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Effect of different botanicals against *Fusarium moniliforme* causing bakanae disease of rice

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Abstract

Bakanae disease is an important disease of rice causing serious threat to basmati production in all basmati rice growing countries including India. It is emerging as major problem in basmati rice producing areas of India. As per report, this disease caused 15% losses in India and 40-50% in Japan. This disease caused by *Fusarium moniliforme* Sheldon (teleomorph- *Gibberella fujikuroi* Sawada) is mainly seed borne but this may be soil borne also. Therefore seed treatment may be an effective method for management of this disease. To know the inhibitory effect, extract of different botanicals (weed host, medicinal plant and tree plant) were evaluated against *F. moniliforme in vitro* through the poison food technique. It was observed that extract of botanicals have quit inhibitory effect against fungal growth whereas extract of some medicinal plant found effective. Among weed host plants, extract of Solenium (*Solanum nigrum*) and Bhang (*Cannabis sativa*) found effective, inhibit 29.65 and 23.89% growth of *F. moniliforme* respectively. Among medicinal plants, extract of Clove (*Syzygium Aromaticum*), Ajwain and Ajwain (*Trachyspermum ammi*), Tulsi (*Ocimum sanctum*) observed with effective result, inhibit fungal growth 100, 97.53 and 55.56% growth respectively. In the evaluated tree plant extract, extract of Neem (*Azadirachta Indica*) and Aonla (*Phyllanthus emblica*) was found effective. Extract of Neem and Aonla inhibited 47.06 and 36.47% fungal growth respectively. Present investigation concluded that extract of some botanical have the good fungicidal effect against the pathogen. Therefore, they can be useful tool in integrated disease management programme.

Keywords: Rice, bakanae disease, foot rot, *Fusarium moniliforme*, and management

Introduction

Rice (*Oryza sativa* L.) is an important cereal crop and growing all over the world. Growing rice in India is primarily divided into basmati rice and non-basmati rice. India is the major producer and exporter of basmati rice to the world. Many diseases of rice which cause by fungi, bacteria, viruses and nematode are responsible for reduction the total yield. Among the fungal diseases, bakanae disease is an emerging disease of basmati rice causing serious threat to basmati production worldwide including India. This disease is caused by *Fusarium moniliforme* Sheldon, the pathogen was later identified as *F. fujikuroi* Nirenberg. The teleomorph stage of *F. moniliforme* is known as *Gibberella fujikuroi* Sawada (Nirenberg, 1976). In rice, *F. moniliforme* induces seedling elongation, foot rot, seedling rot, grain sterility, and grain discoloration (Ou, 1985; Webster and Gunnell, 1992) [10]. The pathogen can be both seed-borne and soil borne. Generally, the seed-borne inoculum provides initial foci for primary infection. Precise information on losses caused by this disease 15% was reported in Eastern districts of Uttar Pradesh of India and 40-50% in Japan (Pavgi and Singh, 1964) [6]. Kanjanasoon (1965) [2] found 3.7-14.7% loss in northern and central Thailand. Seed treatment with fungicide such as thiram has been used for management of bakanae disease (Suzuki *et al.*, 1985) [8]. After the emergence of pathogen resistance to these fungicides, botanicals may be useful tool for to management the disease. Present investigation was carried out to test the efficacy of different botanicals against the *Fusarium moniliforme* because these may be important component in integrated disease management programme.

Materials and methods

To know the inhibitory effect, extract of different botanicals (weed host, medicinal plant and tree plant) were evaluated against *F. moniliforme in vitro* through the poison food technique. In botanicals, extracts of different weed host plants like Aak (*Calotropis procera*), Latjeera

(*Achyranthes aspera*), Lantana (*Lantana camara*), Chhoti dudhi (*Euphorbia serpyllifolia*), Lemon grass (*Cymbopogon flexuosus*), Bhang (*Cannabis sativa*), Congress grass (*Parthenium hysterophorus*), Solenum (*Solanum nigrum*) and Jangli chulai (*Euphorbia prostrata*), extract of medicinal plants like Tulsi (*Ocimum sanctum*), Sargandha (*Rauvolfia serpentina*), Aloe-vera (*Aloe Barbadensis*), Onion (*Allium cepa* L.), Clove (*Syzygium Aromaticum*), Ajwain (*Trachyspermum ammi*), Ashwagandha (*Withania somnifera*), Giloy (*Tinospora cordifolia*), Shatavari (*Asparagus racemosus*) and Garlic (*Allium sativum*) and extract of tree plants like Aonla (*Phyllanthus emblica*), Banana (*Musa paradisiaca*), Jatropha (*Jatropha curcas*) Shisham (*Dalbergia sissoo*), Kadamba (*Neolamarckia cadamba*), Gulmohar (*Delonix regia*), Papaya (*Carica papaya*), Peach (*Prunus persica*), Pear (*Pyrus communis*), Belpatra (*Aegle marmelos*), Neem (*Azadirachta Indica*), Jamun (*Syzygium cumini*), Baiken (*Melia azadirachta*) and Kaner (*Cascabela thevetia*) were evaluated.

Fresh leaves and other part of plants were collected and washed with the tap water properly. After washing, 100 gm plant material was grinded in mixer by adding of double amount of sterilized water. The suspension was filtered through the muslin cloth. All the plant extract were tested at 10% and 20% concentration (10 and 20 ml of plant extract add into 90 and 80 ml of PDA media respectively). Along these, Petri plates containing only PDA medium without any plant extract were maintained as control. After solidification of media into Petri plates, 3 mm bits from 7 days old culture of *F. moniliforme* cut by cork borer and placed in the centre of each Petri plate containing plant extracts treated PDA medium and without treated PDA medium. The observation was recorded on radial growth after each three days interval. Percent growth inhibition was calculated by using formula (Vincent, 1947) [9].

$$\text{Percent inhibition} = \frac{C - T}{C} \times 100$$

Where, C= fungal growth in control T = fungal growth in treatment

Fresh leaves and other part of different plants viz., Turmeric, Clove, Solenum, Ajwain, Ashwagandha, Jatropha, Aonla, Peach, Shisham, Neem and one fungicide carbendazim (1000ppm) were also tested for know the antimicrobial effect on spore germination of *F. moniliforme*. After washing, 100 gm plant material was grinded in mixer by adding of double amount of sterilized water. The suspension was filtered through Whatman-1 filter paper. Filtrate of each plant extract was poured in Petri plate. Rice seeds were dipped in suspension of *F. moniliforme* culture for overnight and then transferred in Petri plates containing extract of different plants. Rice seeds which were dipped only in sterilized water used as control. Three replications were maintained of each treatment. After overnight dip, rice seeds were transferred on blotter paper for soak the extra water. After proper soaking, seeds were transferred in Petri plates containing sterilized PDA medium. Ten rice seeds were inoculated in each Petri

plates. Inoculated Petri plates were incubated in BOD incubator at 26±2 °C temperature. After 4 days of inoculation, growth of *Fusarium moniliforme* was observed around each inoculated seed.

Result and Discussion

Among the weed plants, maximum percent inhibition in pathogen growth was observed with leaf extract of Solenum (Table-1). Leaf extract of Solenum was observed with 28.13% and 29.65% inhibition of pathogen growth at 10 and 20% concentration respectively. Leaf extract of Bhang also was found effective, inhibited 13.39 and 23.89% pathogen growth at 10 and 20% concentration after 9 days of inoculation respectively. Data present in Table-2 and Plate-1 indicate that many medicinal plants have good anti- microbial effect against the pathogen. Maximum inhibition in fungal growth was observed in extract of Clove and Ajwain. Extract of Clove and Ajwain inhibited 100 and 95.06% pathogen growth at 10% concentration whereas at 20% concentration 100 and 97.53% inhibition was observed. Leaf extract of Tulsi, Ashawagandha and stem of Turmeric also have good anti-microbial effect on pathogen. Extract of Tulsi, Ashawagandha and Turmeric was observed with 55.56, 44.86 and 38.27% inhibition in pathogen growth at 20% concentration respectively. Among the leaf extract of fifteen trees, it was observed that leaf extract of some plant have good fungal toxicity (Table-3). Maximum inhibition in fungal growth was observed in extract of Neem and Aonla. Neem and Aonla was observed with 47.06 and 36.47% inhibition in pathogen growth at 20% concentration respectively. Extract of Neem and Aonla was observed with 47.06 and 36.47% inhibition of fungal growth followed by Shisham and Jamun which was observed with 35.88 and 35.69% inhibition at 20% concentration respectively.

Data of Table-4 and indicates that in control Petri plates *Fusarium moniliforme* has grown around the all inoculated rice seeds. Few rice seeds which treated by extract of plants were observed with no any fungal growth around the seeds. Maximum inhibition of fungal growth was observed in Petri plates in which rice seeds were treated by Clove extract. In Clove treated seeds, fungal growth was appeared around of 17 rice seeds out of total 30 inoculated seeds. Treated seeds by extract of Solenum and Peach also were found effective. In Solenum and Peach extract treated rice seeds, only 22 out of 30 rice seeds were observed with fungal growth. Whereas carbendazim treated rice seeds, no fungal growth was observed till the four days after inoculation.

In previous study it has been reported that botanicals have good fungicidal effect against *Fusarium* species. Hundekar *et al.* (1998) [1] observed that neem, cotton, groundnut and safflower cakes reduced the inoculum levels of *Macrophomina phaseolina* and *F. moniliforme* (*Gibberella fujikuroi*). Manmohan and Govindaiah (2004) [3] reported that *A. indica* inhibited 90.7% in spore germination and 67.7% in mycelia growth whereas *P. pinnata* showed 81.1% spore and 63.4% mycelia growth inhibition. Sunderrao *et al.*, (2017) [7] studied the efficacy of botanicals against *Fusarium oxysporum* f.sp. *dianthi* and reported that extracts of neem leaf showing excellent inhibitory effect of (78.19%) reduction.

Table 1: Effect the extract of weed host plants on radial growth of *Fusarium moniliforme*

Treatment	Botanical Name	Plant used	Conc.10%		Conc.20%	
			After 9 days		After 9 days	
			Radial growth (mm)	Percent inhibition (%)	Radial growth (mm)	Percent inhibition (%)
Aak	<i>Calotropis procera</i>	Leaf	78.33	-4.91	80.50	-6.86
Latjeera	<i>Achyranthes aspera</i>	Leaf	68.67	8.03	66.17	12.16
Lantana	<i>Lantana camara</i>	Leaf	64.17	14.06	62.50	17.04
Chhoti dudhi	<i>Euphorbia serpyllifolia</i>	Leaf	67.83	9.16	64.50	14.38
Lemon grass	<i>Cymbopogon flexuosus</i>	Leaf	67.67	9.37	66.00	12.39
Bhang	<i>Cannabis sativa</i>	Leaf	64.67	13.39	57.33	23.89
Congress grass	<i>Parthenium hysterophorus</i>	Leaf	70.33	5.80	68.17	9.51
Solenum	<i>Solanum nigrum</i>	Leaf	53.67	28.13	53.00	29.65
Jangli chulai	<i>Euphorbia prostrata</i>	Leaf	76.33	-2.23	78.17	-3.77
Control			74.67	0.00	75.33	0.00
CD at 5% Level				1.212		1.433

Table 2: Effect the extract of medicinal plants on radial growth of *Fusarium moniliforme*

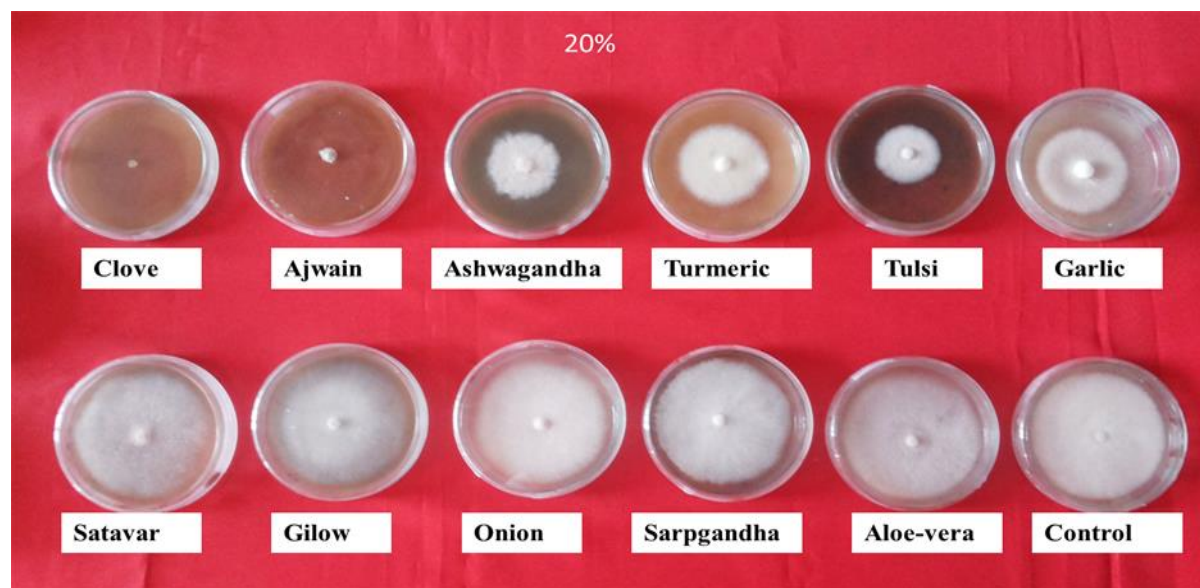
Treatment	Botanical Name	Part used	Conc.10%		Conc.20%	
			After 9 days		After 9 days	
			Radial growth (mm)	Percent inhibition (%)	Radial growth (mm)	Percent inhibition (%)
Tulsi	<i>Ocimum sanctum</i>	Leaf	54.00	33.33	36.00	55.56
Sarpgandha	<i>Rauwolfia serpentina</i>	Leaf	77.00	4.94	76.00	6.17
Turmeric	<i>Curcuma longa</i>	Stem	53.00	34.57	50.00	38.27
Aloe-vera	<i>Aloe Barbadensis</i>	Leaf	80.00	1.23	78.33	3.30
Onion	<i>Allium cepa L.</i>	Bulb	77.50	4.32	72.50	10.49
Clove	<i>Syzygium Aromaticum</i>	Seed	0.00	100.00	0.00	100.00
Ajwain	<i>Trachyspermum ammi</i>	Seed	4.00	95.06	2.00	97.53
Ashwagandha	<i>Withania somnifera</i>	Leaf	46.00	43.21	44.67	44.86
Giloy	<i>Tinospora cordifolia</i>	Leaf	72.50	10.49	68.67	15.22
Shatavari	<i>Asparagus racemosus</i>	Leaf	71.67	11.52	67.17	17.07
Garlic	<i>Allium sativum</i>	Bulb	64.00	20.99	50.00	38.27
Control			81.00	0.00	81.00	0.00
CD at 5% Level				2.102		1.977

Table 3: Effect of extract of tree plants on radial growth of *Fusarium moniliforme*

Treatment	Botanical Name	Part used	Conc.10%		Conc.20%	
			After 9 days		After 9 days	
			Radial growth (mm)	Percent inhibition (%)	Radial growth (mm)	Percent inhibition (%)
Aonla	<i>Phyllanthus emblica</i>	Leaf	56.17	33.92	54.00	36.47
Banana	<i>Musa paradisiacal</i>	Leaf	72.00	15.29	68.50	19.41
Jatropha	<i>Jatropha curcas</i>	Leaf	68.50	19.41	66.83	21.37
Shisham	<i>Dalbergia sissoo</i>	Leaf	70.50	17.06	54.50	35.88
Kadamba	<i>Neolamarckia cadamba</i>	Leaf	72.00	15.29	72.00	15.29
Gulmohar	<i>Delonix regia</i>	Leaf	81.50	4.12	78.67	7.45
Papaya	<i>Carica papaya</i>	Leaf	76.50	10.00	63.33	25.49
Peach	<i>Prunus persica</i>	Leaf	62.83	26.08	63.00	25.88
Pear	<i>Pyrus communis</i>	Leaf	67.83	20.20	63.67	25.10
Belpatra	<i>Aegle marmelos</i>	Leaf	73.83	13.14	71.83	15.49
Neem	<i>Azadirachta Indica</i>	Leaf	54.00	36.47	45.00	47.06
Jamun	<i>Syzygium cumini</i>	Leaf	76.67	9.80	54.67	35.69
Baiken	<i>Melia azadirachta</i>	Leaf	75.00	11.76	74.00	12.94
Kaner	<i>Cascabela thevetia</i>	Leaf	83.67	1.57	85.33	-0.39
Control			85.00	0.00	85.00	0.00
CD at 5% Level				1.110		1.023

Table 4: efficacy of extract of different botanicals on growth and spore germination of *F. moniliforme*

Sr. No.	Treatment	Total seed inoculated in three replications	Growth appear around the seed
1.	Clove	30	17
2.	Ajwain	30	30
3.	Turmeric	30	29
4.	Neem	30	29
5.	Ashwagandha	30	30
6.	Solenum	30	22
7.	Jatropha	30	30
8.	Peach	30	22
9.	Aonla	30	30
10.	Shisham	30	29
11.	Carbendazim	30	0
12.	Control	30	30

**Plate 1:** Effect of extract of medicinal plants on radial growth of *Fusarium moniliforme*

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