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Antifungal Effect of Leaf Extract of Some Medicinal Plants Against *Fusarium oxysporum* Causing Wilt Disease of *Solanum melogena* L.

N. Siva[1]*, S. Ganesan[2] , N. Banumathy[2] and Muthuchelian[1]

[1]Centre for Biodiversity & Forest Studies
Madurai Kamaraj University, Madurai-625021
E-mail: nsivamku@yahoo.com

[2]Centre for research and PG Department of Botany
Thiagarajar College (Autonomous)
Madurai - 625009, TamilNadu, India
*Author for correspondence

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Abstract

The antifungal effect of crude medicinal plant extracts of 20 plants species was determined by *in vitro* study using water, ethanol and acetone as a solvent following poisoned food technique. It was found that all the plant extracts at 50% concentration were effective in reducing the mycelial growth of *Fusarium oxysporum* f. sp. *Melongenae* Mauto and Ishigami. Among the 20 plant extracts, in different solvents, higher inhibition was noticed in 4 plants extracts namely *Adhatoda vasica, Jatropha curcas, Sapindus emarginatus* and *Vitex negundo*. These plants were selected further for different concentrations of 10%, 20% 30% and 40%. Among them *Adhatoda vasica* at 40% alone recorded 100% inhibition and remaining three plants produced almost similar inhibitory effect. At the low concentration of 10% *Vitex negundo* had more inhibitory effect (82%), while *Jatropha curcas* extracts showed very low inhibition (25%). There were not many differences in the inhibition between the extract of *Adhatoda vasica* and *Sapindus emarginatus*. *In vivo* pot culture experiment employing water extract of six plant species showed an increase in the root and shoot length and fresh and dry weight of root and shoot with the consequent reduction in the disease symptoms of the egg plant.

Key words: Antifungal effect, *Fusarium oxysporum*, egg plant, medicinal plants.

Introduction

Brinjal plant (*Solanum melongena* L.) is affected by various diseases, which in turn produce heavy loss to the crop. The diseases include wilt, blight, little leaf, etc. Among them wilting of egg plants is one of the important diseases causing great reduction in the field. The fungus *Fusarium oxysporum* causes wilt. The main symptoms of the disease induce wilting of seedling and adult plants.

The plant infected with the fungus that produces wilt have older leaves that droop and afterwards turn yellow. Leaf yellowing can occur on one side of the plant and gradually most leaves form yellow and wilt. In order to prevent the plant diseases and to protect the crop plants against

pathogens chemical control methods were in practice. In view of the high cost of chemical pesticides and their hazardous consequence use of biodegradable different material like fresh plant extracts from parts gained importance during last three decades from plant disease control (Fowcett and Spenser, 1970; Mitra *et al*., 1984; Grainge and Ahamed, 1988; Jespers and Ward, 1993). Several workers studied the control of *Fusarium* species on various plants extract (Furgal wegrazyeke, (1984); El.Shami *et al*., (1986); Reddy and Reddy, (1989); Eswaramoorthy *et al*.,(1989) Patel (1989); So(1990); Tariq and Magee(1990); Pandey *et al*.,(1992); Gohil and Vala (1996); Gour and Sharmaik, (1998); Bansal and Gupta, (2000). The present study is conducted in order to find out the effect of selected plant extracts on *Fusarium oxysporum* f .sp. *melongenae* Matuo and Ishigami causing wilt disease in Brinjal.

Methodology

The pathogen *Fusarium oxysporum* was isolated from wilt symptom showing on Brinjal plant roots as described by Chatterjee and Rai (1974) and maintained on PDA medium (Potato Dextrose Agar medium).

The common and locally available medicinal plants were selected for screening of antifungal activity. The known quantity of collected plant materials was surface sterilized with 0.1% Mercuric chloride and repeatedly washed in sterile distilled water. Then the plant materials were cut in to small pieces and oven dried at 45ºC and pulverized to obtain dry powder. An extract of each plant was individually prepared using sterile water, Acetone and Ethanol (1:2 w/v). Their different solvent extracts were considered as standard plant extracts (50%) and used for antifungal activity.

The toxicity of the crude plant extract was determined against the pathogen following the poisoned food technique (Mishear and Tiwari, 1992). The percent inhibition of mycelial growth over control was calculated using the formula:

$$\% \text{ Of inhibition} = 1 - \frac{\text{Diameter of treated colony}}{\text{Diameter of control colony}}$$

Further *In vivo* antifungal activity of plant extracts was studied by pot culture method as described by Dubey, (1998).

Results and Discussion

In total, 20 plant extracts were analyzed using *in vitro* study. Among 20 plants, 19 were prepared from fresh leaves and one from a succulent stem. The details regarding the name of the plants, family, vernacular name and parts used are enumerated in Table 1. Among The 20 plants extracts using different solvents (Water, Ethanol and Acetone) that were examined for antifungal activity against *Fusarium* species, it was found that all the plant extracts at 50% concentration were effective in reducing the mycelial growth. Among the 20 plant extracts in different solvents 100%, inhibition was noticed only in 3 plants extracts namely viz. *Adhatoda vasica, Jatropha curcus* and *Sapindus emarginatus* .

Water Extract Method

Other plant extracts in the order of degree of inhibition were leaf extract of Azima *tetracantha* and V*itex negundo* producing 97% inhibition followed by *Azadirachta indica*, *Ocimum sanctum* (96%) and S*antalum album* (92%). The leaf extract of *Datura metal* alone revealed minimum inhibition of

60%. The following 2 plants were less effective showing the inhibition of 64% for *Leucas aspera* and 66% for *Cissus quandrangularis*. The following four plants – *Cadaba indica, Crataeva religiosa, Notonia grandiflora* and *Ricinus communis* recorded 84% inhibition. The remaining five plants showed the range of 78-82% inhibition (Table 2).

Ethanol Extract Method

The leaf extract of *Ricinus communis* showed minimum inhibition of 72% followed by 74% in *Datura metal* and *Leucas aspera*. Seven plants recorded 82-86% inhibition. Only very slight variation was found in the percentage of inhibition among *Azadirachta indica*, C*adaba indica* , *Ocimum sanctum* and *Vitex negundo* (Table 2). *Coleus aromaticus* and S*antalum album* extract produced 94% inhibition followed by *Crataeva religiosa* (92%).

Acetone Extract Method

Azadirachta indica extract recorded 98% inhibition followed by *Ocimum sanctum* (96%), *Vitex negundo* (94%), *Aloe vera* (92%), *Santalum album* (89%) and *Ricinus communis* (86%). Nine plant extracts revealed the range of 78-84% inhibition (Table 2). The rate of inhibition was nearly same in two plant extracts (*Cissus quandrangularis* and *Datura metal)*.

Effect of Different Concentrations of Selected Plant Extracts (Water Extract Method) on *Fusarium* Species

Plant extracts that produced high percentage of inhibition in different solvents, viz.. leaf extracts of *Adhatoda vasica, Jatropha curcas, Sapindus emarginatus* and *Vitex negundo*, were selected. These four extracts were tested further using different concentrations of 10% 20% 30% and 40%. The results are presented in Table 3.

The water extract of *Adhatoda vasica* at 40% alone recorded 100% inhibition and the remaining three plants produced almost similar inhibitory effect. Only very slight veriation in the rate of inhibition was observed at 30% and 20% concentration in different plant extracts except *Jatropha curcas* (Table 3). The percentage of inhibition was high at 10% conc. in *Vitex negundo* (82%) while *Jatropha curcas* extract showed very low inhibtion (25%). There was not much difference in the inhibition between the extract of *Adhatoda vasica* and *Sapindus emarginatus*.

Among the different concentrations of four plant extracts (10-40%) employed in the present study, all the different plant extract concentrations gave above 70% inhibition except *Jatropha curcas* at 10% concentration, thereby proving that the extracts at low concentrations were equally effective in arresting the growth of the pathogen.

Effect of Plant Extract on Root Length in Brinjal Plants

The root length was more (6.8cm) in *Adhatoda vasica, Sapindus emarginatus*_ and *Azadirachta indica* extract treated plants. *Jatropha curcas* and *Ocimum sanctum* treated plants recorded same root length. There was variation found in the control and *Vitex negundo* treated plants. Very low root length (3.6 cm) was observed in *Fusarium* alone treated plants.

Effect of Plant Extract on Shoot Length

The shoot length was high measuring 25.4 cm in *Jatropha curcas* treated plants. Three plant

extracts, viz. *Sapindus emarginatus, Vitex negundo* and *Ocimum sanctum*, showed nearly the same range of length. Less than 1 cm difference was noticed between*Adhatoda vasica* and *Azadirachta indica* treated plants. The plants without any treatment showed 21.6 cm where as *Fusarium* alone treated plants recorded 9 cm.

Effect of Plant Extracts on Fresh and Dry Weight of Root

Sapindus emarginatus treated plants showed maximum fresh and dry weight. The fresh weight was more in *Jatropha curcas* followed by *Ocimum sanctum*, *Adhatoda vasica Vitex negundo* and *Azadirachta indica. Vitex negundo* treated plants recorded more dry weight followed by *Jatropha curcas, Azadirachta indica, Adhatoda vasica* and *Ocimum sanctum*. In the control and *Fusarium* alone treated plants less fresh and dry weight was observed.

Effect of Plant Extracts on Fresh and Dry Weight of Shoot

The plants treated with *Sapindus emarginatus* extract showed maximum fresh and dry weight for shoot. The fresh weight was more in*Azadirachta indica* and *Jatropha curcas*. Less variation was observed in the fresh weight among *Ocimum sanctum*, *Vitex negundo* and *Adhatoda vasica* treated plants. *Vitex negundo* and *Azadirachta indica* treated plants recorded more dry weight. Dry weight was same in *Ocimum sanctum*, *Jatropha curcas* and *Adhatoda vasica* treated plants. Low fresh and dry weight was observed in control and *Fusarium* alone treated plants.

The effect of plant extracts of different parts of plants on various species of*Fusarium* were studied extensively by different workers employing different angiospermic plant species.

Mycelial growth of various species of *Fusarium* was inhibited by the plant extracts of *Convolvulus alsinoides* and *C. Pluricutis* (Furgal wegrazyeka**,** 1984); *Allium cepa* (El**.** Sharmi *et al., 1986) Adhatoda vasica, Azadirachta indica, Cinnamomum camphora* and *Ocimum sanctum* (Prasad and Ojha, 1986); *Agave americana, Cassia nodosa* (Reddy and Reddy, 1987); *Azadirachta indica* (Eswaramoorthy *et al*; 1989); *Allium cepa* (Patel, 1989); *Avicennia marina, Aegiceras corculatum, Kandelia candel, Excoecaria agallocha* and *Acanthus ilicifolius* (So**,** 1990); *Agave americana* (Pandey *et al* 1992); *Allium sativum* and *Sapindus trifoliata* (Gohil and Vala, 1996); Neem seed extract (Gour and Sharmaik, 1998); *Azadirachta indica, Atropha belladona, Calotropis procera, Ocimum basilicum, Eucalyptus amygdalina, Ailanthus excelsa* and *Lantana camera* (Bansal and Gupta, 2000). In accordance with the above reports, in the present study, 100% inhibition of mycelial growth of *Fusarium oxysporum f. sp. Melongenae Matuo* and *Ishigami* by water, ethanol and acetone leaf extracts *of Adhatoda vasica, Jatropha curcas* and *Sapindus emarginatus* and 60% to 98% of mycelial growth inhibition were recorded in the plant extracts of 17 different species of angiosperms (Table 2).

Conclusion

The differences in the inhibitory effect of various plant extracts may be due to qualitative and quantitative differences in the antifungal principles / compounds present in them. This was also confirmed by *invivo* pot culture experiment employing water extract of *Adhatoda vasica, Jatropha curcas, Sapindus emarginatus* and *Vitex negundo* where there was an increase in the shoot / root length and fresh and dry weight of shoot / root with the consequent reduction in the disease symptoms of the egg plant. It is presumed that quantitatively and qualitatively the antifungal compounds were found to be in higher degree so the extracts of the above plants may be utilized as phytofungicide to control the

pathogenic fungi on various economically important crop plants.

Table 1. List of plants used in present work.

Sl. NO	Binomial	Vernacular name	Family	Parts used
1	*Acalypha indica* L.	Kuppaimeni	Euphorbiaceae	Leaves
2	*Adhatoda vasica* Nees.	Adathodai	Acanthaceae	Leaves
3	*Aloe vera* (L) Burm.f.	Katralai	Liliaceae	Succulent leaves
4	*Andrographis paniculata* Nees.	Nila Vembu	Acanthaceae	Leaves
5	*Azadirachta indica* Adr. Juss.	Vembu	Meliaceae	Leaves
6	*Azima tetracantha* Lam.	Sankan	Salvadoraceae	Leaves
7	*Cadaba indica* Lam.	Veeli	Capparidaceae	Leaves
8	*Cissus quadrangularis* L.	Perandai	Vitaceae	Succulent stem
9	*Coleus aromaticus* Benth.	Ooma valli	Lamiaceae	Leaves
10	*Crataeva religiosa* L.	Mavalingam	Capparidaceae	Leaves
11	*Datura metal* L.	Umattai	Solanaceae	Leaves
12	*Jatropha curcas* L.	Kattamanakku	Euphorbiaceae	Leaves
13	*Leucas aspera* Spreng.	Thumbai	Lamiaceae	Leaves
14	*Mimusops elengi* L.	Mahilam	Sapotaceae	Leaves
15	*Notonia grandiflora* DC.	Muyalkadu chedi	Asteraceae	Leaves
16	*Ocimum sanctum* L.	Tulasi	Lamiaceae	Leaves
17	*Ricinus Communis* L.	Aamanakku	Euphorbiaceae	Leaves
18	*Santalum album* L.	Santhanum	Santalaceae	Leaves
19	*Sapindus emarginatus* Vahl.	Poonthikottai	Sapindaceae	Leaves
20	*Vitex negundo* L.	Notchi	Verbenaceae	Leaves

Table 2. Effect of plant extracts in different solvents at 50% concentration on growth of *Fusarium*.

S. No.	Binomial	Percentage of inhibition		
		Water extract	Ethanol extract	Acetone extract
1.	*Acalypha indica* L.	82	86	80
2.	*Adhatoda vasica* Nees.	100	100	100
3.	*Aloe vera* L	79	82	92

4.	*Andrographis paniculata* Nees.	80	84	79
5.	*Azadirachta indica* Adr. Juss.	96	96	98
6.	*Azima tetracantha* Lam.	97	84	84
7.	*Cadaba indica* Lam.	84	97	81
8.	*Cissus quadrangulans* L.	66	82	72
9.	*Coleus aromaticus* Benth	81	94	84
10.	*Crataeva religiosa* L.	84	92	82
11.	*Datura metal* L.	60	74	73
12.	*Jatropha curcas* L.	100	100	100
13.	*Leucas aspera* Spreng.	64	74	83
14.	*Mimusops elengi* L.	78	82	81
15.	*Notonia grandiflora* DC.	84	82	78
16.	*Ocimum sanctum* L	96	98	96
17	*Ricinus communis* L.	84	72	86
18	*Santalum album* L.	92	94	89
19	*Sapindus emarginatus* Vahl.	100	100	100
20	*Vitex negundo* L.	97	96	96

Table 3. Effect of different concentrations of selected plant extracts using water extract method on *Fusarium* species.

S. No.	Concentration of extract	Percentage of Inhibition			
		Adhatoda vasica	*Jatropha curcas*	*Sapindus emarginatus*	*Vitex negundo*
1.	10%	72	25	74	82
2.	20%	82	72	82	84
3.	30%	84	74	84	86
4.	40%	100	86	88	88

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