Potential use of some plant-extracts against *Fusarium moniliforme*

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ABSTRACT

Aqueous extracts from twenty plants were tested for their antifungal activity against Fusarium moniliforme inciting foot rot of paddy. Test results showed a differential activity of the plant extracts against the mycelium growth. The strong inhibitory effect was shown by root extracts of Asparagus racemosus. The bark extracts of Acacia arabicae and leaf extracts of Camellia sinensis showed appreciable inhibitory effect against the test fungi. Other plants viz., Callistemon lanceolatus > Aegle marmelos >Calotropis procera >Brassicae campestris >Aloe vera showed inhibition in that order.

Key words: *Fusarium moniliforme, Antifungal, plant-extracts*

The foot rot disease caused by *Fusarium moniliforme* is widely distributed in all the rice growing areas of the world. This has been reported to cause 3.7% to 70% loss in yield in different countries (Bagga and Kumar, 1999). Many synthetic chemicals such as organo-mercurial compounds marketed so far to manage this diseases are now being discarded due to their adverse effect on human health and environment (Parveen and Kumar, 2000). So there is an urgent need to develop sustainable methods for controlling this seed borne disease. As plants are known to possess various secondary metabolites having antifungal properties against the growth of pathogens (Bowers and Locke, 1997; Patni *et al*., 2005), efforts were made to search economical and safe phytochemicals, which could be utilized for the disease control.

MATERIALS AND METHODS

Plant parts (flowers, leaves, root, seed and stems) of twenty different plant species were collected from various parts of Haryana and their neighboring states on the basis of their traditional values (Table 1). The collected plant materials were thoroughly washed with tap water followed by distilled water and kept in the dark in between filter papers at room temperature (25°C-27°C) till completely dry. Each plant sample was individually grounded into powder for preparation of extract. The fungi *Fusarium moniliforme* used for the study was obtained from the Division of Plant Pathology, IARI, New Delhi. The cultures were maintained at 4°C on Yeast Glucose Agar medium with periodic sub-culturing. 15g dry powder of each plant sample was put in a cheese cloth bag and suspended in 100ml of boiling distilled water for 20 minutes. The extract was allowed to stand for some time and decanted off in to the flask and supernatant was used for assay the antifungal activity of each plant part extract by measuring the mycelium growth inhibition of test fungi as described by Bragulat *et al*., (1991). A known volume of 15% plant sample extract was supplemented with yeast extract, glucose and agar. The medium was sterilized by autoclaving at 15lb. pressure for 15 minutes. Yeast Glucose Agar plates, without any plant extract supplementation, was run as control. The test inoculum consisted of a disc 0.65cm. in diameter cut out from the edge of a growing fungal colony on glucose agar medium using a sterilized cork borer and placed at the centre of the agar medium in sterilized conditions. The experiments were conducted in triplicates along with equal number of controls. The fungus was incubated at 27 ± 1°C and their growth diameters were measured after five days. The percentage inhibition was calculated by the formula as:

$$\% \text{ Inhibition} = [(C-T) \times 100/C]$$

Where C = Diameter of control, T = Diameter of test.

RESULTS AND DISCUSSION

The activity of the plant extracts against the mycelium

Table 1. Common name and families of plants used in the experiment

Botanical Name	Common Name	Name of Family	Distribution	Traditional Uses of the Plant
Acacia arabicae Willd.	Kikar	*Mimosaceae*	India and Tropical Africa	Used for making furniture's, tanning, dyeing fabrics yellow, stem yields gum while seeds are fermented with dates to give beverages (Usher, 1971).
Acacia catechu Willd.	Katha	*Mimosaceae*	East India	Used in the treatment of diarrhoea and throat infections (Usher, 1971).
Acacia fernesiana (L.) Willd.	Ghand Babul	*Mimosaceae*	Tropics	Flowers are a source of essential oil used in perfumery (Usher, 1971).
Achyranthus asper L.	Chirchita	*Amaranthaceae*	Asia	Pulmonary inffections cough asthma and skin diseases (Dastur, 1962).
Adhatoda vasica Nees.	Adusa	*Acanthaceae*	Tropical India	A decoction of the leaves is expectorant, and is used to relieve bronchitis (Usher, 1971).
Aegle marmelos (L.) Corr.	Bael	*Rutaceae*	India	A decoction of the leaves is a febrifuge and expectorant and is particularly used for asthmatic complaints. Also used to treat acute bronchitis, fever and dysentery (Dastur, 1962).
Albizia lebbeck Benth.	Siris	*Mimosaceae*	Tropical Asia to Australia	The bark is used to treat boils and the leaves and seeds to treat diseases of the eyes (Usher, 1971).
Aloe vera L.	Gawar Patha `	*Liliaceae*	Mediterranean, introduces to New World Tropics	The active principle is aloin which is used to treat intestinal worms, to encourage menstruation and as a cathartic (Usher, 1971).
Alstonia scholaris R.Br.	Chitvan	*Apocynaceae*	Ceylon to Australia	The dried bark has been used since ancient times as a tonic and to treat intestinal complaints, including worms (Usher, 1971).
Anthocephalus cadamba Miq.	Kadam	*Rubiaceae*	Tropical Asia	The bark is used as a tonic and reduces fever (Usher, 1971).
Asparagus racemosus Willd.	Satawari	*Liliaceae*	Middle East, India, Australia	The roots are applied to relieve irritations. They are also used to treat dysentery, and are diuretic (Usher, 1971).
Astercantha longifolia Nees.	Talamkhana	*Acanthaceae*	India	Decoction of root is diuretic; seeds are given in gonorrhoea, and with milk sugar in spermatorrhoea (Vasishta, 1972).
Azadirachta indica A. Juss.	Neem	*Meliaceae*	East India, Ceylon	Non-drying oil is extracted from the seeds. It is used for soap-making and to treat skin diseases, locally. The bark and leaf extracts are used as a tonic, and to reduce fevers (Usher, 1971).
Bambusa sapinosa Roxb.	Bans	*Gramineae*	East India	Boiled young shoots eaten locally as a vegetable. Wood used for general construction work. (Usher, 1971).
Brassicae campestris L.	Sarson	*Cruciferae*	Temperate Europe, Asia, introduced to North America. around the Black Sea	The oil (Ravinson Oil), extracted from the seeds. It is used locally as a luminant, Lubricant, and in the manufacture of soap (Usher, 1971).

Bryophyllum calycinum Salisb.	Patherchat	*Crassulaceae*	Throughout India and North Temprate	Leaves are useful in vitiated conditions of *pitta* and *vata*, haematemesis, haemorrhoids, menorrhagia, cuts and wounds, discolouration of the skin, boils, sloughing ulcers, burns, scalds, corn, diarrhoea, dysentery, vomiting and acute inflammations (Sala, 1995).
Caesalpinia bonducella F.	Karnju	*Caesalpiniaceae*	Tropics	In India seeds are mixed with black pepper to make a tonic and to reduce fevers. A tonic is also made from the bark (Usher, 1971).
Callistemon lanceolatus D.C.	Bottle Brush	*Myrtaceae*	Australlia India	Leaves are a Tea substitute and have a delightfully refreshing flavour (Cribb, 1976), tan dye is obtained from the leaves (Grae, 1974).
Calotropis procera Br.	Ak	*Ascliapdaceae*	Tropical Africa and India	The root bark is used to treat leprosy in India (Usher, 1971).
Camellia sinensis (L.) Kuntze.	Chai	*Theaceae*	India and China	Astrigent, diuretic stimulant (Chopra *et al*., 1992).

growth of *Fusarium moniliforme* is presented in Table 2. It was observed that out of twenty plants parts extracts tested, the root extracts of *Asparagus racemosus* (77.0%) showed maximum inhibitory effect against the mycelium growth of *Fusarium moniliforme*. The bark extracts of *Acacia arabicae* (68.24%) and leaf extracts of *Camellia sinensis* (66.29%) were observed to show strong inhibitory effect against the mycelium growth of *Fusarium moniliforme*. Five plants showed moderate inhibitory effect against the mycelium growth of test fungus i.e. bark extracts of *Callistemon lanceolatus* (39.68%), fruit extracts of *Aegle marmelos* (29.32%), leaf extracts of *Calotropis procera* (28.69%), seed extracts of *Brassicae campestris* (28.24%) and stem extracts of *Aloe vera* (28.2%) and seven plants samples have showed intermediate inhibitory effect against the test fungus i.e. flower extracts of *Adhatoda vasika* (21.18%), seed extracts of *Astercantha longifolia* (20.72%), seed extracts of *Acacia fernesiana* (18.92%), leaf extracts of *Azadirachta indica* (18.36%), leaf extracts of *Caesalpinia bonducella* (17.14%), seed extracts of *Albizia lebbeck* (13.52%), bark extracts of *Anthocephalus cadamba* (12.79%) and two plants have shown insignificant inhibition of mycelium growth against the test fungus and rest three plants samples did not show any inhibitory activity.

Among the different plants screened, root extracts of *Asparagus racemosus*, bark extracts of *Acacia arabicae* and leaf extracts of *Camellia sinensis* showed maximum inhibitory activity against the mycelium growth of *Fusarium moniliforme* (Table 2). The root extracts of *Asparagus racemosus* was observed most effective against the mycelium growth of *Fusarium moniliforme*. The plant is reported to possess various medicinal (Usher, 1971) and antifungal properties against phytopathogenic fungi (Mishra and Dixit, 1977; Chitra and Kannabiran, 2002). The strong inhibitory activity of bark extracts of *Acacia arabicae* might be due to the presence of antimicrobial secondary metabolites (1981; Usher, 1971). The antifungal activity of *Camellia sinensis* extracts have been attributed to its different components like caffeine, tannins and other polyphenolic compounds particularly gallocatechin (Fukai *et al*., 1991; Kubo *et al*., 1992). The use of tea extracts for protecting plants against pathogenic organisms have earlier suggested by Dubey (1991). The inhibitory effect of stem extracts of *Aloe vera* might be due to the presence of antimicrobial secondary metabolites in the plant (Singh and Joshi, 1977).

The antimicrobial activities of plants studied have also been reported by various workers i.e. *Acacia catechu* (Singh and Sharma, 1978), *Achyranthes asper* (Aswal *et al*., 1984), *Adhatoda vasika* (Chitra and Cannbiran, 2002), *Aegle marmelos* (Ganesan *et al*., 2004), *Azadirachta indica* (Sharma and Nanda, 2000; Newton *et al*., 2002), *Brassicae campestris* (Mishra and Dixit, 1977), *Caesalpinia bonducella*

Table 2. Anti-fungal activities of plants-extracts against *Fusarium moniliforme*(Mean ± SD)

Plant species	Part Used	Percentage Inhibition of Mycelium Growth
Acacia arabicae	Bark	68.24 ± 0.42
Acacia catechu	Bark	5.97 ± 3.93
Acacia fernesiana	Seed	18.92 ± 1.44
Achyranthus asper	Stem	5.62 ± 2.84
Adhatoda vasica	Flower	21.18 ± 1.08
Aegle marmelos	Fruit	29.32 ± 1.22
Albizia lebbeck	Seed	13.52 ± 3.19
Aloe vera	Stem	28.20 ± 2.46
Alstonia scholaris	Leaf	-
Anthocephalus cadamba	Bark	12.79 ± 2.97
Asparagus racemosus	Root	77.00 ± 0.28
Astercantha longifolia	Seed	20.72 ± 1.44
Azadirachta indica	Leaf	18.36 ± 1.76
Bambusa sapinosa	Seed	-
Brassicae campestris	Seed	28.24 ± 1.48
Bryophyllum calycinum	Leaf	-
Caesalpinia bonducella	Leaf	17.14 ± 2.92
Callistemon lanceolatus	Bark	39.68 ± 1.22
Calotropis procera	Leaf	28.69 ± 1.77
Camellia sinensis	Leaf	66.29 ± 0.47

(Aswal *et al*., 1984), *Callistemon lanceolatus* (Dubey *et al*., 1990) and *Calotropis procera* (Singh and Sharma, 1978).

The presence of various secondary metabolites such as alkaloids, quaternary alkaloids, coumarins, flavanoids, steroids/terpenoids, phenols etc. have been reported in various plants extracts (Aswal *et al*., 1984; Abraham *et al*., 1986; Chopra *et al*., 1992) may be responsible for the antifungal properties of the plants studied.

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