

## Potentiality of Mangrove Plant Extracts for Biocontrol of a Pathogenic Fungi, *Fusarium oxysporum*

**Abstract :** The potentiality of mangrove plants to control plant disease was assessed by using extracts of different parts of mangrove plants against a virulent plant pathogen *Fusarium oxysporum* by disc-assay method. Out of the 13 selected mangroves, 12 plants are having antifungal properties against this pathogen. Leaf extracts showed the highest activity followed by bark, root and fruit. Ethanol and acetone were found most effective among the 8 selected solvents. *Ceriops decandra*, *Heritiera fomes*, *Nypa fruticans*, *Bruguiera gymnorrhiza*, *Aegiceras corniculatum* and *Phoenix paludosa* were found most potential plant species for biocontrol of *Fusarium oxysporum*.

**Key words:** Mangrove plant, *Fusarium oxysporum*. Antifungal activity

*Fusarium oxysporum*, is a plant pathogenic fungi responsible for wilt diseases in more than hundred species of vascular plants. It causes this disease by colonizing in the water-conducting vessels (xylem) of the plant. As a result of this blockage and breakdown of xylem, symptoms appear in plants as leaf wilting, yellowing and eventually plant death. Through out the world lots of approaches had been taken to combat this disease, several chemical fungicides are also applied to control *Fusarium oxysporum*. But almost all these fungicides are harmful to the ecosystem. Alternatively biological control of this fungus draws the attention of the mycopathologists. Several types of biological products are used to control this disease.

Mangrove plants are unique vegetations growing along the land-sea interface, reaching upstream up to the point where the water still remains saline<sup>1</sup>. They show several unique features along with some special biochemical characteristics to prevent microbial growth and can be used as anti microbial agents. So, these bioactive components require to be studied well and documented to utilize them for many useful purposes. These compounds from different parts *i.e.* leaves, barks, roots, rhizomes, flowers and fruits of different mangrove plants have been reported by Adebayo and Ishola<sup>2</sup>. Bioactive compounds present in the mangrove plants are responsible for the microbial growth inhibition revealing their antimicrobial

properties<sup>3,4,5,6,7</sup>. These anti microbial compounds may work effectively even against the phytotoxins secreted by *Fusarium oxysporum* to expand disease symptoms in infected plants<sup>8</sup>. In this study we tried to apply extracts of different mangrove plants to control the growth of *Fusarium oxysporum* in laboratory conditions.

**Materials and Methods:** Thirteen common mangrove plants namely, *Bruguiera gymnorrhiza*, *Rhizophora apiculata*, *Acanthus ilicifolius*, *Acrostichum aureum*, *Aegialitis rotundifolia*, *Excoecaria agallocha*, *Aegiceras corniculatum*, *Phoenix paludosa*, *Heritiera fomes*, *Nypa fruticans*, *Avicennia officinalis*, *Ceriops decandra* and *Sonneratia caseolaris* were selected for this study. Leaves, barks, fruits and roots of these plants were collected freshly from Jharkhali mangrove ecological park (22.08324° N and 88.41518°E) situated in Sundarban Biosphere reserve. They were collected separately in presterilised air-tight plastic bags and transferred to the laboratory.

Extracts of these plant materials were prepared with 8 different solvents namely water, ethanol, acetone, dimethyl sulfoxide, chloroform, petroleum ether, benzene and hexane (1:10 wt by volume ratio), by overnight shaking in a rotary shaker at ambient temperature following the modified procedures of Mishra and Sree<sup>9</sup>.

Pure cultures of *Fusarium oxysporum* (MTCC No.-284) was brought from Microbial Type Collection Center (MTCC) of Institute of Microbial Technology, Chandigarh. The culture was maintained in Potato Sugar Agar as recommended by MTCC. Antifungal screening was performed with culture of *Fusarium oxysporum* by 'Filter paper disc method'<sup>10</sup>. Each plant extract was impregnated onto a small disc of sterile filter paper (diameter 4 mm) aseptically soaked in respective plant extracts and placed on the surface of the seeded medium. Disc soaked with sterilized distilled water was used as control. After 24-48 hrs incubation at 30°C, the zones of inhibition were measured<sup>11,9</sup>.

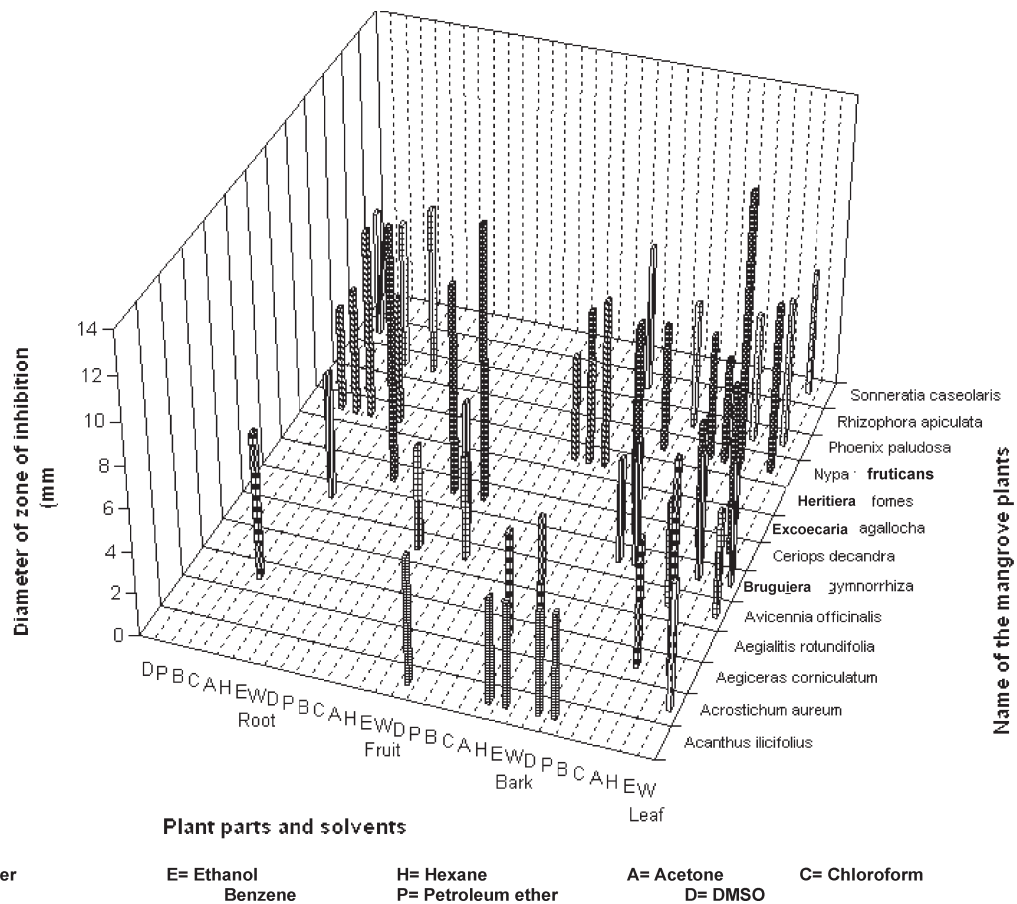
Cluster analysis of the mangrove plants according to their response against *Fusarium oxysporum* was analyzed by using MINITAB Release 13.1.

**Results and Discussions:** Responses of the extracts of different parts of the mangrove plants on *Fusarium oxysporum* growth is shown in Table 1 and the magnitude of the effect expressed in terms of zone of inhibition is

**TABLE 1: Response of the plant extracts of different mangrove plants and their parts on *Fusarium oxysporum* growth**

Solvents	Leaf								Bark								Fruit								Root																							
	W	E	H	A	C	B	P	D	W	E	H	A	C	B	P	D	W	E	H	A	C	B	P	D	W	E	H	A	C	B	P	D																
Name of plants																																																
<i>Acanthus ilicifolius</i>									+	+							+																															
<i>Acrostichum aureum</i>	+																																															
<i>Aegialitis rotundifolia</i>																																																
<i>Aegiceras corniculatum</i>	+	+							+	+																																						
<i>Avicennia officinalis</i>	+	+	+														+	+																														
<i>Bruguiera gymnorrhiza</i>	+	+						+	+																																							
<i>Ceriops decandra</i>	+	+						+																																								
<i>Excoecaria agallocha</i>									+																																							
<i>Heritiera fomes</i>									+	+	+	+																	+	+	+	+																
<i>Nypa fruticans</i>	+	+	+	+					+								+																															
<i>Phoenix paludosa</i>	+	+														+	+																															
<i>Rhizophora apiculata</i>																	+																															
<i>Sonneratia caseolaris</i>	+																																															

W= Water      E= Ethanol      H= Hexane      A= Acetone      C= Chloroform      B= Benzene  
 P= Petroleum ether      D= DMSO  
 + = Positive response against *Fusarium oxysporum* growth



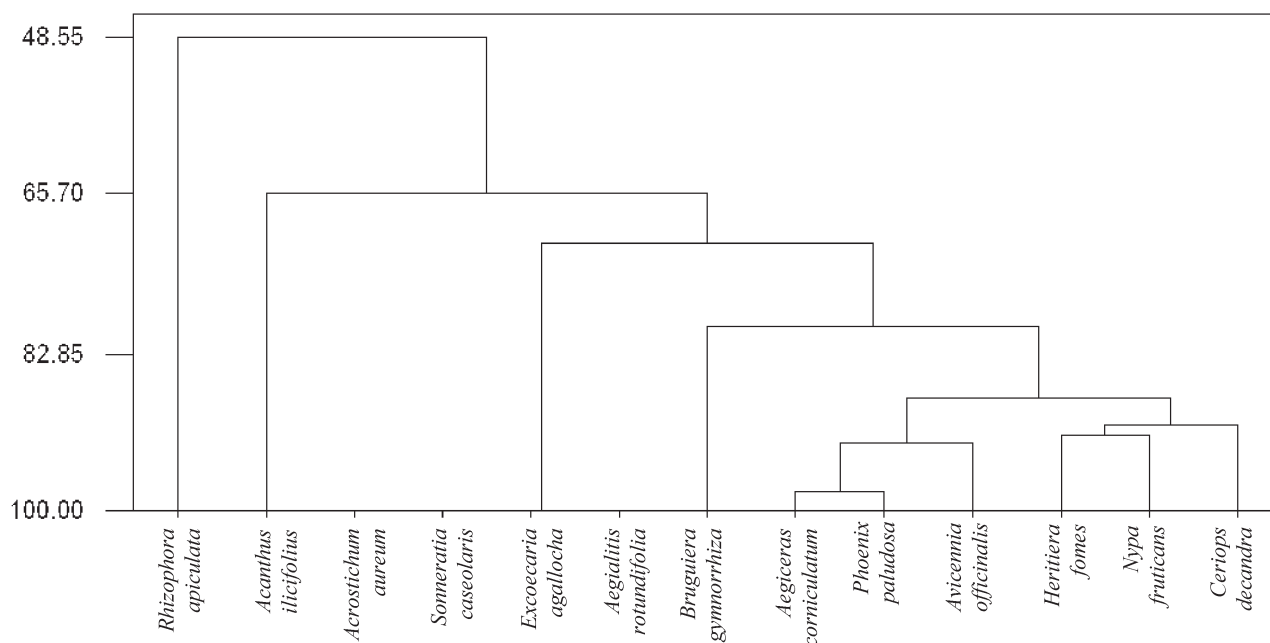
**Fig. 1.** Effect of mangrove plant extract on *Fusarium oxysporum*

given in Figure 1. Except *Aegialitis rotundifolia* all the 13 mangrove species used in this study, had antifungal effect against *Fusarium oxysporum*. Leaf extract of *Bruguiera gymnorhiza* expressed the highest activity. Water, hexane, petroleum ether and DMSO extracts of the leaves of this plant showed prominent zones of inhibition. Beside these, ethanolic extract of fruit and hexane extract of root of *B. gymnorhiza* also expressed antagonistic activity against *Fusarium oxysporum*. *Rhizophora apiculata* showed antifungal activity only by acetone extract of bark and petroleum ether extract of root. In case of *Acanthus ilicifolius*, only DMSO extract of leaf and ethanol and hexane extract of bark responded against *Fusarium oxysporum*. Aqueous extracts of leaf of *Acrostichum aureum* showed antifungal activity against the test organism. Aqueous extract of bark of *Excoecaria agallocha* had positive response against *Fusarium oxysporum*. In case of *Aegiceras corniculatum*, ethanolic extract of leaf and bark and acetone extract of leaf, bark and root expressed good activity against the growth of the test fungi. *Phoenix paludosa* showed highest activity by its leaf extract. Leaf extract of ethanol, acetone, chloroform and DMSO showed prominent inhibition zones on the culture plate. Along with this, ethanol and acetone extract of the root of this plant showed activity against *Fusarium oxysporum*. In case of *Heritiera fomes*, ethanol, acetone, chloroform and benzene extract of both bark and root had good response. *Nypa fruticans* showed highest

activity by its leaf extract. Leaf extract of ethanol, acetone, chloroform and benzene created clear inhibition zones on the culture plates. Acetonic leaf extract of *Nypa fruticans* showed highest activity and the inhibition zones was 13mm. Beside this, water and benzene extract of the bark of *N. fruticans* showed affectivity against *Fusarium oxysporum*. In case of *Avicennia officinalis*, water and acetone extract of both leaf and fruit had good activity. Where as in *Ceriops decandra*, ethanol, acetone and DMSO extract of both leaf and fruit expressed moderate activity against *Fusarium oxysporum* but the ethanolic extract of the fruit of *Ceriops decandra* expressed the highest activity, the inhibition zones was also measured 13mm. Ethanolic extract of leaf of *Sonneratia caseolaris* expressed mild activity against this pathogenic fungi. *Aegialitis rotundifolia* was the only plant which did not express any activity against *Fusarium oxysporum*. Dendrogram of the Cluster analysis (Fig.2) of the mangrove plants according to their response against *Fusarium oxysporum* (similarity index values) represents the similarity in the mode of action against the test fungi. This cluster analysis revealed similar type of observations regarding the most effective plants for biological control of *Fusarium oxysporum*.

**Conclusion :** The present study reveals that 12 out of 13 commonly found mangroves in Indian Sundarban have potentiality to control the growth of pathogenic fungi

### Similarity



**Fig. 2.** Dendrogram of the Cluster analysis of the mangrove plants according to their response against *Fusarium oxysporum* (According to similarity index value)

*Fusarium oxysporum*. Leaf extracts having the highest activity followed by bark, root and fruit. Ethanol and acetone were found most effective among the 8 selected solvents. Among the 12 plants *Ceriops decandra*, *Heritiera fomes*, *Nypa fruticans*, *Bruguiera gymnorrhiza*, *Aegiceras corniculatum* and *Phoenix paludosa* are the most effective. These plants contains bioactive compounds with anti microbial activities. If these compounds are properly isolated, they may be used to produce antifungal agent to combat the wilting disease caused by *Fusarium oxysporum*.

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