Rheum emodi, Eucalyptus globulus, Artemessia annua* and *Ocimum sanctum*. Application of plant extract which are easily available for controlling plant diseases are non-pollutive, cost effective non hazardous and do not disturb ecological balance. Investigations are in progress to test the efficacy of these extracts in field applications.

Key words: *Azardiachta indica* · *Artemessia annua* · *Eucalyptus globulus* · *Ocimum sanctum* · *Rheum emodi* · biological control and plant pathogenic fungi

INTRODUCTION

Brinjal is grown as an important vegetable crop in all over world mostly in Indian subcontinent and Southeast Asia. It is grown in India over an area of 0.4 million hectares with an annual production of 7.8 million tonnes [1]. Among the different diseases that attack brinjal crop, wilt has become a major disease causing significant reduction in yield. The wilt of brinjal is characterized by yellowing of foliage drooping of apical shoot to ultimate death of whole plant. The pathogen is a soil inhabiting fungus and forms in the senescing tissues of the diseased plant and may survive in the soil for many years. There are many methods which are presently being used to control various plant pathogens including wilt pathogen such as physical, chemical, biological, cultural etc. Effective and efficient management of crop disease is generally achieved by the use of synthetic pesticides [2]. Due to increased awareness about the risks involved in use of pesticides, much attention is being focused on the alternative methods of pathogen control. The spiraling up cost of chemical fungicides particularly in those countries where pesticides are imported, pollution to soil, water, air by the accumulation of obnoxious chemicals residues due to continuous use of fungicides and development of resistance races to these chemicals are therefore now facing the scientists to look for methods which are ecologically, friendly, safe and specific for pathogens. The recurrent and indiscriminate use of fungicides have posed a serious threat to human health and to the existing human ecogeographical conditions as some of them have already been proved to be either mutagenic, carcinogenic or tetratogenic. Keeping in view the drawback of chemical management of plant diseases, the use of plant extracts in the management of plant diseases is gaining importance. Perusal of earlier literature indicated that numerous attempts have been made in exploiting host resistance, modified cultural practices and fungicides. Considering the severe wilting of brinjal observed in and around Allahabad over the past several years, objectives of this research were made to evaluate locally available plant extracts to control *Fusarium solani* f. sp. melongenae.

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MATERIALS AND METHODS

Roots and plant parts were collected from infected brinjal parts showing characteristic symptoms of wilt, from the field of Allahabad Agricultural Institute-Deemed University. Plant parts were sampled from the late winter-early summer to early autumn. The plant parts were then examined under microscope to confirm the presence of respective pathogen *Fusarium solani* f. sp. melongenae and the infected plant parts were cut in to pieces (2-3 mm), surface sterilized with 0.1% mercuric chloride solution for 30 seconds. The isolation was made from roots as well as from the foliar parts of wilted brinjal plants. The plant parts were washed three times with sterilized distilled water and then were transferred aseptically on Potato Dextrose Agar (PDA) media. The inoculated plates were incubated at room temperature (27±2°C) and observations were made daily for emergence of culture. After the development of the fungal colonies stock cultures were prepared using PDA in test tubes and stored in refrigerator at 4°C. Brinjal wilt pathogen was isolated from infected brinjal plants and was identified as per the monograph and standard procedures.

Plants used in the present study are, *Azardiachta indica* which belongs to the family *Meliaceae* commonly known as "neem". The plant is found throughout India and its derivatives are of great use in agriculture, public health, medicines, cosmetics and many more. The leaves, bark, seed and flowers are bitter, astringent, acrid, depurative, refrigerant, demulcent, insecticidal, expectorant liver tonic etc. An important application of neem products in agriculture is their ability to regulate nitrogen release from the nitrogenous fertilizers.

Ocimum sanctum, commonly known as "*tulsi*" belongs to the family *Lamiaceae* found throughout India. The plant is much erect, branched, softly pubescent under shrub, 30-60 cm high with red or purple sub-quadrangular branches, leaves simple, opposite, elliptic, whole plant is used as medicine for various diseases. *Tulsi* leaves contain a bright yellow volatile oil, which is reported to posses antibacterial properties and acts as an insecticide. *Eucalyptus globulus* commonly known as Eucalyptus, which belongs to the family Myrtaceae, one of the reputed fast growing trees of the world. Its oil is acrid, bitter, astringent and insect repellent. *Artemisia annua* belonging to family *Astereceae* is a small herbaceous plant and commonly called as *Wormwood.* It has been used since earlier times in Unani system of medicine. It is used against diabetes and to destroy the eggs of *Ascaris*. The plant has got insecticidal and antifungal properties. *Rheum emodi* is also called Rhubarb, belongs to family *Polygonaceae*. The plant has got broad leaves with well-developed roots. The leaves of the plant are used as vegetable as well as medicine and the root of the plant has also got medicinal properties.

The extracts are prepared from roots and leaves, which are used as antifungal. Fresh leaves were washed through under tap water followed by sterilized water the leaves were air dried and were grinded wit the help of pestle and mortar by taking (1:1 w/v) one gram of extract was added in 1 ml distilled water separately for each plant extract and filtered through Muslin cloth and 100% plant extract solution was prepared. The extracts were poured in the flasks plugged with cotton and heated at 100°C for 10 minutes to avoid contamination [3]. The plant extracts *(Azardiachta indica, Artemissia annua, Rheum emodi* and *Eucalyptus globulus and Ocimum sanctum* poisoned food technique was applied [4] Different concentrations (5,10,15, 20%) of plant extracts was incorporated to potato dextrose medium agar for inoculation of the test pathogen in sterilized petridishes. The isolated pathogen was grown on potato dextrose agar medium was placed at the center of petridishes containing different concentration of the poisoned medium and incubated at 27±2°C for 6 days. Radial growth (cm) of fungus was measured after inoculation till 6 days at an interval of 24 h.

The Data recorded during the course of investigation has been subjected to three-way classification. The conclusion was drawn on the basis of analysis of variance. The calculated value of F was compared with table value of F at 5% levels of significance for an appropriate degree of freedom.

RESULTS

The isolated fungus was identified on basis cultural and morphological characteristics as *Fusarium solani* f. sp. melongenae (Table 1). The leaf extracts were prepared in distilled water at 5, 10, 15 and 20 % concentration and its effect was studied. Neem leaf extract inhibited the growth of fungus in all treatments with in six days after inoculation (Table 2). The extracts at 20% concentration were effective in reducing growth (1.45 cm) as compared to T_3, T_2, T_1 and control T_0. *Rheum emodi* extract inhibited the fungal growth in all treatments and minimum growth was recorded in T_4 20% (1.51 cm) as compared untreated control. Results obtained with *Eucalyptus globulus* leaf extract on radial growth of

Table 1: Cultural and morphological characteristics of *Fusarium solani* f. sp. melongenae

Colony propagule	Shape	Septation	Color
Colony	Luxuriant with regular cottony growth	-	White in color later causing brown discoloration of medium
Mycelium	Smooth and branched	Septate	Hyaline
Micro-conidia	Oval in shape singly produced	Aseptate	Hyaline
Macro-conidia	Sickle shaped	Septate	Hyaline
Chlamydospores	Smooth spherical	-	Hyaline

Table 2: Efficacy of plant extracts against *Fusarium solani* f. sp. melongenae.

Conc. of treatments	*Azardiachta indica*	*Rheum emodi*	*Eucalyptus globulus*	*Artemisia annua*	*Ocimum sanctum*
T_0 (control)	3.10	2.42	3.40	3.27	3.41
T_1 (5%)	2.62	2.04	3.01	2.88	2.87
T_2 (10%)	2.26	1.88	2.70	2.52	2.42
T_3 (15%)	2.05	1.60	2.07	2.21	2.23
T_4 (20%)	1.45	1.52	1.81	1.89	1.91
CD at 5%	0.23	0.06	0.12	0.15	0.17
SE	0.11	0.12	0.06	0.08	0.19

Fusarium solani f. sp. melongenae indicated that it was effective in reducing growth of fungus (20%). *Artemissia annua* inhibited the growth of fungus in all concentration. The maximum mycelial growth was observed in control (untreated).

DISCUSSION

The inhibitory effect of the plant extracts might be attributed to the presence of antifungal compounds *viz.,* Azadirachtin *in Azardiachta indica,* Artemessium in *Artemessia annua,* Carotenes in *Ocimum sanctum,* Emodin in *Rheum emodi and* Eucalyptol in *Eucalyptus globulus.* Antifungal properties of *Lantana camara* and *Ocimum sanctum* against *Drechslera sorokiniana* were also reported [7]. However, extracts of *tulsi* (20%) was found least effective in inhibition of growth (1.91 cm). Greater inhibition of fungal growth was observed at higher concentrations of the crude water extract where as the lower concentrations supported the average mycelial growth rate per day. *Fusarium* is one of the common soil inhabiting plant pathogenic fungus which causes diseases such as wilt of brinjal, pigeon pea, guava, gram, tomato etc. Several others species of this genus are responsible for huge loses to their respective host crop. Natural chemicals and their use for integrated plant protection is one of the focus of research workers all over the world [2]. These results of the present investigation are clear indication for the potential of plant extracts to control fungal pathogens and these compounds can be used.

It is evident from the results that all the plant extracts significantly inhibited the radial growth of isolated fungus. The formulation studies of the plant extracts can be successfully devised as fungicides using a simple process with minimum instrumentation and few chemical agents. These formulations may be considered suitable for seed and foliar treatment. Amongst the plant extracts used *Azardiachta indica* was found most effective at 20% concentration followed by *Rheum emodi*, *Eucalyptus globulus*, *Artemessia annua* and *Ocimum sanctum*. Successful attempts have been made for management of *Fusarium* wilts of crop with plant extracts. Plant extracts belonging to twelve families [6] and *Prosopis juliflora* [5] were used to control *Fusarium*. An antifungal property of *Polyalthia longifolia* extracts against *Macrophomina phaseolina* has been reported [1]. However, this is the first report on plant extracts are used to control brinjal wilt pathogen *Fusarium solani* f. sp. melongenae.

Thus it can be recommended that the use of *Azardiachta indica, Rheum emodi, Eucalyptus globulus* and *Artemisia annua* against *Fusarium solani f. sp.* melongenae to give better results as they are biologically based and environmental safe alternatives. It is evident from the reports that plant extracts and plant essential oils are effective antimicrobial agents soil born fungi, food spoilage fungi, foliar pathogens and nematodes and do not produce any residual effects. The botanicals are non-pollutive, cost effective, non-hazardous easily available do not disturb ecological balance. The results of present study can be further exploited for formulating integrated disease management schedule of brinjal wilt. More investigations are needed to investigate this regard for isolation and characterization of antifungal moieties and recommendation in field applications.

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